

The Caldwell Catalogue

Contents

1	Overview	1
1.1	Caldwell catalogue	1
1.1.1	Caldwell Star Chart	1
1.1.2	Number of objects by type in the Caldwell catalogue.	1
1.1.3	Caldwell objects	1
1.1.4	See also	2
1.1.5	References	2
1.1.6	External links	2
1.2	Patrick Moore	2
1.2.1	Early life	2
1.2.2	Career in astronomy	3
1.2.3	Activism and political beliefs	5
1.2.4	Other interests and popular culture	5
1.2.5	Honours and appointments	6
1.2.6	Bibliography	7
1.2.7	Film and television appearances	7
1.2.8	See also	7
1.2.9	References	7
1.2.10	External links	9
2	Objects	10
2.1	Caldwell 1	10
2.1.1	References	10
2.1.2	External links	10
2.2	Caldwell 2	10
2.2.1	Gallery	10
2.2.2	References	10
2.2.3	External links	10
2.3	Caldwell 3	11
2.3.1	Galaxy group information	11
2.3.2	See also	11
2.3.3	References	11
2.3.4	External links	11

2.4	Caldwell 4	11
2.4.1	Notes	11
2.4.2	References	11
2.4.3	External links	11
2.5	Caldwell 5	12
2.5.1	References	12
2.5.2	External links	12
2.6	Caldwell 6	12
2.6.1	General information	12
2.6.2	Observations	13
2.6.3	Distance	14
2.6.4	Age	14
2.6.5	Composition	14
2.6.6	Kinematics and morphology	14
2.6.7	Notes	15
2.6.8	References	15
2.6.9	Cited sources	15
2.6.10	External links	16
2.7	Caldwell 7	16
2.7.1	Supernovae	16
2.7.2	History	17
2.7.3	See also	17
2.7.4	References	17
2.7.5	External links	17
2.8	Caldwell 8	17
2.8.1	References	17
2.8.2	External links	17
2.9	Caldwell 9	17
2.9.1	References	18
2.9.2	External links	18
2.10	Caldwell 10	18
2.10.1	References	18
2.10.2	External links	18
2.11	Caldwell 11	19
2.11.1	Amateur observation	19
2.11.2	Notes	19
2.11.3	References	19
2.11.4	External links	19
2.12	Caldwell 12	19
2.12.1	Supernovae	20
2.12.2	References	20

2.12.3 External links	20
2.13 Caldwell 13	20
2.13.1 References	20
2.13.2 External links	20
2.14 Caldwell 14	20
2.14.1 Mythology	20
2.14.2 History	21
2.14.3 Location	21
2.14.4 References	21
2.14.5 External links	21
2.15 Caldwell 15	21
2.15.1 See also	22
2.15.2 References	22
2.15.3 External links	22
2.16 Caldwell 16	22
2.16.1 Notes	22
2.16.2 References	22
2.16.3 External links	22
2.17 Caldwell 17	22
2.17.1 Characteristics	23
2.17.2 Distance measurements	23
2.17.3 See also	23
2.17.4 Notes	23
2.17.5 References	23
2.17.6 External links	23
2.18 Caldwell 18	23
2.18.1 Distance measurements	24
2.18.2 Star formation	24
2.18.3 Gallery	24
2.18.4 See also	24
2.18.5 Notes	24
2.18.6 References	24
2.18.7 External links	24
2.19 Caldwell 19	24
2.19.1 References	25
2.19.2 External links	25
2.20 Caldwell 20	25
2.20.1 General information	25
2.20.2 See also	26
2.20.3 References	26
2.20.4 External links	26

2.21	Caldwell 21	26
2.21.1	Characteristics	26
2.21.2	External links	26
2.21.3	References	27
2.22	Caldwell 22	27
2.22.1	Image gallery	27
2.22.2	See also	27
2.22.3	References	27
2.22.4	External links	28
2.23	Caldwell 23	28
2.23.1	Peculiarities	28
2.23.2	Trivia	28
2.23.3	In popular culture	29
2.23.4	See also	29
2.23.5	References	29
2.23.6	External links	29
2.24	Caldwell 24	29
2.24.1	Dynamics	29
2.24.2	Gallery	30
2.24.3	References	30
2.24.4	External links	31
2.25	Caldwell 25	31
2.25.1	References	31
2.25.2	External links	32
2.26	Caldwell 26	32
2.26.1	Gallery	32
2.26.2	Notes	32
2.26.3	References	32
2.26.4	External links	32
2.27	Caldwell 27	32
2.27.1	See also	33
2.27.2	References	33
2.27.3	External links	33
2.28	Caldwell 28	33
2.28.1	Components	33
2.28.2	References	33
2.28.3	External links	33
2.29	Caldwell 29	33
2.29.1	Nucleus	34
2.29.2	Companion galaxy	34
2.29.3	Notes	34

2.29.4	External links	34
2.30	Caldwell 30	34
2.30.1	Retrograde bulge	34
2.30.2	Supernova	34
2.30.3	See also	35
2.30.4	References	35
2.30.5	External links	35
2.31	Caldwell 31	35
2.31.1	Notes	35
2.31.2	References	35
2.31.3	External links	35
2.32	Caldwell 32	35
2.32.1	Starburst and superwind	36
2.32.2	Nearby galaxies and galaxy group	36
2.32.3	See also	36
2.32.4	References	36
2.32.5	External links	37
2.33	Caldwell 33 & 34	37
2.33.1	Components	37
2.33.2	Observation	37
2.33.3	In fiction	38
2.33.4	Gallery	38
2.33.5	See also	38
2.33.6	References	38
2.33.7	External links	38
2.34	Caldwell 35	39
2.34.1	Observation	39
2.34.2	Properties	39
2.34.3	Components	40
2.34.4	Environment	40
2.34.5	See also	41
2.34.6	Notes	41
2.34.7	References	41
2.34.8	External links	41
2.35	Caldwell 36	41
2.35.1	See also	41
2.35.2	References	41
2.35.3	External links	41
2.36	Caldwell 37	41
2.36.1	Notes	41
2.36.2	References	41

2.36.3	External links	41
2.37	Caldwell 38	42
2.37.1	Characteristics	42
2.37.2	References	42
2.37.3	External links	43
2.38	Caldwell 39	43
2.38.1	Historic data	43
2.38.2	See also	43
2.38.3	Notes	43
2.38.4	References	43
2.38.5	External links	43
2.39	Caldwell 40	44
2.39.1	Notes	44
2.39.2	References	44
2.39.3	External links	44
2.40	Caldwell 41	44
2.40.1	Proper motion	44
2.40.2	History	45
2.40.3	Morphology and evolution	46
2.40.4	Brightest stars	47
2.40.5	See also	47
2.40.6	References	47
2.40.7	External links	48
2.41	Caldwell 42	48
2.41.1	Gallery	48
2.41.2	References	49
2.41.3	External links	49
2.42	Caldwell 43	49
2.42.1	Gallery	49
2.42.2	See also	49
2.42.3	References	49
2.42.4	External links	49
2.43	Caldwell 44	49
2.43.1	Gallery	49
2.43.2	References	49
2.43.3	External links	50
2.44	Caldwell 45	50
2.44.1	References	50
2.44.2	External links	50
2.45	Caldwell 46	50
2.45.1	See also	50

2.45.2	References	50
2.45.3	External links	50
2.46	Caldwell 47	50
2.46.1	References	51
2.46.2	External links	51
2.47	Caldwell 48	51
2.47.1	Gallery	51
2.47.2	References	51
2.47.3	External links	51
2.48	Caldwell 49	51
2.48.1	Observing the Rosette Nebula	52
2.48.2	Other images	52
2.48.3	References	52
2.48.4	External links	52
2.49	Caldwell 50	52
2.49.1	References	53
2.49.2	External links	53
2.50	Caldwell 51	53
2.50.1	References	53
2.50.2	External links	53
2.51	Caldwell 52	54
2.51.1	References	54
2.51.2	External links	54
2.52	Caldwell 53	54
2.52.1	Star formation	54
2.52.2	Black hole	54
2.52.3	See also	54
2.52.4	References	54
2.52.5	External links	54
2.53	Caldwell 54	55
2.53.1	References	55
2.53.2	External links	55
2.54	Caldwell 55	55
2.54.1	Notes	55
2.54.2	References	56
2.54.3	External links	56
2.55	Caldwell 56	56
2.55.1	References	56
2.55.2	External links	56
2.56	Caldwell 57	56
2.56.1	Observational history	56

2.56.2	Gallery	57
2.56.3	See also	57
2.56.4	Notes	57
2.56.5	References	57
2.56.6	External links	57
2.57	Caldwell 58	57
2.57.1	Notes	58
2.57.2	External links	58
2.58	Caldwell 59	58
2.58.1	Gallery	58
2.58.2	See also	58
2.58.3	References	59
2.58.4	External links	59
2.59	Caldwell 60 & 61	59
2.59.1	General information	59
2.59.2	Timeline	59
2.59.3	X-ray source	60
2.59.4	Gallery	60
2.59.5	See also	60
2.59.6	References	60
2.59.7	External links	60
2.60	Caldwell 62	60
2.60.1	Nearby galaxies and galaxy group information	60
2.60.2	References	60
2.60.3	External links	61
2.61	Caldwell 63	61
2.61.1	General information	61
2.61.2	Structure	61
2.61.3	Visuals	62
2.61.4	Videos	62
2.61.5	See also	62
2.61.6	References	62
2.61.7	External links	63
2.62	Caldwell 64	63
2.62.1	References	63
2.62.2	External links	63
2.63	Caldwell 65	63
2.63.1	Observation	64
2.63.2	Features	64
2.63.3	Gallery	65
2.63.4	See also	65

2.63.5	References	65
2.63.6	External links	66
2.64	Caldwell 66	66
2.64.1	Characteristics	66
2.64.2	References	66
2.64.3	External links	66
2.65	Caldwell 67	66
2.65.1	General information	66
2.65.2	Gallery	67
2.65.3	See also	67
2.65.4	References	67
2.65.5	External links	67
2.66	Caldwell 68	67
2.66.1	References	68
2.66.2	External links	68
2.67	Caldwell 69	68
2.67.1	Observation history	68
2.67.2	Characteristics	68
2.67.3	Central star	68
2.67.4	Dust chemistry	68
2.67.5	Notes	69
2.67.6	References	69
2.67.7	External links	70
2.68	Caldwell 70	70
2.68.1	Nearby galaxies and group information	70
2.68.2	Distance estimates	70
2.68.3	NGC 300-OT	70
2.68.4	SN 2010da	71
2.68.5	Binary black hole system	71
2.68.6	Gallery	71
2.68.7	Notes	71
2.68.8	References	71
2.68.9	External links	72
2.69	Caldwell 71	72
2.69.1	Visual appearance	72
2.69.2	Distance	72
2.69.3	Notes	72
2.69.4	External links	72
2.70	Caldwell 72	72
2.70.1	Nearby galaxies and group information	72
2.70.2	Visual appearance	73

2.70.3	See also	73
2.70.4	Notes	73
2.70.5	References	73
2.70.6	External links	73
2.71	Caldwell 73	73
2.71.1	References	73
2.71.2	External links	74
2.72	Caldwell 74	74
2.72.1	Planetary nebula nucleus (PNN)	74
2.72.2	See also	74
2.72.3	References	74
2.72.4	External links	74
2.73	Caldwell 75	74
2.73.1	References	74
2.73.2	External links	74
2.74	Caldwell 76	74
2.74.1	See also	75
2.74.2	Notes	75
2.74.3	External links	75
2.75	Caldwell 77	75
2.75.1	Morphology	76
2.75.2	Supernova	76
2.75.3	Distance	76
2.75.4	Nearby galaxies and galaxy group information	76
2.75.5	Visibility	76
2.75.6	Gallery	76
2.75.7	See also	77
2.75.8	References	77
2.75.9	External links	78
2.76	Caldwell 78	78
2.76.1	References	78
2.76.2	External links	79
2.77	Caldwell 79	79
2.77.1	References	79
2.77.2	External links	80
2.78	Caldwell 80	80
2.78.1	Observation history	80
2.78.2	Properties	80
2.78.3	Evidence of a central black hole	80
2.78.4	Disrupted dwarf galaxy	81
2.78.5	In fiction	81

2.78.6	See also	81
2.78.7	References	81
2.78.8	External links	82
2.79	Caldwell 81	83
2.79.1	References	83
2.80	Caldwell 82	83
2.80.1	List of stars in cluster	83
2.80.2	Gallery	83
2.80.3	References	83
2.80.4	External links	83
2.81	Caldwell 83	83
2.81.1	Galaxy group	84
2.81.2	References	84
2.81.3	External links	84
2.82	Caldwell 84	84
2.82.1	References	84
2.82.2	External links	84
2.83	Caldwell 85	85
2.83.1	See also	85
2.83.2	References	85
2.83.3	External links	85
2.84	Caldwell 86	85
2.84.1	Astronomical research	85
2.84.2	References	85
2.84.3	External links	86
2.85	Caldwell 87	86
2.85.1	References	86
2.85.2	External links	86
2.86	Caldwell 88	86
2.86.1	External links	86
2.87	Caldwell 89	87
2.87.1	References	87
2.87.2	External links	87
2.88	Caldwell 90	87
2.88.1	See also	87
2.88.2	References	87
2.88.3	External links	87
2.89	Caldwell 91	87
2.89.1	References	88
2.89.2	External links	88
2.90	Caldwell 92	88

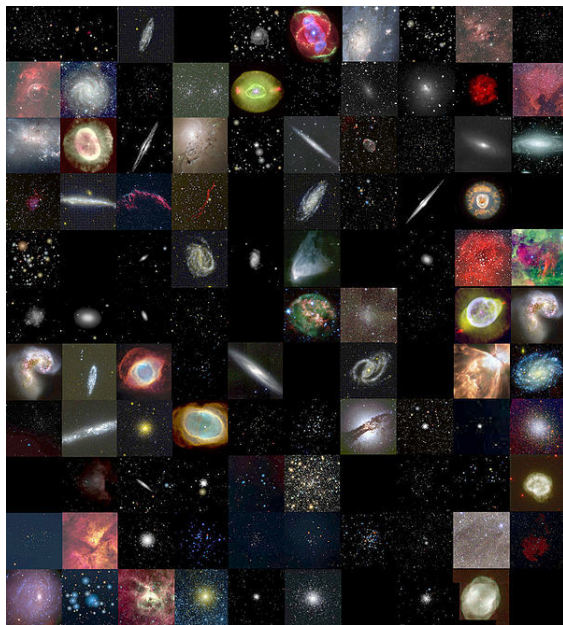
2.90.1	Objects within the Carina Nebula	88
2.90.2	Gallery	89
2.90.3	References	90
2.90.4	External links	91
2.91	Caldwell 93	91
2.91.1	Gallery	91
2.91.2	References	91
2.91.3	External links	92
2.92	Caldwell 94	92
2.92.1	Discovery and observation	92
2.92.2	Physical characteristics	92
2.92.3	Observation	92
2.92.4	Gallery	92
2.92.5	References	92
2.92.6	External links	93
2.93	Caldwell 95	93
2.93.1	External links	93
2.93.2	References	93
2.94	Caldwell 96	93
2.94.1	Description	93
2.94.2	References	94
2.94.3	Bibliography	94
2.94.4	External links	94
2.95	Caldwell 97	94
2.95.1	See also	94
2.95.2	References	94
2.95.3	External links	94
2.96	Caldwell 98	95
2.96.1	External links	95
2.97	Caldwell 99	95
2.97.1	General information	95
2.97.2	In fiction	95
2.97.3	Gallery	96
2.97.4	References	96
2.97.5	External links	96
2.98	Caldwell 100	96
2.98.1	Gallery	96
2.98.2	References	96
2.98.3	External links	96
2.99	Caldwell 101	97
2.99.1	Gallery	97

2.99.2 See also	97
2.99.3 References	97
2.99.4 External links	97
2.100Caldwell 102	97
2.100.1 See also	97
2.100.2 References	97
2.100.3 External links	98
2.101Caldwell 103	98
2.101.1 Gallery	98
2.101.2 References	98
2.101.3 External links	99
2.102Caldwell 104	99
2.102.1 See also	99
2.102.2 References	99
2.102.3 External links	99
2.103Caldwell 105	99
2.103.1 See also	99
2.103.2 References	100
2.103.3 External links	100
2.104Caldwell 106	100
2.104.1 Characteristics	100
2.104.2 History	101
2.104.3 Gallery	101
2.104.4 References	101
2.104.5 External links	102
2.105Caldwell 107	102
2.105.1 References	102
2.106Caldwell 108	102
2.106.1 References	102
2.106.2 External links	102
2.107Caldwell 109	102
2.107.1 References	103
2.107.2 External links	103
3 Text and image sources, contributors, and licenses	104
3.1 Text	104
3.2 Images	113
3.3 Content license	122

Chapter 1

Overview

1.1 Caldwell catalogue



Montage of Caldwell Catalogue objects.

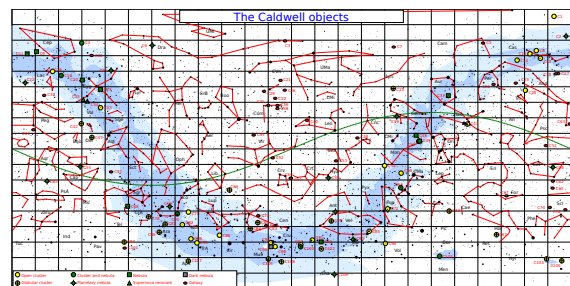
The **Caldwell Catalogue** is an astronomical catalog of 109 star clusters, nebulae, and galaxies for observation by amateur astronomers. The list was compiled by Patrick Moore as a complement to the Messier Catalogue.^[1]

While the Messier Catalogue is used by amateur astronomers as a list of deep-sky objects for observation, Moore noted that Mesier's list did not include many of the sky's brightest deep-sky objects,^[1] such as the Hyades, the Double Cluster (NGC 869 and NGC 884), and the Sculptor Galaxy (NGC 253). Moore also observed that since Messier compiled his list from observations in Paris, it did not include bright deep-sky objects visible in the Southern Hemisphere, such as Omega Centauri, Centaurus A, the Jewel Box, and 47 Tucanae.^{[1][2]} Moore compiled a list of 109 objects – to match the commonly accepted number of Messier objects (110 minus the duplicate 102 acknowledged by Méchain)^[1] – and the list was published in *Sky & Telescope* in December 1995.^[3]

Moore used his other surname (Caldwell) to name the list, as the first letter of “Moore” is already used for the Messier Catalogue.^{[1][4]} Entries in the catalogue are designated with a “C” and the catalogue number (1 to 109).

Unlike objects in the Messier catalogue, which are listed roughly in the order of discovery by Messier and his colleagues,^[5] the Caldwell catalogue is ordered by declination, with C1 being the most northerly and C109 being the most southerly,^[1] although two objects (NGC 4244 and the Hyades) are listed out of sequence.^[1] Other errors in the original list have since been corrected: it incorrectly identified the S Norma Cluster (NGC 6087) as NGC 6067 and incorrectly labelled the Lambda Centauri Cluster (IC 2944) as the Gamma Centauri Cluster.^[1]

1.1.1 Caldwell Star Chart



Caldwell Star Chart

1.1.2 Number of objects by type in the Caldwell catalogue.

1.1.3 Caldwell objects

Key

1–10

11–20

21–30

31–40

41–50

51–60

61–70

71–80

81–90

- [1] C89 was mistakenly written as **NGC 6067** in the original, but its description is that of **NGC 6087**.

91–100

101–109

1.1.4 See also

- **Messier Catalogue**
- **Herschel 400 Catalogue**
- **New General Catalogue (NGC)**
- **Index Catalogue (IC)**
- **Revised New General Catalogue (RNGC)**
- **Revised Index Catalogue (RIC)**

1.1.5 References

- [1] O'Meara, Stephen James (2002). *The Caldwell Objects*. Cambridge University Press. ISBN 978-0-521-82796-6.
- [2] “Caldwell Club Introduction”. Retrieved 2006-09-08.
- [3] Moore, Patrick (December 1995). “Beyond Messier: The Caldwell Catalog” (subscription required). *Sky & Telescope*. p. 38. Retrieved 2006-08-29.
- [4] Mobberley, Martin (2009). *The Caldwell Objects and How to Observe Them*. Springer. ISBN 978-1-4419-0325-9.
- [5] Glyn Jones, Kenneth (1991). “Introduction”. *Messier's Nebulae & Star Clusters*. Cambridge University Press. pp. 1–8. ISBN 0-521-37079-5.

1.1.6 External links

- **The Caldwell Catalogue at SEDS**
- **The Caldwell Club**
- **Caldwell Star Charts, Images and more**
- **Searchable Caldwell Catalogue list**
- **Clickable Caldwell Object table**

1.2 Patrick Moore

For other people named Patrick Moore, see **Patrick Moore (disambiguation)**.

Sir Patrick Alfred Caldwell-Moore CBE, FRS, FRAS (4 March 1923 – 9 December 2012)^{[1][2]} was an **English amateur astronomer** who attained prominent status in that field as a writer, researcher, radio commentator and television presenter.^{[3][4][5]}

Moore was president of the **British Astronomical Association**, co-founder and president of the **Society for Popular Astronomy (SPA)**, author of over 70 books on astronomy, and presenter of the world's longest-running television series with the same original presenter, the BBC's *The Sky at Night*. As an amateur astronomer,^[6] he became known as a specialist in **Moon** observation and for creating the **Caldwell catalogue**. Idiosyncrasies such as his rapid diction and **monocle** made him a popular and instantly recognisable figure on British television.

Moore was also a self-taught **xylophone**, **glockenspiel** player and pianist, as well as an accomplished composer. He was a former amateur cricketer, golfer and chess player. In addition to many **popular science** books, he wrote numerous works of fiction. Moore was an opponent of fox hunting, an outspoken critic of the **European Union**, supporter of the **UK Independence Party** and served as chairman of the short-lived anti-immigration **United Country Party**. He served in the **Royal Air Force** during World War II. He never married or had children.

1.2.1 Early life

Moore was born in **Pinner, Middlesex** on 4 March 1923^[7] to Capt. Charles Trachsel Caldwell-Moore MC (died 1947)^[8] and Gertrude (née White) (died 1981).^[8] His family moved to **Bognor Regis**, and subsequently to **East Grinstead** where he spent his childhood. His youth was marked by heart problems, which left him in poor health and he was educated at home by private tutors.^[7] He developed an interest in astronomy at the age of six^[9] and joined the **British Astronomical Association** at the age of eleven.^[10] He was invited to run a small observatory in **East Grinstead** at the age of 14, after his mentor – who

ran the observatory – was killed in a road accident.^[11] At the age of 16 he began wearing a **monocle** after an **oculist** told him his right eye was weaker than his left.^[12] Three years later, he began wearing a full set of **dentures**.^[13]

During **World War II**, Moore joined the **Home Guard** in East Grinstead where his father had been elected **platoon commander**.^[14] Despite recounting in his autobiography that he had lied about his age to join the **Royal Air Force** in 1940 at age 16,^[15] records show that he enlisted in the **Royal Air Force Volunteer Reserve** in December 1941 at age 18 and was not called up for service until July 1942 as an **Aircraftman**, 2nd Class.^[16] After basic training at various RAF bases in England, he went to Canada under the **British Commonwealth Air Training Plan** and completed training at **RAF Moncton** in **New Brunswick** as a navigator and pilot.^[17] During his time in Canada, he met **Albert Einstein** and **Orville Wright** while on leave in New York.^[18] Returning to England in June 1944, he was commissioned as a **Pilot officer**^[19] and was posted to **RAF Millom** in **Cumbria**, where he was a navigator in the crew of a **Vickers Wellington** bomber, engaged in **maritime patrolling** and bombing missions to mainland Europe.^[20] After the end of hostilities, Moore became an **adjutant** and then an **Area Meteorological Officer**, finally demobilized in October 1945 with the rank of **Flying officer**.^[21] The war had a significant influence on his life: his only romance ended when his fiancée Lorna, a nurse, was killed in London in 1943 by a bomb which struck her ambulance. Moore subsequently remarked that he never married because “there was no one else for me ... second best is no good for me ... I would have liked a wife and family, but it was not to be.” In his autobiography he said that after sixty years he still thought about her, and because of her death “if I saw the entire German nation sinking into the sea, I could be relied upon to help push it down.”^[22]

Moore said he was “exceptionally close” to his mother Gertrude,^[8] a talented artist who shared his **Selsey** home, which was decorated with her paintings of “bogeys” – little friendly aliens – which she produced and sent out annually as the Moores’ Christmas cards.^[23] Moore wrote the foreword for his mother’s 1974 book, *Mrs Moore in Space*.^[24]

1.2.2 Career in astronomy

After the war, Moore rejected a grant to study at the **University of Cambridge**, citing a wish to “stand on my own two feet”.^[10] He wrote his first book, *Guide to the Moon* (later retitled *Patrick Moore on the Moon*) in 1952 and it was published a year later.^[10] He wrote it on a 1908 Woodstock typewriter, which he used for every book he published.^[22] He was a teacher in **Woking** and at **Holmewood House School** in **Langton Green**,^[25] from 1945 to 1953.^[26] His second book was a translation of a work of French astronomer **Gérard de Vaucouleurs** (Moore spoke fluent **French**).^[27] After his second origi-

nal science book, *Guide to the Planets*, he penned his first work of fiction, *The Master of the Moon*,^[28] the first of numerous **young-adult fiction** space adventure books (including the late 1970s series the **Scott Saunders Space Adventure**); he wrote a more adult novel and a **farce** titled *Ancient Lights*, though he did not wish either to be published.^[29]

While teaching at **Holmewood** he set up a 12½ inch **reflector telescope** at his home, which he kept into his old age.^[11] He developed a particular interest in the **far side of the Moon**, a small part of which is visible from Earth as a result of the Moon’s **libration**; the Moon was his specialist subject throughout his life.^[11] He claimed to have discovered and named the **Mare Orientale** (Eastern Sea) in 1946,^[30] along with **H P Wilkins**, though he later conceded that German astronomer **Julius Heinrich Franz** should be credited with the discovery.^[31] The feature had been observed several times since telescopic observations began. Moore described the short-lived glowing areas on the lunar surface, and gave them the name **transient lunar phenomena** in 1968.^[30]

His first television appearance was in a debate about the existence of **flying saucers** following a spate of reported **sightings** in the 1950s; Moore argued against **Lord Dowding** and other **UFO** proponents.^[32] He was invited to present a live astronomy programme and said the greatest difficulty was finding an appropriate theme tune; the opening of **Jean Sibelius’s** *Pelléas et Mélisande* was chosen and used throughout the programme’s existence.^[33] The programme was originally named *Star Map* before *The Sky at Night* was chosen in the *Radio Times*.^[33] On 24 April 1957, at 10:30 pm, Moore presented the first episode about the **Comet Arend–Roland**.^[33] The programme was pitched to casual viewers up to professional astronomers, in a format which remained consistent from its inception.^[34] Moore presented every monthly episode except for one in July 2004 when he suffered a near-fatal bout of **food poisoning** caused by eating a contaminated goose egg and was replaced for that episode by **Chris Lintott**.^[35] Moore appears in the *Guinness World Records* book as the world’s longest-serving TV presenter having presented the programme since 1957. From 2004 to 2012, the programme was broadcast from Moore’s home, when **arthritis** prevented him from travelling to the studios. Over the years he received many lucrative offers to take his programme onto other networks, but rejected them because he held a ‘**gentlemen’s agreement**’ with the **BBC**.^[36]

A highlight of the series in 1959 was when the Russians allowed Moore to be the first Westerner to see the photographic results of the **Luna 3** probe, and to show them live on air.^[37] Less successful was the transmission of the **Luna 4** probe, which ran into technical difficulties and around this time Moore famously swallowed a large fly; both episodes were live and Moore had to continue regardless.^[38] He was invited to visit the **Soviet Union**, where he met **Yuri Gagarin**, the first man to journey

into outer space.^[39] For the fiftieth episode of *The Sky at Night*, in September 1961, Moore's attempt to be the first to broadcast a live direct telescopic view of a planet resulted in another unintended 'comedy episode', as cloud obscured the sky.^[40]

In 1965, he was appointed director of the newly constructed Armagh Planetarium in Northern Ireland, a post he held until 1968.^[41] His stay outside England was short partly because of the beginning of *The Troubles*, a dispute Moore wanted no involvement in.^[42] He was appointed Armagh County secretary of the Scout movement, but resigned after being informed that Catholics could not be admitted.^[43] In developing the Planetarium, Moore travelled to Japan to secure a Goto Mars projector.^[44] He helped with the redevelopment of the Birr Telescope in the Republic of Ireland.^[45] He was a key figure in the development of the Herschel Museum of Astronomy in Bath.^[46]

In June 1968 he returned to England, settling in Selsey after resigning his post in Armagh.^[47] During the NASA Apollo programme, presenting on the Apollo 8 mission, he said that "this is one of the great moments of human history", only to have his broadcast interrupted by the children's programme *Jackanory*.^[48] He was a presenter for the Apollo 9 and Apollo 10 missions, and a commenter, with Cliff Micheltore and James Burke, for BBC television's coverage of the Moon landing missions.^[48] Moore could not remember his words at the "Eagle has landed" moment, and the BBC has lost the tapes of the broadcast.^[49] A homemade recording reveals that the studio team was very quiet during the landing sequence, leaving the NASA commentary clear of interruptions. Some 14 seconds after "contact" Burke says "They've touched". At 36 seconds he says "Eagle has landed". Between 53 and 62 seconds he explains the upcoming stay/no-stay decision and NASA announces the T1 stay at 90 seconds after contact. At 100 seconds the recorded sequence ends. Thus any real-time comment Moore made was not broadcast live and the recording ends before Burke polls the studio team for comment and reaction. Moore participated in TV coverage of Apollo missions 12 to 17.^[50]

"Patrick was the last of a lost generation, a true gentleman, the most generous in nature that I ever knew, and an inspiration to thousands in his personal life, and to millions through his 50 years of unique broadcasting. It's no exaggeration to say that Patrick, in his tireless and ebullient communication of the magic of astronomy, inspired every British astronomer, amateur and professional, for half a century. There will never be another Patrick Moore. But we were lucky enough to get one."

— Brian May, speaking shortly after Moore's death.^[51]

He was elected a member of the International Astronomical Union in 1966,^{[52][53]} having twice edited the Union's General Assembly newsletters.^[54] He attempted to es-

tablish an International Union of Amateur Astronomers, which failed due to lack of interest.^[55] During the 1970s and 80s, he reported on the *Voyager* and *Pioneer* programs, often from NASA headquarters.^[56] At this time he became increasingly annoyed by conspiracy theorists and reporters who asked him questions such as "Why waste money on space research when there is so much to be done here?". He said that when asked these type of questions "I know that I'm dealing with an idiot."^[57] Another question that annoyed him was "what is the difference between astronomy and astrology?"^[58] Despite this he made a point of responding to all letters delivered to his house, and sent a variety of standard replies to letters asking basic questions, as well as those from conspiracy theorists, proponents of hunting and 'cranks'.^[59] Despite his fame, his telephone number was always listed in the telephone directory and he was happy to show members of the public his observatory.^[60]

He compiled the Caldwell catalogue of astronomical objects and in 1982, asteroid 2602 Moore was named in his honour.^[61] In February 1986 he presented a special episode of *The Sky at Night* on the approach of Halley's Comet, though he later said the BBC's better-funded *Horizon* team "made a complete hash of the programme."^[62] In January 1998, a tornado destroyed part of Moore's garden observatory; it was subsequently rebuilt.^[63] Moore campaigned unsuccessfully against the closure of the Royal Observatory, Greenwich in 1998.^[64] Among Moore's favourite episodes of *The Sky at Night* were those that dealt with eclipses, and he said "there is nothing in nature to match the glory of a total eclipse of the Sun."^[65]

Moore was a BBC presenter for the total eclipse in England in 1999, though the view he and his team had from Cornwall was obscured by cloud.^[66] Moore was the patron of the South Downs Planetarium & Science Centre, which opened in 2001.^[67]



Moore with his co-presenter Chris Lintott and Brian May, astrophysicist and *Queen* guitarist, at AstroFest in 2007

On 1 April 2007, a 50th anniversary semi-spoof edition of the programme was broadcast on BBC One, with Moore depicted as a Time Lord and featured special guests, amateur astronomers Jon Culshaw (impersonating

Moore presenting the first *The Sky at Night*) and **Brian May**. On 6 May 2007, a special edition of *The Sky at Night* was broadcast on BBC One, to commemorate the programme's 50th anniversary, with a party in Moore's garden at Selsey, attended by amateur and professional astronomers. Moore celebrated the record-breaking 700th episode of *The Sky at Night* at his home in Sussex on 6 March 2011. He presented with the help of special guests **Professor Brian Cox**, **Jon Culshaw** and **Lord Rees**, the **Astronomer Royal**.

It was reported in January 2012 that because of arthritis and the effects of an old spinal injury he was no longer able to operate a telescope. However, he was still able to present *The Sky at Night* from his home.^[68]

He died aged 89 at 12:25 p.m. on 9 December 2012 at home.^{[69][70][71]}

On 9 December 2014 it was reported that the **Science Museum, London** had acquired a large collection of Patrick Moore's objects and manuscripts and memorabilia, including *The Sky at Night* scripts, and about 70 of his observation books, over more than 60 years, and manuscripts for astronomy and fiction books, and a 12.5 inch **reflecting telescope**.^[72]

1.2.3 Activism and political beliefs

Moore was known for his conservative political views. In the 1970s, he was chairman of the anti-immigration **United Country Party**, a position he held until the party was absorbed by the **New Britain Party** in 1980. He campaigned for the politician **Edmund Iremonger** in the **1979 British general election**, as they agreed the French and Germans were not to be trusted.^[73] Iremonger and Moore gave up political campaigning after deciding they were **Thatcherites**.^[73] Moore campaigned on behalf of **Douglas Denny (UKIP)** for the **Chichester constituency** in 2001.^[74] A **Tory** voter for many years, he was a supporter and patron of the **eurosceptic UK Independence Party** until his death.^[75] He briefly supported the **Liberal Party** in the 1950s, though condemned the **Liberal Democrats**, saying he believed they could alter their position radically and that they "would happily join up with the **BNP** or the **Socialist Workers Party** ... if [by doing so] they could win a few extra votes."^[74] He admired the **Official Monster Raving Loony Party** and was briefly their financial advisor.^[76] He wrote in his autobiography that **Liechtenstein** – a constitutional monarchy headed by a prince – had the best political system in the world.^[77] Moore was a critic of the **Iraq War**,^[78] and said "the world was a safer place when **Ronald Reagan** was in the White House".^[79] He was a patron of the **British Weights and Measures Association**.

Proudly declaring himself to be English (rather than British) with "not the slightest wish to integrate with anybody",^[76] he stated his admiration for controversial MP **Enoch Powell**.^[80] Moore devoted an entire chap-

ter ("The Weak Arm of the Law") of his autobiography to denouncing modern British society, particularly "motorist-hunting" policemen, sentencing policy, the **Race Relations Act**, **Sex Discrimination Act** and the "**Thought Police/Politically Correct Brigade**".^[81] He wrote that "homosexuals are mainly responsible for the spreading of **AIDS** (the **Garden of Eden** is home of **Adam and Eve**, not **Adam and Steve**)".^[82]

In an interview with *Radio Times*, he asserted that the BBC was being "ruined by women", commenting that: "The trouble is that the BBC now is run by women and it shows: soap operas, cooking, quizzes, **kitchen-sink plays**. You wouldn't have had that in the golden days." In response, a BBC spokeswoman described Moore as being one of TV's best-loved figures and remarked that his "forthright" views were "what we all love about him".^[83] In his June 2002 appearance on *Room 101* he banished female news readers into Room 101.^[84]

"I may be accused of being a dinosaur, but I would remind you that dinosaurs ruled the Earth for a very long time."
— Moore responds to those who criticise his **Euro-sceptic** and right-wing beliefs.^[85]

Moore cited his opposition to **fox hunting**, **blood sports** and **capital punishment** to rebut claims that he had ultra right-wing views.^{[76][86]} Though not a vegetarian, he held "a deep contempt for people who go out to kill merely to amuse themselves."^[87] He was an animal lover, supporting many animal welfare charities (particularly **Cats Protection**). He had a particular affinity for cats and stated that "a catless house is a soulless house".^[88]

1.2.4 Other interests and popular culture

Because of his long-running television career and eccentric demeanour, Moore was widely recognised and became a popular public figure. In 1976 it was used to good effect for an **April Fools' Day** spoof on **BBC Radio 2**, when Moore announced a once-in-a-lifetime astronomical event that meant that if listeners could jump at that exact moment, 9.47 a.m. they would experience a temporary sensation of **weightlessness**.^[89] The BBC received many telephone calls from listeners alleging they experienced the sensation.^[89] He was a key figure in the establishment of the *International Birdman* event in **Bognor Regis**, which was initially held in Selsey.^[90]

Moore appeared in other television and radio shows, including *Just a Minute* and, from 1992 until 1998, playing the role of **GamesMaster** in the television show of the same name: a character who professed to know everything there is to know about video gaming.^[91] He would issue video game challenges and answered questions on cheats and tips. The show's host, **Dominik Diamond**,

claimed that Moore did not understand anything that he said on the show, yet managed to record his contributions in single takes.^[92]

Moore was a keen amateur actor, appearing in local plays.^[93] He appeared in self-parodying roles, in several episodes of *The Goodies* and on the *Morecambe and Wise* show, and broadcast with *Kenneth Horne* only a few days before Horne's death.^[94] He had a minor role in the fourth radio series of *The Hitchhiker's Guide to the Galaxy*, and a lead role in the Radio 1 sci-fi BBC/20th Century Fox radio play, *Independence Day UK* in which amongst other things, Moore fills in as a navigator. He appeared in *It's a Celebrity Knockout*, *Blankety Blank* and *Face the Music*. He appeared on television at least once in a film prop space suit.

He expressed appreciation for the science fiction television series *Doctor Who* and *Star Trek*, but stated that he had stopped watching when "they went PC - making women commanders, that kind of thing".^[95] Despite this he subsequently made a cameo appearance in the *Doctor Who* episode "The Eleventh Hour" in 2010, which was Matt Smith's debut as the Eleventh Doctor.^[96] In the 1960s, Moore had been approached by the *Doctor Who* story editor Gerry Davis to act as a scientific advisor on the series to help with the accuracy of stories, a position ultimately taken by Kit Pedler.^[97]

A keen amateur chess player, Moore carried a pocket set and was vice president of Sussex Junior Chess Association.^[98] In 2003, he presented Sussex Junior David Howell with the best young chess player award on Carlton Television's *Britain's Brilliant Prodigies* show. Moore had represented Sussex in his youth.^[39]

Moore was an enthusiastic amateur cricketer, playing for the Selsey Cricket Club well into his seventies.^[99] He played for the Lord's Taverners, a cricketing charity team, as a bowler with an unorthodox action. Though an accomplished leg spin bowler, he was a number 11 batsman and a poor fielder.^[100] The jacket notes to his book "Suns, Myths and Men" (1968) said his hobbies included "chess, which he plays with a peculiar leg-spin, and cricket." He played golf, and won a Pro-Am competition in Southampton in 1975.^[101]

Until forced to give up because of arthritis, Moore was a keen pianist and accomplished xylophone player, having first played the instrument at the age of 13.^[102] He composed a substantial corpus of works, including two operettas.^[103] Moore had a ballet, *Lyra's Dream*, written to his music. He performed at a Royal Command Performance, and performed a duet with Evelyn Glennie.^[104]

In 1998, as a guest on *Have I Got News for You*, he accompanied the show's closing theme tune on the xylophone and as a pianist, he once accompanied Albert Einstein playing *The Swan* by Camille Saint-Saëns on the violin (no recording was made).^[105] In 1981 he performed a solo xylophone rendition of the Sex Pistols' "Anarchy in the U.K." in a Royal Variety Performance.^[106] He did

not enjoy most popular music: when played ten modern rock songs by such artists as Hawkwind, Muse and Pink Floyd, in a 2009 interview with journalist Joel McIver, he explained, "To my ear, all these songs are universally awful."^[107]

On 7 March 2006 he was hospitalised and fitted with a pacemaker because of a cardiac abnormality.^[108] Before encountering health problems he was an extensive traveller, and had visited all seven continents, including Antarctica; he said his favourite two countries were Iceland and Norway.^[109] He spoke in favour of Esperanto on the hundredth anniversary of the help-language.^[110]

He was a friend of Queen guitarist and astrophysicist Brian May, who was an occasional guest on *The Sky at Night*.^[111] May bought Moore's Selsey home in 2008, leasing it back to him for a peppercorn rent the same day to provide financial security.^[112] May, Moore and Chris Lintott co-wrote a book *Bang! The Complete History of the Universe*. In February 2011, Moore completed (with Robin Rees and Iain Nicolson) his comprehensive *Patrick Moore's Data Book of Astronomy* for Cambridge University Press. In 1986 he was identified as the co-author of a book published in 1954 called *Flying Saucer from Mars*, attributed to Cedric Allingham, which was intended as a practical joke on UFO believers.^[113] Moore never admitted his involvement. He once joined the Flat Earth Society as an ironic joke.^[114]

Moore believed himself to be the only person to have met the first man to fly, Orville Wright, the first man in space, Yuri Gagarin, and the first man on the moon, Neil Armstrong.^[115]

In March 2015 BBC Radio 4 broadcast a 45-minute play based on the life of Moore, *The Far Side of the Moore* by Sean Grundy, starring Tom Hollander as Moore and Patricia Hodge as his mother.^[116]

1.2.5 Honours and appointments

In 1945, Moore was elected a fellow of the Royal Astronomical Society; in 1977 he was awarded the society's Jackson-Gwilt Medal. In 1968, he was appointed an Officer of the Order of the British Empire (OBE) and promoted to a Commander (CBE) of the order in 1988. In 1999 he became the honorary president of the East Sussex Astronomical Society, a position he held until his death. In 2001, he was knighted for "services to the popularisation of science and to broadcasting".^[117]

In 2001, he was appointed an Honorary Fellow of the Royal Society, the only amateur astronomer ever to achieve the distinction.^[118] In June 2002, he was appointed as the honorary vice president of the Society for the History of Astronomy. Also in 2002, Buzz Aldrin presented him with a British Academy of Film and Television Arts (BAFTA) award for services to television.^[119] He was patron of Torquay Boys' Grammar School in

south Devon. Moore had a long association with the University of Leicester and its Department of Physics and Astronomy, and was awarded an honorary Doctor of Science degree in 1996 and a Distinguished Honorary Fellowship in 2008, the highest award that the university can bestow.^[120]

In 2009, after saving Airdrie Public Observatory from closure in 2002, Moore accepted the position of Honorary President of Airdrie Astronomical Association, a position which he held until his death.

1.2.6 Bibliography

Moore wrote many popular books. The website *Astronomy Now Online* estimates that he published over a thousand books on popular science, including all known editions and reprints.^[121] From 1962 to 2011 he also edited the long running *Yearbook of Astronomy*, published annually; and was editor on many other science books in that period. He also wrote science fiction novels for children; and, under the pen name R T Fishall,^[122] he wrote humorous works. Therefore, the list below is not exhaustive:

1.2.7 Film and television appearances

1.2.8 See also

- Jack Horkheimer, host of the American astronomy show *Jack Horkheimer: Star Gazer*

1.2.9 References

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1.2.10 External links

- Bang! The Complete History of the Universe by Brian May, Patrick Moore and Chris Lintott

Chapter 2

Objects

2.1 Caldwell 1

NGC 188 is an **open cluster** in the constellation **Cepheus**. It was discovered by **John Herschel** in 1825. Unlike most open clusters that drift apart after a few million years because of the gravitational interaction of our galaxy, NGC 188 lies far above the plane of the galaxy and is one of the most ancient of open clusters known, at approximately 5 billion years old.

NGC 188 is very close to the North Celestial Pole, under five degrees away, and in the constellation of Cepheus at an estimated 5,000 light year distance, this puts it slightly above the Milky Way's disc and further from the center of the galaxy than the Sun.

2.1.1 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 188*. Retrieved 2006-12-08.
- [2] Bonatto, C.; Bica, E.; Santos, J. F. C., Jr. (April 2005). "Spatial dependence of 2MASS luminosity and mass functions in the old open cluster NGC 188". *Astronomy and Astrophysics* **433** (3): 917–929. arXiv:astro-ph/0502453. Bibcode:2005A&A...433..917B. doi:10.1051/0004-6361:20041113.

2.1.2 External links

- **NGC 188** at SEDS NGC objects pages
- **NGC 188** at NightSkyInfo.com
-
- **NGC 188** on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- **NGC 188** at the *SIMBAD Astronomical Database*.
 - Ids - Bibliography - Image - B&W Image.

Coordinates:  00^h 48^m 26^s, +85° 15' 18"

2.2 Caldwell 2

For the Bow Tie Nebula in Centaurus, see **Boomerang Nebula**.

NGC 40 (also known as the **Bow-Tie Nebula** and **Caldwell 2**) is a planetary nebula discovered by **William Herschel** on November 25, 1788, and is composed of hot gas around a dying star. The star has ejected its outer layer which has left behind a smaller, hot star with a temperature on the surface of about 50,000 degrees Celsius.^[3] Radiation from the star causes the shed outer layer to heat to about 10,000 degrees Celsius,^[3] and is about one light-year across.^[3] About 30,000 years from now, scientists theorize that NGC 40 will fade away, leaving only a white dwarf star approximately the size of Earth.^[3]

2.2.1 Gallery

- **HST**

2.2.2 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 40*. Retrieved 2006-12-22.
- [2] O'Meara, Stephen James (2002). *Deep Sky Companions: The Caldwell Objects*. Sky Publishing Corporation. pp. 22–23. ISBN 0-933346-97-2.
- [3] "Chandra X-Ray Observatory". Retrieved 2007-06-05.

2.2.3 External links

-
- **NGC 40** on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 13^m 01^s, +72° 31' 19"

2.3 Caldwell 3

NGC 4236 (also known as **Caldwell 3**) is a **barred spiral galaxy** located in the **constellation Draco**.

2.3.1 Galaxy group information

NGC 4236 is a member of the **M81 Group**, a group of galaxies located at a distance of approximately 11.7 Mly (3.6 Mpc) from Earth.^[3] The group also contains the well-known spiral galaxy **Messier 81** and the well-known starburst galaxy **Messier 82**.^[3]

2.3.2 See also

- **NGC 55** - a similar galaxy

2.3.3 References

- [1] R. W. Sinnott, ed. (1988). *The Complete New General Catalogue and Index Catalogue of Nebulae and Star Clusters* by J. L. E. Dreyer. Sky Publishing Corporation and Cambridge University Press. ISBN 0-933346-51-4.
- [2] “NASA/IPAC Extragalactic Database”. *Results for NGC 4236*. Retrieved 2007-03-30.
- [3] I. D. Karachentsev (2005). “The Local Group and Other Neighboring Galaxy Groups”. *Astronomical Journal* **129** (1): 178–188. arXiv:astro-ph/0410065. Bibcode:2005AJ....129..178K. doi:10.1086/426368.

2.3.4 External links

-
- **NGC 4236 on WikiSky**: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.4 Caldwell 4

The **Iris Nebula**, also **NGC 7023** and **Caldwell 4**, is a bright **reflection nebula** and **Caldwell object** in the **constellation Cepheus**. NGC 7023 is actually the cluster within the nebula, LBN 487, and the nebula is lit by a magnitude +7 star, **SAO 19158**.^[1] It shines at magnitude +6.8. It is located near the **Mira-type variable star T Cephei**, and near the bright magnitude +3.23 variable star **Beta Cephei (Alphirk)**. It lies 1,300 light-years away and is six light-years across.^[2]

2.4.1 Notes

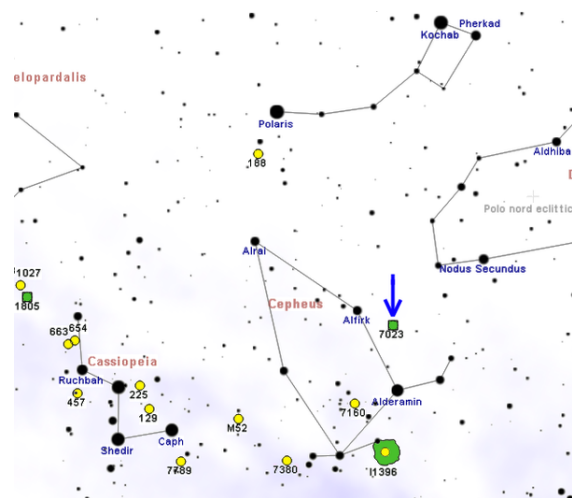
- [1] Perkins, Philip (2005). “NGC 7023”. astrocruise.com. Retrieved 2008-08-06.
- [2] Nemiroff, Robert; Bonnell, Jerry (2004-11-04). “APOD: 2004 November 4 - NGC 7023: The Iris Nebula”. APOD (NASA). Retrieved 2008-08-06.

2.4.2 References

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- Caldwell-Moore, Sir Patrick (2003). *Firefly Atlas of the Universe*. Firefly Books Limited. ISBN 1-55297-819-2.

2.4.3 External links

- **SEDS – NGC 7023**
- **Simbad – NGC 7023**
- **VizieR – NGC 7023**
- **NED – NGC 7023**
- **Dark Atmospheres Photography – Iris Nebula NGC 7023**
- **See NGC 7023 in WorldWide Telescope**
-
- **Iris Nebula on WikiSky**: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images



Map showing location of NGC 7023 (Roberto Mura)

Coordinates:  21^h 01^m 36^s, +68° 09′ 48″

2.5 Caldwell 5

IC 342 (IC=*Index Catalogue*)(also known as **Caldwell 5**) is an intermediate spiral galaxy in the constellation Camelopardalis. The galaxy is near the galactic equator where dust obscuration makes it a difficult object for both amateur and professional astronomers to observe,^[1] though it can readily be detected even with binoculars.^[4] The dust of the Milky Way makes it difficult to determine the precise distance; modern estimates range from about 7 Mly^[5] to about 11 Mly.^[2]

IC 342 is one of the brightest two galaxies in the IC 342/Maffei Group of galaxies, one of the galaxy groups that is closest to the Local Group. The galaxy was discovered by William Frederick Denning in 1895. Edwin Hubble first thought it to be in the Local Group, but later it was demonstrated that the galaxy is outside the Local Group.^[6]

In 1935, Harlow Shapley declared that this galaxy was the third largest spiral galaxy by angular size then known, smaller only than the Andromeda Galaxy (M31) and the Triangulum Galaxy (M33), being wider than the full moon.^[7] (Modern estimates are more conservative, giving the apparent size as one-half to two-thirds the diameter of the full moon).^{[1][4]}

It has an H II nucleus.^[8]

2.5.1 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for IC 342*. Retrieved 2006-11-01.
- [2] I. D. Karachentsev, V. E. Karachentseva, W. K. Hutchmeier, D. I. Makarov (2004). “A Catalog of Neighboring Galaxies”. *Astronomical Journal* **127** (4): 2031–2068. Bibcode:2004AJ....127.2031K. doi:10.1086/382905.
- [3] Karachentsev, I. D.; Kashibadze, O. G. (2006). “Masses of the local group and of the M81 group estimated from distortions in the local velocity field”. *Astrophysics* **49** (1): 3–18. Bibcode:2006Ap....49....3K. doi:10.1007/s10511-006-0002-6.
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- [5] “Hidden Galaxy IC 342”. *Astronomy Picture of the Day*. NASA. 22 December 2010. Retrieved 28 January 2013.
- [6] SEDS IC 342.
- [7] Border Cities Star (Windsor, Ontario), “Spiral Galaxy Third Biggest”, 24 June 1935, p.8
- [8] Ho, Luis C.; Filippenko, Alexei V.; Sargent, Wallace L. W. (1997). “A Search for 'Dwarf' Seyfert Nuclei. III. Spectroscopic Parameters and Properties of the Host Galaxies”. *Astrophysical Journal Supplement* **112**: 315. arXiv:astro-ph/9704107. Bibcode:1997ApJS..112..315H. doi:10.1086/313041.

2.5.2 External links

- NASA Astronomy Picture of the Day – 22 December 2010
- IC 342 (image included)
-
- IC 342 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  03^h 46^m 48.5^s, +68° 05′ 46″

2.6 Caldwell 6

Coordinates:  17^h 58^m 33.423^s, +66° 37′ 59.52″

The **Cat's Eye Nebula** or **NGC 6543**, is a relatively bright planetary nebula in the northern constellation of Draco, which was discovered by William Herschel on February 15, 1786. It was notably the first planetary nebula whose spectrum was investigated by the English amateur astronomer William Huggins, demonstrating that planetary nebulae were gaseous and not stellar in nature. Structurally, the object has had high-resolution images by the Hubble Space Telescope revealing knots, jets, bubbles and complex arcs, being illuminated by the central hot planetary nebula nucleus or PNN. It is a well-studied object that has been observed from radio to X-ray wavelengths.

2.6.1 General information

NGC 6543 is a high northern declination deep-sky object and is near the apparent position of the North Ecliptic Pole. It has the combined magnitude of 8.1, with high surface brightness. Its small bright inner nebula subtends an average of 16.1 arcsec, with the outer prominent condensations about 25 arcsec.^[3] Deep images reveal an extended halo about 300 arcsec or 5 arcmin across,^[4] that was once ejected by the central progenitor star during its red giant phase.

Observations show the bright nebulosity has temperatures between 7000 and 9000 K, whose densities average of about 5000 particles per cubic centimetre.^[5] Its outer halo has the higher temperature around 15000 K, but is of much lower density.^[6] Velocity of the fast stellar wind is about 1900 km/s, where spectroscopic analysis shows the current rate of mass loss averages 3.2×10^{-7} solar masses per year, equivalent to twenty trillion tons per second (20 Eg/s).^[5]

Surface temperature for the central star is about 80000 K, being 10000 times as luminous as the sun. Stellar classification is O7 + [WR]–type star^[5] Calculations suggest



An optical Image of the Nebula's Surrounding Halo

the central star is over one **solar mass**, from a theoretical initial 5 solar masses.^[7] Radius is about 0.65 times the Sun or 910000 km.

The Cat's Eye nebula, given in some sources, lies about three thousand light-years from Earth.^[8]

2.6.2 Observations

The Cat's Eye was the first planetary nebula to be observed with a **spectroscope** by **William Huggins** on August 29, 1864.^[9] Huggins' observations, which revealed that the nebula's spectrum was non-continuous and made of a few bright emission lines, first indication that planetary nebulae consist of tenuous ionised gas. Spectroscopic observations at these wavelengths are used in abundance determinations,^[10] while images at these wavelengths have been used to reveal the intricate structure of the nebula.^[11]

Infrared observations

Observations of NGC 6543 at **far-infrared** wavelengths (about 60 μm) reveal the presence of **stellar dust** at low temperatures. The dust is believed to have formed during the last phases of the progenitor star's life. It absorbs light from the central star and re-radiates it at **infrared** wavelengths. The spectrum of the infrared dust emission implies that the dust temperature is about 85 K, while the mass of the dust is estimated at 6.4×10^{-4} solar masses.^[12]

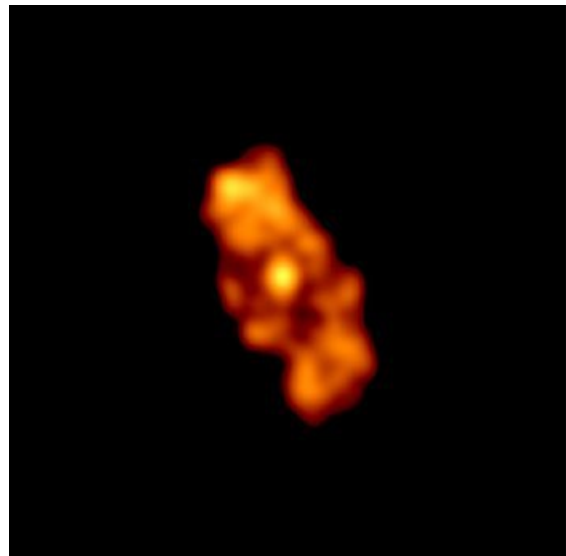
Infrared emission also reveals the presence of **un-ionised** material such as **molecular hydrogen** (H_2) and **argon**. In many planetary nebulae, molecular emission is greatest at larger distances from the star, where more material is un-ionised, but molecular hydrogen emission in NGC 6543 seems to be bright at the inner edge of its outer halo. This

may be due to **shock waves** exciting the H_2 as ejecta moving at different speeds collide. The overall appearance of the Cat's Eye Nebula in infrared (wavelengths 2–8 μm) is similar in visible light.^[13]

Optical and ultraviolet observations

The Hubble Space Telescope image produced here is in false colour, designed to highlight regions of high and low ionisation. Three images were taken, in filters isolating the light emitted by singly ionised **hydrogen** at 656.3 nm, singly ionised **nitrogen** at 658.4 nm and doubly ionised **oxygen** at 500.7 nm. The images were combined as red, green and blue channels respectively, although their true colours are red, red and green. The image reveals two "caps" of less ionised material at the edge of the nebula.^[14]

X-ray observations



X-ray image of Nebula.

In 2001, observations at **X-ray** wavelengths by the **Chandra X-ray Observatory** revealed the presence of extremely hot gas within NGC 6543 with the temperature of 1.7×10^6 K.^[15] The image at the top of this article is a combination of optical images from the Hubble Space Telescope with the Chandra X-ray images. It is thought that the very hot gas results from the violent interaction of a fast stellar wind with material previously ejected. This interaction has hollowed out the inner bubble of the nebula.^[11] Chandra observations have also revealed a **point source** at the position of the central star. The spectrum of this source extends to the hard part of the X-ray spectrum, to 0.5–1.0 keV. A star with the **photospheric** temperature of about 100000 K would not be expected to emit strongly in hard X-rays, and so their presence is something of a mystery. It may suggest the presence

of a high temperature accretion disk within a binary star system.^[16] The hard X-ray data remain intriguing more than ten years later: the Cat's Eye was included in a 2012 Chandra survey of 21 central stars of planetary nebulae (CSPNe) in the solar neighborhood, which found: "All but one of the X-ray point sources detected at CSPNe display X-ray spectra that are harder than expected from hot (~ 100000 K) central star photospheres, possibly indicating a high frequency of binary companions to CSPNe. Other potential explanations include self-shocking winds or PN mass fallback."^[17]

2.6.3 Distance

Planetary nebulae distances like NGC 6543 are generally very inaccurate and not well known.^[18] Some recent Hubble Space Telescope observations of NGC 6543 taken several years apart calculates its distance by measuring the angular expansion rate is 3.457 milliarcseconds per year. Assuming a line of sight expansion velocity of $16.4 \text{ km}\cdot\text{s}^{-1}$, implies that NGC 6543's distance is 1001 ± 269 parsecs (3×10^{19} m or 3300 light-years) away from Earth.^[19] Several other distance references, like what is quoted in SIMBAD in 2014 Stanghellini, L., et al. (2008) says distance is 1623 parsecs (5300 light-years).

2.6.4 Age

The angular expansion of the nebula can also be used to estimate its age. If it has been expanding at a constant rate of 10 milliarcseconds a year, then it would take 1000 ± 260 years to reach a diameter of 20 arcseconds. This may be an upper limit to the age, because ejected material will be slowed when it encounters material ejected from the star at earlier stages of its evolution, and the interstellar medium.^[19]

2.6.5 Composition

Like most astronomical objects, NGC 6543 consists mostly of hydrogen and helium, with heavier elements present in small quantities. The exact composition may be determined by spectroscopic studies. Abundances are generally expressed relative to hydrogen, the most abundant element.^[6]

Different studies generally find varying values for elemental abundances. This is often because spectrographs attached to telescopes do not collect all the light from objects being observed, instead gathering light from a slit or small aperture. Therefore, different observations may sample different parts of the nebula.

However, results for NGC 6543 broadly agree that, relative to hydrogen, the helium abundance is about 0.12, carbon and nitrogen abundances are both about 3×10^{-4} , and the oxygen abundance is about 7×10^{-4} .^[10] These



Image of NGC 6543 processed to reveal the concentric rings surrounding the inner core. Also visible are the linear structures, possibly caused by precessing jets from a binary central star system.

are fairly typical abundances for planetary nebulae, with the carbon, nitrogen and oxygen abundances all larger than the values found for the sun, due to the effects of nucleosynthesis enriching the star's atmosphere in heavy elements before it is ejected as a planetary nebula.^[20]

Deep spectroscopic analysis of NGC 6543 may indicate that the nebula contains a small amount of material which is highly enriched in heavy elements; this is discussed below.^[10]

2.6.6 Kinematics and morphology

The Cat's Eye Nebula is structurally a very complex nebula, and the mechanism or mechanisms that have given rise to its complicated morphology are not well understood.^[11] The central bright part of the nebular consists of the inner elongated bubble (inner ellipse) filled with hot gas. It in turn is nested into a pair of larger spherical bubbles conjoined together along their waist. The waist is observed as the second larger ellipse lying perpendicular to the bubble with hot gas.^[3]

The structure of the bright portion of the nebula is primarily caused by the interaction of a fast stellar wind being emitted by the central star with material ejected during the formation of the nebula. This interaction causes the emission of X-rays discussed above. The stellar wind, blowing with the velocity as high as 1900 km/s, has 'hollowed out' the inner bubble of the nebula, and appears to have burst the bubble at both ends.^[11]

It is also suspected that the central star of the nebula may be a binary star. The existence of an accretion disk caused by mass transfer between the two components of the sys-

tem may give rise to **polar jets**, which would interact with previously ejected material. Over time, the direction of the polar jets would vary due to **precession**.^[21]

Outside the bright inner portion of the nebula, there are a series of concentric rings, thought to have been ejected before the formation of the planetary nebula, while the star was on the **asymptotic giant branch** of the **Hertzsprung-Russell diagram**. These rings are very evenly spaced, suggesting that the mechanism responsible for their formation ejected them at very regular intervals and at very similar speeds.^[4] The total mass of the rings is about 0.1 solar masses.^[22] The pulsations that formed the rings probably started 15,000 years ago and ceased about 1000 years ago, when the formation of the bright central part began (see above).^[23]

Further out, a large faint halo extends to large distances from the star. The halo again predates the formation of the main nebula. The mass of the halo is estimated as 0.26–0.92 solar masses.^[22]

2.6.7 Notes

- [1] Distance $\times \sin(\text{diameter_angle} / 2) = 0.2$ ly. radius
- [2] $9.8\text{B apparent magnitude} - 5 \times \{\log(1.0 \pm 0.3 \text{ kpc distance}) - 1\} = -0.2 + 0.8$
 $-0.6\text{B absolute magnitude}$

2.6.8 References

- [1] (SIMBAD 2006)
- [2] (Reed et al. 1999)
- [3] (Reed et al. 1999, p. 2433)
- [4] (Balick, Wilson & Hajian 2001, p. 354)
- [5] (Wesson & Liu 2004, pp. 1026, 1028)
- [6] (Wesson & Liu 2004, p. 1029)
- [7] (Bianchi, Cerrato & Grewing 1986)
- [8] Nemiroff, Robert. “The Cat’s Eye Nebula From Hubble”. NASA. Retrieved October 26, 2011.
- [9] (kwok 2000, p. 1)
- [10] (Wesson & Liu 2004, pp. 1026–1027, 1040–1041)
- [11] (Balick & Preston 1987, pp. 958, 961–963)
- [12] (Klaas et al. 2006, p. 523)
- [13] (Hora et al. 2004, p. 299)
- [14] (Wesson & Liu 2004, pp. 1027–1031)
- [15] (Chu et al. 2001)
- [16] (Guerrero et al. 2001)
- [17] (Kastner et al. 2012)

- [18] (Reed et al. 1999, p. 2430)
- [19] (Reed et al. 1999, pp. 2433–2438)
- [20] (Hyung et al. 2000)
- [21] (Miranda & Solf 1992)
- [22] (Balick, Wilson & Hajian 2001, p. 358)
- [23] (Balick, Wilson & Hajian 2001, pp. 359–360)

2.6.9 Cited sources

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- Hora, Joseph L.; Latter, William B.; Allen, Lori E.; Marengo, Massimo; et al. (2004), “Infrared Array Camera (IRAC) Observations of Planetary Nebulae”, *Astrophysical Journal Supplement Series* **154** (1): 296–301, Bibcode:2004ApJS...154..296H, doi:10.1086/422820
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- Klaas, U.; Walker, S. J.; Müller, T. G.; Richards, P. J.; et al. (2006), “Multi-aperture photometry of extended IR sources with ISOPHOT. I. The nature of extended IR emission of planetary Nebulae”, *Astronomy and Astrophysics* **452** (2): 523–535, Bibcode:2006A&A...452..523K, doi:10.1051/0004-6361:20053245
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- SIMBAD (December 22, 2006), *Results for Cat’s Eye Nebula*, SIMBAD, Centre de Données Astronomiques de Strasbourg
- Wesson, R.; Liu, X.-W. (2004), “Physical conditions in the planetary nebula NGC 6543”, *Monthly Notices of the Royal Astronomical Society* **351** (3): 1026–1042, Bibcode:2004MNRAS.351.1026W, doi:10.1111/j.1365-2966.2004.07856.x
- The Cat’s Eye Nebula October 31, 1999
- Halo of the Cat’s Eye 2010 May 9
- Hubble Probes the Complex History of a Dying Star—HubbleSite article about the Cat’s Eye Nebula.
- NGC6543 The Cats Eye Nebula
- Hubble’s Color Toolbox: Cat’s Eye Nebula—article showing image composite process used to produce an image of the nebula
-
- Cat’s Eye Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Cat’s Eye Nebula at Constellation Guide

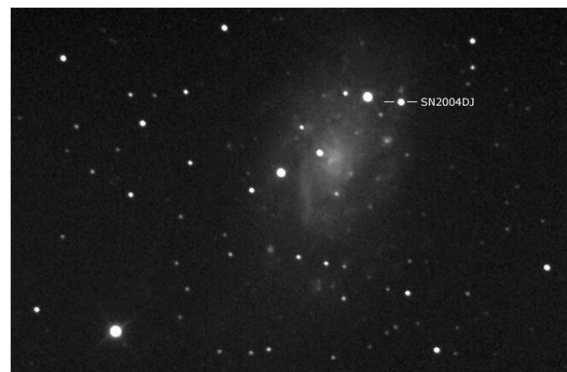
2.7 Caldwell 7

Coordinates:  07^h 36^m 51.4^s, +65° 36′ 09″

NGC 2403 (also **Caldwell 7**) is an intermediate spiral galaxy in the constellation Camelopardalis. NGC 2403 is an outlying member of the M81 Group,^[2] and is approximately 8 million light-years distant. It bears a striking similarity to M33, being about 50,000 light years in diameter and containing numerous star-forming H II regions.^[3] The northern spiral arm connects it to nearby galaxy NGC 2404.^[2] NGC 2403 can be observed using 10x50 binoculars.^[2]

2.7.1 Supernovae

As of late 2004, there had been two reported supernovae in the galaxy: SN 1954J, which attained a magnitude of 16 at its brightest, and SN 2004dj.



SN2004dj

2.6.10 External links

- Cat’s Eye Nebula Release at ESA/Hubble
- Cat’s Eye Nebula images at ESA/Hubble
- Chandra X-Ray Observatory Photo Album: NGC 6543
- Astronomy Picture of the Day

2.7.2 History

NGC 2403 was discovered by **William Herschel** in 1788. **Allan Sandage** detected **Cepheid variables** in NGC 2403 using the **Hale telescope**, giving it the distinction of being the first galaxy beyond our **local group** within which a Cepheid was discovered.^[2] He derived a distance of a mere 8 thousand light years.^[2] Today, it is thought to be a thousand times further away at about 8 million light years (2.5 Mpc).

2.7.3 See also

- SN 2004DJ

2.7.4 References

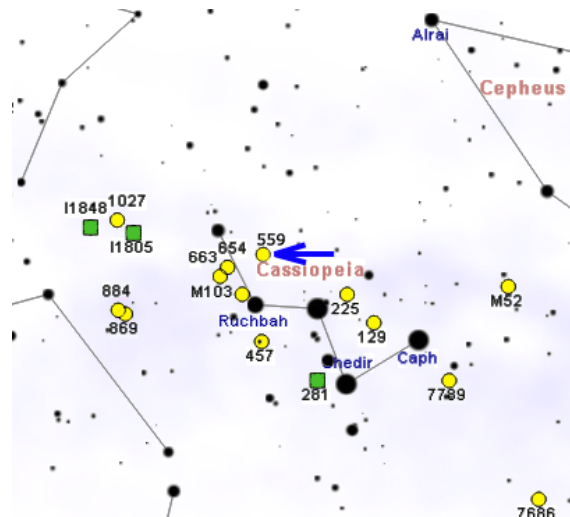
- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 2403*. Retrieved 2006-11-21.
- [2] Kepple, George Robert; Glen W. Sanner (1998). *The Night Sky Observer's Guide, Volume 1*. Willmann-Bell, Inc. p. 73. ISBN 0-943396-58-1.
- [3] Ho, Luis C.; Filippenko, Alexei V.; Sargent, Wallace L. W. (October 1997). “A Search for “Dwarf” Seyfert Nuclei. III. Spectroscopic Parameters and Properties of the Host Galaxies”. *Astrophysical Journal Supplement* **112**: 315–390. arXiv:astro-ph/9704107. Bibcode:1997ApJS..112..315H. doi:10.1086/313041.

2.7.5 External links

- Spiral Galaxy NGC 2403 at the astro-photography site of Mr. Takayuki Yoshida
- NGC 2403 at ESA/Hubble
- NGC 2403 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.8 Caldwell 8

NGC 559, also **Caldwell 8**, is an **open cluster** and **Caldwell object** in the constellation **Cassiopeia**. It shines at magnitude +9.5. Its celestial coordinates are RA 01^h 29.5^m, dec +63° 18′. It is located near the open cluster NGC 637, and the bright magnitude +2.2 irregular variable star **Gamma Cassiopeiae**. The cluster is 7 arcmins across.^[1]



Map showing the location of NGC 559

2.8.1 References

- [1] Seligman, Courtney. “Celestial Atlas: NGC Objects: NGC 550 - 599”. *cseligman.com*. Archived from the original on 26 July 2015. Retrieved 26 July 2015.

2.8.2 External links

- SEDS – NGC 559
- Simbad – NGC 559
- VizieR – NGC 559
- NED – NGC 559
- NGC 559 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.9 Caldwell 9

S 155, also known as the **Cave Nebula**, **Sh2–155** or **Caldwell 9**, is a dim and very diffuse bright nebula within a larger nebula complex containing emission, reflection, and dark nebulosity. It is located in the constellation **Cepheus**.

Visually it is a difficult object, but with adequate exposure, makes a striking image. The nebula gets its name *Cave Nebula* from the dark lane at the eastern side abutting the brightest curve of emission nebulosity which gives the appearance of a deep cave when seen through a telescope visually.

2.9.1 References

Patrick Moore (1990). *The Amateur Astronomer* (11th ed), W.W. Norton & Company, ISBN 0-393-02864-X

2.9.2 External links

- S 155 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- The Scale of the Universe (Astronomy Picture of the Day 2012 March 12)

2.10 Caldwell 10

NGC 663, also known as **Caldwell 10**, is young open cluster of about 400 stars in the Cassiopeia constellation. It has an estimated 400 stars and spans about a quarter of a degree across the sky. It can reportedly be detected with the unaided eye, although a telescope is recommended for best viewing. The brightest members of the cluster can be viewed with binoculars. Although the listed visual magnitude is 7.1, several observers have reported higher estimates.^[1]

After adjusting for reddening due to interstellar dust, the distance modulus is estimated as 11.6 magnitudes. It is located about 2,100 parsecs distant with an estimated age of 20–25 million years.^[2] This means that stars of spectral class B2 or higher (in the sense of higher mass), are reaching the end of their main sequence lifespan.^[3] This cluster appears to be located in front of a molecular cloud, although the two are not physically associated. This cloud has the effect of blocking background stars from the visual image of the cluster as it lies at a distance of 300 parsecs.^[4]

This cluster is of interest because of the high number of Be stars, with a total of about 24 discovered. These are spectral class B stars that show prominent emission lines of hydrogen in their spectrum. Most of the Be stars in the cluster lie between spectral class B0 and B3.^[2] A candidate member of the cluster, LS I +61° 235, is a Be star with an X-ray binary component that has a period of about three years.^[5] There are at least five blue stragglers in the cluster. These are stars that formed by the merger of two other stars.^[3] Two of the cluster's star systems are likely eclipsing binaries with periods of 0.6 and 1.03 days.^[6] NGC 663 also has two red supergiant stars, both located on its periphery^{[7][8]}

NGC 663 is assumed to form part of the stellar association Cassiopeia OB8, that is located in the Perseus arm of the Milky Way, along with the open clusters M103, NGC 654, NGC 659, and some supergiant stars scattered between them, all of them having similar ages and distances.^{[9][10]}

2.10.1 References

- [1] O'Meara, S. J. (2002). *The Caldwell objects, Deep-sky companions*. Cambridge University Press. pp. 50–51. ISBN 0-521-82796-5.
- [2] Pigulski, A.; Kopacki, G.; Kolaczowski, Z. (2001). "The young open cluster NGC 663 and its Be stars". *Astronomy & Astrophysics* **376** (1): 144–153. Bibcode:2001A&A...376..144P. doi:10.1051/0004-6361:20010974.
- [3] Marco, A.; Negueruela, I.; Motch, C. (2007). "Blue Stragglers, Be Stars and X-ray Binaries in Open Clusters". *ASP Conference Series* **361**: 388. Bibcode:2007ASPC..361..388M.
- [4] Phelps, Randy L.; Janes, Kenneth A. (1993). "Young open clusters as probes of the star-formation process. 2: Mass and luminosity functions of young open clusters". *Astronomical Journal* **106** (5): 1870–1884. Bibcode:1993AJ....106.1870P. doi:10.1086/116772.
- [5] Reig, P.; Fabregat, J.; Coe, M. J.; Roche, P.; et al. (1997). "The Be/X-ray binary LS I +61 235/RX J0146.9+6121: physical parameters and V/R variability" (PDF). *Astronomy and Astrophysics* **322** (1): 183–192. Bibcode:1997A&A...322..183R.
- [6] Pietrzynski, G. (1996). "Variable Stars in the Young Open Cluster NGC 663". *Acta Astronomica* **46**: 357–360. Bibcode:1996AcA....46..357P.
- [7] Mermilliod, J. C.; Mayor, M.; Udry, S. (2008). "Red giants in open clusters. XIV. Mean radial velocities for 1309 stars and 166 open clusters". *Astronomy & Astrophysics* **485** (1): 303–314. Bibcode:2008A&A...485..303M. doi:10.1051/0004-6361:200809664.
- [8] Pandey, A. K.; Upadhyay, K.; Ogura, K.; Sagar, Ram; et al. (2005). "Stellar contents of two young open clusters: NGC 663 and 654". *Monthly Notices of the Royal Astronomical Society* **358** (4): 1290–1308. Bibcode:2005MNRAS.358.1290P. doi:10.1111/j.1365-2966.2005.08784.x.
- [9] Negueruela, I.; González-Fernández, C.; Marco, A.; Clark, J. S. (2011). "A massive association around the obscured open cluster RSGC3". *Astronomy & Astrophysics* **528**. arXiv:1102.0028. Bibcode:2011A&A...528A..59N. doi:10.1051/0004-6361/201016102.
- [10] Humphreys, R. M. (1978). "Studies of luminous stars in nearby galaxies. I. Supergiants and O stars in the Milky Way.". *Astrophysical Journal Supplement Series* **38**: 309–350. Bibcode:1978ApJS...38..309H. doi:10.1086/190559.

2.10.2 External links

-
- NGC 663 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  01^h 46^m 16^s, +61° 13′ 06″

2.11 Caldwell 11

“Bubble Nebula” redirects here. For the Bubble Nebula in Barnard’s Galaxy, see [Bubble Nebula \(NGC 6822\)](#).

NGC 7635, also called the **Bubble Nebula**, **Sharpless 162**, or **Caldwell 11**, is a **H II region**^[1] emission nebula in the constellation **Cassiopeia**. It lies close to the direction of the **open cluster** **Messier 52**. The “bubble” is created by the **stellar wind** from a massive hot, 8.7^[1] **magnitude** young central star, the $15 \pm 5 M_{\odot}$ ^[4] **SAO 20575** (**BD+60 2522**).^[7] The nebula is near a giant **molecular cloud** which contains the expansion of the bubble nebula while itself being excited by the hot central star, causing it to glow.^[7] It was discovered in 1787 by **William Herschel**.^[5] The star **SAO 20575** or **BD+602522** is thought to have a mass of 10-40 Solar masses.

2.11.1 Amateur observation

With an 8 or 10-inch (250 mm) telescope, the nebula is visible as an extremely faint and large shell around the star.^{[6][1]} The nearby 7th magnitude star on the west hinders observation, but one can view the nebula using **averted vision**.^[6] Using a 16 to 18-inch (460 mm) scope, one can see that the faint nebula is irregular, being elongated in the north south direction.^[6]



Widefield image of **NGC 7635** and **M52** as captured by an amateur telescope

2.11.2 Notes

- [1] [SIMBAD 2007](#).

- [2] [HubbleSite 2000](#).

- [3] [APOD 2004](#).

- [4] [APOD 2006](#).

- [5] “[NGC-IC Project Database](#)”. Retrieved 2008-12-15.

- [6] [Kepple & Sanner 1998](#).

- [7] [APOD 2005](#).

2.11.3 References

- [SIMBAD](#) (February 23, 2007). “Results for **NGC 7635**”. [SIMBAD](#), Centre de Données Astronomiques de Strasbourg.
- [Kepple, George Robert; Sanner, Glen W. \(1998\). *The Night Sky Observer's Guide* 1. Willmann-Bell, Inc. pp. 108–109. ISBN 0-943396-58-1.](#)
- [HubbleSite](#) (2000). “An Expanding Bubble in Space”.
- [APOD](#) (July 16, 2004). “Astronomy Picture of the Day: The Bubble”. [NASA](#).
- [APOD](#) (November 7, 2005). “Astronomy Picture of the Day: NGC 7635: The Bubble Nebula”. [NASA](#).
- [APOD](#) (October 18, 2006). “Astronomy Picture of the Day: NGC 7635: The Bubble”. [NASA](#).

2.11.4 External links

- [NGC7635 The Bubble Nebula](#)
-
- [NGC 7635 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)
- [Bubble Nebula at Constellation Guide](#)

2.12 Caldwell 12

NGC 6946, (also known as the **Fireworks Galaxy**, **Arp 29**, and **Caldwell 12**), is an intermediate spiral galaxy about 18 million light-years away,^[2] in the constellations **Cepheus** and **Cygnus**. It was discovered by **William Herschel** on September 9, 1798. **NGC 6946** is highly obscured by interstellar matter of the Milky Way galaxy, as it is quite close to the galactic plane. The diameter of the galaxy is approximately 40,000 light-years or just about a third of the size of the Milky Way.^[3]

2.12.1 Supernovae

Nine supernovae (SN 1917A, SN 1939C, SN 1948B, SN 1968D, SN 1969P, SN 1980K, SN 2002hh, SN 2004et, and SN 2008S) in the last 60 years or so, have been observed in NGC 6946.^[4]

2.12.2 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 6946*. Retrieved 2006-11-18.
- [2] “Distance Results for NGC 6946”. *NASA/IPAC Extragalactic Database*. Retrieved 2010-06-18.
- [3] “Fireworks Galaxy NGC 6946”. Astronomy Picture of the Day. 1 January 2011.
- [4] “List of Supernovae”. Harvard-Smithsonian Center for Astrophysics (IAU). Retrieved 2010-07-12.

2.12.3 External links

- **SEDs**: Spiral Galaxy NGC 6946
- Pictures of NGC 6946
- Atlas of the Universe
-
- NGC 6946 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  20^h 34^m 52.3^s, +60° 09′ 14″

2.13 Caldwell 13

NGC 457 (also known as the **Owl Cluster**, the **ET Cluster**, or **Caldwell 13**) is an open star cluster in the constellation Cassiopeia. It was discovered by William Herschel in 1787,^[2] and lies over 7,900 light years away from the Sun. It has an estimated age of 21 million years.^[1] The cluster is sometimes referred by amateur astronomers as the *Owl Cluster*, *Kachina Doll Cluster*,^[2] the *ET Cluster* (due to its resemblance to the movie character) or the “Skiing Cluster”. Two bright stars, magnitude 5 Phi-1 Cassiopeiae and magnitude 7 Phi-2 Cassiopeiae can be imagined as eyes. The cluster features a rich field of about 150 stars of magnitudes 12-15.^[2]

2.13.1 References

- [1] Frinchaboy, Peter M. et al. (2008). “Open Clusters as Galactic Disk Tracers. I. Project Motivation, Cluster Membership, and Bulk Three-Dimensional

Kinematics”. *The Astronomical Journal* **136**: 118–145. arXiv:0804.4630. Bibcode:2008AJ....136..118F. doi:10.1088/0004-6256/136/1/118. See table I, p. 12.

- [2] “NGC 457”. The NGC/IC Project Database. Retrieved 2012-05-09.

2.13.2 External links

- NGC 457 at SEDS
-
- NGC 457 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.14 Caldwell 14

The **Double Cluster** (also known as **Caldwell 14**) is the common name for the naked-eye open clusters NGC 869 and NGC 884 (often designated η Persei and χ Persei, respectively),^[1] which are close together in the constellation Perseus. NGC 869 and NGC 884 both lie at a distance of 7500 light years.^[2] NGC 869 has a mass of 3700 solar masses and NGC 884 weighs in at 2800 solar masses; however, later research has shown both clusters are surrounded with a very extensive halo of stars, with a total mass for the complex of at least 20,000 solar masses.^[3] Based on their individual stars, the clusters are relatively young, both 12.8 million years old.^[4] In comparison, the *Pleiades* have an estimated age ranging from 75 million years to 150 million years. There are more than 300 blue-white super-giant stars in each of the clusters. The clusters are also **blueshifted**, with NGC 869 approaching Earth at a speed of 39 km/s (24 mi/s) and NGC 884 approaching at a similar speed of 38 km/s (24 mi/s).^[5] Their hottest main sequence stars are of **spectral** type B0.

2.14.1 Mythology

Perseus is the mythological symbol of adventure. Perseus was born the son of Zeus (The “Father of Gods and men”) and the mortal Danae. He was a demigod but not immortal. Perseus was challenged by King Polydectes of Seriphos to slay one of the Gorgons (Medusa), whose gaze turned an on-looking victim into stone. Athena, Hermes, and other gods gave Perseus a helmet, a shield, and a curved sword with studded jewels on its handle to aid him in the challenge. Along with beheading Medusa, Perseus performed other heroic deeds as well, such as saving Andromeda who was a princess chained to a rock as a sacrifice to a sea monster. Due to his great accomplishments, the gods placed Perseus among the stars, with the head of Medusa in one hand and the jeweled sword in the

other. The Double Cluster represents the jeweled handle of Perseus's sword.

2.14.2 History



The Double Cluster in Perseus

Hipparchus, a Greek astronomer, cataloged the object (a patch of light in Perseus) as early as 130 B.C. However, the true nature of the Double Cluster wasn't discovered until the invention of the telescope many centuries later. In the early 19th century **William Herschel** was the first to recognize the object as two separate clusters. The Double Cluster is not included in Messier's catalog, but is included in the **Caldwell catalogue** of popular deep-sky objects not in Messier.^{[6][7]}

2.14.3 Location

The Double Cluster is **circumpolar** (continuously above the horizon) from most northern temperate latitudes. It is in close proximity to the constellation **Cassiopeia**. The Double Cluster is approximately the radiant of the **Perseid meteor shower**, which peaks annually around August 12 or 13. Although easy to locate in the northern sky, observing the Double Cluster in its two parts requires optical aid. They are described as being an "awe-inspiring" and "breathtaking" sight, and are often cited as a target in astronomy observer's guides.^[8]

2.14.4 References

- [1] Some confusion surrounds what Bayer intended by these designations. It is sometimes claimed that Bayer could not have resolved the pair into two patches of nebulousity, and that Chi refers to the Double Cluster and h to a nearby star; see Stephen James O'Meara and Daniel W.E. Green, 2003, "The Mystery of the Double Cluster", *Sky and Telescope*, Vol. 105, No. 2 (February 2003), p. 116–119. Bayer's *Uranometria* chart for Perseus does not show them

as nebulous objects, but his chart for Cassiopeia does, and they are described as *Nebulosa Duplex* in Schiller's *Coelum Stellatum Christianum*, which was assembled with Bayer's help; see Morton Wagman, *Lost Stars*, McDonald & Woodward, 2003, ISBN 0939923785, p. 240.

- [2] "UBVI and H α Photometry of the h and χ Persei Cluster". Retrieved 8 April 2013.
- [3] "The Stellar Population of h and χ Persei: Cluster Properties, Membership, and the Intrinsic Colors and Temperatures of Stars". Retrieved 13 July 2013.
- [4] "The Star Formation History and Mass Function of the Double Cluster h and χ Persei" (PDF). Retrieved 8 April 2013.
- [5] "Astrophysical parameters of Galactic open clusters". Retrieved 8 April 2013.
- [6] O'Meara, Stephen James (2002). *The Caldwell Objects*. Cambridge University Press. ISBN 978-0-521-82796-6.
- [7] "Caldwell Club Introduction". Retrieved 2006-09-08.
- [8] Chaple, Glenn (January 2011). "A double take" **39** (1). *Astronomy*.

2.14.5 External links

- [SEDS page on the Double Cluster](#)
- [AstroPhoto.net page the Double Cluster](#)
- [Dark Atmospheres Photography - Perseus Double Cluster](#)
- [The Double Cluster - Astronomy Picture of the Day 2009 December 4](#)
- [Double Cluster on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

2.15 Caldwell 15

NGC 6826 (also known as **Caldwell 15**) is a **planetary nebula** located in the constellation **Cygnus**. It is commonly referred to as the "blinking planetary", although many other nebulae exhibit such "blinking". When viewed through a small telescope, the brightness of the central star overwhelms the eye when viewed directly, obscuring the surrounding nebula. However, it can be viewed well in the peripheral vision (**averted vision**), which causes it to "blink" in and out of view as the observer's eye wanders.

A distinctive feature of this nebula are the two bright patches on either side, which are known as **FLIERs**, or Fast Low-Ionization Emission Regions. They appear

to be relatively young, moving outwards at supersonic speeds. According to Bruce Balick (University of Washington), “some of their observed characteristics suggest that they are like sparks flung outward from the central star late in the very recent past (a thousand years ago). Yet their shapes ... seem to suggest that they are stationary, and that material ejected from the star flows past them, scraping gas from their surfaces. Future Hubble observations will monitor any changes in the positions of FLIERs to resolve this issue. In either case, the formation of FLIERs cannot be easily explained by any models of stellar evolution.”^[3]

2.15.1 See also

- List of NGC objects
- Planetary nebulae

2.15.2 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 6826*. Retrieved 2007-04-17.
- [2] “Stellar Scenes Image Collection”. *NGC 6826*. Retrieved 2007-10-05.
- [3] “astroimages.org”. *NGC 6826 : The Blinking Nebula*. Retrieved 2007-10-05.

2.15.3 External links

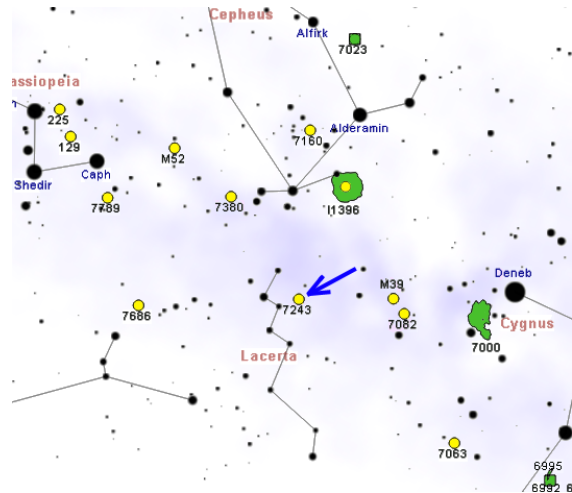
- The Hubble European Space Agency Information Centre Hubble picture and information on NGC 6826
-
- NGC 6826 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.16 Caldwell 16

NGC 7243, also **Caldwell 16**, is an open cluster and Caldwell object in the constellation Lacerta. It shines at magnitude +6.4. Its celestial coordinates are RA 22^h 15.3^m, dec +49° 53′. It is located near the naked-eye stars Alpha Lacertae, 4 Lacertae, an A-class double star, and planetary nebula IC 5217. It lies approximately 2,800 light-years away, and is thought to be just over 100 million years old, consisting mainly of white and blue stars.^[1]

2.16.1 Notes

- [1] “NGC 7243”. eSky. Retrieved 2008-08-06.



Map showing location of NGC 7243

2.16.2 References

- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. pp. 578 pg. ISBN 0-395-93432-X.
- Caldwell-Moore, Sir Patrick (2003). *Firefly Atlas of the Universe*. Firefly Books Limited. ISBN 1-55297-819-2.

2.16.3 External links

- SEDS – NGC 7243
- Simbad – NGC 7243
- VizieR – NGC 7243
- NED – NGC 7243
-
- NGC 7243 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  22^h 15^m 08.6^s, +49° 53′ 51″

2.17 Caldwell 17

NGC 147 (also known as **DDO3** or **Caldwell 17**) is a dwarf spheroidal galaxy about 2.58 Mly away in the constellation Cassiopeia. NGC 147 is a member of the Local group of galaxies and a satellite galaxy of the Andromeda Galaxy (M31). It forms a physical pair with the nearby galaxy NGC 185,^[5] another remote satellite of M31. It was discovered by John Herschel in September 1829. Visually it is both fainter and slightly larger than NGC 185 (and therefore has a considerably lower surface

brightness). This means that NGC 147 is more difficult to see than NGC 185, which is visible in small **telescopes**. In the *Webb Society Deep-Sky Observer's Handbook*,^[6] the visual appearance of NGC 147 is described as follows:

Large, quite faint, irregularly round; it brightens in the middle to a stellar nucleus.

The membership of NGC 147 in the Local Group was confirmed by **Walter Baade** in 1944 when he was able to resolve the galaxy into individual stars with the 100-inch (2.5 m) telescope at **Mount Wilson** near **Los Angeles**.

2.17.1 Characteristics

A survey of the brightest **asymptotic giant branch** (AGB) stars in the area of radius 2' from the center of NGC 147 shows that the last significant star-forming activity in NGC 147 occurred around 3 Gyr ago.^[7] NGC 147 contains a large population of older stars which show a spread in **metallicity** and age. The metallicity spread suggests that NGC 147 has had chemical enrichment. However, **H I** has not been seen and the **interstellar medium** (ISM) mass upper limit is much lower than expected had the material which is emitted from evolving stars been kept in the galaxy. This implies depletion of the ISM.^[7]

2.17.2 Distance measurements

At least two techniques have been used to measure distances to NGC 147. The surface brightness fluctuations distance measurement technique estimates distances to spiral galaxies based on the graininess of the appearance of their bulges. The distance measured to NGC 147 using this technique is 2.67 ± 0.18 Mly (870 ± 60 kpc).^[2] However, NGC 147 is close enough that the tip of the **red giant branch** (TRGB) method may be used to estimate its distance. The estimated distance to NGC 147 using this technique is 2.21 ± 0.09 Mly (680 ± 30 kpc).^[3] Averaged together, these distance measurements give a distance estimate of 2.53 ± 0.11 Mly (780 ± 30 kpc).^[a]

2.17.3 See also

- **Andromeda's satellite galaxies**

2.17.4 Notes

1. ^a $\text{average}(870 \pm 60, 680 \pm 30) = ((870 + 680) / 2) \pm ((60^2 + 30^2)^{0.5} / 2) = 780 \pm 30$

2.17.5 References

- [1] "NASA/IPAC Extragalactic Database". *Results for NGC 147*. Retrieved 2006-12-07.

- [2] J. L. Tonry; A. Dressler; J. P. Blakeslee; E. A. Ajhar et al. (2001). "The SBF Survey of Galaxy Distances. IV. SBF Magnitudes, Colors, and Distances". *Astrophysical Journal* **546** (2): 681–693. arXiv:astro-ph/0011223. Bibcode:2001ApJ...546..681T. doi:10.1086/318301.
- [3] McConnachie, A. W.; Irwin, M. J.; Ferguson, A. M. N.; Ibata, R. A. et al. (2005). "Distances and metallicities for 17 Local Group galaxies". *Monthly Notices of the Royal Astronomical Society* **356** (4): 979–997. arXiv:astro-ph/0410489. Bibcode:2005MNRAS.356..979M. doi:10.1111/j.1365-2966.2004.08514.x.
- [4] Karachentsev, I. D.; Kashibadze, O. G. (2006). "Masses of the local group and of the M81 group estimated from distortions in the local velocity field". *Astrophysics* **49** (1): 3–18. Bibcode:2006Ap....49....3K. doi:10.1007/s10511-006-0002-6.
- [5] "SIMBAD Astronomical Database". *Results for NGC 147*. Retrieved 2006-12-07.
- [6] Jones, K. G. (1981). *Webb Society Deep-Sky Observer's Handbook*. Enslow Publishers. ISBN 0-89490-134-6.
- [7] Davidge, T. J. (2005). "The Evolved Stellar Content of NGC 147, NGC 185, and NGC 205". *The Astronomical Journal* **130** (5): 2087–2103. arXiv:astro-ph/0509612. Bibcode:2005AJ....130.2087D. doi:10.1086/491706.

2.17.6 External links

- **SEDs – NGC 147**
-
- **NGC 147 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images**

Coordinates:  00^h 33^m 12.1^s, +48° 30' 32"

2.18 Caldwell 18

NGC 185 (also known as **Caldwell 18**) is a dwarf spheroidal galaxy about 2.08 million light-years away in the constellation Cassiopeia. It is a member of the Local Group, and is a satellite of the Andromeda Galaxy (M31).^[6] NGC 185 was discovered by William Herschel on November 30, 1787, and he cataloged it "H II.707".^[6] John Herschel observed the object again in 1833 when he cataloged it as "h 35", and then in 1864 when he cataloged it as "GC 90" within his *General Catalogue of Nebulae and Clusters*.^[6] NGC 185 was first photographed between 1898 and 1900 by James Edward Keeler with the Crossley Reflector of Lick Observatory.^[6] Unlike most dwarf elliptical galaxies, NGC 185 contains young stellar clusters, and star formation proceeded at a low rate until the recent past. NGC 185 has an active galactic nucleus (AGN) and is usually classified as a type 2 Seyfert

galaxy,^[7] though its status as a Seyfert is questioned.^[8] It is possibly the closest Seyfert galaxy to Earth, and is the only known Seyfert in the Local Group.

2.18.1 Distance measurements

At least two techniques have been used to measure distances to NGC 185. The surface brightness fluctuations distance measurement technique estimates distances to galaxies based on the graininess of their appearance. The distance measured to NGC 185 using this technique is 2.08 ± 0.15 Mly (640 ± 50 kpc).^[3] However, NGC 185 is close enough that the **tip of the red giant branch (TRGB)** method may be used to estimate its distance. The estimated distance to NGC 185 using this technique is 2.02 ± 0.2 Mly (620 ± 60 kpc).^{[4][5]} Averaged together, these distance measurements give a distance estimate of 2.05 ± 0.13 Mly (630 ± 40 kpc).^[Note 1]

2.18.2 Star formation

Martínez-Delgado, Aparicio, & Gallart (1999) looked into the **star formation** history of NGC 185 and found that the majority of star formation in NGC 185 happened at early times.^[8] In the last ~1 Gyr, stars have formed only near the center of this galaxy. **Walter Baade** discovered young blue objects within this galaxy in 1951, but these have turned out to be star clusters and not individual stars. A **supernova remnant** near the center was also discovered by Martínez-Delgado et al.^[9]

2.18.3 Gallery

- Hubble
- 2MASS
- Odd Trondal

2.18.4 See also

- List of Andromeda's satellite galaxies

2.18.5 Notes

- [1] average $(640 \pm 50, 620 \pm 60) = ((640 + 620) / 2) \pm ((50^2 + 60^2)^{0.5} / 2) = 630 \pm 40$

2.18.6 References

- [1] “SIMBAD”. *NGC 185 -- Seyfert 2 Galaxy*. Retrieved 2014-05-05.
- [2] “NASA/IPAC Extragalactic Database”. *Results for NGC 185*. Retrieved 2006-11-29.

- [3] J. L. Tonry; A. Dressler; J. P. Blakeslee; E. A. Ajhar et al. (2001). “The SBF Survey of Galaxy Distances. IV. SBF Magnitudes, Colors, and Distances”. *Astrophysical Journal* **546** (2): 681–693. arXiv:astro-ph/0011223. Bibcode:2001ApJ...546..681T. doi:10.1086/318301.
- [4] I. D. Karachentsev; V. E. Karachentseva; W. K. Hutcheon; D. I. Makarov (2004). “A Catalog of Neighboring Galaxies”. *Astronomical Journal* **127** (4): 2031–2068. Bibcode:2004AJ....127.2031K. doi:10.1086/382905.
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2.18.7 External links

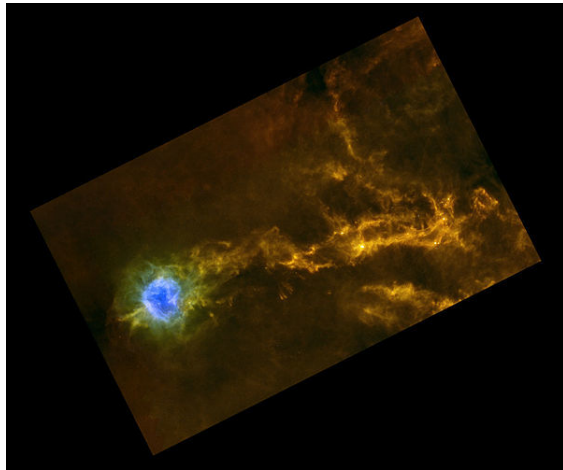
-
- NGC 185 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 38^m 58.0^s, +48° 20′ 15″

2.19 Caldwell 19

IC 5146 (also **Caldwell 19**, **Sh 2-125**, and the **Cocoon Nebula**) is a reflection^[1]/emission^[2] nebula and Caldwell object in the constellation Cygnus. The NGC description refers to IC 5146 as a cluster of 9.5 mag stars involved in a bright and dark nebula. The cluster is also known as Collinder 470.^[3] It shines at magnitude +10.0^[4]/+9.3^[2]/+7.2.^[5] Its celestial coordinates are RA 21^h 53.5^m, dec+47° 16′. It is located near the

naked-eye star **Pi Cygni**, the open cluster **NGC 7209** in **Lacerta**, and the bright open cluster **M39**.^{[1][4]} The cluster is about 4,000 ly away, and the central star that lights it formed about 100,000 years ago;^[6] the nebula is about 12 arcmins across, which is equivalent to a span of 15 light years.^[5] When viewing IC 5146, dark nebula **Barnard 168 (B168)** is an inseparable part of the experience, forming a dark lane that surrounds the cluster and projects westward forming the appearance of a trail behind the Cocoon.



View of the IC 5146 star-forming region from ESA's *Herschel Space Telescope*


2.19.1 References

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2.19.2 External links

- SEDS – IC 5146
- Simbad – IC 5146
- NED – IC 5146

- IC5146
- Sharpless Catalog 125
-
- IC 5146 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  21^h 53^m 32^s, +47° 16′ 06″

2.20 Caldwell 20

The **North America Nebula (NGC 7000 or Caldwell 20)** is an **emission nebula** in the **constellation Cygnus**, close to **Deneb** (the tail of the swan and its brightest star). The remarkable shape of the nebula resembles that of the continent of **North America**, complete with a prominent **Gulf of Mexico**. It is sometimes incorrectly called the "North American Nebula".^[3]

2.20.1 General information



NGC 7000 is one of the well-known nebulae in Cygnus.

The North America Nebula is large, covering an area of more than four times the size of the full moon; but its surface brightness is low, so normally it cannot be seen with the unaided eye. **Binoculars** and **telescopes** with large **fields of view** (approximately 3°) will show it as a foggy patch of light under sufficiently dark skies. However, using a **UHC filter**, which filters out some unwanted **wavelengths** of light, it can be seen without magnification under dark skies. Its prominent shape and especially its reddish color (from the **hydrogen H α emission line**) show up only in photographs of the area.

Cygnus's Wall is a term for the "Mexico and Central America part" of the North America Nebula. The Cygnus Wall exhibits the most concentrated **star formations** in the nebula.

The North America Nebula and the nearby **Pelican Nebula, (IC 5070)** are in fact parts of the same interstellar cloud of **ionized hydrogen (H II region)**. Between the Earth and the nebula complex lies a band of **interstellar dust** that absorbs the light of stars and nebulae behind it, and thereby determines the shape as we see it. The distance of the nebula complex is not precisely known, nor

is the star responsible for ionizing the hydrogen so that it emits light. If the star inducing the ionization is **Deneb**, as some sources say, the nebula complex would be about 1800 **light years** distance, and its absolute size (6° apparent diameter on the sky) would be 100 light years.

The nebula was discovered by **William Herschel** on October 24, 1786, from **Slough, England**.

- Amateur photo.
-
- **Infrared** view of the nebula.
- **Play media**

The North America Nebula.

2.20.2 See also

- **Pelican Nebula**

2.20.3 References

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Coordinates:  20^h 59^m 18^s, +44° 30′ 60″

2.20.4 External links

- The North America Nebula (NGC 7000) at the astro-photography site of Mr. T. Yoshida.
- NASA APOD: The North America and Pelican Nebulae (June 30, 2009)
- NASA APOD: The North America Nebula (May 1, 2000)
- NASA APOD: The North America Nebula (June 6, 1996)
- NGC7000
- starpointing.com – Central part of the North America Nebula: The Great Wall
-

- North America Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.21 Caldwell 21

NGC 4449 (also known as **Caldwell 21**) is an irregular galaxy in the constellation **Canes Venatici**. It is located about 12 million light-years away, part of the **M94 Group** (the Canes Venatici I Group), a galaxy group relatively close to the **Local Group** containing the Milky Way.

2.21.1 Characteristics

This well-studied galaxy is similar in size and brightness, and often compared to, the Milky Way’s satellite galaxy, the **Large Magellanic Cloud (LMC)**.^[3] NGC 4449 has a general bar shape, also characteristic of the LMC, with scattered young blue star clusters.

Starburst galaxy

Unlike the Large Magellanic Cloud, however, NGC 4449 is considered a **starburst galaxy** due to its high rate of star formation (twice the one of the LMC)^[4] and includes several massive and young star clusters,^{[5][6]} one of them in the galaxy’s center.^[7]

Near the bottom (of the Hubble photo) is the pinkish glow of atomic hydrogen gas, the telltale tracer of massive star forming regions.

NGC 4449 is surrounded by a large envelope of **neutral hydrogen** that extends over an area of 75 arc minutes (14 times larger than the optical diameter of the galaxy). The envelope shows distortions and irregularities likely caused by interactions with nearby galaxies.^[8]

Interactions with nearby galaxies are thought to have influenced star formation in NGC 4449 and, in fact, in 2012 two small galaxies have been discovered interacting with this galaxy: a very low **surface brightness** disrupted dwarf **spheroidal** with the same stellar mass as NGC 4449’s **halo** but with a ratio of **dark matter** to stellar matter between 5 and 10 times that of NGC 4449^[9] and a highly flattened **globular cluster** with two **tails** of young stars that may be the nucleus of a gas-rich galaxy.^[10] Both satellites have apparently been disrupted by NGC 4449 and are now being absorbed by it.^{[9][10]}

2.21.2 External links

- Astronomy Picture of the Day – May 3, 2007, 10 July 2007, and 25 February 2011
-

- NGC 4449 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.21.3 References

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2.22 Caldwell 22

Coordinates:  23^h 25^m 54^s, +42° 32′ 6″

NGC 7662, also known as the **Blue Snowball Nebula** or **Snowball Nebula**, is a planetary nebula located in the constellation **Andromeda**.

The distance to this nebula is not known with any real accuracy. According to the Skalnate Pleso Catalogue (1951) the distance of NGC 7662 is about 1,800 light years, the actual diameter about 20,000 AU. In a more recent survey of the brighter planetaries, C.R.O'Dell (1963) derived a distance of 1,740 parsecs or about 5,600 light years, increasing the actual size to 0.8 light year, or nearly 50,000 AU. It has a faint central star that is variable, with a magnitude range of 12 to 16.^[4] The central star is a bluish dwarf with a continuous spectrum and a computed temperature of about 75,000K. The nuclei of the planetary nebulae are among the hottest stars known.^[5]

NGC 7662 is a popular planetary nebula for casual observers. A small telescope will reveal a star-like object with slight nebulosity. A 6” telescope with a magnification around 100x will reveal a slightly bluish disk, while telescopes with a primary mirror at least 16” in diameter may reveal slight color and brightness variations in the interior.

2.22.1 Image gallery

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-

2.22.2 See also

- NGC 2392
- NGC 3242
- List of NGC objects
- Planetary nebulae

2.22.3 References

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2.22.4 External links

-
- NGC 7662 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.23 Caldwell 23

NGC 891 (also known as **Caldwell 23**) is an edge-on unbarred spiral galaxy about 30 million light-years away in the constellation Andromeda. It was discovered by William Herschel on October 6, 1784. The galaxy is a member of the NGC 1023 group of galaxies in the Local Supercluster. It has an H II nucleus.^[3]

The object is visible in small to moderate size telescopes as a faint elongated smear of light with a dust lane visible in larger apertures.

In 1999, the Hubble Space Telescope imaged NGC 891 in infrared.

In 2005, due to its attractiveness and scientific interest, NGC 891 was selected to be the first light image of the Large Binocular Telescope.^{[4][5]} In 2012, it was again used as a first light image of the Discovery Channel Telescope with the Large Monolithic Imager.^[6]

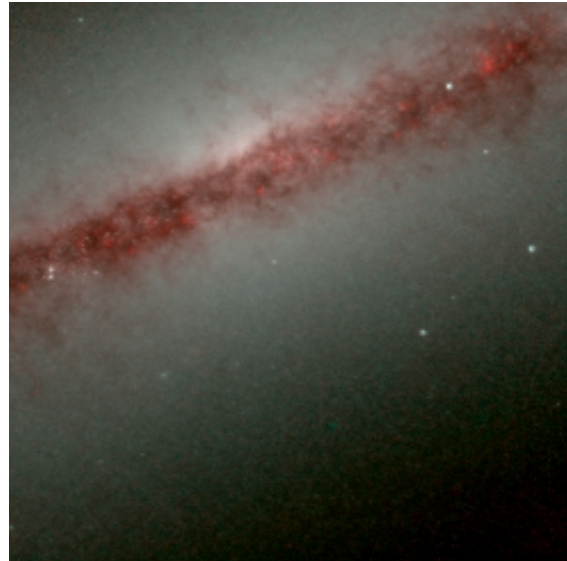
Supernova SN 1986J was discovered on August 21, 1986 at apparent magnitude 14.^[7]

2.23.1 Peculiarities

NGC 891 looks as we think the Milky Way would look like when viewed edge-on (some astronomers have even noted how similar to NGC 891 our galaxy looks as seen from the Southern Hemisphere^[8]) and in fact both galaxies are considered very similar in terms of luminosity and size;^[9] studies of the dynamics of its molecular hydrogen have also proven the likely presence of a central bar.^[10] Despite this, recent high-resolution images of its dusty disk show unusual filamentary patterns. These patterns are extending into the halo of the galaxy, away from its galactic disk. Scientists presume that supernova explosions caused this interstellar dust to be thrown out of the galactic disk toward the halo.^[11]

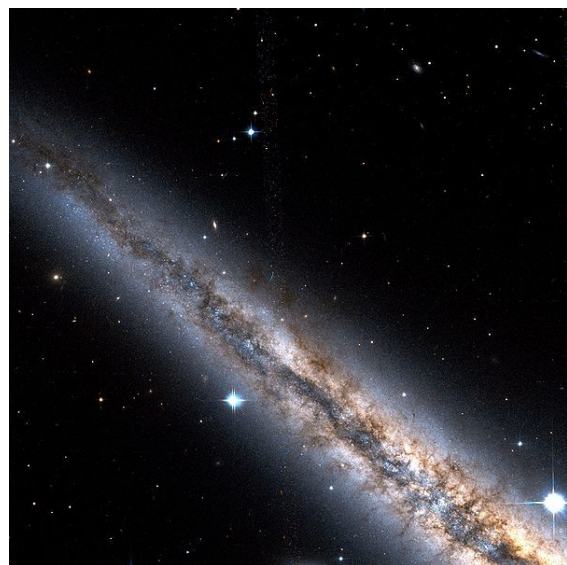
It may also be possible that the light pressure from surrounding stars causes this phenomenon.^[12]

The galaxy is a member of a small group of galaxies, sometimes called the NGC 1023 Group. Other galaxies in this group are the NGCs 925, 949, 959, 1003, 1023, and 1058, and the UGCs 1807, 1865 (DDO 19), 2014 (DDO 22), 2023 (DDO 25), 2034 (DDO 24), and 2259.^[13] Its outskirts are populated by multiple low-surface brightness, coherent, and vast substructures, like giant streams that loop around the parent galaxy up to



A close-up infrared Hubble Space Telescope (HST) image of NGC 891. Credit: HST/NASA/ESA.

distances of approximately 50 kpc. The bulge and the disk are surrounded by a flat and thick cocoon-like stellar structure. These have vertical and radial distances of up to 15 kpc and 40 kpc, respectively^[14] and are interpreted as the remnant of a satellite galaxy disrupted and in the process of being absorbed by NGC 891.^[15]



NGC 891 (North part) close up by HST, 3.24' view. Credit: NASA/STScI/WikiSky

2.23.2 Trivia

There are a number of galaxies that are easy to see from the Milky Way, but for hypothetical observers located in NGC 891, the Milky Way would be invisible, at least in the optical, due to its inclination as they lie in the Zone of Avoidance of this galaxy and thus their light is blocked

by NGC 891's **interstellar dust**. Examples of this include not only our galaxy but also the **Andromeda Galaxy**, that would appear so edge-on as we see NGC 891, and most notably the **Virgo Cluster**.^[8]

2.23.3 In popular culture

The soundtrack of the 1974 film *Dark Star* by John Carpenter features a *muzak* style instrumental piece called *When Twilight Falls On NGC 891*.^[16]

The first solo album by Edgar Froese, *Aqua*, contained a track called "NGC 891". Side 2 of the album, which included this track, was unusual in having been a rare example of a commercially issued piece of music recorded using the *artificial head* system.

2.23.4 See also

- **Cigar Galaxy**

2.23.5 References

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- [2] J. L. Tonry; A. Dressler; J. P. Blakeslee; E. A. Ajhar et al. (2001). "The SBF Survey of Galaxy Distances. IV. SBF Magnitudes, Colors, and Distances". *Astrophysical Journal* **546** (2): 681–693. arXiv:astro-ph/0011223. Bibcode:2001ApJ...546..681T. doi:10.1086/318301.
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2.23.6 External links

-
- NGC 891 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- **APOD**: Interstellar Dust-Bunnies of NGC 891 (9/9/1999)
- SEDS: Information on NGC 891
- NGC 891 on Astrophotography by Wolfgang Kloeher

Coordinates:  02^h 22^m 33.4^s, +42° 20′ 57″

2.24 Caldwell 24

NGC 1275 (also known as **Perseus A** or **Caldwell 24**) is a type 1.5 Seyfert galaxy^[3] located around 237 million light-years away^[2] in the direction of the constellation Perseus. NGC 1275 corresponds to the radio galaxy **Perseus A** and is situated near the center of the large **Perseus Cluster** of galaxies.

2.24.1 Dynamics

NGC 1275 consists of two galaxies, a central type-cD galaxy in the **Perseus Cluster**, and a so-called "high velocity system" (HVS) which lies in front of it. The HVS is moving at 3000 km/s^[4] towards the dominant system, and is believed to be merging with the **Perseus Cluster**. The HVS is not affecting the cD galaxy as it lies at least 200 thousand light years from it,^[5] however tidal interactions are disrupting it and ram-pressure stripping produced by its interaction with the intracluster medium of Perseus is



Hubble Space Telescope image of the center of NGC 1275

stripping its gas as well as producing large amounts of star formation within it^[6]

The central cluster galaxy contains a massive network of spectral line emitting filaments,^[7] which apparently are being dragged out by rising bubbles of relativistic plasma generated by the central active galactic nucleus.^[8] Long gaseous filaments made up of threads of gas stretch out beyond the galaxy, into the multimillion-degree, X-ray-emitting gas that fills the cluster. The amount of gas contained in a typical thread is approximately one million times the mass of our own Sun. They are only 200 light-years wide, are often very straight, and extend for up to 20,000 light-years.^[9]

The existence of the filaments poses a problem. As they are much cooler than the surrounding intergalactic cloud, it is unclear how they have existed for such a long time, or why they have not warmed, dissipated or collapsed to form stars.^{[10][11]} One possibility is that weak magnetic fields (about one-ten-thousandth the strength of Earth's field) exert enough force on the ions within the threads to keep them together.^{[10][11]}

NGC 1275 contains 13 billion solar masses of molecular hydrogen that seems to be infalling from Perseus' intracluster medium in a cooling flow, both feeding its active nucleus^[12] and fueling significant amounts of star formation^[13] O'Connell, Robert (2007). "Star Formation in the Perseus Cluster Cooling Flow". *HST Proposal ID #11207. Cycle 16: 11207*. Bibcode:2007hst..prop11207O.</ref>

A supermassive black hole with a mass 340 million times that of our Sun may be present in NGC 1275's center.^[13]

2.24.2 Gallery

- NGC 1275 multi-wavelength composite
- Hubble Space Telescope 1.73' view of NGC 1275

2.24.3 References

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- [2] "Distance Results for NGC 1275". *NASA/IPAC Extragalactic Database*. Retrieved 2010-03-31.
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- [5] Gillmon K., Sanders J.S., Fabian A.C., An X-ray absorption analysis of the high-velocity system in NGC 1275, 2004, MNRAS, 348, 159
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2.24.4 External links

-
- NGC 1275 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- APOD (2003-05-05) – NASA image & description
- APOD (2005-07-25) – NASA image showing unusual gas filaments
- Fabian, A.C., et al. “A deep Chandra observation of the Perseus cluster: shocks and ripples”. *Monthly Notices of the Royal Astronomical Society*. Vol. 344 (2003): L43 (arXiv:astro-ph/0306036v2).
- Fabian, A.C. *Nature* 454, 968-970.
- Gabany, R. Jay. *cosmotography.com* – An image made with a 20” telescope, which displays the unusual gas filaments

Coordinates:  03^h 19^m 48.1^s, +41° 30' 42"

2.25 Caldwell 25

NGC 2419 (also known as **Caldwell 25**) is a globular cluster in the constellation **Lynx**. It was discovered by **William Herschel** on December 31, 1788.^[6] NGC 2419 is at a distance of about 300,000 light years from the solar system and at the same distance from the galactic center.



NGC 2419 (Credit: Adam Block/Mount Lemmon SkyCenter/University of Arizona)

NGC 2419 bears the nickname “the Intergalactic Wanderer,” which was bestowed when it was erroneously thought not to be in orbit around the Milky Way. Its orbit brings it further away from the galactic center than the

Magellanic Clouds, but it can (with qualifications) be considered as an element of the Milky Way. At this great distance it takes three billion years to make one trip around the galaxy.^[7]

The cluster is dim in comparison to more famous globular clusters such as **M13**. Nonetheless, NGC 2419 is a 9th magnitude object and is readily viewed, in good sky conditions, with good quality telescopes as small as 102mm (four inches) in aperture. Intrinsically it is one of the brightest and most massive globular clusters of our galaxy, having an absolute magnitude of $-9.42^{[3]}$ and being 900,000 times more massive than our Sun.^[8]

It was proposed too NGC 2419 could be, as **Omega Centauri**, the remnant of a dwarf spheroidal galaxy disrupted and accreted by the Milky Way.^[9] However, later research seems to disprove that possibility^[10]

Astronomer Leos Ondra has noted that NGC 2419 would be the “best and brightest” for any observers in the **Andromeda Galaxy**, looking for globular clusters in our galaxy since it lies outside the obscuring density of the main disk.^[7] This is analogous to the way the cluster **G1** can be seen orbiting outside of the **Andromeda Galaxy** from Earth.

2.25.1 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] “SIMBAD Astronomical Database”. *Results for NGC 2419*. Retrieved 2006-11-17.
- [3] Harris, W.E. (1996). “A Catalog of Parameters for Globular Clusters in the Milky Way”. *AJ* **112**: 1487. Bibcode:1996AJ....112.1487H. doi:10.1086/118116.
- [4] $\text{distance} \times \sin(\text{diameter_angle} / 2) = 260 \text{ ly. radius}$
- [5] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.
- [6] <http://messier.seds.org/xtra/ngc/n2419.html> NGC 4189 at SEDS
- [7] Ferris, Timothy. *Seeing in the Dark*. 2002. p. 244
- [8] Baumgardt, H.; Côté, P.; Hilker, M.; Rejkuba, M. et al. (2009). “The velocity dispersion and mass-to-light ratio of the remote halo globular cluster NGC2419”. *Monthly Notices of the Royal Astronomical Society* **396** (4): 2051–2060. arXiv:0904.3329. Bibcode:2009MNRAS.396.2051B. doi:10.1111/j.1365-2966.2009.14932.x.

- [9] van den Bergh, Sidney; Mackey, A. D. (2004). “Globular clusters and the formation of the outer Galactic halo”. *Monthly Notices of the Royal Astronomical Society* **354** (3): 713–719. arXiv:astro-ph/0407346. Bibcode:2004MNRAS.354..713V. doi:10.1111/j.1365-2966.2004.08228.x.
- [10] RIPEPI V.; CLEMENTINI G.; DI CRISCIENZO M.; GRECO C. et al. (2007). “On the remote galactic globular cluster NGC 2419.”. *The Astrophysical Journal* **667**: L61–L64. arXiv:0705.0966. Bibcode:2007ApJ...667L..61R. doi:10.1086/522000.

2.25.2 External links

- SEDS – NGC 2419
- [perseus.gr](#) – NGC 2419 in a LRGB CCD image based on 2 hrs total exposure
- APOD (2009-01-23) – NGC 2419
-
- NGC 2419 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC 2419 at the *SIMBAD Astronomical Database*.
 - Ids - Bibliography - Image - B&W Image.

Coordinates:  07^h 38^m 08.51^s, +38° 52′ 54.9″

2.26 Caldwell 26

NGC 4244, also **Caldwell 26**, is an edge-on loose Spiral galaxy and Caldwell object in the constellation Canes Venatici. It is part of the **M94 Group** (the Canes Venatici I Group), a galaxy group relatively close to the Local Group containing the Milky Way. It shines at magnitude +10.2/+10.6. Its celestial coordinates are RA 12^h 17.5^m, dec +37° 49′. It is located near a naked-eye G-class star Beta Canum Venaticorum, barred spiral galaxy NGC 4151, and irregular galaxy NGC 4214. The galaxy lies approximately 6.5 million^[1]/14 million^[2] light years away, with a redshift of +243/493^[1] km/s. A nuclear star cluster and halo is located at the centre of this galaxy.^{[2][3]}

2.26.1 Gallery

- NGC 4244 image by the Hubble Space Telescope.^[1]
- ¹ ^ “A silver needle in the sky”. *www.spacetelescope.org*. ESA/Hubble. Retrieved 23 August 2014.

2.26.2 Notes

- [1] Jurasevich, David M. (2004). “NGC 4244”. *starimager.com*. Retrieved 2008-08-08.
- [2] “A Rotating Compact Nuclear Stellar Cluster in NGC 4244”. Gemini Observatory. July 31, 2008. Retrieved 2008-08-08.
- [3] Seth, A.; de Jong, R.; Dalcanton, J. (2006). “CJO - Abstract - Detection of a stellar halo in NGC 4244”. Cambridge University Press. Retrieved 2008-08-08.

2.26.3 References

- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. pp. 578 pg. ISBN 0-395-93432-X.
- Eicher, David J. (1988). *The Universe from Your Backyard: A Guide to Deep-Sky Objects from Astronomy Magazine*. AstroMedia (Kalmbach Publishing Company). ISBN 0-521-36299-7.

2.26.4 External links

-
- NGC 4244 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- SEDS – NGC 4244
- Simbad – NGC 4244
- VizieR – NGC 4244
- NED – NGC 4244

Coordinates:  12^h 17^m 29.6^s, +37° 48′ 26″

2.27 Caldwell 27

The **Crescent Nebula** (also known as **NGC 6888**, **Caldwell 27**, **Sharpless 105**) is an emission nebula in the constellation Cygnus, about 5000 light-years away. It was discovered by Friedrich Wilhelm Herschel in 1792.^[2] It is formed by the fast stellar wind from the Wolf-Rayet star WR 136 (HD 192163) colliding with and energizing the slower moving wind ejected by the star when it became a red giant around 250,000^[3] to 400,000 years ago. The result of the collision is a shell and two shock waves, one moving outward and one moving inward. The inward moving shock wave heats the stellar wind to X-ray-emitting temperatures.

It is a rather faint object located about 2 degrees SW of Sadr. For most telescopes it requires a UHC or OIII filter to see. Under favorable circumstances a telescope as

small as 8 cm (with filter) can see its nebulosity. Larger telescopes (20 cm or more) reveal the crescent or a Euro sign shape which makes some to call it the “Euro sign nebula”. Some observers even can see the Euro symbol shape in a telescope as small as 11 cm with an OIII filter. [4]

2.27.1 See also

- Cygnus Bubble

2.27.2 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 6888*. Retrieved 2007-04-23.
- [2] Erdmann, Robert. “NGC 6888”. *The NGC/IC Project*.
- [3] “WR 136”.
- [4] Own visual observation with a Kunming ED 110 refractor.

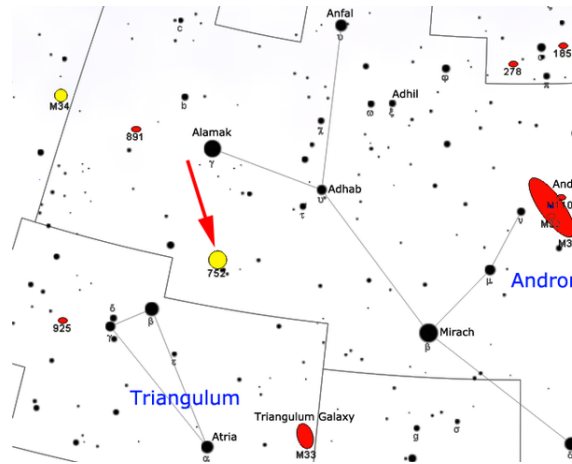
2.27.3 External links

- APOD (2007-11-11) – NASA Astro Picture of the Day: Image by Franck Bugnet
- NOAO image
- Chandra image
- Image by Arran Hill
- Image by Daniel Lopez
- Sharpless Catalog 105
- Crescent Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.28 Caldwell 28

NGC 752 (also known as **Caldwell 28**) is an open cluster in the constellation **Andromeda**. The cluster was discovered by **Caroline Herschel** in 1783 and cataloged by her brother **William Herschel** in 1786, although an object that may have been NGC 752 was described by **Giovanni Batista Hodierna** before 1654.

The large cluster lies 1,300 light-years away from the Earth and is easily seen through binoculars, although it may approach naked eye visibility under good observing conditions. A telescope reveals about 60 stars no brighter than 9th magnitude within NGC 752.^{[1][2]}



Map showing the location of NGC 752

2.28.1 Components

2.28.2 References

- [1] Dunlop, Storm (2005). *Atlas of the Night Sky*. Collins. ISBN 0-00-717223-0.
- [2] Frommert, Kronberg, SEDS: NGC 752

2.28.3 External links

- SEDS – NGC 752
- perseus.gr – NGC 752 in a hires LRGB CCD image
- NGC 752 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  01^h 57^m 55^s, +37° 51′ 57″

2.29 Caldwell 29

NGC 5005 (also known as **Caldwell 29**) is an inclined spiral galaxy in the constellation **Canes Venatici**. The galaxy has a relatively bright nucleus and a bright disk that contains multiple dust lanes.^[3] The galaxy’s high surface brightness makes it an object that is visible to amateur astronomers using large amateur telescopes.

Distance measurements for NGC 5005 vary from 13.7 megaparsecs (45 million light-years) to 34.6 megaparsecs (113 million light-years), averaging about 20 megaparsecs (65 million light-years).^[2]

2.29.1 Nucleus

NGC 5005 contains a **low ionization nuclear emission region (LINER) nucleus**.^[4] LINER nuclei contain weakly ionized gas. The power source for the LINER emission has been debated extensively, with some researchers suggesting that LINERs are powered by **active galactic nuclei** that contain **supermassive black holes** and other researchers suggesting that LINERs are powered by **star formation activity**.

X-ray emission

X-ray observations of NGC 5005 have revealed that it contains a variable, point-like hard **X-ray** source in its nucleus.^[5] These results imply that NGC 5005 contains a **supermassive black hole**. The strong, variable X-ray emission is characteristic of the emission expected from the hot, compressed gas in the environment outside a black hole in an **active galactic nucleus**.

2.29.2 Companion galaxy

NGC 5005 and the nearby spiral galaxy **NGC 5033** comprise a physical galaxy pair.^[6] The two galaxies weakly influence each other gravitationally, but they are not yet close enough to each other to be distorted by the tidal forces of the gravitational interaction.

2.29.3 Notes

- [1] R. W. Sinnott, ed. (1988). *The Complete New General Catalogue and Index Catalogue of Nebulae and Star Clusters* by J. L. E. Dreyer. Sky Publishing Corporation and Cambridge University Press. ISBN 0-933346-51-4.
- [2] “NASA/IPAC Extragalactic Database”. *Results for NGC 5005*. Retrieved 2006-08-24.
- [3] A. Sandage; J. Bedke (1994). *Carnegie Atlas of Galaxies*. Washington, D.C.: Carnegie Institution of Washington. ISBN 0-87279-667-1.
- [4] L. C. Ho; A. V. Filippenko; W. L. W. Sargent (1997). “A Search for “Dwarf” Seyfert Nuclei. III. Spectroscopic Parameters and Properties of the Host Galaxies”. *Astrophysical Journal Supplement* **112** (2): 315–390. arXiv:astro-ph/9704107. Bibcode:1997ApJS..112..315H. doi:10.1086/313041.
- [5] Y. Terashima; N. Iyomoto; L. C. Ho; A. F. Ptak (2002). “X-Ray Properties of LINERs and Low-Luminosity Seyfert Galaxies Observed with ASCA. I. Observations and Results”. *Astrophysical Journal Supplement* **139** (1): 1–36. arXiv:astro-ph/0203005. Bibcode:2002ApJS..139....1T. doi:10.1086/324373.
- [6] G. Helou; E. E. Salpeter; Y. Terzian (1982). “Neutral hydrogen in binary and multiple galaxies”. *Astronomical Journal* **87**: 1443–1464. Bibcode:1982AJ.....87.1443H. doi:10.1086/113235.

2.29.4 External links

Media related to **NGC 5005** at Wikimedia Commons

-
- **NGC 5005 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images**

2.30 Caldwell 30

NGC 7331 (also known as **Caldwell 30**) is a **spiral galaxy** about 40 million **light-years** (12 Mpc) away in the **constellation Pegasus**. It was discovered by **William Herschel** in 1784.^[3] NGC 7331 is the brightest member of the **NGC 7331 Group** of galaxies.

The galaxy is similar in size and structure to the galaxy we inhabit, and is often referred to as “the **Milky Way's twin**”,^[4] although recent discoveries regarding the structure of the Milky Way may call this similarity into doubt.^[5]

2.30.1 Retrograde bulge

In spiral galaxies the central bulge typically co-rotates with the disk but the bulge in the galaxy NGC 7331 is rotating in the **opposite direction** to the rest of the disk.^[6] The current bulge may have formed from infalling material, however if it has been there since the formation of the galaxy then it would be difficult to explain how such a situation arose.



NGC 7331 spiral galaxy. 24 inch telescope on Mt. Lemmon, AZ.

2.30.2 Supernova

SN 1959D, a **Type IIL supernova**,^[7] is the only supernova that has been identified within NGC 7331.^[1] The supernova was discovered by **Milton Humason** and **H. S. Gates** in a survey at **Palomar Observatory**.^[8]

Possible 2014 Supernova^[9]

2.30.3 See also

- **M94** – another galaxy with a prominent starburst ring
- **NGC 1512** – another galaxy with a prominent starburst ring

2.30.4 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 7331*. Retrieved 2006-11-10.
- [2] Jensen, Joseph B.; Tonry, John L.; Barris, Brian J.; Thompson, Rodger I.; et al. (February 2003). “Measuring Distances and Probing the Unresolved Stellar Populations of Galaxies Using Infrared Surface Brightness Fluctuations”. *Astrophysical Journal* **583** (2): 712–726. arXiv:astro-ph/0210129. Bibcode:2003ApJ...583..712J. doi:10.1086/345430.
- [3] The NGC/IC Project : *NGC Discoverers List* by Bob Erdmann.
- [4] “Seeing Double: Spitzer Captures Our Galaxy’s Twin”. *Spitzer Space Telescope Newsroom*. Spitzer Science Center. 2004-06-28. Retrieved 2008-04-24.
- [5] “The Milky Way Has Only Two Spiral Arms”. 2008-06-03. Retrieved 2008-06-04.
- [6] A Counter-rotating Bulge in the Sb Galaxy NGC 7331 , F. Prada, C. Gutierrez, R.F. Peletier, C.D. McKeith, THE ASTROPHYSICAL JOURNAL, 463 :L9–L12, 1996 May 20
- [7] “NASA/IPAC Extragalactic Database”. *Results for SN 1959D*. Retrieved 2006-11-10.
- [8] M. L. Humason; H. S. Gates (1960). “The 1959 Palomar Supernova Search”. *Publications of the Astronomical Society of the Pacific* **72**: 208–209. Bibcode:1960PASP...72..208H. doi:10.1086/127513.
- [9] “SN2014”.

2.30.5 External links

- Calar Alto Observatory – NGC 7331
- APOD (2004-07-01) – “A Galaxy So Inclined”
- SST – “Morphology of Our Galaxy’s ‘Twin’”
- NGC 7331 at the astro-photography site of Mr. T. Yoshida
- NGC7331 at W. Kloeher Astrophotography
-
- NGC 7331 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  22^h 37^m 04.1^s, +34° 24′ 56″

2.31 Caldwell 31

IC 405 (also known as the **Flaming Star Nebula**, **SH 2-229**, or **Caldwell 31**) is an **emission/reflection nebula**^[1] in the constellation **Auriga**, surrounding the bluish star **AE Aurigae**. It shines at magnitude +6.0. Its celestial coordinates are RA 05^h 16.2^m dec +34° 28′.^[2] It surrounds the irregular variable star **AE Aurigae** and is located near the emission nebula **IC 410**, the open clusters **M38** and **M36**, and the naked-eye K-class star **Hassaleh**. The nebula measures approximately 37.0' x 19.0', and lies about 1,500 light-years away.^[2] It is believed that the proper motion of the central star can be traced back to the **Orion's Belt** area.^[2] The nebula is about 5 light-years across.^[1]

2.31.1 Notes

- [1] Nemiroff, Robert; Bonnell, Jerry (2003-11-24). “APOD: 2003 November 24 - IC 405: The Flaming Star Nebula”. APOD (NASA). Retrieved 2008-08-08.
- [2] Darling, David. “Flaming Star Nebula (IC 405)”. The Internet Encyclopedia of Science. Retrieved 2008-08-08.

2.31.2 References

- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. p. 578. ISBN 0-395-93432-X.
- Eicher, David J. (1988). *The Universe from Your Backyard: A Guide to Deep-Sky Objects from Astronomy Magazine*. AstroMedia (Kalmbach Publishing Company). ISBN 0-521-36299-7.

2.31.3 External links

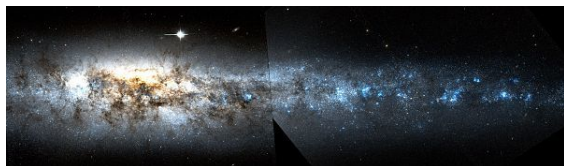
- SIMBAD Data: IC405 - Radio Source
- NEDData: IC 0405
- SEDS Data: IC 405
-
- IC 405 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Flaming Star Nebula at Constellation Guide

2.32 Caldwell 32

NGC 4631 (also known as the **Whale Galaxy** or **Caldwell 32**) is an edge-on spiral galaxy in the constellation **Canes Venatici**. This galaxy’s slightly distorted wedge

shape gives it the appearance of a herring or a whale, hence its nickname.^[3] Because this nearby galaxy is seen edge-on from Earth, professional astronomers observe this galaxy to better understand the gas and stars located outside the plane of the galaxy.

2.32.1 Starburst and superwind



NGC 4631 mosaic of two HST images; 7.2'x2.2' view.
Credit: NASA/STScI/WikiSky

NGC 4631 contains a central **starburst**, which is a region of intense **star formation**. The strong star formation is evident in the emission from **ionized hydrogen**^[4] and **interstellar dust** heated by the stars formed in the starburst.^[5] The most massive stars that form in star formation regions only burn hydrogen gas through **fusion** for a short period of time, after which they explode as **supernovae**. So many supernovae have exploded in the center of NGC 4631 that they are blowing gas out of the plane of the galaxy. This **superwind** can be seen in **X-rays**^[6] and in **spectral line emission**.^[4] The gas from this superwind has produced a giant, diffuse corona of hot, X-ray emitting gas around the whole galaxy.^[7]



NGC 4631 in visible light. Credit: Scott Anttila.

2.32.2 Nearby galaxies and galaxy group

NGC 4631 has a nearby companion **dwarf elliptical galaxy**, NGC 4627. NGC 4627 and NGC 4631 together were listed in the *Atlas of Peculiar Galaxies* as an example of a “double galaxy” or a galaxy pair.^[8]

NGC 4631 and NGC 4627 are part of the **NGC 4631 Group**, a group of galaxies that also includes the interacting galaxies NGC 4656 and NGC 4657.^{[9][10][11][12]}

However, exact group identification is problematic because this galaxy and others lie in a part of the sky that is relatively crowded. Estimates of the number of galaxies in this group range from 5^[9] to 27,^[12] and all studies identify very different member galaxies for this group.

2.32.3 See also

- **NGC 891**, a similar edge-on spiral galaxy
- **NGC 4565**, a similar edge-on spiral galaxy
- **NGC 5907**, a similar edge-on spiral galaxy


2.32.4 References

- [1] R. W. Sinnott, ed. (1988). *The Complete New General Catalogue and Index Catalogue of Nebulae and Star Clusters* by J. L. E. Dreyer. Sky Publishing Corporation and Cambridge University Press. ISBN 0-933346-51-4.
- [2] “NASA/IPAC Extragalactic Database”. *Results for NGC 4631*. Retrieved 2006-11-21.
- [3] “SIMBAD astronomical database”. *Results for NGC 4631*. Retrieved 2006-08-22.
- [4] R. J. Rand; S. R. Kulkarni; J. J. Hester (1992). “Warm ionized gas in the edge-on galaxies NGC 4565 and NGC 4631”. *Astrophysical Journal* **396**: 97–103. Bibcode:1992ApJ...396...97R. doi:10.1086/171699.
- [5] G. J. Bendo; D. A. Dale; B. T. Draine; C. W. Engelbracht et al. (2006). “The Spectral Energy Distribution of Dust Emission in the Edge-on Spiral Galaxy NGC 4631 as Seen with Spitzer and the James Clerk Maxwell Telescope”. *Astrophysical Journal* **652** (1): 283–305. arXiv:astro-ph/0607669. Bibcode:2006ApJ...652..283B. doi:10.1086/508057.
- [6] Q. D. Wang; R. A. S. Walterbos; M. F. Steakley; C. A. Norman et al. (1994). “ROSAT detection of diffuse hot gas in the edge-on galaxy NGC 4631”. *Astrophysical Journal* **439**: 176–184. Bibcode:1995ApJ...439..176W. doi:10.1086/175162.
- [7] Q. D. Wang; S. Immler; R. Walterbos; J. T. Lauroesch et al. (2001). “Chandra Detection of a Hot Gaseous Corona around the Edge-on Galaxy NGC 4631”. *Astrophysical Journal* **555** (2): L99–L102. arXiv:astro-ph/0105541. Bibcode:2001ApJ...555L..99W. doi:10.1086/323179.
- [8] H. Arp (1966). “Atlas of Peculiar Galaxies”. *Astrophysical Journal Supplement* **14**: 1–20. Bibcode:1966ApJS...14....1A. doi:10.1086/190147.
- [9] R. B. Tully (1988). *Nearby Galaxies Catalog*. Cambridge: Cambridge University Press. ISBN 0-521-35299-1.
- [10] P. Fouque; E. Gourgoulhon; P. Chamaraux; G. Paturel (1992). “Groups of galaxies within 80 Mpc. II - The catalogue of groups and group members”. *Astronomy and Astrophysics Supplement* **93**: 211–233. Bibcode:1992A&AS...93..211F.

- [11] A. M. Garcia (1993). “General study of group membership. II - Determination of nearby groups”. *Astronomy and Astrophysics Supplement* **100**: 47–90. Bibcode:1993A&AS..100...47G.
- [12] G. Giuricin; C. Marinoni; L. Ceriani; A. Pisani (2000). “Nearby Optical Galaxies: Selection of the Sample and Identification of Groups”. *Astrophysical Journal* **543** (1): 178–194. arXiv:astro-ph/0001140. Bibcode:2000ApJ...543..178G. doi:10.1086/317070.

2.32.5 External links

- [APOD \(2004-01-23\)](#) – The Whale Galaxy
- [APOD \(2010-05-17\)](#) – The Whale Galaxy (a better image)
- [NGC 4631 on WikiSky](#): DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- [NGC 4631 at the SIMBAD Astronomical Database](#).
- [Ids - Bibliography - Siblings - Image - B&W Image](#).

Coordinates:  12^h 42^m 08^s, +32° 32′ 29″

2.33 Caldwell 33 & 34

The **Veil Nebula** is a cloud of heated and ionized gas and dust in the constellation **Cygnus**. It constitutes the visible portions of the **Cygnus Loop** (radio source W78, or Sharpless 103), a large but relatively faint **supernova remnant**. The source **supernova** exploded some 5,000 to 8,000 years ago, and the remnants have since expanded to cover an area roughly 3 degrees in diameter (about 6 times the diameter, or 36 times the area, of the full moon). The distance to the nebula is not precisely known, but Far Ultraviolet Spectroscopic Explorer (FUSE) data supports a distance of about 1,470 light-years.^[2]

The **Hubble Space Telescope** captured several images of the nebula. The analysis of the **emissions** from the nebula indicate the presence of **oxygen**, **sulfur**, and **hydrogen**. This is also one of the largest, brightest features in the **x-ray sky**.

September 24, 2015 new images and videos of the Veil Nebula were released,^[4] with an explanation of the images.^[5]

2.33.1 Components

In modern usage, the names *Veil Nebula*, **Cirrus Nebula**, and **Filamentary Nebula** generally refer to all the visible structure of the remnant, or even to the entire loop itself.

The structure is so large that several NGC numbers were assigned to various arcs of the nebula.^[6] There are three main visual components:

- **The Western Veil** (also known as **Caldwell 34**), consisting of **NGC 6960** (the “Witch’s Broom”, “Finger of God”,^[7] or “Filamentary Nebula”^[7]) near the foreground star 52 Cygni;
- **The Eastern Veil** (also known as **Caldwell 33**), whose brightest area is **NGC 6992**, trailing off farther south into **NGC 6995** and **IC 1340**; and
- **Pickering’s Triangle** (or **Pickering’s Triangular Wisp**), brightest at the north central edge of the loop, but visible in photographs continuing toward the central area of the loop.

NGC 6974 and **NGC 6979** are luminous knots in a fainter patch of nebulosity on the northern rim between NGC 6992 and Pickering’s Triangle.^{[8][9]}

2.33.2 Observation



A broad view of Cygnus loop/Veil nebula in ultraviolet

The nebula was discovered on 1784 September 5 by **William Herschel**. He described the western end of the nebula as “*Extended; passes thro' 52 Cygni... near 2 degree in length*”, and described the eastern end as “*Branching nebulosity... The following part divides into several streams uniting again towards the south.*”

When finely resolved, some parts of the image appear to be rope-like filaments. The standard explanation is that the shock waves are so thin, less than one part in 50,000 of the radius,^[10] that the shell is visible only when viewed exactly edge-on, giving the shell the appearance of a filament. Undulations in the surface of the shell lead to multiple filamentary images, which appear to be intertwined.

Even though the nebula has a relatively bright integrated magnitude of 7, it is spread over so large an area that the

surface brightness is quite low, so the nebula is notorious among astronomers as being difficult to see. However, an observer can see the nebula clearly in a telescope using an OIII filter (a filter isolating the **wavelength** of light from doubly **ionized oxygen**), as almost all light from this nebula is emitted at this wavelength. An 8-inch (200 mm) telescope equipped with an OIII filter shows the delicate lacework apparent in photographs, and with an OIII filter almost any telescope could conceivably see this nebula. Some argue that it can be seen without any optical aid except an OIII filter held up to the eye.

The brighter segments of the nebula have the **New General Catalogue** designations NGC 6960, 6974, 6979, 6992, and 6995. The easiest segment to find is 6960, which runs behind the naked eye star **52 Cygni**. NGC 6992/5 are also relatively easy objects on the eastern side of the loop. NGC 6974 and NGC 6979 are visible as knots in an area of nebulosity along the northern rim. Pickering's Triangle is much fainter, and has no NGC number (though 6979 is occasionally used to refer to it). It was discovered photographically in 1904 by **Williamina Fleming** (after the New General Catalogue was published), but credit went to **Edward Charles Pickering**, the director of her observatory, as was the custom of the day.

2.33.3 In fiction

See Veil Nebula in fiction.

2.33.4 Gallery

- *Eastern Veil* (NGC 6992/95)
- *Eastern Veil Detail* (NGC6992)
- *Pickering's (Fleming's) Triangular Wisp*
- *Western Veil* (NGC 6960)
- Portion photographed by Hubble Space Telescope
- Detail of the Veil Nebula.
- Cygnus Loop with labels

2.33.5 See also

- **Veil Nebula in fiction**

2.33.6 References

- [1] "SIMBAD Astronomical Database". *Results for Veil Nebula*. Retrieved 2007-01-02.
- [2] William Blair. "Piercing the Veil: FUSE Observes a Star Behind the Cygnus Loop Supernova Remnant". *FUSE Science Summaries*. Retrieved 2010-11-29.

- [3] "Astronomy Picture of the Day". *NGC 6960: The Witch's Broom Nebula*. Retrieved 2007-01-02.
- [4] "HubbleSite - NewsCenter - Hubble Zooms in on Shrapnel from an Exploded Star (09/24/2015) - Related Links". *hubblesite.org*. Retrieved 2015-09-25.
- [5] Blair, William (September 2015). "The Cygnus Loop/Veil Nebula Hubble Space Telescope" (PDF). *http://hubblesite.org/*.
- [6] Tirion; Rappaport; Lovi (1991) [1987]. *Uranometria 2000 I*. Richmond, VA: William-Bell, Inc. p. 120. ISBN 0-943396-14-X.
- [7] Tom Trussock, "Small Wonders: Cygnus ...", [section] "The Veil", *Cloudy Nights Telescope Reviews*
- [8] "NGC/IC Project". *Results for NGC 6974*. Retrieved 2010-12-03.
- [9] "NGC/IC Project". *Results for NGC 6979*. Retrieved 2010-12-03.
- [10] William Blair. "Cygnus Loop HST Photo Release". *William Blair Homepage at Johns Hopkins University*. Retrieved 2010-11-29.

Coordinates:  20^h 45^m 38^s, +30° 42' 30"

2.33.7 External links

- Australian Astronomical Observatory – IC 1340, photograph by David Malin
- spacetelescope.com – "Uncovering the Veil Nebula", with several Hubble Space Telescope photos
- APOD (2010-11-19) – Nebulae in the Northern Cross, showing Veil Nebula to scale in Cygnus
- APOD (2010-09-16) – Photo of the entire Veil Nebula
- APOD (2009-12-01) – NGC 6992: Filaments of the Veil Nebula
- APOD (2003-01-18) – Filaments in the Cygnus Loop
- APOD (1999-07-25) – Shockwaves in the Cygnus Loop (and underlying HST photo)
- Bill Blair (Johns Hopkins University) – Cygnus Loop HST Photo Release
- Bill Blair (Johns Hopkins University) – Photo combining optical and X-ray data
- Bill Blair (Johns Hopkins University) – Overview photo of Cygnus Loop and Veil Nebula
-

- The Veil Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Veil Nebula at Constellation Guide

2.34 Caldwell 35

NGC 4889 (also known as **Caldwell 35**, **Coma B**) is a class-4 supergiant elliptical galaxy.^[4] It was discovered in 1785 by the British astronomer **Frederick William Herschel I**, who catalogued it as a bright, nebulous patch. The brightest galaxy within the northern **Coma Cluster**, it is located at a distance of 94 million parsecs (308 million light years) from Earth. Unlike a flattened, disc-shaped spiral galaxy like the **Milky Way**, NGC 4889 has no visible dust lanes or spiral arms and has a smooth, featureless, egg-shaped profile that diminishes in luminosity with distance from the center. At the core of the galaxy is a **supermassive black hole** that heats up the intracluster medium through the action of friction from infalling gases and dust. The X-ray emission from the galaxy extends out to several million light years of the cluster.

As with other similar elliptical galaxies, only a fraction of the mass of NGC 4889 is in the form of stars. They have a flattened, unequal distribution that bulges within its edge. Between the stars is a dense **interstellar medium** full of heavy elements emitted by evolved stars. In addition it also has a diffuse stellar halo that extends out to one million light years in diameter. Orbiting the galaxy is a very large population of globular clusters. NGC 4889 is also a strong source of soft X-ray, ultraviolet, and radio frequency radiation.

As the largest and the most massive galaxy easily visible to Earth, NGC 4889 has played an important role in both amateur and professional astronomy, and has become a prototype in studying the dynamical evolution of other supergiant elliptical galaxies in the more distant universe.

2.34.1 Observation

NGC 4889 was not included by the French astronomer **Charles Messier** in his famous **Messier catalogue** despite being an intrinsically bright object quite close to some Messier objects. The first known observation of NGC 4889 was that of Frederick William Herschel I, assisted by his sister, **Caroline Lucretia Herschel**, in 1785, who included it in the **Catalogue of Nebulae and Clusters of Stars** published a year later. In 1864, Herschel's son, **John Frederick William Herschel**, published the **General Catalogue of Nebulae and Clusters of Stars**. He included the objects catalogued by his father, including the later to be called NGC 4889, plus other objects he found that were somehow missed by his father. In 1888 the Danish-Irish astronomer **John Louis Emil Dreyer** published the

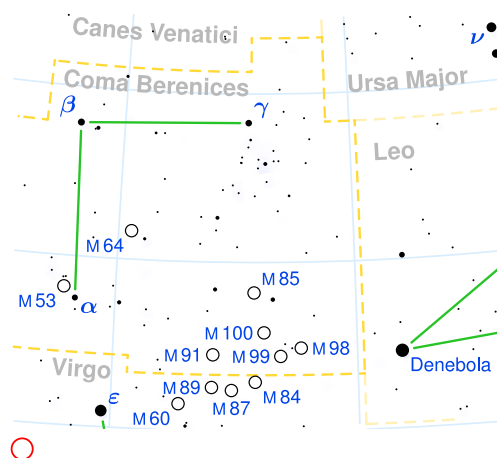


Wide-field image of the Coma Cluster. NGC 4889 is the bright galaxy to the left. The galaxy at the right is NGC 4874, while the star above it is HD 112887 which is a foreground star and is completely unrelated to the cluster.

New General Catalogue of Nebulae and Clusters of Stars (NGC), with a total of 7,840 objects, but he erroneously duplicated the galaxy in two designations, **NGC 4884** and **NGC 4889**. Within the following century, several projects aimed to revise the NGC catalogue were conducted, such as The NGC/IC Project, Revised New General Catalogue of Nebulae and Clusters of Stars, and the NGC 2000.0 projects, discovered the duplication. It was then decided that the object to be called by its latter designation, NGC 4889, which is in use today.

In December 1995, **Patrick Caldwell Moore** compiled the **Caldwell catalogue**, a list of 109 persistent, bright objects that were somehow missed by Messier in his catalogue. The list also includes NGC 4889, which is given the designation **Caldwell 35**.

2.34.2 Properties



The location of NGC 4889 (circled) in Coma Berenices

NGC 4889 is located along the high declination region of Coma Berenices, south of the constellation **Canes Ve-**

natici. It can be traced by following the line from **Beta Comae Berenices** to **Gamma Comae Berenices**. With an apparent magnitude of 11.4, it can be seen by telescopes with 12 inch aperture, but its visibility is greatly affected by light pollution due to glare of the light from Beta Comae Berenices. However, under very dark, moonless skies, it can be seen by small telescopes as a faint smudge, but larger telescopes are needed in order to see the galaxy's halo.

In the updated **Hubble sequence galaxy morphological classification** scheme by the French astronomer **Gérard de Vaucouleurs** in 1959, NGC 4889 is classified as an E4 type galaxy, which means it has a flat distribution of stars within its width. It is also classified as a cD galaxy, a giant type of D galaxy, a classification devised by the **American astronomer William Wilson Morgan** in 1958 for galaxies with an elliptical-shaped nucleus surrounded by an immense, diffuse, dustless, extended halo.

NGC 4889 is far enough that its distance can be measured using redshift. With the redshift of 0.0266 as derived from the **Sloan Digital Sky Survey**, and the **Hubble constant** as determined in 2013 by the **ESA COBRAS/SAMBA/Planck Surveyor** translates its distance of 94 Mpc (308 million light years) from Earth.

NGC 4889 is probably the largest and the most massive galaxy out to the radius of 100 Mpc (326 million light years) of the Milky Way. The galaxy has an effective radius which extends at 2.9 arcminutes of the sky, translating it to the diameter of 239,000 light years, about the size of the **Andromeda Galaxy**. In addition it has an immense diffuse light halo extending to 17.8 arcminutes, roughly half the angular diameter of the **Sun**, translating to 1.3 million light years in diameter.

As for its large size, NGC 4889 may also be extremely massive. If we took Milky Way as the standard of mass, it may be close to 8 trillion solar masses. However, as NGC 4889 is a spheroid, and not a flat spiral, it has a three-dimensional profile, so it may be as high as 15 trillion solar masses. However, as for elliptical galaxies, only a small fraction of the mass of NGC 4889 is in the form of stars that radiate energy. Assuming a mass to light ratio of 6.5 as with other elliptical galaxies, NGC 4889 may be a thousand times more massive than the Milky Way.

2.34.3 Components

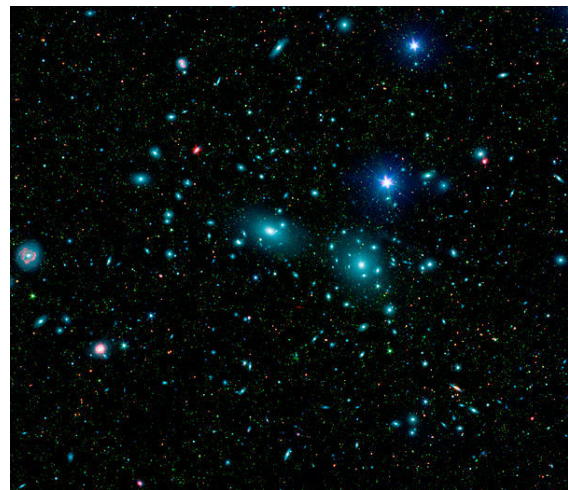
On December 5, 2011, astronomers measured the velocity dispersion of the central regions of two massive galaxies, NGC 4889, and the other being NGC 3842 in the **Leo Cluster**. According to the data of the study, they found out the central black hole of NGC 4889 is 5,200 times more massive than the central black hole of the Milky Way, or equivalent to 2.1×10^{10} (21 billion) solar masses (best fit of data; possible range is from 6 billion to 37 billion solar masses).^[5] This makes it one of the **most massive black holes** on record. The diameter of the black

hole's immense event horizon is about 124 billion kilometers, 12 times the diameter of **Pluto's** orbit. The ionized medium detected around the black hole suggests that NGC 4889 may have been a quasar in the past.

Giant elliptical galaxies like NGC 4889 are believed to be the result of multiple mergers of smaller galaxies. There is now little dust remaining to form the diffuse nebulae where new stars are created, so the stellar population is dominated by old, population II stars that contain relatively low abundances of elements other than hydrogen and helium. The egg-like shape of this galaxy is maintained by random orbital motions of its member stars, in contrast to the more orderly rotational motions found in a spiral galaxy such as the Milky Way.

The space between the stars in the galaxy is filled with a diffuse interstellar medium of gas, which has been filled by the elements ejected from stars as they passed beyond the end of their main sequence lifetime. Carbon and nitrogen are being continuously supplied by intermediate mass stars as they pass through the asymptotic giant branch. The heavier elements from oxygen to iron are primarily produced by supernova explosions within the galaxy. The interstellar medium is continuously heated by the emission of in-falling gases towards its central SMBH.

2.34.4 Environment



The Coma Cluster taken using data from the Sloan Digital Sky Survey and the Spitzer Space Telescope. NGC 4889 is at the center.

NGC 4889 lies at the center of the component A of the **Coma Cluster**, a giant cluster of 20,000 galaxies which it shares with NGC 4874, although NGC 4889 is sometimes referred as the cluster center, and it has been called by its other designation **A1656-BCG**. The total mass of the cluster is estimated to be on the order of $4 \times 10^{15} M_{\odot}$.

The Coma Cluster is located at exactly the center of the **Coma Supercluster**, which is one of the nearest super-

clusters to the **Laniakea Supercluster**. The Coma Supercluster itself is within the CfA Homunculus, the center of the **CfA2 Great Wall**, the nearest galaxy filament to Earth and one of the largest structures in the known universe.

2.34.5 See also

- **NGC 3842**

2.34.6 Notes

- [1] “NASA/IPAC Extragalactic Database”. *Results for 3C 147*. Retrieved 2010-05-02.
- [2] “Distance Results for NGC 4889”. *NASA/IPAC Extragalactic Database*. Retrieved 2015-01-04.
- [3] Revised NGC Data for NGC 4889
- [4] Jacobsen, Den (2006). “Abell 1656, NGC 4889, NGC 4874”. *astrophoto.net*. Retrieved 2008-08-09.
- [5] McConnell, Nicholas J. (2011-12-08). “Two ten-billion-solar-mass black holes at the centres of giant elliptical galaxies”. *Nature*. Archived from the original (PDF) on 2011-12-06. Retrieved 2011-12-06.

2.34.7 References

- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. ISBN 0-395-93432-X.
- Eicher, David J. (1988). *The Universe from Your Backyard: A Guide to Deep-Sky Objects from Astronomy Magazine*. AstroMedia (Kalmbach Publishing Company). ISBN 0-521-36299-7.

2.34.8 External links

- **SEDS** – NGC 4889
- **Simbad** – NGC 4889
- **VizieR** – NGC 4889
-
- NGC 4889 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- The Scale of the Universe (Astronomy Picture of the Day 2012 March 12)

2.35 Caldwell 36

NGC 4559 (also known as **Caldwell 36**) is a **spiral galaxy** in the constellation **Coma Berenices**. Distance estimates for NGC 4559 range from about 29 million **light-years** to 51 million light-years, averaging about 29 million light-years.^[1]

2.35.1 See also

- **Messier 99** – a similar spiral galaxy

2.35.2 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 4559*. Retrieved 2007-03-31.

2.35.3 External links

- NGC 4559 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.36 Caldwell 37

NGC 6885, also **Caldwell 37**, is an open cluster in the constellation **Vulpecula**. It shines at magnitude +5.7/+8.1.^[1] Its celestial coordinates are RA 20^h 12.0^m, dec +26° 29′. It surrounds a naked-eye O or B-class star, and is located near **M27** (Dumbbell nebula), the nebula **IC 4954**, and open clusters **NGC 6882**^[1] and **NGC 6940**. It is 7′/18′ across.^[1]

2.36.1 Notes

- [1] “NGC 6885/6882”. *earthlink.net*. 2006. Retrieved 2008-08-09.


2.36.2 References

- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. ISBN 0-395-93432-X.
- Caldwell-Moore, Sir Patrick (2003). *Firefly Atlas of the Universe*. Firefly Books Limited. ISBN 1-55297-819-2.

2.36.3 External links

- NGC 6885 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

- SEDS – NGC 6885
- Simbad – NGC 6885
- VizieR – NGC 6885
- NED – NGC 6885

Coordinates:  20^h 12^m 00^s, +26° 29′ 00″

2.37 Caldwell 38

NGC 4565 (also known as the **Needle Galaxy** or **Caldwell 38**) is an edge-on spiral galaxy about 30 to 50 million light-years away^[2] in the constellation Coma Berenices.

The 10th magnitude galaxy sits perpendicular to our own Milky Way galaxy and is almost directly above the North Galactic Pole (in the same way Polaris is located above the Earth's North Pole).

It is known as the Needle Galaxy for its narrow profile.^[4] First spotted in 1785 by Sir William Herschel (1738–1822), this is one of the most famous examples of an edge-on spiral galaxy.^[5] “Visible through a small telescope, some sky enthusiasts consider NGC 4565 to be a prominent celestial masterpiece Messier missed.”^[4]

2.37.1 Characteristics

NGC 4565 is a giant spiral galaxy more luminous than the **Andromeda Galaxy**^[6] and it has been proposed that if it were viewed face-on, it would be the most spectacular of the galaxies of its type in the nearby Universe.^[7]

Much speculation exists in the literature as to the nature of the central bulge. In the absence of clear-cut dynamical data on the motions of stars in the bulge, the photometric data alone cannot adjudge among various options put forth. However, its exponential shape suggested that it is a **barred spiral galaxy**.^[8] Subsequent studies with the help of the **Spitzer Space Telescope** not only confirmed the presence of a central bar but also showed a **pseudobulge** within it as well as an inner ring.^[7]

NGC 4565 has at least two companion galaxies, one of which is interacting with it.^[9]

It has a population of roughly 240 globular clusters, more than the Milky Way.^[6]

2.37.2 References

- [1] “Results for NGC 4565”. *NASA/IPAC Extragalactic Database*. Retrieved 2006-10-12.
- [2] “Distance Results for NGC 4565”. *NASA/IPAC Extragalactic Database*. Retrieved 2010-05-02.



NGC 4565 and apparently smaller NGC 4562. 24-inch telescope on Mt. Lemmon, AZ.



A detailed view of part of the disc of the spiral galaxy NGC 4565 imaged by the Hubble Space Telescope

- [3] Jensen, Joseph B.; Tonry, John L.; Barris, Brian J.; Thompson, Rodger I. et al. (February 2003). “Measuring Distances and Probing the Unresolved Stellar Populations of Galaxies Using Infrared Surface Brightness Fluctuations”. *Astrophysical Journal* **583** (2): 712–726. arXiv:astro-ph/0210129. Bibcode:2003ApJ...583..712J. doi:10.1086/345430.
- [4] NGC4565 at <http://apod.nasa.gov/apod/ap040409.html>
- [5] Spiral Galaxy NGC 4565 at <http://www.eso.org/gallery/v/ESOPIA/Galaxies/phot-24a-05.tif.html>
- [6] Globular Cluster Systems in Galaxies Beyond the Local Group
- [7] Detection of a Distinct Pseudobulge Hidden Inside the “Box-Shaped Bulge of NGC 4565
- [8] “Intermediate-band surface photometry of the edge-on galaxy NGC 4565” at <http://www.iop.org/EJ/article/1538-3881/123/3/1364/201272.text.html>
- [9] HALOGAS: H I Observations and Modeling of the Nearby Edge-on Spiral Galaxy NGC 4565

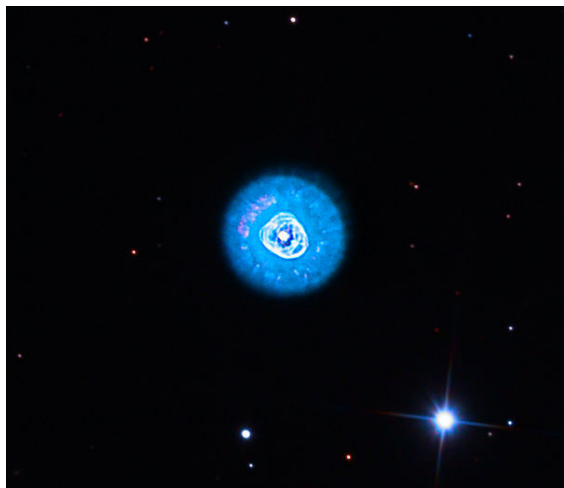
2.37.3 External links

-
- NGC 4565 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- National Optical Astronomical Observatory – NGC 4565
- APOD (2010-03-04) – NGC 4565: Galaxy on Edge
- APOD (2009-04-28) – NGC 4565

Coordinates:  12^h 36^m 20.8^s, +25° 59′ 16″

2.38 Caldwell 39

The **Eskimo Nebula** (NGC 2392), also known as the **Clownface Nebula**^[4] or **Caldwell 39**, is a bipolar^[2] double-shell^[5] planetary nebula (PN). It was discovered by astronomer William Herschel in 1787. The formation resembles a person's head surrounded by a parka hood. It is surrounded by gas that composed the outer layers of a Sun-like star. The visible inner filaments are ejected by a strong wind of particles from the central star. The outer disk contains unusual light-year-long filaments.



NGC 2392, Eskimo Nebula in 32 inch telescope

NGC 2392 lies more than 2,870 light-years away and is visible with a small telescope (but more preferably with a larger telescope) in the constellation of Gemini.

2.38.1 Historic data

The nebula was discovered by William Herschel on January 17, 1787, in Slough, England. He described it as “A star 9th magnitude with a pretty bright middle, nebulosity equally dispersed all around. A very remarkable

phenomenon.”^[6] NGC 2392 WH IV-45 is included in the Astronomical League's Herschel 400 observing program.

2.38.2 See also

- List of planetary nebulae
- New General Catalogue

2.38.3 Notes

1. [^] Radius = distance × sin(angular size / 2) = ≥2900 ly * sin(48″ / 2) = ≥0.34 ly
2. [^] 10.1 apparent magnitude - 5 * (log₁₀(≥880 pc distance) - 1) = ≤0.4 absolute magnitude

2.38.4 References

- [1] “SIMBAD Astronomical Database”. *Results for Eskimo Nebula*. Retrieved 2006-12-22.
- [2] O'dell, C. R.; Balick, B.; Hajian, A. R.; Henney, W. J. et al. (2003). “Knots in Planetary Nebulae”. *Winds, Bubbles, and Explosions: a conference to honor John Dyson, Pátzcuaro, Michoacán, México, September 9–13, 2002* (Eds. S. J. Arthur & W. J. Henney) *Revista Mexicana de Astronomía y Astrofísica (Serie de Conferencias)* (<http://www.astroscu.unam.mx/~{rmaa/}>) **15**: 29–33. Bibcode:2003RMxAC..15...29O.
- [3] O'Dell, C. R.; Balick, B.; Hajian, A. R.; Henney, W. J. et al. (2002). “Knots in Nearby Planetary Nebulae”. *The Astronomical Journal* **123** (6): 3329–3347. Bibcode:2002AJ....123.3329O. doi:10.1086/340726.
- [4] Windows to the Universe
- [5] Guerrero, M. A.; Chu, Y.-H.; Gruendl, R. A.; Meixner, M. (2005). “XMM-Newton detection of hot gas in the Eskimo Nebula: Shocked stellar wind or collimated outflows?”. *Astronomy and Astrophysics* **430** (3): L69–L72. arXiv:astro-ph/0412540. Bibcode:2005A&A...430L..69G. doi:10.1051/0004-6361:200400131.
- [6] *The Scientific Papers of Sir William Herschel* by J. L. E. Dreyer, Royal Society, London 1912

2.38.5 External links

- APOD (2003-12-07) – NGC 2392: The Eskimo Nebula
-
- The Eskimo Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  07^h 29^m 10.7669^s, +20° 54′ 42.488″

- Eskimo Nebula at Constellation Guide

2.39 Caldwell 40

NGC 3626, also **Caldwell 40**, is a medium-tightness spiral galaxy and Caldwell object in the constellation Leo. It was discovered by William Herschel, on 14 March 1784. It shines at magnitude +10.6^[1]/+10.9. Its celestial coordinates are RA 11^h 20.1^m, dec +18° 21′. It is located near the naked-eye class A4 star **Zosma**, as well as galaxies **NGC 3608**, **NGC 3607**, **NGC 3659**, **NGC 3686**, **NGC 3684**, **NGC 3691**, **NGC 3681**, and **NGC 3655**. Its dimensions are 2′.7 × 1′.9.^[1] The galaxy belongs to the **NGC 3607** group some 70 million light-years distant, itself one of the many **Leo II** groups.^[2]

2.39.1 Notes

- [1] Erdmann, Jr., Robert E. (1996–2008). “Object Data”. The NGC / IC Project. Retrieved 2008-08-11.
- [2] Powell, Richard (2006). “The Leo II Groups”. Atlas of The Universe. Retrieved 2008-08-11.

2.39.2 References

- Bratton, Mark (2011). *The Complete Guide to the Herschel Objects*. Cambridge University Press. ISBN 978-0-521-76892-4.
- Pasachoff, Jay M. (2000). “Atlas of the Sky”. *Stars and Planets*. New York, NY: Peterson Field Guides. ISBN 0-395-93432-X.
- Caldwell-Moore, Sir Patrick (2003). *Firefly Atlas of the Universe*. Firefly Books Limited. ISBN 1-55297-819-2.

2.39.3 External links

- **NGC 3626** on **WikiSky**: **DSS2**, **SDSS**, **GALEX**, **IRAS**, **Hydrogen α** , **X-Ray**, **Astrophoto**, **Sky Map**, **Articles** and **images**
- **SEDs** – **NGC 3626**
- **Simbad** – **NGC 3626**
- **VizieR** – **NGC 3626**
- **NED** – **NGC 3626**

Coordinates:  11^h 20^m 03.8^s, +18° 21′ 25″

2.40 Caldwell 41

The **Hyades** (/ˈhaɪ.ədiːz/; Greek Ἥαδες, also known as **Melotte 25** or **Collinder 50**) is the nearest open cluster to the Solar System and one of the best-studied of all star clusters. The Hipparcos satellite, the Hubble Space Telescope, and infrared color-magnitude diagram fitting have been used to establish a distance of ~153 ly (47 pc) to the cluster center.^{[1][2][3][4]} The distances established by these three independent methods agree, thereby making the Hyades an important rung on the cosmic distance ladder. The cluster consists of a roughly spherical group of hundreds of stars sharing the same age, place of origin, chemical content, and motion through space.^{[1][5]} From the perspective of observers on Earth, the Hyades Cluster appears in the constellation Taurus, where its brightest stars form a “V” shape along with the still brighter red giant Aldebaran. However, Aldebaran is unrelated to the Hyades, as it is located much closer to Earth (hence its apparent brightness) and merely happens to lie along the same line of sight.

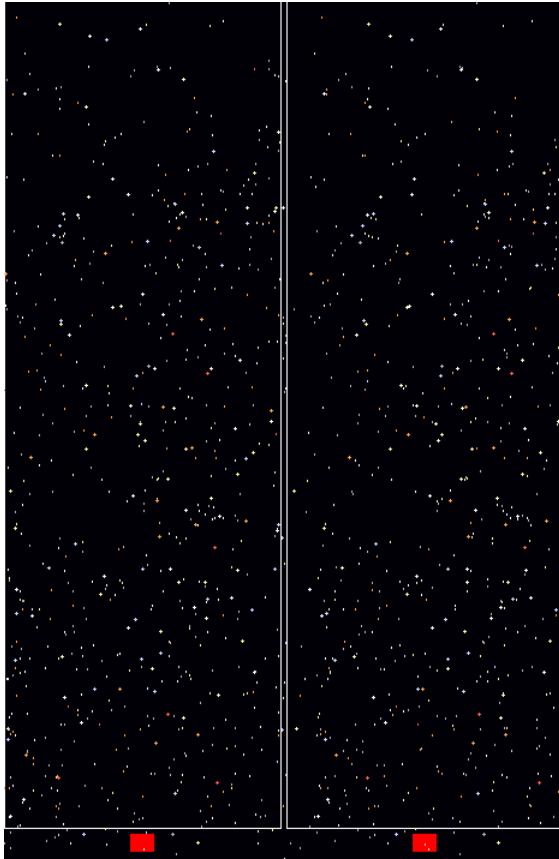
The five brightest member stars of the Hyades have all evolved away from the Main Sequence and now lie at the bottom of the giant branch.^[6] Four of these stars, with Bayer designations **Gamma**, **Delta 1**, **Epsilon**, and **Theta Tauri**, form an asterism that is traditionally identified as the head of Taurus the Bull.^[6] The other is **Zeta 1 Tauri**, which lies 2° further south. **Epsilon Tauri**, known as *Ain* (the “Bull’s Eye”), has a gas giant exoplanet candidate,^[7] the first planet to be found in any open cluster.

The age of the Hyades is estimated to be about 625 million years.^[1] The cluster core, where stars are most densely packed, has a radius of 2.7 parsecs (corresponding to a diameter of 17.6 light years), and the cluster’s tidal radius is 10 parsecs (corresponding to a diameter of 65 light years).^[1] However, about one-third of confirmed member stars have been observed well outside this boundary, in the cluster’s extended halo; these stars are probably in the process of escaping from its gravitational influence.^[1]

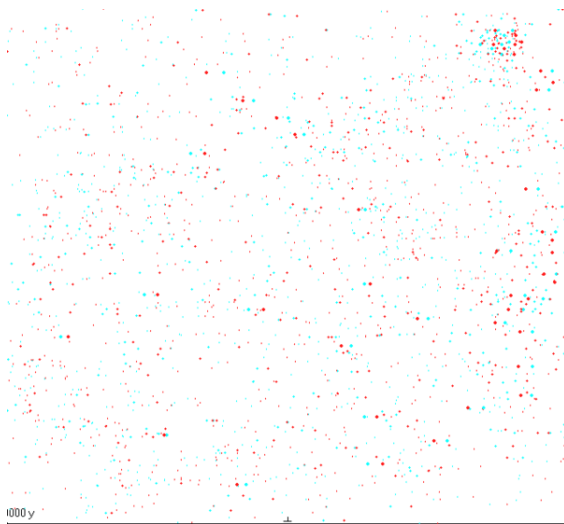
2.40.1 Proper motion

The stars of the Hyades are more enriched in heavy elements than our Sun and other ordinary stars in the Solar neighborhood, with the overall cluster metallicity measured at +0.14.^[1]

The Hyades Cluster is related to other stellar groups in the Sun’s vicinity. Its age, metallicity, and proper motion coincide with those of the larger and more distant **Praesepe Cluster**,^[8] and the trajectories of both clusters can be traced back to the same region of space, indicating a common origin.^[9] Another associate is the **Hyades Stream**, a large collection of scattered stars that also share a similar trajectory with the Hyades Cluster. Recent results have found that at least 15% of stars in the Hyades stream



Animation of proper motion in $\pm 300\,000$ years (cross-eyed viewing)



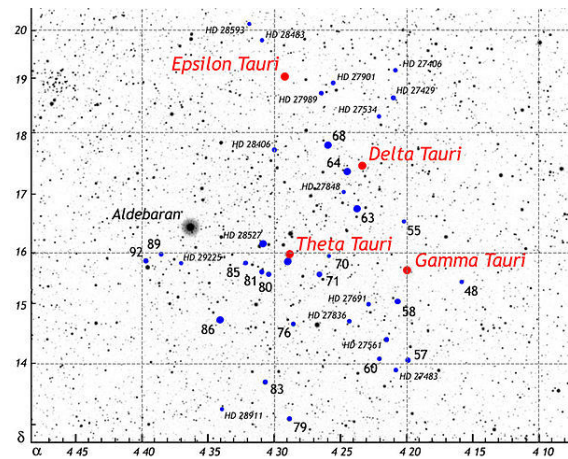
Animation of proper motion in million years for 3D glasses (red-green or red-blue)

share the same chemical fingerprint as the Hyades cluster stars.^[10] However, about 85% of stars in the Hyades Stream have been shown to be completely unrelated to the original cluster on the grounds of dissimilar age and metallicity; their common motion is attributed to tidal effects of the massive rotating bar at the center of the Milky Way Galaxy.^[11] Among the remaining members of the

Hyades Stream, the exoplanet host star *Iota Horologii* has recently been proposed as an escaped member of the primordial Hyades Cluster.^[12]

The Hyades are unrelated to two other nearby stellar groups, the *Pleiades* and the *Ursa Major Stream*, which are easily visible to the naked eye under clear dark skies.

2.40.2 History



Bright stars in the core of the Hyades Cluster

In Greek mythology, the *Hyades* were the five daughters of *Atlas* and half-sisters to the *Pleiades*. After the death of their brother, *Hyas*, the weeping sisters were transformed into a cluster of stars that was afterwards associated with rain.

As a naked-eye object, the Hyades cluster has been known since prehistoric times. It is mentioned by numerous Classical authors from *Homer* to *Ovid*.^[13] In Book 18 of the *Iliad* the stars of the Hyades appear along with the *Pleiades*, *Ursa Major*, and *Orion* on the shield that the god *Hephaistos* made for *Achilles*.^[14]

In England the cluster was known as the “April Rainers” from an association with April showers, as recorded in the folk song “*Green Grow the Rushes, O*”.

The cluster was probably first catalogued by *Giovanni Batista Hodierna* in 1654, and it subsequently appeared in many star atlases of the 17th and 18th centuries.^[13] However, *Charles Messier* did not include the Hyades in his 1781 catalog of deep sky objects.^[13] It therefore lacks a Messier number, unlike many other, more distant open clusters – e.g., *M44* (Praesepe), *M45* (Pleiades), and *M67*.

In 1869, the astronomer *R.A. Proctor* observed that numerous stars at large distances from the Hyades share a similar motion through space.^[15] In 1908, *Lewis Boss* reported almost 25 years of observations to support this premise, arguing for the existence of a co-moving group of stars that he called the *Taurus Stream* (now generally known as the *Hyades Stream* or *Hyades Superclus-*

ter). Boss published a chart that traced the scattered stars' movements back to a common point of convergence.^[16]

By the 1920s, the notion that the Hyades shared a common origin with the Praesepe Cluster was widespread,^[17] with Rudolf Klein-Wassink noting in 1927 that the two clusters are “probably cosmically related.”^[18] For much of the twentieth century, scientific study of the Hyades focused on determining its distance; modeling its evolution; confirming or rejecting candidate members; and characterizing individual stars.

2.40.3 Morphology and evolution

All stars form in clusters, but most clusters break up less than 50 million years after star formation concludes.^[19] The astronomical term for this process is “evaporation.” Only extremely massive clusters, orbiting far from the Galactic center, can avoid evaporation over extended timescales.^[20] As one such survivor, the Hyades Cluster probably contained a much larger star population in its infancy. Estimates of its original mass range from 800 to 1600 times the mass of our Sun (M_{\odot}), implying still larger numbers of individual stars.^{[21][22]}

Star populations

Theory predicts that a young cluster of this size should give birth to stars and substellar objects of all spectral types, from huge, hot O stars down to dim brown dwarfs.^[22] However, studies of the Hyades show that it is deficient in stars at both extremes of mass.^{[5][23]} At an age of 625 million years, the cluster's main sequence turn-off is about $2.3 M_{\odot}$, meaning that all heavier stars have evolved into subgiants, giants, or white dwarfs, while less massive stars continue fusing hydrogen on the main sequence.^[21] Extensive surveys have revealed a total of 8 white dwarfs in the cluster core,^[24] corresponding to the final evolutionary stage of its original population of B-type stars (each about $3 M_{\odot}$).^[21] The preceding evolutionary stage is currently represented by the cluster's four red clump giants. Their present spectral type is K0 III, but all are actually “retired A stars” of around $2.5 M_{\odot}$.^{[7][25][26]} An additional “white giant” of type A7 III is the primary of θ^2 Tauri, a binary system that includes a less massive companion of spectral type A; this pair is visually associated with θ^1 Tauri, one of the four red giants, which also has an A-type binary companion.^{[25][27]}

The remaining population of confirmed cluster members includes numerous bright stars of spectral types A (at least 21), F (about 60), and G (about 50).^{[1][23]} All these star types are concentrated much more densely within the tidal radius of the Hyades than within an equivalent 10-parsec radius of the Earth. By comparison, our local 10-parsec sphere contains only 4 A stars, 6 F stars, and 21 G stars.^[28]

The Hyades' cohort of lower-mass stars – spectral types

K and M – remains poorly understood, despite proximity and long observation. At least 48 K dwarfs are confirmed members, along with about a dozen M dwarfs of spectral types M0-M2.^{[1][23][29]} Additional M dwarfs have been proposed, but few are later than M3, and only about 12 brown dwarfs are currently reported.^{[5][30][31]} This deficiency at the bottom of the mass range contrasts strongly with the distribution of stars within 10 parsecs of the Solar System, where at least 239 M dwarfs are known, comprising about 76% of all neighborhood stars.^[28]

Mass segregation

The observed distribution of stellar types in the Hyades Cluster demonstrates a history of mass segregation. With the exception of its white dwarfs, the cluster's central 2 parsecs (6.5 light years) contain only star systems of at least $1 M_{\odot}$.^[1] This tight concentration of heavy stars gives the Hyades its overall structure, with a core defined by bright, closely packed systems and a halo consisting of more widely separated stars in which later spectral types are common. The core radius is 2.7 parsecs (8.8 light years, a little more than the distance between the Sun and Sirius), while the half-mass radius, within which half the cluster's mass is contained, is 5.7 parsecs (18.6 light years). The tidal radius of 10 parsecs (32.6 light years) represents the Hyades' average outer limit, beyond which a star is unlikely to remain gravitationally bound to the cluster core.^{[1][21]}

Stellar evaporation occurs in the cluster halo as smaller stars are scattered outward by more massive insiders. From the halo they may then be lost to tides exerted by the Galactic core or to shocks generated by collisions with drifting hydrogen clouds.^[20] In this way the Hyades probably lost much of its original population of M dwarfs, along with substantial numbers of brighter stars.

Stellar multiplicity

Another result of mass segregation is the concentration of binary systems in the cluster core.^{[1][23]} More than half of the known F and G stars are binaries, and these are preferentially located within this central region. As in the immediate Solar neighborhood, binarity increases with increasing stellar mass. The fraction of binary systems in the Hyades increases from 26% among K-type stars to 87% among A-type stars.^[23] Hyades binaries tend to have small separations, with most binary pairs in shared orbits whose semimajor axes are smaller than 50 astronomical units.^[32] Although the exact ratio of single to multiple systems in the cluster remains uncertain, this ratio has considerable implications for our understanding of its population. For example, Perryman and colleagues list about 200 high-probability Hyades members.^[1] If the binary fraction is 50%, the total cluster population would be at least 300 individual stars.

Future evolution

Surveys indicate that 90% of open clusters dissolve less than 1 billion years after formation, while only a tiny fraction survive for the present age of the Solar System (about 4.6 billion years).^[20] Over the next few hundred million years, the Hyades will continue to lose both mass and membership as its brightest stars evolve off the main sequence and its dimmest stars evaporate out of the cluster halo. It may eventually be reduced to a remnant containing about a dozen star systems, most of them binary or multiple, which will remain vulnerable to ongoing dissipative forces.^[20]

2.40.4 Brightest stars

This is a list of Hyades cluster member stars that are fourth magnitude or brighter.^[33]

2.40.5 See also

- List of stars in the Hyades

2.40.6 References

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- [3] Majaess, D.; Turner, D.; Lane, D.; Krajci, T. "Deep Infrared ZAMS Fits to Benchmark Open Clusters Hosting delta Scuti Stars", JAAVSO, 2011
- [4] McArthur, Barbara E.; Benedict, G. Fritz; Harrison, Thomas E.; van Altena, William "Astrometry with the Hubble Space Telescope: Trigonometric Parallaxes of Selected Hyads", AJ, 2011
- [5] Bouvier J, Kendall T, Meeus G, Testi L, Moraux E, Stauffer JR, James D, Cuillandre J-C, Irwin J, McCaughrean MJ, Baraffe I, Bertin E. (2008) Brown dwarfs and very low mass stars in the Hyades cluster: a dynamically evolved mass function. *Astronomy & Astrophysics*, 481: 661-672. Abstract at <http://adsabs.harvard.edu/abs/2008A%26A...481..661B>.
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- [15] Zuckerman B, Song I. (2004) Young stars near the Sun. *Annual Review of Astronomy & Astrophysics*. Volume 42, 685-721. Abstract at <http://adsabs.harvard.edu/abs/2004ARA%26A...42..685Z>.
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2.40.7 External links

- [Simbad](#)
- [Information on the Hyades from SEDS](#)
- [Astronomy Picture of the Day \(2000-09-29\)](#)
- [WEBDA open cluster database website for Hyades cluster – E. Paunzen \(Univ. Vienna\)](#)
- [Distance to the Hyades undergraduate lab – J. Lucey \(University of Durham\)](#)
- [Hyades \(star cluster\) on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

Coordinates:  04^h 28^m 17^s, +15° 45′ 40″

- [Hyades at Constellation Guide](#)

2.41 Caldwell 42

NGC 7006 (also known as **Caldwell 42**) is a globular cluster^[2] in the constellation Delphinus. NGC 7006 resides in the outskirts of the Milky Way. It is about 135,000^[6] light-years away, five times the distance between the Sun and the centre of the galaxy, and it is part of the galactic halo. This roughly spherical region of the Milky Way is made up of dark matter, gas and sparsely distributed stellar clusters.

NGC 7006 appears in the science fiction novel *Beyond the Farthest Star* by Edgar Rice Burroughs, where it is used as a point of reference by the inhabitants of the planet Poloda to determine the approximate location of Earth.^[7]

2.41.1 Gallery

- NGC 7006 imaged by Hubble’s Advanced Camera for Surveys.

2.41.2 References

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- [2] “SIMBAD Astronomical Database”. *Results for NGC 7006*. Retrieved 2007-04-21.
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- [4] “SEDS NGC Catalog Online”. *Results for NGC 7006*. Retrieved 2010-11-27.
- [5] Boyles, J. et al. (November 2011), “Young Radio Pulsars in Galactic Globular Clusters”, *The Astrophysical Journal* **742** (1): 51, arXiv:1108.4402, Bibcode:2011ApJ...742...51B, doi:10.1088/0004-637X/742/1/51.
- [6] “A Remote Outpost of the Milky Way”. *ESA/Hubble Picture of the Week*. 12 September 2011. Retrieved 13 September 2011.
- [7] Burroughs, Edgar Rice (2012). *Beyond the Farthest Star*. eStar Books. p. 47. Retrieved 2014-11-19.

2.41.3 External links

-
- NGC 7006 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  21^h 01^m 29.4^s, +16° 11′ 14.4″

2.42 Caldwell 43

NGC 7814 (also known as **UGC 8** or **Caldwell 43**) is a spiral galaxy about 40 million light-years away in the constellation Pegasus. The galaxy is seen edge-on from Earth. It is sometimes referred to as “the little sombrero”, a miniature version of **Messier 104**. The star field behind NGC 7814 is known for its density of faint, remote galaxies as can be seen in the image here – in the same vein as the Hubble Deep Field.

2.42.1 Gallery

- NGC 7814 has a bright central bulge and a bright halo of gas.^[1]
- NGC 7814 in an amateur telescope.

1. ^ “Dancing on the edge”. Retrieved 24 June 2015.

2.42.2 See also

- Sombrero Galaxy

2.42.3 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 7814*. Retrieved 2006-11-25.
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2.42.4 External links

- **NOAO**: NGC 7814
-
- NGC 7814 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 03^m 14.9^s, +16° 08′ 44″

2.43 Caldwell 44

NGC 7479 (also known as **Caldwell 44**) is a barred spiral galaxy about 105 million light-years away in the constellation Pegasus. It was discovered by William Herschel in 1784. Supernovae SN 1990U and SN2009jf occurred in NGC 7479. NGC 7479 is also recognized as a Seyfert galaxy undergoing starburst activity in the nucleus and the outer arms (Kohn, 2007). Polarization studies of this galaxy indicate that it recently underwent a minor merger and that it is unique in the radio continuum, with arms opening in a direction opposite to the optical arms (Laine, 2005).

2.43.1 Gallery

- An ultraviolet image of NGC 7479 taken with GALEX. Credit: GALEX/NASA.
- NGC 7479 in an amateur telescope.
- NGC 7479 24 inch Schulman Foundation telescope on Mt. Lemmon, AZ.

2.43.2 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 7479*. Retrieved 2006-11-25.

2.43.3 External links

- Media related to **NGC 7479** at Wikimedia Commons
- **NGC 7479** on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.44 Caldwell 45



NGC 5248 imaged with a 32-inch telescope

NGC 5248 (also known as **Caldwell 45**) is a compact intermediate spiral galaxy about 59 million light-years away in the constellation Boötes. It is a member of the NGC 5248 Group of galaxies, itself one of the Virgo III Groups strung out to the east of the Virgo Supercluster of galaxies.^[2] Distance measurements to NGC 5248 vary from 41.4 million light-years (12.7 Mpc) to 74.0 million light-years (22.7 Mpc), averaging about 58.7 million light-years (17.7 Mpc).^[1]

2.44.1 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 5248*. Retrieved 2010-11-27.
- [2] “The Virgo III Groups”. *Atlas of the Universe*. Retrieved 2010-11-27.

2.44.2 External links

- **NGC 5248** on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.45 Caldwell 46

NGC 2261 (also known as **Hubble’s Variable Nebula** or **Caldwell 46**) is a variable nebula located in the constellation Monoceros. It is illuminated by the star R Monocerotis (R Mon), which is not directly visible itself.

NGC 2261 was imaged as Palomar Observatory’s Hale Telescope’s first light by Edwin Hubble on January 26, 1949,^[2] some 20 years after the Palomar Observatory project began in 1928. Hubble had studied the nebula previously at Yerkes and Mt. Wilson.^[2]

One explanation proposed for the variability is that dense clouds of dust near R Mon periodically block the illumination from the star.^[3]

2.45.1 See also

- **NGC 1555**
- New General Catalogue

2.45.2 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 2261*. Retrieved 2007-04-11.
- [2] <http://365daysofastronomy.org/2009/01/26/january-26-60th-anniversary-of-hale-telescope-first-light/>
- [3] “A model for the cometary nebula NGC 2261”. *SAO/NASA ADS Astronomy Abstract Service*. Retrieved 2010-11-28.

2.45.3 External links

- European Homepage for the HST – Hubble photos and information on NGC 2261
- wikispaces.com – Images by amateur astronomers
- **NGC 2261** on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.46 Caldwell 47

NGC 6934 (also known as **Caldwell 47**) is a globular cluster^[6] in the constellation Delphinus, about 50,000 light years distant.^[4] It was discovered by William Herschel on 24 September 1785.^[4]

2.46.1 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Hessels, J. W. T. et al. (November 2007), “A 1.4 GHz Arecibo Survey for Pulsars in Globular Clusters”, *The Astrophysical Journal* **670** (1): 363–378, arXiv:0707.1602, Bibcode:2007ApJ...670..363H, doi:10.1086/521780.
- [4] “NGC 6934”. *SEDS*. Retrieved 2010-10-09.
- [5] Boyles, J. et al. (November 2011), “Young Radio Pulsars in Galactic Globular Clusters”, *The Astrophysical Journal* **742** (1): 51, arXiv:1108.4402, Bibcode:2011ApJ...742...51B, doi:10.1088/0004-637X/742/1/51.
- [6] “SIMBAD Astronomical Object Database”. *Results for NGC 6934*. Retrieved 2007-04-21.

2.46.2 External links

-
- NGC 6934 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- A Distant Backwater of the Milky Way — ESA/Hubble Picture of the Week

Coordinates:  20^h 34^m 11.5^s, +07° 24′ 14.9″

2.47 Caldwell 48

NGC 2775 (also known as **Caldwell 48**) is a spiral galaxy in the constellation Cancer. This galaxy has a bulge and multiple spiral arms, on which few HII regions can be detected, implying recent star formation. It was discovered by William Herschel in 1783.

NGC 2775 is the most prominent galaxy in a small galaxy group known as NGC 2775 group, part of the Virgo Supercluster, along with our own Local Group. Other members of the NGC 2775 group include NGC 2777 and UGC 4781.^[2]

SN1993z is the only supernova known to have occurred in NGC 2775 and was a Type Ia with a peak magnitude of 13.9.^[3]

2.47.1 Gallery

- NGC 2775 imaged with a 32-inch telescope.
- Map showing the location of NGC 2775.

2.47.2 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 2775*. Retrieved 2010-03-24.
- [2] “A List of Nearby Galaxy Groups”. *Atlas of the Universe*. Retrieved 2010-11-28.
- [3] “List of Supernovae”. *IAU Central Bureau for Astronomical Telegrams*. Retrieved 2012-01-10.

2.47.3 External links

- NGC 2775 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC 2775 at Deepskypedia

2.48 Caldwell 49

The **Rosette Nebula** (also known as **Caldwell 49**) is a large, circular H II region located near one end of a giant molecular cloud in the Monoceros region of the Milky Way Galaxy. The open cluster NGC 2244 (Caldwell 50) is closely associated with the nebulosity, the stars of the cluster having been formed from the nebula’s matter.

The complex has the following NGC designations:

- NGC 2237 – Part of the nebulous region (Also used to denote whole nebula)
- NGC 2238 – Part of the nebulous region
- NGC 2239 – Part of the nebulous region (Discovered by John Herschel)
- NGC 2244 – The open cluster within the nebula (Discovered by John Flamsteed in 1690)
- NGC 2246 – Part of the nebulous region

The cluster and nebula lie at a distance of some 5,000 light-years from Earth^[3] and measure roughly 50 light years in diameter. The radiation from the young stars excites the atoms in the nebula, causing them to emit radiation themselves producing the emission nebula we see. The mass of the nebula is estimated to be around 10,000 solar masses.

A survey of the nebula with the Chandra X-ray Observatory has revealed the presence of numerous new-born stars inside optical Rosette Nebula and studded within

a dense molecular cloud. Altogether, approximately 2500 young stars lie in this **star-forming complex**, including the massive **O-type stars** HD 46223 and HD 46150, which are primarily responsible for blowing the ionized bubble.^{[4][5]} Most of the ongoing star-formation activity is occurring in the dense molecular cloud to the south east of the bubble.^[6]

A diffuse **X-ray** glow is also seen between the stars in the **bubble**, which has been attributed to a super-hot plasma with temperatures ranging from 1 to 10 million K.^[7] This is significantly hotter than the 10,000 K plasmas seen in **HII regions**, and is likely attributed to the shock-heated winds from the massive O-type stars.

2.48.1 Observing the Rosette Nebula

The cluster of stars is visible in binoculars and quite well seen in small **telescopes** while the nebula itself is more difficult to spot visually and requires a telescope with a low magnification. A **dark site** is a must to see it. **Photographically** the Rosette Nebula is easier to record and it is the only way to record the red color which is not seen visually.

2.48.2 Other images

- Optical and X-ray (red) view of the Rosette Nebula
-
-
- A close up view of the Rosette Nebula
-

2.48.3 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 2237*. Retrieved 2006-10-23.
- [2] Phelps, Randy L.; Ybarra, Jason E. (2005). "A Parsec-Scale Outflow in the Rosette Molecular Cloud?". *The Astrophysical Journal* **627** (2): 845–849. Bibcode:2005ApJ...627..845P. doi:10.1086/430431.
- [3] 'Cambridge Deep Sky Companions - The Caldwell Objects', S.J. O'Meara & P. Moore, Cambridge University Press, ISBN 0-521-82796-5 (2002)
- [4] Kuhn, M. A.; et al. (2015). "The Spatial Structure of Young Stellar Clusters. II. Total Young Stellar Populations". *Astrophysical Journal* **802** (1): 60. Bibcode:2015ApJ...802...60K. doi:10.1088/0004-637X/802/1/60.
- [5] Wang, J.; et al. (2008). "A CHANDRA STUDY OF THE ROSETTE STAR-FORMING COMPLEX. I. THE STELLAR POPULATION AND STRUCTURE OF THE YOUNG OPEN CLUSTER NGC 2244". *Astrophysical Journal* **675** (1): 464–490. Bibcode:2008ApJ...675..464W. doi:10.1086/526406.
- [6] Ybarra, J. E.; et al. (2013). "THE PROGRESSION OF STAR FORMATION IN THE ROSETTE MOLECULAR CLOUD". *Astrophysical Journal* **769** (2): 140. Bibcode:2013ApJ...769..140Y. doi:10.1088/0004-637X/769/2/140.
- [7] Townsley, L. K.; et al. (2003). "10 MK Gas in M17 and the Rosette Nebula: X-Ray Flows in Galactic H II Regions". *Astrophysical Journal* **593** (2): 874–905. Bibcode:2003ApJ...593..874T. doi:10.1086/376692.

2.48.4 External links

- Rosette Nebula (SEDS)
- *Chandra Observatory* study of the Rosette Nebula
- *NOAO; "Fitful Young Star Sputters to Maturity in the Rosette Nebula"*
- NightSkyInfo.com – Rosette Nebula
- Astronomy Picture of the Day
 - Dust Sculptures in the Rosette Nebula – 2007 June 6
 - Dust Sculptures in the Rosette Nebula – 2009 December 2
 - Field of Rosette – 2010 February 14
- Slooh Videocast on Rosette Nebula
- Rosette Nebula from the Netherlands
- Deep image of the Rosette Nebula
- The Scale of the Universe (Astronomy Picture of the Day 2012 March 12)
- Rosette Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Rosette Nebula at Constellation Guide

2.49 Caldwell 50

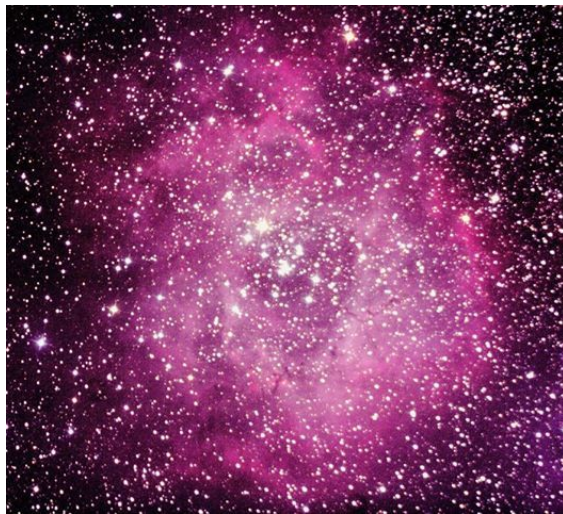
NGC 2244 (also known as **Caldwell 50**) is an open cluster in the Rosette Nebula, which is located in the constellation Monoceros. This cluster has several O-type stars, super hot stars that generate large amounts of radiation and stellar wind.

The age of this cluster has been estimated to be less than 5 million years and its two brightest stars are HD 46223 of spectral class O4V, 400,000 times brighter than the Sun, and approximately 50 times more massive, and HD 46150, whose spectral type is O5V, has a luminosity

450,000 times larger than that of our star, and is up to 60 times more massive, but it may actually be a double star.^[2]

2.49.1 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 2244*. Retrieved 2007-04-20.
- [2] A quantitative study of O stars in NGC 2244 and the Monoceros OB2 association, Martins, F.; Mahy, L.; Hillier, D. J.; Rauw, G., *Astronomy and Astrophysics* **538**, pp. A39, Bibcode: 2012A&A...538A..39M, doi:10.1051/0004-6361/201117458.



/ NGC 2244

2.49.2 External links

- NASA – photo and information on NGC 2244
- Spitzer Space Telescope site – Photo of NGC 2244
- NGC 2244 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.50 Caldwell 51

IC 1613 (also known as **Caldwell 51**) is an irregular dwarf galaxy in the constellation Cetus near the star 26 Ceti.^[4] It was discovered in 1906 by Max Wolf,^[4] and is approaching Earth at 234 km/s.

IC 1613 is a member of our Local Group.^[4] It has played an important role in the calibration of the Cepheid variable period luminosity relation for estimating distances.^[4] Other than the Magellanic Clouds, it is

the only Local Group dwarf irregular galaxy where **RR Lyrae-type variables** have been observed.^[4]

In 1999, Cole et al.^[4] used the Hubble Space Telescope to find that the dominant population of this galaxy has an age of ~7 Gyr. Using its **Hess diagram**, they found that its evolutionary history may be similar to that of the **Pegasus Dwarf Irregular Galaxy**. Both galaxies are classified as Ir V in the DDO system. Also in 1999, Antonello et al. found five cepheids of **Population II** in IC 1613, giving self-evident support for the existence of a very old stellar population component of IC 1613. In 1999, King, Modjaz, & Li discovered the first nova ever detected in IC 1613.^[5]

2.50.1 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for IC 1613*. Retrieved 2006-11-29.
- [2] I. D. Karachentsev, V. E. Karachentseva, W. K. Hutchmeier, D. I. Makarov (2004). “A Catalog of Neighboring Galaxies”. *Astronomical Journal* **127** (4): 2031–2068. Bibcode:2004AJ....127.2031K. doi:10.1086/382905.
- [3] Karachentsev, I. D.; Kashibadze, O. G. (2006). “Masses of the local group and of the M81 group estimated from distortions in the local velocity field”. *Astrophysics* **49** (1): 3–18. Bibcode:2006Ap....49....3K. doi:10.1007/s10511-006-0002-6.
- [4] Cole, Andrew A.; Tolstoy, Eline; Gallagher, John S., III; Hoessel, John G.; Mould, Jeremy R.; Holtzman, Jon A.; Saha, Abhijit; Ballester, Gilda E.; Burrows, Christopher J.; Clarke, John T.; Crisp, David; Griffiths, Richard E.; Grillmair, Carl J.; Hester, Jeff J.; Krist, John E.; Meadows, Vikki; Scowen, Paul A.; Stapelfeldt, Karl R.; Trauger, John T.; Watson, Alan M.; Westphal, James R. (1999). “Stellar Populations at the Center of IC 1613”. *The Astronomical Journal* **118** (4): 1657–1670. arXiv:astro-ph/9905350. Bibcode:1999AJ....118.1657C. doi:10.1086/301042.
- [5] van den Bergh, Sidney (April 2000). “Updated Information on the Local Group”. *The Publications of the Astronomical Society of the Pacific* **112** (770): 529–536. arXiv:astro-ph/0001040. Bibcode:2000PASP..112..529V. doi:10.1086/316548.

2.50.2 External links

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- IC 1613 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  01^h 04^m 47.8^s, +02° 07′ 04″

2.51 Caldwell 52

NGC 4697 (also known as **Caldwell 52**) is an elliptical galaxy some 40 to 50 million light-years away in the constellation Virgo. It is a member of the **NGC 4697 Group**, a group of galaxies also containing **NGC 4731** and several generally much smaller galaxies.^[3] This group is about 55 million light-years away; it is one of the many **Virgo II Groups**, which form a southern extension of the **Virgo Supercluster** of galaxies.^[3]

The distance to NGC 4697 is not known with high precision: measurements vary from 28 to 76 million light-years.^[1] According to the NASA Extra-galactic Database, the average is about 38 million light-years;^[1] according to SIMBAD, about 50 million light-years.^[2]

2.51.1 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 4697*. Retrieved 2010-11-28.
- [2] “SIMBAD Astronomical Database”. *Results for NGC 4697*. Retrieved 2010-11-28.
- [3] “The Virgo II Groups”. *Atlas of the Universe*. Retrieved 2010-11-28.

2.51.2 External links

- NGC 4697 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.52 Caldwell 53

NGC 3115 (also called the **Spindle Galaxy** or **Caldwell 53**) is a field lenticular (S0) galaxy in the constellation Sextans. The galaxy was discovered by William Herschel on February 22, 1787.^{[3][4]} At about 32 million light-years away from us it is several times bigger than our Milky Way. It is a lenticular (S0) galaxy because it contains a disk and a central bulge of stars, but without a detectable spiral pattern. NGC 3115 is seen almost exactly edge-on, but was nevertheless mis-classified as elliptical. There is some speculation that NGC 3115, in its youth, was a quasar.

2.52.1 Star formation

NGC 3115 has consumed most of the gas of its youthful accretion disk. It has very little gas and dust left that would trigger new star formation. The vast majority of its component stars are very old.

2.52.2 Black hole

In 1992 John Kormendy of the University of Hawaii and Douglas Richstone of the University of Michigan announced what was observed to be a supermassive black hole in the galaxy.^[5] Based on orbital velocities of the stars in its core, the central black hole has mass measured to be approximately one billion solar masses (M_{\odot}). The galaxy appears to have mostly old stars and little or no activity. The growth of its black hole has also stopped.

In 2011, NASA’s Chandra X-ray Observatory examined the black hole at the center of the large galaxy. A flow of hot gas toward the supermassive black hole has been imaged, making this the first time clear evidence for such a flow has been observed in any black hole. As gas flows toward the black hole, it becomes hotter and brighter. The researchers found the rise in gas temperature begins at about 700 light years from the black hole, giving the location of the Bondi radius. This suggests that the black hole in the center of NGC 3115 has a mass of about two billion M_{\odot} , supporting previous results from optical observations. This would make NGC 3115 the nearest billion-solar-mass black hole to Earth.

2.52.3 See also

- **NGC 5866** – another lenticular galaxy sometimes referred to as the *Spindle Galaxy*

2.52.4 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 3115*. Retrieved October 12, 2006.
- [2] J. L. Tonry; A. Dressler; J. P. Blakeslee; E. A. Ajhar et al. (2001). “The SBF Survey of Galaxy Distances. IV. SBF Magnitudes, Colors, and Distances”. *Astrophysical Journal* **546** (2): 681–693. arXiv:astro-ph/0011223. Bibcode:2001ApJ...546..681T. doi:10.1086/318301.
- [3] O’Meara, Stephen James (2002). *The Caldwell Objects*. Cambridge: Cambridge University Press. p. 211. ISBN 0-521-82796-5.
- [4] Materne, J. (April 1979). “The structure of nearby groups of galaxies - Quantitative membership probabilities”. *Astronomy and Astrophysics* **74** (2): 235–243. Bibcode:1979A&A....74..235M.
- [5] Kormendy, J. and Richstone, D. “Evidence for a supermassive black hole in NGC 3115”, *Astrophysical Journal*, Part 1, vol. 393, no. 2, July 10, 1992, p. 559-578.

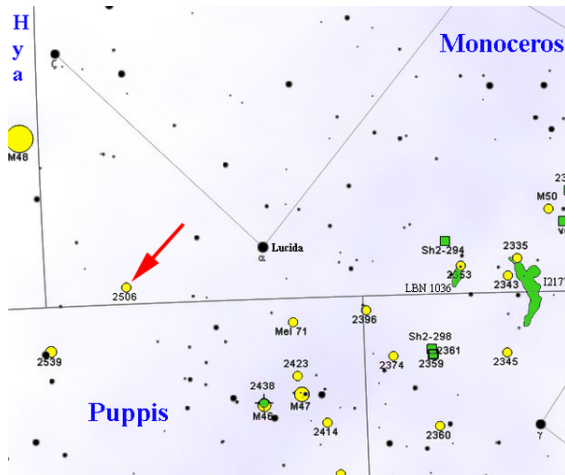
2.52.5 External links

- Chandra Press Release
- SEDS: NGC 3115

-
- NGC 3115 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  $10^{\text{h}} 05^{\text{m}} 14.0^{\text{s}}, -07^{\circ} 43' 07''$

2.53 Caldwell 54



Map showing the location of NGC 2506

NGC 2506 is an open cluster in the constellation Monoceros. It was discovered by William Herschel in 1791.^[4]

2.53.1 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 2506*. Retrieved 2010-11-28.
- [2] "WEBDA Database". *Results for NGC 2506*. Retrieved 2010-11-28.
- [3] "SEDs NGC Catalog Online". *Results for NGC 2506*. Retrieved 2010-11-28.
- [4] Robert E. Erdmann. "NGC Discoverers". *The NGC/IC Project*. Retrieved 2010-11-28.

2.53.2 External links

-
- NGC 2506 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  $00^{\text{h}} 48^{\text{m}} 26^{\text{s}}, +85^{\circ} 15' 18''$

2.54 Caldwell 55

The **Saturn Nebula** or **NGC 7009** is a planetary nebula in the constellation Aquarius. It appears as a greenish-yellowish hue in a small amateur telescope. It was discovered by William Herschel on September 7, 1782, using a telescope of his own design in the garden at his home in Datchet, England, and was one of his earliest discoveries in his sky survey. The nebula was originally a low-mass star that ejected its layers into space, forming the nebula. The central star is now a bright white dwarf star of apparent magnitude 11.5. The Saturn Nebula gets its name from its superficial resemblance to the planet Saturn with its rings nearly edge-on to the observer. It was so named by Lord Rosse in the 1840s, when telescopes had improved to the point that its Saturn-like shape could be discerned. William Henry Smyth said that the Saturn Nebula is one of Struve's nine "Rare Celestial Objects."

The Saturn Nebula is a complex planetary nebula and contains many morphological and kinematic sub-systems in three dimensions. It includes a halo, jet-like streams, multiple shells, ansae ("handles"), and small-scale filaments and knots. The ansae are expanding non-radially from the central star.^[3] Although the ansae are most prominent in the Saturn Nebula, they are also visible in other planetary nebulae, including NGC 3242, NGC 6543 and NGC 2371-2.

The distance of the Saturn Nebula is not known precisely. Sabbadin et al. 2004 estimates the distance to be 5,200 light-years (1.6 kpc). In 1963 O'Dell estimated it to be 3,900 light-years (1.2 kpc), which gives an approximate diameter of 0.5 light years for the object as a whole.

The central star, a very hot bluish dwarf with a temperature of 55,000 K, from which the nebula is believed to originate, has an absolute magnitude of +1.5, which equates to a luminosity of about 20 solar luminosities and a visual magnitude of 11.5. This strong ultraviolet irradiation from the central star creates the characteristic fluorescent green tint of the nebula via the radiation of doubly ionized oxygen. The object overall has a visual magnitude of 8 and a radial velocity of 28 miles per second towards the Earth.

The nebula is 1 degree west of the star Nu Aquarii. The central portion measures $25'' \times 17''$, while the outer shell extends to $41'' \times 35''$. The object is on many "best of" observing lists.^{[4][5][6]}

2.54.1 Notes

- [1] "SIMBAD Astronomical Database". *Results for Saturn Nebula*. Retrieved 2006-12-26.
- [2] "Messier Online Astronomical Database". *Saturn Nebula*. Retrieved 2012-08-28.
- [3] Steffen, W.; Espíndola, M.; Martínez, S.; Koning, N. (October 2009). "The 3D velocity structure of the plan-

etary nebula NGC 7009". *Revista Mexicana de Astronomía y Astrofísica* **45**: 143–54. arXiv:0905.2148. Bibcode:2009RMxAA...45..143S. NGC 7009 is a planetary nebula with several morphological and kinematical sub-systems with multiple shells, a halo, jet-like streams, ansae and small-scale filaments and knots.

[4] SAC 110 best NGC object list

[5] RASC's Finest N.G.C. Objects Objects

[6] The Caldwell Catalog (#55)

2.54.2 References

- Sabbadin, Franco; Turatto, M.; Cappellaro, E.; Benetti, S.; Ragazzoni, R. (March 2004). "The 3-D ionization structure and evolution of NGC 7009 (Saturn Nebula)". *Astronomy and Astrophysics* **416** (3): 955–81. arXiv:astro-ph/0312261. Bibcode:2004A&A...416..955S. doi:10.1051/0004-6361:20031729.

2.54.3 External links

- NASA APOD (1997-12-30) – NGC 7009: The Saturn Nebula
- The Saturn Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  21^h 04^m 10.877^s, −11° 21′ 48.25″

2.55 Caldwell 56

NGC 246, known as the **Skull Nebula**,^[4] is a planetary nebula in the constellation Cetus. The nebula and the stars associated with it are listed in several catalogs, as summarized by the SIMBAD database.^[1] It is roughly 1,600 light-years away.^[6] The nebula's central star is the 12th magnitude^[6] white dwarf HIP 3678.

Among some amateur astronomers, NGC 246 is known as the "Pac-Man Nebula" because of the arrangement of its central stars and the surrounding star field.^[5]

2.55.1 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 246*. Retrieved 2006-12-22.
- [2] "SEDs NGC Catalog Online". *Results for NGC 246*. Retrieved 2010-11-29.
- [3] "NGC 246". *Astronomy: Stars & Planets*. Retrieved 2013-01-07.

[4] "The Night Sky", *Astronomy Now*, Oct 2008.

[5] David H. Levy, *Deep Sky Objects*, Prometheus Books, 2005, ISBN 1-59102-361-0, p 129.

[6] Stephen James O'Meara, *The Caldwell Objects*, Sky Publishing Corporation, ISBN 0-933346-97-2, p 223.

2.55.2 External links

- NGC 246 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC 246 acquired using the Schulman 0.8m Telescope atop Mount Lemmon, AZ. This is a full color (visual) image.

2.56 Caldwell 57

NGC 6822 (also known as **Barnard's Galaxy**, **IC 4895**, or **Caldwell 57**) is a barred irregular galaxy approximately 1.6 million light-years away in the constellation Sagittarius. Part of the Local Group of galaxies, it was discovered by E. E. Barnard in 1884 (hence its name), with a six-inch refractor telescope. It is one of the closer galaxies to the Milky Way. It is similar in structure and composition to the Small Magellanic Cloud. It is about 7,000 light-years in diameter.^[5]

2.56.1 Observational history

Edwin Hubble wrote the seminal paper *N.G.C. 6822, A Remote Stellar System* (Hubble 1925) wherein he identified 15 variable stars (11 of which were Cepheids). He also surveyed the galaxy's stars distribution down to magnitude 19.4. He provided spectral characteristics, luminosities and dimensions for the five brightest "diffuse nebulae" (giant H II regions) that included the Bubble Nebula and the Ring Nebula. He also computed the absolute magnitude of the entire galaxy.

Hubble's detection of eleven Cepheid variable stars was a milestone in astronomy. Utilizing the Cepheid Period-Luminosity relationship, Hubble determined a distance of more than 700,000 light-years. This was the first system beyond the Magellanic Clouds to have its distance accurately determined. (Hubble continued this process with the Andromeda Galaxy and the Triangulum Galaxy). His distance to the galaxy was way beyond Harlow Shapley's value of 300,000 light-years for the size of universe. In this paper, Hubble concluded the "Great Debate" of 1920 between Heber Curtis and Shapley over the scale of the universe and the nature of the "spiral nebula". It soon became evident that all spiral nebulae were in fact spiral galaxies far outside our own Milky Way.

In 1977, **Paul W. Hodge** extended the list of known H II regions in Barnard to 16. Today, there are over 150 of these regions cataloged in Barnard's Galaxy.

2.56.2 Gallery

- NGC 6822 in ultraviolet by **GALEX**.
- “Star-Forming Region” in NGC 6822.
- “A Giant Star Factory” in NGC 6822.
- NGC 6822 from ESO's Wide Field Imager.

2.56.3 See also

- Bubble Nebula (NGC 6822)
- Ring Nebula (NGC 6822)
- Large Magellanic Cloud - another irregular galaxy within the Local Group
- Small Magellanic Cloud - another irregular galaxy within the Local Group

2.56.4 Notes

- [1] “NASA/IPAC Extragalactic Database”, *Results for NGC 6822*, retrieved 2007-03-15
- [2] Karachentsev et al. 2004
- [3] Karachentsev & Kashibadze 2006
- [4] Cannon et al. 2006
- [5] NGC 6822: Barnard's Galaxy APOD , NASA , 8 February 2013

2.56.5 References

- Cannon, John M.; Walter, Fabian; Armus, Lee; Bendo, George J.; Calzetti, Daniela; Draine, Bruce T.; Engelbracht, Charles W.; Helou, George; et al. (December 2006), “The Nature of Infrared Emission in the Local Group Dwarf Galaxy NGC 6822 as Revealed by Spitzer”, *The Astrophysical Journal* **652** (2): 1170–1187, arXiv:astro-ph/0608249, Bibcode:2006ApJ...652.1170C, doi:10.1086/508341
- Hubble, Edwin P. (December 1925), “NGC 6822, a remote stellar system”, *Astrophysics Journal* **62**: 409–433, Bibcode:1925ApJ....62..409H, doi:10.1086/142943

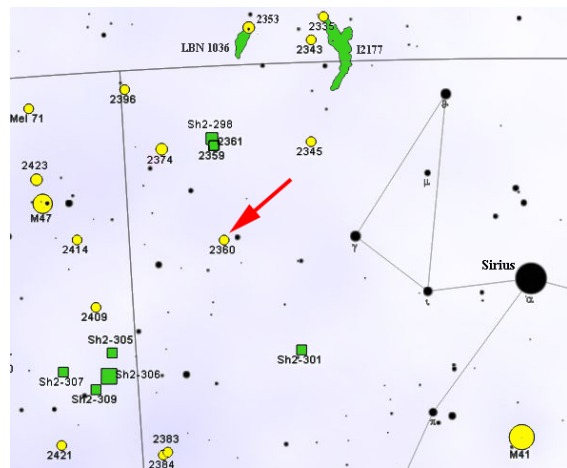
- Karachentsev, I. D.; Karachentseva, V. E.; Hutchmeier, W. K.; Makarov, D. I. (April 2004), “A Catalog of Neighboring Galaxies”, *Astronomical Journal* **127** (4): 2031–2068, Bibcode:2004AJ....127.2031K, doi:10.1086/382905
- Karachentsev, I. D.; Kashibadze, O. G. (January 2006), “Masses of the local group and of the M81 group estimated from distortions in the local velocity field”, *Astrophysics* **49** (1): 3–18, Bibcode:2006Ap....49....3K, doi:10.1007/s10511-006-0002-6

2.56.6 External links

- The Milky Way's Tiny but Tough Galactic Neighbour — ESO Press Release
- NGC 6822: Barnard's Galaxy
- NGC 6822 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  19^h 44^m 56.6^s, −14° 47′ 21″

2.57 Caldwell 58



Map showing the location of NGC 2360

NGC 2360, also known as **Caroline's Cluster**,^[3] is an open cluster in the constellation Canis Major. It was discovered on 26 February 1783,^[4] by Caroline Herschel who wrote, “A beautiful cluster of pretty compressed stars near 1/2 degree in diameter.”^[5] Her notes were overlooked until her brother William included the cluster in his 1786 catalogue of 1000 clusters and nebulae and acknowledged her as the discoverer.^[4] The cluster lies 3.5

degrees east of **Gamma Canis Majoris** and less than one degree northwest of the eclipsing binary star **R Canis Majoris**; it has a combined apparent magnitude of 7.2.^[5] It is 13 arc minutes in diameter.^[2] By the western edge of the cluster is the unrelated star, 5.5-magnitude **HD 56405**.^[6]


American astronomer Olin J. Eggen surveyed the cluster in 1968, concluding that the brightest star in the field, magnitude-8.96 **HD 56847**, is likely to lie in the field and not a true member of the cluster. He also identified one or possibly two **blue stragglers**.^[7] These are unexpectedly hot and luminous stars that appear younger than surrounding stars, and have likely developed by sucking matter off companion stars.^[8] Four are now recognised to be in the cluster.^[9] By analysing the masses of the smallest stars that have evolved into **red giants**—namely, stars of 1.8 or 1.9 solar masses—Swiss astronomers Jean-Claude Mermilliod and Michel Mayor were able to date the age of the cluster at 2.2 billion years.^[10] The cluster has a diameter of around 15 light-years and is located 3700 light-years from Earth.^[5]

2.57.1 Notes

- [1] “NGC/IC Project Database”. *Results for NGC 2360*. Retrieved 2010-12-03.
- [2] “SEDs Online NGC Database”. *Results for NGC 2360*. Retrieved 2010-12-03.
- [3] “SIMBAD Astronomical Database”. *Results for NGC 2360*. Retrieved 2010-12-03.
- [4] Hoskin, Michael (2005). “Caroline Herschel as observer” (PDF). *Journal for the History of Astronomy* **36** (4): 373–406. Bibcode:2005JHA....36..373H.
- [5] O'Meara, Stephen James (2002). *The Caldwell Objects*. Cambridge University Press. pp. 231–33. ISBN 978-0-521-82796-6.
- [6] Streicher, Magda (April 2006). “Caroline Herschel's Deepsky Discoveries” (PDF). *Deepsky Delights*. The Astronomical Society of Southern Africa. pp. 234–36. Retrieved 16 March 2014.
- [7] Eggen, Olin J. “The Intermediate-Age Cluster NGC 2360” (PDF). *The Astrophysical Journal* **152**: 83–87. Bibcode:1968ApJ...152...83E. doi:10.1086/149526.
- [8] Fellman, Megan (17 October 2011). “Astronomers Explain 'Blue Stragglers'”. *News*. Evanston, Illinois: Northwestern University. Retrieved 18 March 2014.
- [9] Ahumada, J. A.; Lapasset, E. (2007). “New catalogue of blue stragglers in open clusters”. *Astronomy and Astrophysics* **463** (2): 789–97. Bibcode:2007A&A...463..789A. doi:10.1051/0004-6361:20054590.
- [10] Mermilliod, Jean-Claude; Mayor, Michel (1990). “Red Giants in Open Clusters. III - Binarity and Stellar Evolution in Five Intermediate-age Clusters: NGC 2360, 2423, 5822, 6811, and IC 4756” (PDF). *Astronomy and Astrophysics* **273** (1): 61–72. Bibcode:1990A&A...237...61M.

2.57.2 External links

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- NGC 2360 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  07^h 17^m 42^s, −15° 38′ 00″

2.58 Caldwell 59

NGC 3242, commonly known as the **Ghost of Jupiter**, is a **planetary nebula** located in the constellation **Hydra**.

William Herschel discovered the nebula on February 7, 1785, and cataloged it as H IV.27. **John Herschel** observed it from the **Cape of Good Hope**, South Africa, in the 1830s, and numbered it as h 3248, and included it in the 1864 General Catalogue as GC 2102; this became NGC 3242 in J. L. E. Dreyer's *New General Catalogue* of 1888.

This planetary nebula is most frequently called the *Ghost of Jupiter*, or *Jupiter's Ghost* due to its similar size to the planet, but it is also sometimes referred to as the *Eye Nebula*.^[3] The nebula measures around two light years long from end to end, and contains a central white dwarf with an apparent magnitude of eleven. The inner layers of the nebula were formed some 1,500 years ago.^[4] The two ends of the nebula are marked by **FLIERs**, lobes of fast moving gas often tinted red in false-color pictures.^[5] NGC 3242 can easily be observed with amateur telescopes, and appears bluish-green to most observers. Larger telescopes can distinguish the outer halo as well.^[6]

2.58.1 Gallery

- Imaged with a 10" Schmidt-Cassegrain telescope
- A different Hubble image of the core region
- Ultraviolet image from NASA's **Galaxy Evolution Explorer**
- NGC 3242, 32 inch Schulman telescope on Mt. Lemmon, AZ

2.58.2 See also

- List of NGC objects
- Planetary nebulae

2.58.3 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 3242*. Retrieved 2007-04-20.
- [2] “NGC 3242: The ‘Ghost of Jupiter’ Planetary Nebula”. *NASA Astro Pic of the Day*. Retrieved 2010-12-03.
- [3] Frommert, Hartmut. “NGC 3242”. SEDS. Retrieved 22 June 2014.
- [4] Mobberley, Martin (2009). *The Caldwell Objects and How to Observe Them*. New York: Springer Science+Business Media, LLC. p. 128.
- [5] “NGC 3242, Ghost of Jupiter”. ESA. Retrieved 22 June 2014.
- [6] “The Ghost of Jupiter”. Retrieved 2010-02-25.

2.58.4 External links

- The Hubble European Space Agency Information Centre – Hubble picture and information on NGC 3242
-
- NGC 3242 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC3242 on astro-pics.com
- FLIERs in NGC 3242

2.59 Caldwell 60 & 61

The **Antennae Galaxies**, also known as **NGC 4038/NGC 4039**, are a pair of interacting galaxies in the constellation **Corvus**. They are currently going through a **starburst** phase, in which the collision of clouds of gas and dust, with entangled magnetic fields, causes rapid star formation. They were discovered by **William Herschel** in 1785.^[3] NGC 4038 is located at RA 12^h 01^m 53.0^s, Dec −18° 52′ 10″; and NGC 4039 at RA 12^h 01^m 53.6^s, Dec −18° 53′ 11″.

2.59.1 General information

The Antennae Galaxies are undergoing a galactic collision. Located in the NGC 4038 group with five other galaxies, these two galaxies are known as the Antennae Galaxies because the two long tails of stars, gas and dust ejected from the galaxies as a result of the collision resemble an insect’s antennae. The nuclei of the two galaxies are joining to become one giant galaxy. Most galaxies probably undergo at least one significant collision in their lifetimes. This is likely the future of our Milky Way when it collides with the Andromeda Galaxy.



Ground-based telescopic view of the Antennae galaxies.

Five supernovae have been discovered in NGC 4038: SN 1921A, SN 1974E, SN 2004GT, SN 2007sr and SN 2013dk.^[4]

A recent study finds that these interacting galaxies are less remote from the Milky Way than previously thought—at 45 million light-years instead of 65 million light-years.^[5]

They are located 0.25° north of 31 Crateris and 3.25° southwest of Gamma Corvi.^[6]

2.59.2 Timeline

About 1.2 billion years ago, the Antennae were two separate galaxies. NGC 4038 was a **barred spiral galaxy** and NGC 4039 was a **spiral galaxy**. Before the galaxies collided, NGC 4039 was larger than NGC 4038. 900 million years ago, the Antennae began to approach one another, looking similar to NGC 2207 and IC 2163. 600 million years ago, the Antennae passed through each other, looking like the **Mice Galaxies**. 300 million years ago, the Antennae’s stars began to be released from both galaxies. Today the two streamers of ejected stars extend far beyond the original galaxies, resulting in the antennae shape.

Within 400 million years, the Antennae’s nuclei will collide and become a single core with stars, gas, and dust around it. Observations and simulations of colliding galaxies suggest that the Antennae Galaxies will eventually form an elliptical galaxy.^[7]

2.59.3 X-ray source

Areas containing large amounts of neon, magnesium, and silicon were found when the **Chandra X-ray Observatory** analyzed the Antennae Galaxies. These elements are necessary in order for planets that may contain life to form. The clouds imaged contain 16 times as much magnesium and 24 times as much silicon as the Sun.

2.59.4 Gallery

- ESO's **VLT** observes the Antennae Galaxies.
- Antennae Galaxies composite of **ALMA** and Hubble observations

2.59.5 See also

- Whirlpool Galaxy

2.59.6 References

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2.59.7 External links

- Astronomy Picture of the Day: The Antennae Galaxies (10/22/1997)
- Astronomy Picture of the Day: The Antennae (04/29/2011)
- Astronomy Picture of the Day: The Antennae (02/12/2015)

- **The Register:** Galactic prang fingered in star formation mystery

- ESA/Hubble News Release

- ESA/Hubble images of Antennae Galaxies

- Animations of galactic collision producing antennae structures

-

- Antennae Galaxies on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

- Antennae Galaxies at Constellation Guide

Coordinates:  12^h 01^m 53^s, −18° 52′ 10″

2.60 Caldwell 62

NGC 247 is an intermediate spiral galaxy (although it is sometimes classified as a dwarf spiral galaxy) about 11.1 Mly away in the constellation Cetus. This distance was confirmed in late February 2011. Previous measurements showed that the galaxy was about 12.2 Mly away, but this was proved to be wrong.^[2] NGC 247 is a member of the Sculptor Group.

NGC 247 is marred by an unusually large void on one side of its spiral disk. This void contains some older, redder stars but no younger, bluer stars.^[3]

2.60.1 Nearby galaxies and galaxy group information

NGC 247 is one of several galaxies that is gravitationally bound to the Sculptor Galaxy (NGC 253). These galaxies form a small core in the center of the Sculptor Group, which is one of the nearest groups of galaxies to the Milky Way.^[4] Most other galaxies associated with the Sculptor Group are only weakly gravitationally bound to this core.^{[4][5]}

2.60.2 References

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2.60.3 External links

- NGC 247 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 47^m 08.5^s, −20° 45′ 37″

2.61 Caldwell 63

For the different but similarly named nebula, see Double Helix Nebula.

“Eye of God” redirects here. For other uses, see Eye of God (disambiguation).

The **Helix Nebula**, also known as **The Helix**, **NGC 7293**, is a large planetary nebula (PN) located in the constellation Aquarius. Discovered by Karl Ludwig Harding, probably before 1824, this object is one of the closest to the Earth of all the bright planetary nebulae.^[5] The estimated distance is about 215 parsecs (700 light-years). It is similar in appearance to the Cat’s Eye Nebula and the Ring Nebula, whose size, age, and physical characteristics are similar to the Dumbbell Nebula, varying only in its relative proximity and the appearance from the equatorial viewing angle.^[6] The Helix Nebula has sometimes been referred to as the “Eye of God” in pop culture,^[7] as well as the “Eye of Sauron”.^{[8][9]}

2.61.1 General information

The Helix Nebula is an example of a **planetary nebula**, or 'planetary' formed at the end of a star’s evolution. Gases from the star in the surrounding space appear, from our vantage point, as if we are looking down a helix structure. The remnant central stellar core, known as a planetary nebula nucleus or PNN, is destined to become a white dwarf star. The observed glow of the central star is so energetic that it causes the previously expelled gases to brightly fluoresce.

The Helix Nebula in the constellation of Aquarius lies about 700 light-years away, spanning about 0.8 parsecs

(2.5 light-years). Recent images by the **Hubble Space Telescope** of the Helix Nebula are a composite of newly released images from the **ACS** instrument and the wide-angle images from the Mosaic Camera on the **WIYN** 0.9-metre telescope at **Kitt Peak National Observatory**.

Currently, the age is estimated to be 10600+2300 –1200 years, based solely upon a measured expansion rate of 31 km·s^{−1}.^[6]

2.61.2 Structure



NGC 7293 in infrared by HST

The Helix Nebula is thought to be shaped like a prolate spheroid with strong density concentrations toward the filled disk along the equatorial plane, whose major axis is inclined about 21° to 37° from our vantage point. The size of the inner disk is 8×19 arcmin in diameter (0.52 pc); the outer torus is 12×22 arcmin in diameter (0.77 pc); and the outer-most ring is about 25 arcmin in diameter (1.76 pc). We see the outer-most ring as flattened on one side due to its colliding with the ambient interstellar medium.

Expansion of the whole planetary nebula structure is estimated to have occurred in the last 6,560 years, and 12,100 years for the inner disk. Spectroscopically, the outer ring’s expansion rate is 40 km·s^{−1}, and about 32 km·s^{−1} for the inner disk.

Knots

The Helix Nebula was the first planetary nebula discovered to contain cometary knots.^[10] Its main ring contains knots of nebulosity, which have now been detected in many nearby planetaries. These knots are highly radially symmetric (from the PNN) and are described as “cometary”, each containing bright cusps (lo-



Closer view of knots in Helix

cal photoionization fronts) and tails. All extend away from the PNN in a radial direction. Excluding the tails, they are (very approximately) the size of the Solar system, while each of the cusp knots are optically thick due to *Lyc photons* from the PNN.^{[4][6][11]} There are more than 20,000 cometary knots estimated to be in the Helix Nebula.^[12]

The excitation temperature varies across the Helix nebula.^[12] The rotational-vibrational temperature ranges from 1800 K in a cometary knot located in the inner region of the nebula are about 2.5' (arcmin) from the central PNN, calculated at about 900 K in the outer region at the distance of 5.6'.^[12]

2.61.3 Visuals

- NGC7293 (2004)
 - Infrared image of the Helix Nebula, taken by the Spitzer space telescope, 2007^[1] Credit: NASA, JPL, and K. Su (University of Arizona)
 - Helix Nebula by 2.2-metre Max-Planck Society/ESO telescope at the La Silla observatory in Chile
1. ^ Su, K. Y. L.; Chu, Y.-H.; Rieke, G. H.; Huggins, P. J.; et al. (March 2007). "A Debris Disk around the Central Star of the Helix Nebula?". *The Astrophysical Journal* **657** (2): L41–L45. arXiv:astro-ph/0702296. Bibcode:2007ApJ...657L..41S. doi:10.1086/513018.

2.61.4 Videos



This zoom sequence starts with a wide-field view of the rather empty region of sky around the constellation of Aquarius.



This video compares a new view of the Helix Nebula acquired with the VISTA telescope in infrared light with the more familiar view in visible light from the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory.

2.61.5 See also

- New General Catalogue (NGC)

2.61.6 References

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2.61.7 External links

- NASA APOD – December 31, 2009 - The Helix Nebula (NGC 7293)
- NASA APOD – May 10, 2003 - The Helix Nebula (NGC 7293)
- NASA/JPL-Caltech - The Helix Nebula (NGC 7293)
- SEDS - The Helix Nebula (NGC 7293)
- NightSkyInfo – The Helix Nebula (NGC 7293)
- Snopes - Helix Eye of God - Urban Legend
-
- The Helix Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  22^h 29^m 38.55^s, −20° 50′ 13.6″

- Helix Nebula (NGC 7293) at Constellation Guide

2.62 Caldwell 64

NGC 2362 is an open cluster in the constellation Canis Major. It was discovered by Giovanni Batista Hodierna before 1654. Its brightest star is Tau Canis Majoris, and therefore it is sometimes called the **Tau Canis Majoris Cluster**. NGC 2362 has a distance of 1.48 kpc and is a relatively young 4–5 million years in age. It is a massive open cluster, with more than 500 solar masses.^[4] The cluster is in relation with the giant nebula Sh2-310, that lies at the same distance.^[5]

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2.62.2 External links

-
- NGC 2362 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  07^h 18.8^m 00^s, −24° 57′ 00″

2.63 Caldwell 65

The **Sculptor Galaxy**, also known as the **Silver Coin** or **Silver Dollar Galaxy**, **NGC 253**, is an intermediate spiral galaxy in the constellation Sculptor. The Sculptor Galaxy is a starburst galaxy, which means that it is currently undergoing a period of intense star formation.

2.63.1 Observation

Observational history

The galaxy was discovered by **Caroline Herschel** in 1783 during one of her systematic comet searches.^{[4][5]} About half a century later, **John Herschel** observed it using his 18-inch metallic mirror reflector at the **Cape of Good Hope**.^[5] He wrote, “*very bright and large (24' in length); a superb object.... Its light is somewhat streaky, but I see no stars in it except 4 large and one very small one, and these seem not to belong to it, there being many near...*”^[5]

In 1961 **Allan Sandage** wrote in the *Hubble Atlas of Galaxies* that the Sculptor Galaxy is “*the prototype example of a special subgroup of Sc systems....photographic images of galaxies of the group are dominated by the dust pattern. Dust lanes and patches of great complexity are scattered throughout the surface. Spiral arms are often difficult to trace.... The arms are defined as much by the dust as by the spiral pattern.*”^[6] **Bernard Y. Mills**, working out of **Sydney**, discovered that the Sculptor Galaxy is also a fairly strong radio source.^[5]

In 1998 the **Hubble Space Telescope** took a detailed image of NGC 253.^[7]

Amateur observation

As one of the brightest galaxies in the sky, the Sculptor Galaxy can be seen through **binoculars** and is near the star **Beta Ceti**. It is considered one of the most easily viewed galaxies in the sky after the **Andromeda Galaxy**.^{[5][8]}

The Sculptor Galaxy is a good target for observation with a telescope with a 300 mm diameter or larger.^[8] In such telescopes, it appears as a galaxy with a long, oval bulge and a mottled disc.^[8] Although the bulge appears only slightly brighter than the rest of the galaxy, it is fairly extended compared to the disk.^[8] In 400 mm scopes and larger, a dark dust lane northwest of the nucleus is visible, and over a dozen faint stars can be seen superimposed on the bulge.^[8]

2.63.2 Features

The Sculptor Galaxy is located at the center of the **Sculptor Group**, one of the nearest groups of galaxies to the **Milky Way**.^[9] The Sculptor Galaxy (the brightest galaxy in the group and one of the intrinsically brightest galaxies in the vicinity of ours, only surpassed by the **Andromeda Galaxy** and the **Sombrero Galaxy**^[10]) and the companion galaxies **NGC 247**, **PGC 2881**, **PGC 2933**, **Sculptor-dE1**, and **UGCA 15** form a gravitationally-bound core near the center of the group. Most other galaxies associated with the Sculptor Group are only weakly gravitationally bound to this core.^{[9][11]}

Starburst

NGC 253's most notable feature is the earlier-mentioned starburst which is taking place within it, and which has created several **super star clusters** on NGC 253's center (discovered with the aid of the **Hubble Space Telescope**): one with a mass of 1.5×10^6 solar masses, and **absolute magnitude** of at least -15 , and two others with 5×10^4 solar masses and absolute magnitudes around -11 .^[12] later studies have discovered an even more massive cluster heavily obscured by NGC 253's **interstellar dust** with a mass of 1.4×10^7 solar masses, an age of around 5.7×10^6 years, and rich in **Wolf-Rayet stars**.^[13]

Star formation is also high in the northeast of NGC 253's disk, where a number of **red supergiant stars** can be found, and in its halo there are young stars as well as some amounts of **neutral hydrogen**. This, along with other peculiarities found in NGC 253, suggest that a gas-rich **dwarf galaxy** collided with it 200 million years ago, disturbing its disk and starting the present starburst.^[14]

As happens in other galaxies suffering strong star formation such as **Messier 82**, **NGC 4631**, or **NGC 4666**, the **stellar winds** of the massive stars produced in the starburst as well as their deaths as **supernovae** have blown out material to NGC 253's halo, in the form of a **superwind** that seems to be inhibiting star formation in the galaxy.^[15]

Although **supernovae** are generally associated with starburst galaxies, only one supernova has been detected within the Sculptor Galaxy.^[1] The supernova, named **SN 1940E**, is located approximately 54" southwest of the galaxy's nucleus.^[16] It was discovered in November 1940.^[16]

Central black hole

Recent research suggests the presence in the center of this galaxy of a **supermassive black hole**, with a mass estimated to be 5 million times that of our Sun^[17]

Recent distance estimates

At least two techniques have been used to measure distances to Sculptor in the past ten years.

Using the **planetary nebula luminosity function** method, an estimate of 10.89 ± 0.85 -1.24 Mly* (3.34 ± 0.26 -0.38 Mpc*) was achieved in 2006.^[2]

Sculptor is close enough that the **tip of the red giant branch** (TRGB) method may also be used to estimate its distance. The estimated distance to Sculptor using this technique in 2004 yielded 12.8 ± 1.2 Mly (3.94 ± 0.37 Mpc).^{[18][19]}

A weighted average of the most reliable distance estimates gives a distance of 11.4 ± 0.7 Mly (3.5 ± 0.2

Mpc).^[2]

2.63.3 Gallery

- Three-dimensional view of **ALMA** observations of the outflows.^[1]
 - NGC 253. (Courtesy Hunter Wilson)
 - NGC253 from 24 inch telescope on Mt. Lemmon, AZ.
 - Spiral Galaxy NGC 253. (Credit: ESO)
 - Detail of NGC 253 by Hubble Space Telescope. (Credit: HST/NASA/ESA)
 - Image taken by Prompt 2 telescope.
1. ^ “Starburst to Star Bust”. *ESO Press Release*. Retrieved 15 August 2013.

2.63.4 See also

- Globular cluster **NGC 288**, located 1°.8 south-southeast of the Sculptor Galaxy.
- **2MASX J00482185-2507365** occulting pair, discovered while photographing NGC 253

2.63.5 References

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2.63.6 External links

- STScI news release: Hubble Probes the Violent Birth of Stars in Galaxy NGC 253
- STScI news release: Behind a Dusty Veil Lies a Cradle of Star Birth
- Sculptor Galaxy on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 47^m 33^s, −25° 17′ 18″

2.64 Caldwell 66



The core of NGC 5694 imaged by the Hubble Space Telescope

NGC 5694 is a globular cluster in the constellation Hydra. It was discovered in 1784 by William Herschel.

2.64.1 Characteristics

This globular cluster is located at a distance of 105,000 light-years (32,000 pc) from the Sun and 96,000 light-years (29,000 pc) from the Galactic center^[4] and is one of the oldest known globular clusters in the Milky Way Galaxy, forming nearly 12 billion years ago.^[5]

2.64.2 References

- [1] “SEDS NGC Catalog Online”. *Results for NGC 5694*. Retrieved 2010-12-07.
- [2] “SIMBAD Astronomical Database”. *Results for NGC 5694*. Retrieved 2010-12-07.

- [3] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.

- [4] Harris, W.E. (1996). “A Catalog of Parameters for Globular Clusters in the Milky Way”. *AJ* **112**: 1487. Bibcode:1996AJ....112.1487H. doi:10.1086/118116.

- [5] “NGC/IC Project”. *Results for NGC 5694*. Retrieved 2010-12-07.

2.64.3 External links

-
- NGC 5694 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  14^h 39^m 36.5^s, −26° 32′ 18.0″

2.65 Caldwell 67

NGC 1097 is a barred spiral galaxy about 45 million light-travel years away in the constellation Fornax. It was discovered by William Herschel on 9 October 1790. It is a severely interacting galaxy with obvious tidal debris and distortions caused by interaction with the companion galaxy NGC 1097A.^[3] Three supernovae (SN 1992bd, SN 1999eu, and SN 2003B) have been observed in NGC 1097 since 1992.^[4]

2.65.1 General information

NGC 1097 is also a Seyfert galaxy. Deep photographs revealed four narrow optical jets that appear to emanate from the nucleus. These have been interpreted as manifestations of the (currently weak) active nucleus. Subsequent analysis of the brightest jet’s radio-to-X-ray spectral energy distribution were able to rule out synchrotron and thermal free-free emission. The optical jets are in fact composed of stars. The failure to detect atomic hydrogen gas in the jets (under the assumption that they were an example of tidal tails) using deep 21 cm HI imaging with the Very Large Array radio telescope and numerical simulations led to the current interpretation that the jets are actually the shattered remains of a cannibalized dwarf galaxy.

NGC 1097 has a supermassive black hole at its center, which is 140 million times the mass of the Sun.^{[5][6]} Around the central black hole is a glowing ring of star-forming regions with a network of gas and dust that spirals from the ring to the black hole. An inflow of material

toward the central bar of the galaxy causes new stars to be created in the ring. The ring is approximately 5,000 light-years in diameter, the spiral arms of the galaxy extend tens of thousands of light-years beyond the ring.^[5]

NGC 1097 has two **satellite galaxies**, NGC 1097A and NGC 1097B. Dwarf elliptical galaxy NGC 1097A is the larger of the two. It is a peculiar **elliptical galaxy** that orbits 42,000 light-years from the center of NGC 1097. Dwarf galaxy NGC 1097B (5×10^6 solar masses), the outermost one, was discovered by its HI emission, and appears to be a typical dwarf irregular. Little else is known about it.

2.65.2 Gallery

- Star forming ring in NGC 1097. HST. 0.9' view
- Colour-composite image of the central 5,500 light-years wide region of the spiral galaxy NGC 1097, obtained with the NACO adaptive optics on the VLT. Credit: ESO
- False-colour image of NGC 1097 in infrared, from the Spitzer Space Telescope

2.65.3 See also

- NGC 1300, a spiral galaxy
- NGC 1232, a spiral galaxy

2.65.4 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 1097*. Retrieved 2006-11-25.
- [2] “Feeding the Monster: New VLT Images Reveal the Surroundings of a Super-massive Black Hole”. European Southern Observatory. Retrieved 2008-03-15.
- [3] Buta, Ronald J; Corwin, Harold G; Odewahn, Stephen C (2007). *The de Vaucouleurs Atlas of Galaxies*. Cambridge University Press. p. 193. ISBN 9780521820486. Retrieved 21 June 2015.
- [4] Harrington, Philip S. (2010). *Cosmic Challenge: The Ultimate Observing List for Amateurs*. Cambridge, United Kingdom: Cambridge University Press. p. 351. ISBN 9781139493680.
- [5] “Astronomers Measure Mass of Supermassive Black Hole in NGC 1097 | Astronomy | Sci-News.com”. *www.sci-news.com*. Retrieved 2015-06-20.
- [6] Onishi, K.; Iguchi, S.; Sheth, K.; Kohno, K. (2015-06-10). “A Measurement of the Black Hole Mass in NGC 1097 Using ALMA”. *The Astrophysical Journal* **806** (1): 39. doi:10.1088/0004-637X/806/1/39. ISSN 0004-637X.

2.65.5 External links

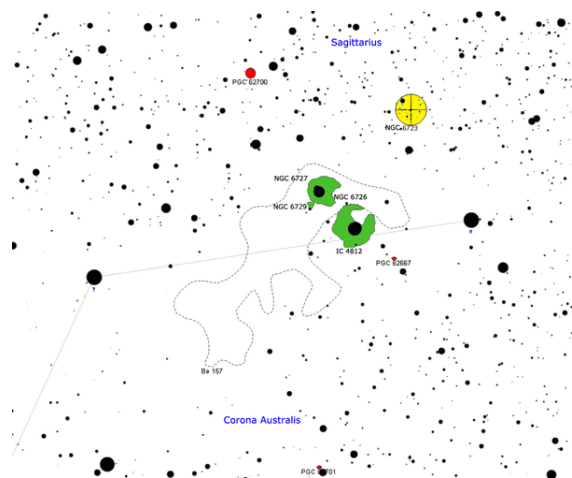
- **VLT observations** – NGC 1097’s “dog-leg” tidal stream
- **weblore.com** – NGC 1097: The Galaxy with the Longest known Optical Jets
- **Antilhue-Chile** – NGC 1097 in Fornax
- **ESO** – Very Large Telescope observations of NGC 1097
- **Astronomy Picture of the Day** – In the Arms of NGC 1097 (2006-12-01)
- **The dance of stars and space**, 29 December 2012, Thomas Anderson, *TG Daily*
-
- NGC 1097 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  02^h 46^m 19.0^s, −30° 16′ 30″

2.66 Caldwell 68

NGC 6729 is a **reflection/emission nebula** in the constellation Corona Australis. It was discovered by Johann Friedrich Julius Schmidt in 1861.^[1]

This fan-shaped nebula opens from the star R Coronae Australis toward the star T CrA to the south-east. R CrA is a pre-main-sequence star in the Corona Australis molecular complex, one of the closer star-forming regions of the galaxy.^[1]




Map showing location of NGC 6729 (Roberto Mura)

2.66.1 References

- [1] “NGC/IC Project Database”. *Results for NGC 6729*. Retrieved 2010-12-09.
- [2] “NASA/IPAC Extragalactic Database”. *Results for NGC 6729*. Retrieved 2010-12-09.

2.66.2 External links

-
- NGC 6729 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  19^h 01^m 54^s, −36° 57′ 12″

2.67 Caldwell 69

For other uses of “Butterfly Nebula”, see [Butterfly Nebula \(disambiguation\)](#).

NGC 6302, also called the **Bug Nebula**, **Butterfly Nebula**, is a bipolar planetary nebula in the constellation *Scorpius*. The structure in the nebula is among the most complex ever observed in planetary nebulae. The spectrum of NGC 6302 shows that its central star is one of the hottest stars in the galaxy, with a surface temperature in excess of 200,000 K, implying that the star from which it formed must have been very large (*cf.* PG 1159 star).

The central star, a white dwarf, was only recently discovered (Szyszka et al. 2009), using the upgraded Wide Field Camera 3 on board the Hubble Space Telescope. The star has a current mass of around 0.64 solar masses. It is surrounded by a particularly dense equatorial disc composed of gas and dust. This dense disc is postulated to have caused the star’s outflows to form a bipolar structure (Gurzadyan 1997) similar to an hour-glass. This bipolar structure shows many interesting features seen in planetary nebulae such as ionization walls, knots and sharp edges to the lobes.

2.67.1 Observation history

As it is included in the *New General Catalogue*, this object has been known since at least 1888.^[7] The earliest known study of NGC 6302 is by Edward Emerson Barnard, who drew and described it in 1907 (Meaburn et al. 2005).

Since then it has been the focus of many works and displays many interesting characteristics worthy of study. Interest in recent years has shifted from discussions over the excitation method in the nebula (shock-excitation or

photo-ionisation) to the properties of the large dust component.

It featured in some of the first images released after the final servicing mission of the Hubble Space Telescope in September 2009.^[8]

2.67.2 Characteristics

NGC 6302 has a complex structure, which may be approximated as bipolar with two primary lobes, though there is evidence for a second pair of lobes that may have belonged to a previous phase of mass loss. A dark lane runs through the waist of the nebula obscuring the central star at all wavelengths (Matsuura et al. 2005). Observations of NGC 6302 suggest that there may be an orthogonal skirt (or *chakram*) similar to that found in *Menzel 3* (Meaburn et al. 2005). The nebula is orientated at an angle of 12.8° against the plane of the sky.

This planetary nebula contains a prominent northwest lobe which extends up to 3′.0 away from the central star and is estimated to have formed from an eruptive event around 1,900 years ago. It has a circular part whose walls precisely follow a Hubble-type outflow (where outflow speed is proportional to distance from the central source). At an angular distance of 1′.71 from the central star, the flow velocity of this lobe is measured to be 263 km/s. At the extreme periphery of the lobe, the outward velocity exceeds 600 km/s. The western edge of the lobe displays characteristics suggestive of a collision with pre-existing globules of gas which modified the outflow in that region (Meaburn et al. 2005).

2.67.3 Central star

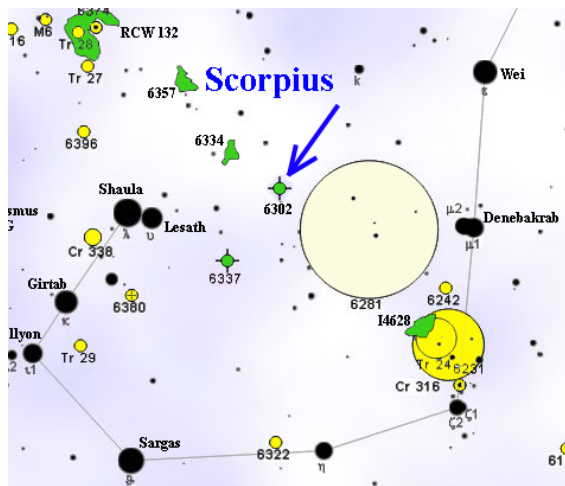
The central star, among the hottest stars known, had escaped detection because of a combination of its high temperature (so that it radiates mainly in the ultraviolet), the dusty torus (which absorbs a large fraction of the light from the central regions, especially in the ultraviolet) and the bright background from the star. It was not seen in the first HST images (APoD 2004). But the improved resolution and sensitivity of the new Wide Field Camera 3 of the Hubble Space Telescope revealed the faint star at the centre (Szyszka et al. 2009). A temperature of 200,000 Kelvin is indicated, and a mass of 0.64 solar masses. The original mass of the star was much higher, but most was ejected in the event which created the planetary nebula. The luminosity and temperature of the star indicate it has ceased nuclear burning and is on its way to becoming a white dwarf, fading at a predicted rate of 1% per year.

2.67.4 Dust chemistry

The prominent dark lane that runs through the centre of the nebula has been shown to have an extraordinary dust

chemistry, showing evidence for multiple crystalline silicates, crystalline water ice and **quartz**, with other features which have been interpreted as the first extra-solar detection of carbonates (Kemper et al. 2002). This detection has been disputed, due to the difficulties in forming carbonates in a non-aqueous environment (Ferrarotti & Gail 2005). The dispute remains unresolved.

One of the most interesting characteristics of the dust detected in NGC 6302 is the existence of both oxygen-rich material (i.e. silicates) and carbon-rich material (i.e. poly-aromatic-hydrocarbons or PAHs) (Kemper et al. 2002). Stars are usually either O-rich or C-rich, the change from the former to the latter occurring late in the evolution of the star due to nuclear and chemical changes in the star's atmosphere. NGC 6302 belongs to a group of objects where hydrocarbon molecules formed in an oxygen-rich environment (Matsuura et al. 2005).



Position of NGC 6302

2.67.5 Notes

- [1] (SIMBAD 2007)
- [2] (Meaburn et al. 2005)
- [3] $\text{Radius} = \text{distance} \times \sin(\text{angular size} / 2) = 3.4 \pm 0.5 \text{ kly} \times \sin(>3'.0 / 2) = >1.5 \pm 0.2 \text{ ly}$
- [4] $7.1\text{B apparent magnitude} - 5 * (\log_{10}(1040 \pm 160 \text{ pc distance}) - 1) = -3.0\text{B} + 0.4 - 0.3 \text{ absolute magnitude}$
- [5] (APoD 1998)
- [6] (APoD 2004)
- [7] Many sources credit its discovery to James Dunlop in 1826. E.g. (1) Wolfgang Steinicke, *Nebel und Sternhaufen: Geschichte ihrer Entdeckung, Beobachtung und Katalogisierung- von Herschel bis Dreyers*, 2009, p.429. (2) Universe Today; (3) Stephen James O'Meara, *The Caldwell objects*. Cambridge University Press, 2002, p.274.. (O'Meara argues that Barnard credited it to Dunlop - but may have been mistaken.)
- [8] News Release Number: STScI-2009-25: Hubble Opens New Eyes on the Universe

2.67.6 References

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- APoD (May 5, 2004), *Astronomy Picture of the Day*, NASA and Michigan Technological University (MTU)
- Szyszka, C.; Walsh, J. R.; Zijlstra, A. A.; Tsamis, Y.G. (2009), "Detection of the Central Star of the Planetary Nebula NGC 6302", *Astrophysical Journal, Letters* **707**: L32–L36, arXiv:0909.5143, Bibcode:2009ApJ...707L..32S, doi:10.1088/0004-637x/707/1/132
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- Matsuura, M.; Zijlstra, A. A.; Molster, F.J.; Waters, L. B. F. M. et al. (2005), "The dark lane of the planetary nebula NGC 6302", *Monthly Notices of the Royal Astronomical Society* **359**: 383–400, Bibcode:2005MNRAS.359..383M, doi:10.1111/j.1365-2966.2005.08903.x

2.67.7 External links

- NASA News Release
- Discovery of the star
- ESA/Hubble News Release
- SIMBAD Query Result
-
- NGC 6302 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Butterfly Nebula at Constellation Guide
- Fine photo at Astronomy Picture of the Day

Coordinates:  17^h 13^m 44.211^s, −37° 06′ 15.94″

2.68 Caldwell 70

NGC 300 is a spiral galaxy in the constellation Sculptor. It is one of the closest galaxies to the Local Group, and probably lies between us and the Sculptor Group. It is the brightest of the five main spirals in the direction of the Sculptor Group.^[2] It is inclined at an angle of 42° when viewed from Earth and shares many characteristics of the Triangulum Galaxy.^[3]

2.68.1 Nearby galaxies and group information

NGC 300 and the irregular galaxy NGC 55 have traditionally been identified as members of the Sculptor Group, a nearby group of galaxies in the constellation of the same name. However, recent distance measurements indicate that these two galaxies actually lie in the foreground.^[4] It is likely that NGC 300 and NGC 55 form a gravitationally bound pair.^[5]

2.68.2 Distance estimates

In 1986, Allan Sandage estimated the distance to NGC 300 to be 5.41 Mly (1.66 Mpc).^[6] By 1992, this had been updated to 6.9 Mly (2.1 Mpc) by Freedman et al.^[2] In 2006, this was revised by Karachentsev et al. to be 7.0±0.3 Mly (2.15±0.10 Mpc).^[7] At about the same time, the tip of the red giant branch (TRGB) method was used to produce an estimate of 5.9±0.4 Mly (1.82±0.13 Mpc) using edge detection and 6.1±0.4 Mly (1.87±0.12 Mpc) using maximum likelihood.^[2] These results were consistent with estimates using near-infrared photometry of Cepheid variables by Gieren et al. 2005 that provided an

estimate of 6.1±0.2 Mly (1.88±0.07 Mpc).^[2] Combining the recent TCGB and Cepheid estimates the distance to NGC 300 is estimated at 6.07±0.23 Mly (1.86±0.07 Mpc).^[a]

2.68.3 NGC 300-OT

On a CCD image obtained on May 14, 2008, amateur astronomer L.A.G. Berto Monard discovered an interesting bright optical transient (OT) in NGC 300 that is designated NGC 300-OT.^[8] It is located at RA: 00^h 54^m 34.552^s and DEC: −37° 38′ 31.79″^[9] in a spiral arm containing active star formation.^[10] Its broad-band magnitude was 14.3 in that image. An earlier image (from April 24, 2008), taken just after NGC 300 reemerged from behind the Sun, evidenced an already brightening OT at ~16.3 magnitude.^[10] No brightening was detected on a February 8, 2008 image or on any earlier ones.^[10] The transient's peak measured magnitude was 14.69 on May 15, 2008.^[10]

At discovery, the transient had an absolute magnitude of MV ≈ −13, making it faint in comparison to a typical core-collapse supernova but bright in comparison to a classical nova.^{[8][10]} Additionally, the photometric and spectroscopic properties of the OT imply that it is not a luminous blue variable either.^[10] Since its peak, brightness dropped smoothly through September 2008 while becoming continuously redder.^[10] After September 2008, brightness continued to fall at a lower rate in the optical spectrum but with strong H α emissions.^[10] Further, the optical spectrum is mostly made up of fairly narrow Hydrogen Balmer and Ca II emission lines coupled with strong Ca II H&K absorption.^[8] Research into historical Hubble images provide an accurate upper bound on the progenitor star's brightness.^[8] This suggested a low-mass main sequence star as progenitor with the transient resulting from a stellar merger similar to red Galactic nova V838 Monocerotis.^[8] Analysis of historical images of the area of the OT suggest with 70% certainty that the progenitor formed in a burst of stars around 8–13 Myr ago and implies the progenitor's mass to be 12–25 M \odot assuming the OT is due to an evolving massive star.^[9]

However, in 2008 a bright mid-infrared progenitor to the transient was discovered in historical Spitzer data. This was a star that was obscured by dust, with energy distribution analogous to a black-body of $R \approx 300$ AU and radiating at $T \approx 300$ K with $L_{\text{bol}} \approx \times 10^6 L_{\odot}$. This demonstrated that the transient was associated with an energetic explosion of a low-mass $\approx 10 M_{\odot}$ star. The transient's low luminosity as compared to typical core-collapse supernova, combined with its spectral attributes and dust covered properties, make it nearly identical to NGC 6946's SN 2008S.^[8]

The spectrum of NGC 300-OT observed with Spitzer shows strong, broad emission features at 8 μm and 12 μm . Such features are also seen in Galactic carbon-rich

protoplanetary nebulae.^[8]

2.68.4 SN 2010da

On May 23, 2010, Monard discovered another transient object of 16th magnitude, denoted as SN 2010da.^[11] The optical transient was detected 15".9 west and 16".8 north the center of the galaxy at coordinates 00 55 04.86 –37 41 43.7.^[12]

Two sets of independent follow-up spectroscopy data suggested that this was again another optical transient rather than a supernova, possibly an outbursting luminous blue variable star according to one spectrum,^{[13][14]} as earlier predicted from the nature of the candidate mid-infrared progenitor.^[15] The transient faded by 0.5–0.7 mag in 9 days, much faster than the 2008 transient in NGC 300.^[16]

2.68.5 Binary black hole system

The x-ray source at the core of NGC 300 is designated NGC 300 X-1.^[17] Astronomers speculate that NGC 300 X-1 is a new kind of Wolf-Rayet black hole binary system similar to the confirmed such system IC 10 X-1.^[17] Their shared properties include an orbital period of ~30 hours and x-ray brightness of $\sim 1 \times 10^{38}$ ergs.^[17]

2.68.6 Gallery

- NGC 300 zoom-in by the Hubble Space Telescope
- ESO's La Silla Observatory Wide Field Imager view of NGC 300.^[1] Credits: ESO
- Cepheids in NGC 300. Credits: ESO
- Artist's impression of a stellar-mass black hole X-ray binary in NGC 300. Credit: ESO/L. Calçada
- The surroundings of NGC 300. Credit: ESO/Digitized Sky Survey 2
- NGC 300 X-1 in the spiral galaxy NGC 300.
- Stellar-mass black hole NGC 300 X-1.
- Play media

This video zooms in onto the position of the system containing the stellar-mass black hole, and finishes with an artist's impression of the system.

- Play media

Video zooming into NGC 300.

1. ^ "A Nearby Galactic Exemplar". ESO Press Release. 2010-09-08. Retrieved 2010-09-21.

2.68.7 Notes

1. ^ Average $(1.845 \pm 0.125, 1.86 \pm 0.07) = ((1.845 + 1.86) / 2) \pm ((0.125^2 + 0.07^2)^{0.5} / 2) = 1.86 \pm 0.07$

2.68.8 References

- [1] "NASA/IPAC Extragalactic Database". *Results for NGC 300*. Retrieved 2006-11-18.
- [2] Rizzi, L.; Bresolin, F.; Kudritzki, R.-P.; Gieren, W. et al. (2006). "The Araucaria Project: The Distance to NGC 300 from the Red Giant Branch Tip Using HST ACS Imaging". *The Astrophysical Journal* **638** (2): 766–771. arXiv:astro-ph/0510298. Bibcode:2006ApJ...638..766R. doi:10.1086/498705.
- [3] Vlajić, M.; Bland-hawthorn, J.; Freeman, K.C. (2009). "The Abundance Gradient in the Extremely Faint Outer Disk of NGC 300". *The Astrophysical Journal* **697** (1): 361–372. arXiv:0903.1855. Bibcode:2009ApJ...697..361V. doi:10.1088/0004-637X/697/1/361.
- [4] Karachentsev, I.D.; Grebel, E.K.; Sharina, M.E.; Dolphin, A.E. et al. (2003). "Distances to nearby galaxies in Sculptor". *Astronomy and Astrophysics* **404**: 93–111. arXiv:astro-ph/0302045. Bibcode:2003A&A...404...93K. doi:10.1051/0004-6361:20030170.
- [5] van de Steene, G.C.; Jacoby, G.H.; Praet, C.; Ciardullo, R.; Dejonghe, H. (2006). "Distance determination to NGC 55 from the planetary nebula luminosity function". *Astronomy and Astrophysics* **455** (3): 891–896. Bibcode:2006A&A...455..891V. doi:10.1051/0004-6361:20053475.
- [6] Sandage, A. (1986). "The redshift-distance relation. IX - Perturbation of the very nearby velocity field by the mass of the Local Group". *Astrophysical Journal* **307**: 1–19. Bibcode:1986ApJ...307....1S. doi:10.1086/164387.
- [7] Karachentsev, I.D.; Kashibadze, O.G. (2006). "Masses of the local group and of the M81 group estimated from distortions in the local velocity field". *Astrophysics* **49** (1): 3–18. Bibcode:2006Ap....49....3K. doi:10.1007/s10511-006-0002-6.
- [8] Prieto, J.L.; Sellgren, K.; Thompson, T.A.; Kochanek, C.S. (2009). "A Spitzer/IRS Spectrum of the 2008 Luminous Transient in NGC 300: Connection to Protoplanetary Nebulae". *The Astrophysical Journal* **705** (2): 1425. arXiv:0907.0230. Bibcode:2009ApJ...705.1425P. doi:10.1088/0004-637X/705/2/1425.
- [9] Gogarten, S.M.; Dalcanton, J.J.; Murphy, J.W.; Williams, B.F. et al. (2009). "The NGC 300 Transient: An Alternative Method for Measuring Progenitor Masses". *The Astrophysical Journal* **703** (1): 300–310. arXiv:0907.0710. Bibcode:2009ApJ...703..300G. doi:10.1088/0004-637X/703/1/300.

- [10] Bond, H.E.; Bedin, L.R.; Bonanos, A.Z.; Humphreys, R.M. et al. (2009). “The 2008 Luminous Optical Transient in the Nearby Galaxy NGC 300”. *The Astrophysical Journal Letters* **695** (2): L154–L158. arXiv:0901.0198. Bibcode:2009ApJ...695L.154B. doi:10.1088/0004-637X/695/2/L154.
- [11] “ATEL 2640: Optical Photometry of the New Optical Transient SN 2010da in NGC 300”. Astronomers Telegram. 2010-05-26. Retrieved 2010-05-25.
- [12] “List of Supernovae”. Central Bureau for Astronomical Telegrams. Retrieved 2011-07-03.
- [13] “ATEL 2636: SN 2010da is a SN *impostor*”. Astronomers Telegram. 2010-05-25. Retrieved 2010-05-25.
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2.68.9 External links

-
- NGC 300 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Confirmation image of SN 2010da (2010-05-24) / Wikisky DSS2 zoom-in of same region

Coordinates:  00^h 54^m 53.5^s, −37° 41′ 04″

2.69 Caldwell 71

NGC 2477 is an open cluster in the constellation Puppis. It contains about 300 stars,^[3] and was discovered by Abbé Lacaille in 1751.^[3] The cluster’s age has been estimated at about 700 million years.^[3]

2.69.1 Visual appearance

NGC 2477 is a stunning cluster, almost as extensive in the sky as the full moon. It has been called “one of the top open clusters in the sky”,^[1] like a highly resolved globular

cluster without the dense center characteristic of globular clusters. Burnham notes that several observers have remarked on its richness, and that although it is smaller than M46 (also an open cluster in Puppis), it is richer and more compact.^[2]

2.69.2 Distance


Burnham cites several published distances, ranging from 700 parsecs (2,300 ly) to 1,900 parsecs (6,200 ly), where “ly” is the abbreviation for light year.^[2]

2.69.3 Notes

- [1] “NGC/IC Project Public Database”. *Results for NGC 2477*. Retrieved 2010-12-13.
- [2] Robert Burnham, Jr. (1978). *Burnham’s Celestial Handbook III*. New York: Dover. p. 1516. ISBN 0-486-24065-7.
- [3] “NGC 2477”. *SEDs Messier Objects Database*. Retrieved 2010-12-13.

2.69.4 External links

-
- NGC 2477 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  07^h 52.3^m 00^s, −38° 33′ 00″

2.70 Caldwell 72

NGC 55 is a Magellanic type barred spiral galaxy located about 7 million light-years away in the constellation Sculptor. Along with its neighbor NGC 300, it is one of the closest galaxies to the Local Group, probably lying between us and the Sculptor Group.

2.70.1 Nearby galaxies and group information

NGC 55 and the spiral galaxy NGC 300 have traditionally been identified as members of the Sculptor Group, a nearby group of galaxies in the constellation of the same name. However, recent distance measurements indicate that the two galaxies actually lie in the foreground.^[7]

It is likely that NGC 55 and NGC 300 form a gravitationally bound pair.^[4]

2.70.2 Visual appearance

The *Webb Society Deep-Sky Observer's Handbook*,^[8] writes the following about NGC 55: “Nearly edge-on and appears asymmetrical with some signs of dust near the bulge, which is diffuse, broad and somewhat elongated with the south edge sharp; southeast of the bulge it is strongly curved and lined with 4 or 5 faint knots; north edge of the curve is sharp.” Burnham calls it “one of the outstanding galaxies of the southern heavens”, somewhat resembling a smaller version of the Large Magellanic Cloud.^[9]

2.70.3 See also

- NGC 4236 – a similar edge-on spiral galaxy
- NGC 4631 – a similar edge-on spiral galaxy

2.70.4 Notes

1. \wedge average(6.9 ± 0.7 ,^[3] 7.5 ± 1.1 ^[4]) = $((6.9 + 7.5) / 2) \pm ((0.7^2 + 1.1^2)^{0.5} / 2) = 7.2 \pm 0.7$

2.70.5 References

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2.70.6 External links

- NGC 55 in Sculptor
- SEDS: Spiral Galaxy NGC 55
-
- NGC 55 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  00^h 14^m 53.6^s, −39° 11′ 48″

2.71 Caldwell 73

NGC 1851 is a globular cluster located in the constellation Columba.

2.71.1 References

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- [7] “NASA/IPAC Extragalactic Database”. *Results for NGC 1851*. Retrieved 2011-01-09.

2.71.2 External links

- [Galex image of NGC 1851](#)
- [NGC 1851 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

Coordinates:  $5^{\text{h}} 14^{\text{m}} 6.7^{\text{s}}, -40^{\circ} 2' 48''$

2.72 Caldwell 74

NGC 3132, also known as the **Eight-Burst Nebula**,^[2] the **Southern Ring Nebula**,^[2] is a bright and extensively studied planetary nebula in the constellation Vela. Its distance from Earth is estimated at about 550 pc. or 2,000 light-years.^[2]

2.72.1 Planetary nebula nucleus (PNN)

Images of NGC 3132 reveal two stars close together within the nebulosity, one of 10th magnitude, the other 16th. The central planetary nebula nucleus (PNN) or white dwarf central star is the fainter of these two stars. This hot central star of about 100,000 K has now blown off its layers and is making the nebula fluoresce brightly from the emission of its intense ultraviolet radiation.

2.72.2 See also

- [List of NGC objects](#)
- [List of planetary nebulae](#)

2.72.3 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 3132*. Retrieved 2007-01-03.
- [2] "Fast Facts – Planetary Nebula NGC 3132". *Hubble Heritage Project*. Space Telescope Science Institute. Retrieved 2007-10-06.
- [3] "Results for NGC 3132". *NGC/IC Project Database*. Retrieved 2011-01-09.

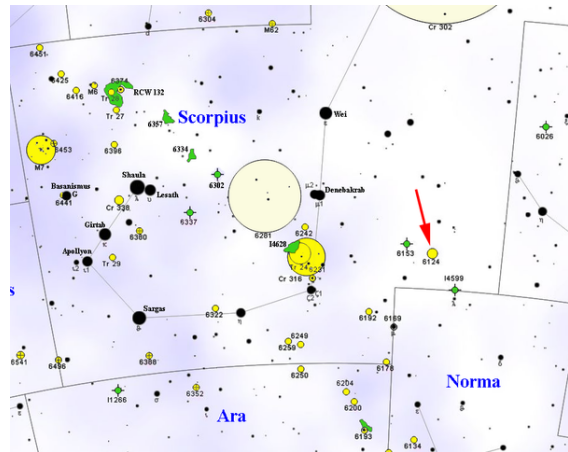
2.72.4 External links

- [Hubble Heritage release – A Glowing Pool of Light](#)
- [Hubble Heritage Project – Image of NGC 3132](#)
- [NGC 3132 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

- [NGC 3132 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

Coordinates:  $10^{\text{h}} 07^{\text{m}} 01.76^{\text{s}}, -40^{\circ} 26' 11''$

2.73 Caldwell 75



Map showing the location of NGC 6124

NGC 6124 is an open cluster located 18,600 light years away^[1] in the constellation Scorpius. It was discovered by Abbe Lacaille in 1751^[2] during his South African tour.


The cluster is large and bright, with about 125 stars visible.^[2]

2.73.1 References

- [1] "NGC 6124". *SEDS NGC Online*. Retrieved 2011-01-13.
- [2] "Results for NGC 6124". *NGC/IC Project*. Retrieved 2011-01-13.

2.73.2 External links

- [NGC 6124 at Messier45](#)
- [NGC 6124 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

Coordinates:  $16^{\text{h}} 25^{\text{m}} 36^{\text{s}}, -40^{\circ} 40' 00''$

2.74 Caldwell 76

NGC 6231, also known as the **Northern Jewel Box**, is an open cluster located near Zeta Scorpii. Zeta¹ (HR

Like other **starburst galaxies**, a collision is suspected to be responsible for the intense burst of star formation. Models have suggested that Centaurus A was a large elliptical galaxy which collided and merged with a smaller spiral galaxy.^[16]

2.75.1 Morphology

Centaurus A may be described as having a **peculiar** morphology. As seen from Earth, the galaxy looks like a **lenticular or elliptical galaxy** with a superimposed dust lane.^[17] The peculiarity of this galaxy was first identified in 1847 by John Herschel, and the galaxy was included in Halton Arp's *Atlas of Peculiar Galaxies* (published in 1966) as one of the best examples of a “disturbed” galaxy with dust absorption.^[18] The galaxy's strange morphology is generally recognized as the result of a **merger** between two smaller galaxies.^[19]

The bulge of this galaxy is composed mainly of evolved red stars.^[17] The dusty disk, however, has been the site of more recent **star formation**;^[12] over 100 star formation regions have been identified in the disk.^[20]

2.75.2 Supernova

One **supernova** has been detected in Centaurus A.^[21] The supernova, named SN 1986G, was discovered within the dark dust lane of the galaxy by R. Evans in 1986.^[22] It was later identified as a **type Ia supernova**,^[23] which forms when a **white dwarf**'s mass grows large enough to ignite carbon fusion in its center, touching off a **runaway** thermonuclear reaction, as may happen when a white dwarf in a **binary star** system strips gas away from the other star. SN 1986G was used to demonstrate that the spectra of type Ia supernovae are not all identical, and that type Ia supernovae may differ in the way that they change in brightness over time.^[23]

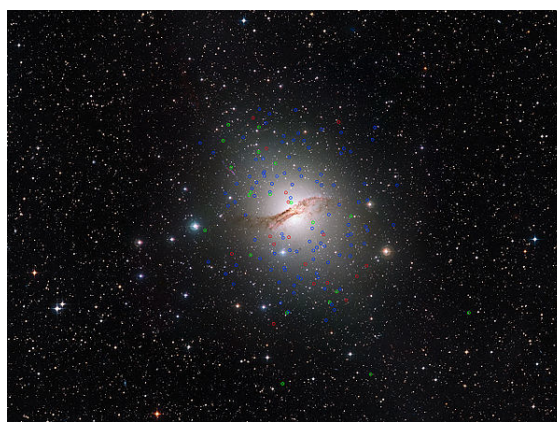
2.75.3 Distance

Distance estimates to NGC 5128 established since the 1980s typically range between 3–5 Mpc.^{[2][3][4][5][6][24]} **Classical Cepheids** discovered in the heavily-obscured dust lane of NGC 5128 yield a distance between ~3–3.5 Mpc, depending on the nature of the extinction law adopted and other considerations.^{[4][5]} **Mira variables**^[24] and **Type II Cepheids**^{[4][5]} were also discovered in NGC 5128, the latter being rarely detected beyond the **Local Group**.^[25] The distance to NGC 5128 established from several indicators such as **Mira variables** and **planetary nebulae** favour a more distant value of ~3.8 Mpc.^{[7][6]}

2.75.4 Nearby galaxies and galaxy group information

Centaurus A is at the center of one of two subgroups within the **Centaurus A/M83 Group**, a nearby **group of galaxies**.^[26] **Messier 83** (the Southern Pinwheel Galaxy) is at the center of the other subgroup. These two groups are sometimes identified as one group^{[27][28]} and sometimes identified as two groups.^[29] However, the galaxies around Centaurus A and the galaxies around M83 are physically close to each other, and both subgroups appear not to be moving relative to each other.^[30] The Centaurus A/M83 Group is located in the **Virgo Supercluster**.

2.75.5 Visibility



Elliptical galaxy Centaurus A and its strange globular clusters.^[31]

Centaurus A is located approximately 4° north of **Omega Centauri** (a **globular cluster** visible with the naked eye).^[13] Because the galaxy has a high surface brightness and relatively large angular size, it is an ideal target for amateur astronomy observations. The bright central bulge and dark dust lane are visible even in finderscopes and large binoculars,^[13] and additional structure may be seen in larger telescopes.^[13] Centaurus A is visible to the naked eye under exceptionally good conditions.^[32]

2.75.6 Gallery

- Centaurus A halo
- The radio galaxy Centaurus A, as seen by **ALMA**
- Image taken by the Wide Field Imager attached to the **MPG/ESO 2.2-meter telescope** at the **La Silla Observatory**.
- “Hubble’s panchromatic vision... reveals the vibrant glow of young, blue star clusters...”^[1]
- A **Hubble Space Telescope (HST)** image of the dust disk in front of the nucleus of Centaurus A. Credit: **HST/NASA/ESA**.

- This image of the central parts of Centaurus A reveals the parallelogram-shaped remains of a smaller galaxy that was absorbed about 200 to 700 million years ago.
- The heavily-obscured inner (barred?) spiral disk at 24 μm as shown by the *Spitzer* IR telescope
- *Chandra* X-ray view of Cen A in X-rays showing one relativistic jet from the central black hole
-
- A composite image showing the size of the radio glow from the galaxy Centaurus A in comparison to the full Moon.
- Play media

Video about Centaurus A jets.

- "False-colour image of the nearby radio galaxy Centaurus A, showing radio (red), 24-micrometre infrared (green) and 0.5-5 keV X-ray emission (blue). The jet can be seen to emit synchrotron emission in all three wavebands. The lobes only emit in the radio frequency range, and so appear red. Gas and dust in the galaxy emits thermal radiation in the infrared. Thermal X-ray radiation from hot gas and non-thermal emission from relativistic electrons can be seen in the blue 'shells' around the lobes, particularly to the south (bottom)."^[2]

1. ^ "Firestorm of Star Birth in Galaxy Centaurus A". NASA. Retrieved 27 September 2012.
2. ^ Radio galaxy

2.75.7 See also

- *Messier 87 – a giant elliptical galaxy that is also a strong radio source*
- *NGC 1316 – a similar lenticular galaxy that is also a strong radio source*

2.75.8 References

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- STScI. Hubble Provides Multiple Views of How to Feed a Black Hole. Press release: *Space Telescope Science Institute*. March 14, 1998.
- Chandra X-Ray Observatory Photo Album Centaurus A Jet

2.75.9 External links

- Helmut Steinle Centaurus A project
- **SEDS**: Peculiar Galaxy NGC 5128
- ESA/Hubble images of Centaurus A
- **NASA’s APOD**: The Galaxy Within Centaurus A (3/4/06)
- **NASA’s APOD**: X-Rays from an Active Galaxy (7/5/03)
- High-resolution image of Centaurus A showing the discrete elements of galactic core
- Centaurus A at UniverseToday.com
- NGC5128 Centaurus A
- NGC 5128 at **DOCdb** (Deep Sky Observer’s Companion)
- Centaurus A on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Centaurus A at Constellation Guide

Coordinates:  13^h 25^m 27.6^s, −43° 01′ 09″

2.76 Caldwell 78

NGC 6541 is a globular cluster in the southern constellation of Corona Australis. It is estimated to be around 14 billion years old.^[6]

The globular cluster was discovered by Nicolò Cacciatore (1780 - 1841) at the Palermo Astronomical Observatory, Italy, on March 19, 1826. It was independently found by James Dunlop (1793 – 1848) on July 3, 1826.

2.76.1 References

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2.76.2 External links

- [NGC 6541](#) at SEDS NGC objects pages
- [NGC 6541](#) at DOCdb (Deep Sky Observer’s Companion)
- [NGC 6541 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen \$\alpha\$, X-Ray, Astrophoto, Sky Map, Articles and images](#)

Coordinates:  18^h 08^m 02^s, −43° 53′ 00″

2.77 Caldwell 79

NGC 3201 is a low galactic latitude globular cluster in the southern constellation of **Vela**. It has a very low central concentration of stars.^[9] This cluster was discovered by **James Dunlop** on May 28, 1826 and listed it in his 1827 catalogue. He described it as “a pretty large pretty bright round nebula, 4′ or 5′ diameter, very gradually condensed towards the centre, easily resolved into stars; the figure is rather irregular, and the stars are considerably scattered on the south”.^[10]

The **radial velocity** of this cluster is unusually high at 490 km/s, larger than any other cluster known. This corresponds to a peculiar velocity of 240 km/s. While high, this is lower than the **escape velocity** of the Milky Way galaxy.^[10] It is located at a distance of 16,300 **light years** from the Sun and has an estimated 254,000 times the **mass of the Sun**.^[3] This cluster is about 10.24 billion years old.^[7]



Colour-composite image of NGC 3201, obtained with the WFI instrument on the ESO/MPG 2.2-m telescope at La Silla Observatory

The stellar population of this cluster is inhomogeneous, varying with distance from the core. The **effective temperature** of the stars shows an increase with greater distance, with the redder and cooler stars tending to be located closer to the core. As of 2010, is one of only two clusters (including **Messier 4**) that shows a definite inhomogeneous population.^[11]

2.77.1 References

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2.77.2 External links

- Globular Cluster NGC 3201 at SEDS pages
-
- NGC 3201 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC 3201 at DOCdb (Deep Sky Observer’s Companion)

Coordinates:  10^h 17^m 36.76^s, −46° 24′ 40.4″

2.78 Caldwell 80

Omega Centauri (ω Cen), or **NGC 5139**, is a globular cluster in the constellation of Centaurus that was first identified as a non-stellar object by Edmond Halley in 1677. Located at a distance of 15,800 light-years (4,850 pc), it is the largest globular cluster in the Milky Way galaxy at a diameter of roughly 150 light-years.^[10] It is estimated to contain approximately 10 million stars and a total mass equivalent to 4 million solar masses.^[11]

Omega Centauri is so distinctive from the other galactic globular clusters that it is thought to have an alternate origin as the core remnant of a disrupted dwarf galaxy.^[12]

2.78.1 Observation history

In 150 A.D., Greco-Roman writer and astronomer Ptolemy catalogued this object in his *Almagest* as a

star on the horse’s back, “Quae est in principio scapulae”. German lawyer and cartographer Johann Bayer used Ptolemy’s data to designate this object “Omega Centauri” with his 1603 publication of *Uranometria*. Using a telescope from the South Atlantic island of Saint Helena, English astronomer Edmond Halley rediscovered this object in 1677, listing it as a non-stellar object. In 1715, it was published by Halley among his list of six “luminous spots or patches” in the *Philosophical Transactions of the Royal Society*.^[13]

Swiss astronomer Jean-Philippe de Cheseaux included Omega Centauri in his 1746 list of 21 nebulae,^[13] as did French astronomer Lacaille in 1755, who gave it the catalogue number L I.5. It was first recognized as a globular cluster by Scottish astronomer James Dunlop in 1826, who described it as a “beautiful globe of stars very gradually and moderately compressed to the centre”.^{[14][15]}

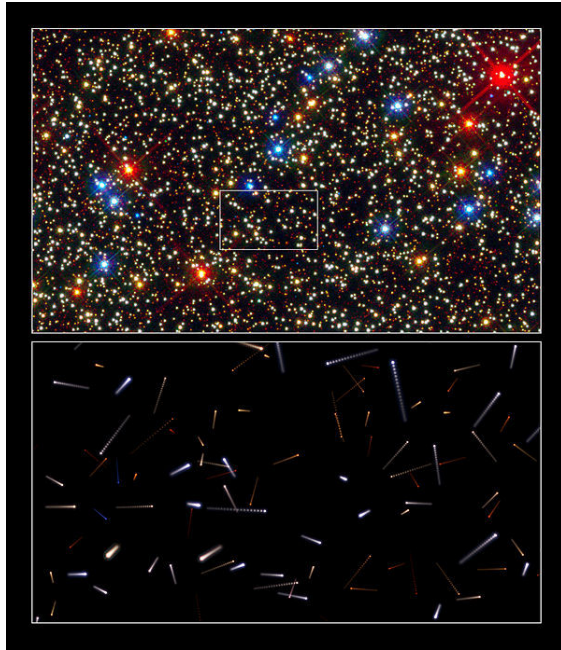
2.78.2 Properties

At a distance of about 15,800 light-years (4,850 pc) from Earth, Omega Centauri is one of the few globular clusters visible to the naked eye—and appears almost as large as the full Moon when seen from a dark, rural area.^[16] It is the brightest, largest and at 4 million solar masses^[6] the most massive known globular cluster associated with our galaxy. Of all the globular clusters in the Local Group of galaxies, only Mayall II in the Andromeda Galaxy is brighter and more massive.^[17] Orbiting through the Milky Way, Omega Centauri contains several million Population II stars and is about 12 billion years old.^[18]

The stars in the core of Omega Centauri are so crowded that they are estimated to average only 0.1 light years away from each other.^[18] The internal dynamics have been analyzed using measurements of the radial velocities of 469 stars.^[19] The members of this cluster are orbiting the center of mass with a peak velocity dispersion of 7.9 km s^{−1}. The mass distribution inferred from the kinematics is slightly more extended than, though not strongly inconsistent with, the luminosity distribution.

2.78.3 Evidence of a central black hole

A 2008 study presented evidence for an intermediate-mass black hole at the center of Omega Centauri, based on observations made by the Hubble Space Telescope and Gemini Observatory on Cerro Pachon in Chile.^{[20][21]} Hubble’s Advanced Camera for Surveys showed that stars are bunching up near the center of Omega Centauri, as evidenced by the gradual increase in starlight near the center. Using instruments at the Gemini Observatory to measure the speed of stars swirling in the cluster’s core, E. Noyola and colleagues found that stars closer to the core are moving faster than stars farther away. This measurement was interpreted to mean that unseen matter at the core is interacting gravitationally with nearby stars.



The central region of Omega Centauri. The lower illustration charts the future positions of the stars highlighted by the white box in the top image. Each streak represents the star's predicted motion over the next 600 years. The period between dots corresponds to 30 years. October 2010

By comparing these results with standard models, the astronomers concluded that the most likely cause was the gravitational pull of a dense, massive object such as a black hole. They calculated the object's mass at 4.0×10^4 solar masses.^[20]

However, more recent work has challenged these conclusions, in particular disputing the proposed location of the cluster center.^{[22] [23]} Calculations using a revised location for the center found that the velocity of core stars does not vary with distance, as would be expected if an intermediate-mass black hole were present. The same studies also found that starlight does not increase toward the center but instead remains relatively constant. The authors noted that their results do not entirely rule out the black hole proposed by Noyola and colleagues, but they do not confirm it, and they limit its maximum mass to 1.2×10^4 solar masses.

2.78.4 Disrupted dwarf galaxy

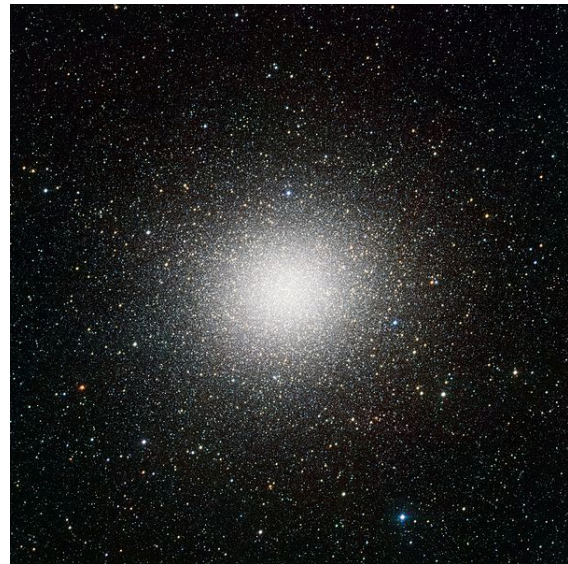
It has been speculated that Omega Centauri may be the core of a dwarf galaxy which was disrupted and absorbed by our Milky Way galaxy.^[24] Indeed, Kapteyn's star, which is currently only 13 light years away, is thought to originate from Omega Centauri.^[25] Omega Centauri's chemistry and motion in the galaxy is also consistent with this picture.^[16] Like Mayall II, Omega Centauri has a range of metallicities and stellar ages which hints that it did not all form at once (as globular clusters are thought

to form) and may in fact be the remainder of the core of a smaller galaxy long since incorporated into the Milky Way.^[26]

2.78.5 In fiction

- Singularity (2012), by Ian Douglas. The novel presents as fact that Omega Centauri and Kapteyn's star originate from a disrupted dwarf galaxy, and this origin is central to the novel's plot. A number of scientific aspects of Omega Centauri are discussed as the story progresses, including the likely radiation environment inside the cluster and what the sky might look like from inside the cluster.^[27]

2.78.6 See also



VLT Survey Telescope image of Omega Centauri. Credit: ESO.

- Sagittarius Dwarf Elliptical Galaxy
- Canis Major Dwarf Galaxy
- Globular Cluster M54
- Mayall II

2.78.7 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), "A Classification of Globular Clusters", *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), "The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters", *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.

- [3] van de Ven, G.; van den Bosch, R. C. E.; Verolme, E. K.; de Zeeuw, P. T. (2 January 2006). “The dynamical distance and intrinsic structure of the globular cluster ω Centauri”. *Astronomy and Astrophysics* **445** (2): 513–543. arXiv:astro-ph/0509228. Bibcode:2006A&A...445..513V. doi:10.1051/0004-6361:20053061. best-fit dynamical distance $D=4.8\pm0.3$ kpc ... consistent with the canonical value 5.0 ± 0.2 kpc obtained by photometric methods
- [4] Skiff, Brian A. (May 2, 1999), “Observational Data for Galactic Globular Clusters”, *The NGC/IC Project*, retrieved 2013-08-13.
- [5] Arnold, H. J. P.; Doherty, Paul; Moore, Patrick (1999), *The Photographic Atlas of the Stars*, CRC Press, p. 173, ISBN 0750306548.
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- [7] distance $\times \sin(\text{diameter_angle} / 2)$, using distance of 5kpc and angle $36.3'$, $= 86 \pm 6$ ly. radius
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- [9] “SIMBAD Astronomical Database”. *Results for NGC 5139*. Retrieved 2006-11-16.
- [10] “Omega Centauri: The Largest Globular Cluster”. *Universe for Facts*. Retrieved 21 December 2014.
- [11] <http://apod.nasa.gov/apod/ap100331.html>
- [12] Noyola, Eva; Gebhardt, Karl; Bergmann, Marcel (2008). “Gemini and Hubble Space Telescope Evidence for an Intermediate Mass Black Hole in omega Centauri”. *The Astrophysical Journal* **676** (2): 1008. arXiv:0801.2782. Bibcode:2008ApJ...676.1008N. doi:10.1086/529002.
- [13] O'Meara, Stephen James (2013), *Deep-Sky Companions: Southern Gems*, Cambridge University Press, p. 244, ISBN 1107015014.
- [14] Dunlop, J. (1828). “A catalogue of nebulae and clusters of stars in the southern hemisphere, observed at Parramatta in New South Wales”. *Philosophical Transactions of the Royal Society* **118**: 113–151. Bibcode:1828RSPT..118..113D. doi:10.1098/rstl.1828.0010. Omega Centauri is listed as No. 440 on p. 136.
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- [17] Frommert, Hartmut; Kronberg, Christine (March 22, 1998), “NGC 5139”, *The Munich Astro Archive*, retrieved 2013-08-13.
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- [19] Merritt, David; Meylan, Georges; Mayor, Michel (September 1997). “The stellar dynamics of Omega Centauri”. *The Astrophysical Journal* **114**: 1074–1086. arXiv:astro-ph/9612184. Bibcode:1997AJ....114.1074M. doi:10.1086/118538.
- [20] Noyola, E.; Gebhardt, K.; Bergmann, M. (April 2008). “Gemini and Hubble Space Telescope Evidence for an Intermediate-Mass Black Hole in ω Centauri”. *The Astrophysical Journal* **676** (2): 1008–1015. arXiv:0801.2782. Bibcode:2008ApJ...676.1008N. doi:10.1086/529002.
- [21] Noyola, Eva; Christensen, Lars Lindberg; Villard, Ray; Michaud, Peter (April 2, 2008), *Black hole found in enigmatic Omega Centauri*, ESA, retrieved 2013-08-13.
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- [27] Douglas, Ian (2012). *Singularity*. Harper Voyager. ISBN 978-0061840272.

2.78.8 External links

- **StarDate**: Omega Centauri Fact Sheet
- Hubblesite - Peering into the core of a globular cluster
- Omega Centauri: Former Core of a Dwarf Galaxy?
- Omega Centauri: Proud Cluster or Sad Remnant?
- Omega Centauri at ESA/Hubble

- Omega Centauri on Wikisky.org
- Omega Centauri, Galactic Globular Clusters Database page
-
- Omega Centauri on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Omega Centauri at Constellation Guide

Coordinates:  13^h 26^m 45.89^s, −47° 28′ 36.7″

2.79 Caldwell 81

NGC 6352 is a globular cluster in the southern constellation Ara. A telescope with a 15 cm (5.9 in) aperture is required to resolve the stars within this loose cluster.^[3]

2.79.1 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Dunlop, Storm (2005). *Atlas of the Night Sky*. Harper Collins. ISBN 0-00-717223-0.
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- [5] Marks, Michael; Kroupa, Pavel (August 2010), “Initial conditions for globular clusters and assembly of the old globular cluster population of the Milky Way”, *Monthly Notices of the Royal Astronomical Society* **406** (3): 2000–2012, arXiv:1004.2255, Bibcode:2010MNRAS.406.2000M, doi:10.1111/j.1365-2966.2010.16813.x. Mass is from MPD on Table 1.
- [6] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.

2.80 Caldwell 82

NGC 6193 is open cluster containing 27 stars in the constellation Ara, visible to the unaided eye.^[1] NGC 6193 lies at the center of the Ara OB1 association, which extends over a square degree. The cluster is associated with (and provides the energizing radiation for) neighboring regions of the nebula NGC 6188.

2.80.1 List of stars in cluster

2.80.2 Gallery

- Star cluster NGC 6193 and nebula NGC 6188.^[1]
- Map showing the location of NGC 6193.

1. ^ “Star cluster NGC 6193 and nebula NGC 6188”. Retrieved 18 June 2015.

2.80.3 References

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2.80.4 External links

-
- NGC 6193 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Universität Wien: Plot of stars in NGC 6193 (WEBDA)
- Universität Wien: IDs of stars in NGC 6193 (WEBDA)
- Encyclopedia of Science: Entry for NGC 6193
- Simbad: Entry for NGC 6193
- Simbad: Entry for NGC 6193 1 (HD 150136)
- Aladin: Image of NGC 6193, centered on HD 150136

2.81 Caldwell 83

Coordinates:  13^h 05^m 27.5^s, −49° 28′ 06″

NGC 4945 is a spiral galaxy in the constellation Centaurus, and near the bright star, Zeta Centauri.^[3] The galaxy was discovered by James Dunlop in 1826. It is thought to be similar to the Milky Way Galaxy, although X-ray observations show that NGC 4945 has an unusual energetic Seyfert 2 nucleus that might house a large black hole.^[4]

2.81.1 Galaxy group

NGC 4945 one of the brightest galaxies of the **Centaurus A/M83 Group**, a large, nearby group of galaxies. The galaxy is the second brightest galaxy in the subgroup centered on **Centaurus A**.^{[2][5]}

2.81.2 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 4945*. Retrieved 2006-11-25.
- [2] I. D. Karachentsev; M. E. Sharina; A. E. Dolphin; E. K. Grebel et al. (2002). “New distances to galaxies in the Centaurus A group”. *Astronomy and Astrophysics* **385** (1): 21–31. Bibcode:2002A&A...385...21K. doi:10.1051/0004-6361/20020042.
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- [4] “Milky Way’s Not-So-Distant Cousin Likely Harbors Supermassive Black Hole”. Science Daily.
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2.81.3 External links

-
- NGC 4945 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- APOD: Nearby Spiral Galaxy NGC 4945 (7/21/02)
- ESO: The milkyway’s nearby cousin (2/10/09)

2.82 Caldwell 84

NGC 5286, also known as **Caldwell 84**, is a globular cluster of stars located some 35,900^[3] light years away in the constellation Centaurus. At this distance, the light from the cluster has undergone reddening from interstellar gas and dust equal to $E(B - V) = 0.24$ magnitude in the UBV photometric system. The cluster lies 4 arc-minutes north of the naked-eye star M Centauri.^[6] It was discovered by Scottish astronomer James Dunlop from Australia and listed in his 1827 catalog.^[7]

This cluster is about 29 kly (8.9 kpc) from the Galactic Center and is currently orbiting in the Milky Way halo. It may be associated with the Monoceros Ring—a long tidal stream of stars that could have been formed from a disrupted dwarf galaxy. NGC 5286 may be one of the oldest globular clusters in the galaxy,^[6] with an estimated

age of 12.54 billion years.^[5] It is not perfectly spherical, but has a projected ellipticity of 0.12.^[6]

The velocity dispersion of stars at the center of the cluster is (8.1 ± 1.0) km/s. Based upon the motions of stars at the core of this cluster, it may host an intermediate mass black hole with less than 1% of the cluster’s mass. The upper limit for the mass estimate of this object is 6,000 times the mass of the Sun.^[6]

2.82.1 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astronomical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Paust, Nathaniel E. Q. et al. (February 2010), “The ACS Survey of Galactic Globular Clusters. VIII. Effects of Environment on Globular Cluster Global Mass Functions”, *The Astronomical Journal* **139** (2): 476–491, Bibcode:2010AJ....139..476P, doi:10.1088/0004-6256/139/2/476.
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- [5] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.
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- [7] O’Meara, Stephen James (2002), *The Caldwell Objects*, Cambridge University Press, p. 337.

2.82.2 External links

- NGC 5286 at Astrosurf
-
- NGC 5286 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  13^h 46^m 00^s, −51° 22′ 00″

2.83 Caldwell 85

IC 2391 (also known as the **Omicron Velorum Cluster** or **Caldwell 85**) is an **open cluster** in the constellation **Vela**. The Persian astronomer **Al Sufi** may have first described it about 964. It was found by **Abbe Lacaille** and cataloged as **Lac II 5**.

The cluster is about 500 **light-years** away from **Earth** and can be seen with the **naked eye**. It contains about 30 stars with a total **visual magnitude** of 2.5, spread out along 50 arcminutes. The cluster appears to be about the same age as the open cluster **IC 2602**,^[1] and has a **lithium depletion boundary** age of about 50 million years.^[2]

2.83.1 See also

- **Omicron Velorum**

2.83.2 References

- [1] Stauffer, J.R. et al. (1997). “Rotational Velocities and Chromospheric/Coronal Activity of Low-Mass Stars in the Young Open Clusters IC 2391 and IC 2602”. *Astrophysical Journal* **479** (2): 776. Bibcode:1997ApJ...479..776S. doi:10.1086/303930.
- [2] Barrado y Navascues, D., Stauffer, J.R., & Jayawardhana, R. (2002). “Spectroscopy of Very Low Mass Stars and Brown Dwarfs in IC 2391: Lithium Depletion and H α Emission”. *Astrophysical Journal* **614** (1): 386–397. arXiv:astro-ph/0406436. Bibcode:2004ApJ...614..386B. doi:10.1086/423485.

2.83.3 External links

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- **IC 2391 on WikiSky:** **DSS2**, **SDSS**, **GALEX**, **IRAS**, **Hydrogen α** , **X-Ray**, **Astrophoto**, **Sky Map**, **Articles** and **images**
- **SEDs:** entry for **IC 2391**
- **Atlas of the Universe:** list of open clusters
- **Simbad:** entry for **IC 2391**

Coordinates:  08^h 40^m 18^s, −52° 54′ 60″

2.84 Caldwell 86

NGC 6397, also known as **Caldwell 86**, is a **globular cluster** in the constellation **Ara**. It is located about 7,200 **light-years** from **Earth**, making it one of the two nearest globular clusters to **Earth** (the other one being **Messier 4**). The cluster contains around 400,000 stars,^[3] and

can be seen with the **naked eye** under good observing conditions.^[8]

NGC 6397 is one of the at least 20 globular clusters of our **Milky Way Galaxy** that have undergone a **core collapse**,^[3] meaning that the core has contracted to a very dense stellar agglomeration.

2.84.1 Astronomical research

Estimating the age of the Milky Way

In 2004, a team of **astronomers**^[3] focused on the cluster to estimate the age of the **Milky Way Galaxy**. The team consisted of **Luca Pasquini**, **Piercarlo Bonifacio**, **Sofia Randich**, **Daniele Galli**, and **Raffaele G. Gratton**. They used the **UV-Visual Echelle Spectrograph** of the **Very Large Telescope** at **Cerro Paranal** to measure the **beryllium** content of two stars in the cluster. This allowed them to deduce the time elapsed between the rise of the first generation of stars in the entire Galaxy and the first generation of stars in the cluster. This, added to the estimated age of the stars in the cluster, gives an estimate for the age for the Galaxy: about 13.6 **billion** years, which is nearly as old as the **universe** itself.

Lower mass limit for stars

In 2006, a study of **NGC6397** using the **Hubble Space Telescope** was published that showed a clear lower limit in the **brightness** of the cluster’s population of faint stars. The authors deduce that this indicates a lower limit for the **mass** necessary for stars to develop a core capable of **fusion**: roughly 0.083 times the mass of the **Sun**.^[9]

2.84.2 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] “How Old is the Milky Way?”. *Results for NGC 6397*. Retrieved 2006-09-26.
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- [5] Marks, Michael; Kroupa, Pavel (August 2010), “Initial conditions for globular clusters and assembly of the old globular cluster population of the Milky Way”, *Monthly Notices of the Royal Astronomical Society* **406** (3): 2000–2012, arXiv:1004.2255,

Bibcode:2010MNRAS.406.2000M, doi:10.1111/j.1365-2966.2010.16813.x. Mass is from MPD on Table 1.

[6] $\text{distance} \times \sin(\text{diameter_angle} / 2) = \sim 34 \text{ ly. radius}$

[7] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.

[8] Dunlop, Storm (2005). *Atlas of the Night Sky*. Collins. ISBN 0-00-717223-0.

[9] “HST analysis of faint stars in NGC6397”. *Results for NGC 6397*. Retrieved 2006-09-26.

2.84.3 External links

-
- NGC 6397 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- APOD: Blue Stragglers in NGC 6397 (2003/08/08)
- APOD: Oddities of Star Cluster NGC 6397 (2002/02/20)

2.85 Caldwell 87

NGC 1261, also known as **Caldwell 87**, is a globular cluster in the constellation **Horologium**, first discovered by **James Dunlop** in 1826.

2.85.1 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astronomical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Paust, Nathaniel E. Q. et al. (February 2010), “The ACS Survey of Galactic Globular Clusters. VIII. Effects of Environment on Globular Cluster Global Mass Functions”, *The Astronomical Journal* **139** (2): 476–491, Bibcode:2010AJ....139..476P, doi:10.1088/0004-6256/139/2/476.

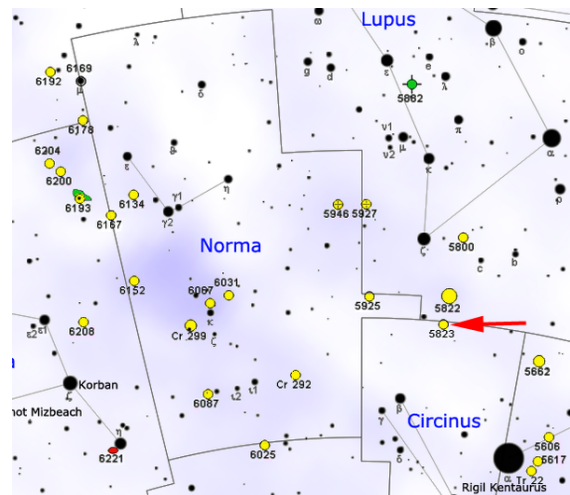
[4] Boyles, J. et al. (November 2011), “Young Radio Pulsars in Galactic Globular Clusters”, *The Astrophysical Journal* **742** (1): 51, arXiv:1108.4402, Bibcode:2011ApJ...742...51B, doi:10.1088/0004-637X/742/1/51

[5] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.

2.85.2 External links

-
- NGC 1261 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- SEDS
- NASA data
- Photometry paper
- Globular Clusters Database

2.86 Caldwell 88



Map showing the location of NGC 5823

NGC 5823 (Caldwell 88) is an open cluster in the southern constellation of **Circinus**, near (and extending across) its border with the constellation **Lupus**. It was discovered by **James Dunlop** in 1826.

2.86.1 External links

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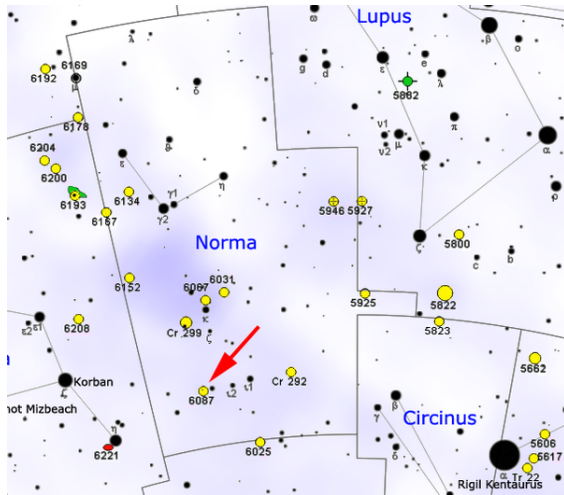
- NGC 5823 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  15^h 05^m 44.8^s, −55° 37′ 30″

- NGC 6087 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  16^h 18^m 48^s, −57° 56′ 00″

2.87 Caldwell 89



Map showing the location of NGC 6087

NGC 6087 is an open cluster of 40 or more^{[2][3]} stars centered on the Cepheid variable S Normae in the constellation Norma. At a distance of about 3500 ly and covering a field of almost one quarter of a degree, the stars range from seventh to eleventh magnitude, the brightest being 6.5 magnitude S Normae. The aggregate visual magnitude of the cluster is about 5.4.

Spectral analysis of the radial motion of the stars confirm that S Normae is a member of the cluster,^[3] and the period/luminosity relationship of Cepheid variables allows the distance to be determined with confidence.

2.87.1 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 6087*. Retrieved 2007-04-18.
- [2] Burnham's *Celestial Handbook* gives the number 40, though other studies go as high as 349; see Stephen James O'Meara, *The Caldwell Objects*, Cambridge University Press, 2002, p. 351.
- [3] A. U. Landolt (1964). "The Galactic Cluster NGC 6087". *Astrophysical Journal Supplement* **8**: 329–351. Bibcode:1964ApJS....8..329L. doi:10.1086/190092. Retrieved 4 April 2013.

2.87.2 External links

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2.88 Caldwell 90

NGC 2867 is a planetary nebula in the constellation Carina. It was discovered by John Herschel on April 1, 1834.^[3] Herschel initially thought he might have found a new planet.^[3]

2.88.1 See also

- List of NGC objects

2.88.2 References

- [1] "SIMBAD Astronomical Database". *Results for NGC 2867*. Retrieved 2007-04-10.
- [2] "SEDs Online NGC Catalogue". *Results for NGC 2867*. Retrieved 2010-12-07.
- [3] "NCG/IC Project". *Results for NGC 2867*. Retrieved 2010-12-07.

2.88.3 External links

- The Hubble European Space Agency Information Centre – Hubble picture and information on NGC 2867
- NGC 2867 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.89 Caldwell 91

NGC 3532, also known as the Football Cluster,^{[4][6]} and the Black Arrow Cluster,^[7] is an open cluster in the constellation Carina, lies some 1,321^[2] light years away. It consists of approximately 150 stars of 7th magnitude or fainter, including seven red giants^[8] and seven white dwarfs.^{[9][10]} On 20 May 1990 it became the first target ever observed by the Hubble Space Telescope. A line from Beta Crucis through Delta Crucis passes somewhat to the north of NCG 3532. The cluster lies between the constellation Crux and the larger but fainter "False Cross" asterism. The 4th-magnitude Cepheid variable star x Carinae (V382 Carinae) is the nearest naked-eye star, but it is not a member of the cluster. NGC 3532

lies near the **Eta Carinae** nebula (NGC 3372) and several other prominent open clusters like NGC 3293 and IC 2581.

The cluster was first catalogued by Nicolas Louis de Lacaille in 1751. It was admired by John Herschel, who thought it one of the finest irregular clusters in the sky,^{[3][11]} with many double stars (binary stars).^[5]

2.89.1 References

- [1] “NGC 3532”. *SIMBAD Astronomical Database*. Centre de Données astronomiques de Strasbourg. Retrieved 2010-05-23.
 - [2] Robichon, N. et al. (2005). “Open clusters with Hipparcos. I. Mean astrometric parameters”. *Astronomy and Astrophysics* **345**: 471–484. arXiv:astro-ph/9903131. Bibcode:1999A&A...345..471R.
 - [3] Deep Sky Observer’s Companion – the online database, *DOCdb Lacaille II.10*
 - [4] Amateur Astronomer Association of New York, *Nebula of the Month - Carina’s Football*
 - [5] ScienceDaily, “A colorful gathering of middle-aged stars”, European Southern Observatory, 26 November 2014
 - [6] IceInSpace - Australian Amateur Astronomy, *Challenge Objects - June 2005*, 2005
 - [7] Stephen Chadwick and Ian Cooper “Imaging the Southern Sky” Springer 2013, p.94
 - [8] Claria, J.J., Lapasset, E., (1988) “A UBV and DDO astrophysical study of the open cluster NGC3532”, *Monthly Notices of the Royal Astronomical Society*, 235, 1129–1139
 - [9] Reimers, D., Koester, D., (1989) “Spectroscopic identification of white dwarfs in galactic clusters. V - NGC 3532”, *Astronomy & Astrophysics*, 218, 118–122
 - [10] Dobbie, P., Day-Jones, A., Williams, K., Casewell, S., Burleigh, M., Lodieu, N., Parker, Q., Baxter, R. (2012) “Further investigation of white dwarfs in the open clusters NGC2287 and NGC3532”, *Monthly Notices of the Royal Astronomical Society*, 423, 2815–2828
 - [11] Herschel, J. (1847). *Results of Astronomical Observations Made During the Years 1834, 5, 6, 7, 8, at the Cape of Good Hope*. London, Smith, Elder & Co.
- Ridpath, Ian & Tirion, Wil, *Collins Guide to Stars & Planets*, Collins, 2007
 - Bakich, Michael E. (editor), *Hubble’s Greatest Pictures*, Kalmbach, 2008

2.89.2 External links

•

- NGC 3532 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  11^h 05^m 12^s, −58° 44′ 1″

2.90 Caldwell 92

Coordinates:  10^h 45^m 08.5^s, −59° 52′ 04″

“Eta Carinae Nebula” redirects here. It is not to be confused with Eta Carinae’s **Homunculus Nebula**.

The **Carina Nebula** (also known as the **Great Nebula in Carina**, the **Eta Carinae Nebula**, NGC 3372, as well as the **Grand Nebula**) is a large bright nebula that has within its boundaries several related open clusters of stars, all part of the large OB association Carina OB1. The two star clusters Trumpler 14 and Trumpler 16 are the youngest clusters in the association, but Trumpler 15, Collinder (Cr) 228, Cr 232, NGC 3324, and NGC 3293 are all considered members. Trumpler 14 is one of the youngest known star clusters, at half a million years old. Trumpler 16 is the home of WR 25, currently the most luminous star known in our Milky Way galaxy, together with the less luminous but more massive and famous Eta Carinae star system, and HD 93129A. NGC 3293 is the oldest furthest from Trumpler 14, indicating sequential and ongoing star formation. The nebula lies at an estimated distance between 6,500 and 10,000 light years from Earth. It appears in the constellation of Carina, and is located in the Carina–Sagittarius Arm. The nebula contains multiple O-type stars.

The nebula is one of the largest diffuse nebulae in our skies. Although it is some four times as large and even brighter than the famous Orion Nebula, the Carina Nebula is much less well known, due to its location in the southern sky. It was discovered by Nicolas Louis de Lacaille in 1751–52 from the Cape of Good Hope.

2.90.1 Objects within the Carina Nebula

Eta Carinae

Main article: Eta Carinae

Eta Carinae is a highly luminous hypergiant star. Estimates of its mass range from 100 to 150 times the mass of the Sun, and its luminosity is about four million times that of the Sun.

This object is currently the most massive star that can be studied in great detail, because of its location and



Carina Nebula, glowing intensely red in the middle of the image.^[5]

size. Several other known stars *may* be more luminous and more massive, but data on them is far less robust. (Caveat: Since examples such as the *Pistol Star* have been demoted by improved data, one should be skeptical of most available lists of “most massive stars.” In 2006, Eta Carinae still had the highest *confirmed* luminosity, based on data across a broad range of wavelengths.) Stars with more than 80 times the mass of the Sun produce more than a million times as much light as the Sun. They are quite rare—only a few dozen in a galaxy as big as ours—and they flirt with disaster near the *Eddington limit*, i.e., the outward pressure of their *radiation* is almost strong enough to counteract *gravity*. Stars that are more than 120 solar masses exceed the theoretical Eddington limit, and their gravity is barely strong enough to hold in its radiation and gas, resulting in a possible *supernova* or *hypernova* in the near future.

Eta Carinae’s effects on the nebula can be seen directly. The dark *globules* in the above image and some other less visible objects have tails pointing directly away from the massive star. The entire nebula would have looked very different before the Great Eruption in the 1840s surrounded Eta Carinae with dust, drastically reducing the amount of *ultraviolet* light it put into the nebula.

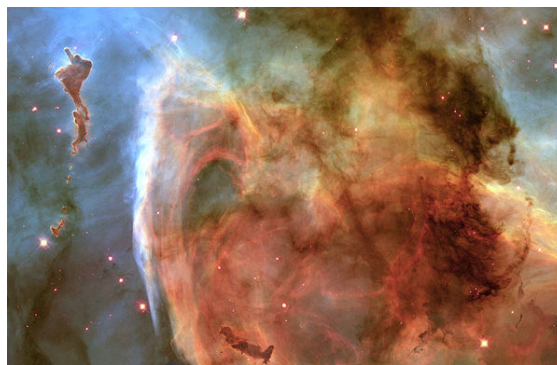
Homunculus Nebula

Main article: [Homunculus Nebula](#)

Within the large bright nebula is a much smaller feature, immediately surrounding Eta Carinae itself, known as the *Homunculus* Nebula (from the *Latin* meaning *Little Man*). It is believed to have been ejected in an enormous outburst in 1841 which briefly made Eta Carinae the second-brightest star in the sky.

Keyhole Nebula

A portion of the Carina Nebula is known as the Keyhole, a name introduced by *John Herschel* in the 19th century. The Keyhole is often called the Keyhole Nebula (though



Detail of the Keyhole Nebula, imaged by Hubble Space Telescope. The small nebula to the upper left has been nicknamed “finger of God” or “God’s birdie”, due to the gesture it appears to be making.

that name is often applied to the Carina Nebula as a whole, signifying “the nebula containing the Keyhole”).^[6] The Keyhole is a much smaller and darker cloud of cold molecules and dust within the Carina Nebula, containing bright filaments of hot, fluorescing gas, silhouetted against the much brighter background nebula. The diameter of the Keyhole structure is approximately 7 light years.

The Keyhole does not have its own NGC designation. It is often erroneously called NGC 3324,^[7] but that catalogue designation refers to a reflection and emission nebula just northwest of the Carina Nebula (or to its embedded star cluster).^{[8][9][10]}

Mystic Mountain

Main article: [Mystic Mountain](#)

The “Mystic Mountain” is an image of a dust–gas pillar in the Carina Nebula taken by *Hubble Space Telescope* on its 20th anniversary. The area was observed by Hubble’s Wide Field Camera 3 on February 1–2, 2010. The pillar measures three *light years* in height; nascent stars inside the pillar fire off gas jets, that stream from towering peaks.

2.90.2 Gallery

- Overview of the Carina Nebula. The Keyhole is superimposed on the bright area above center, and Eta Carinae is the bright star just to its left. Credit *ESO*.
- The Eta Carinae Nebula. Credit *ESO*.
- The Carina Nebula from the observatory OALM, Montevideo, Uruguay. South is up; NGC 3324 is visible in the lower left corner.
- The Eta Carinae Nebula around the Wolf–Rayet star WR 22. Credit *ESO*.

- A **Hubble Space Telescope** (HST) false-color image/diagram of the Carina Nebula ([Zoomable version](#)); Credit: HST/NASA/ESA.
- Supermassive star **Eta Carinae** within the Homunculus Nebula, as imaged by **Hubble Space Telescope**.
- Colour-composite image of the Eta Carinae Nebula, revealing exquisite details in the stars and dust of the region. Credit ESO.
- The open cluster known as **Trumpler 14** imaged by the Multi-conjugate Adaptive optics Demonstrator (MAD) on ESO's **VLT**.
- Hubble's photo of turbulent neighborhood near eruptive star.
- "Mystic Mountain".
- Infrared image of "Mystic Mountain" from the Hubble Space Telescope.



Tour of the Carina Nebula.



Carina Nebula.



This video starts from a wide-field view of the constellation of Carina (The Keel), and zooms in to the Carina Nebula region.



This zoom sequence starts with a broad view of the **Milky Way** and closes in on the Carina Nebula. In the final sequence we see a new image taken in **infrared** light using the HAWK-I camera on ESO's **Very Large Telescope**. Many previously hidden features, scattered across a spectacular celestial landscape of gas, dust and young stars, have emerged.



This video sequence compares a view of the Carina Nebula taken in visible light with a new picture taken in infrared light. The visible-light view comes from the MPG/ESO 2.2-metre telescope at the **La Silla Observatory** and the new infrared picture comes from the HAWK-I camera on ESO's Very Large Telescope. Many new features that are not seen at all in visible light can be seen in great detail in the new sharp infrared image from the VLT.

2.90.3 References

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- [2] "NGC 3372 - The Eta Carinae Nebula". *Atlas of the Universe*. Retrieved 2013-10-01.
- [3] "NGC 3372". *SIMBAD*. Centre de données astronomiques de Strasbourg. Retrieved 2013-09-03.
- [4] O'Meara, S. J. (2002). *The Caldwell Objects*. Cambridge University Press. pp. 361–369. ISBN 0-521-82796-5.
- [5] "One Picture, Many Stories". *ESO Picture of the Week*. Retrieved 13 February 2013.

- [6] See, e.g., *Burnham's Celestial Handbook*, Dover, 1978, p. 467.
- [7] For example, see *APOD - NGC 3324*.
- [8] Kepple et al. (2008). *The Night Sky Observer's Guide*. Vol. 3. Willman Bell, Inc. p. 52. ISBN 9780943396897.
- [9] "Results for NGC 3324". *NGC/IC Project*. Retrieved 17 May 2014.
- [10] "NGC 3324". *SIMBAD*. Retrieved 17 May 2014.

2.90.4 External links

- **European Southern Observatory**: Carina Nebula shown in colourful detail - February 12, 2009
- **NASA Astronomy Picture of the Day**: Open star cluster Trumpler 16 - December 1, 2008
- **NASA Astronomy Picture of the Day**: Eta Carinae and the Homunculus Nebula - June 17, 2008
- **NASA Astronomy Picture of the Day**: The Great Nebula in Carina - July 19, 1999
- **SEDs**: The Eta Carinae Nebula
- **The ESA Hubble Space Telescope site**: Results for the Carina Nebula
-
- Carina Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- Interactive: The Carina Nebula in all its Glory...
- Carina Nebula on Constellation Guide

2.91 Caldwell 93

NGC 6752 is a globular cluster in the constellation Pavo.^[7] It is the third brightest in the sky, after 47 Tucanae and Omega Centauri,^[8] and is best seen from June to October.^[9]

NGC 6752 was first identified by one James Dunlop of Parramatta on 30 June 1826, who described it as an irregular bright nebula which could be resolved into a cluster of many stars, highly compressed at the centre. This corresponds with a core region densely populated with stars around 1.3 light years in diameter, which indicates it has undergone core collapse. The cluster lies around 13,000 light years distant and is one of the closer globular clusters to Earth. It also lies 17,000 light years away from the galactic centre.^[7] It belongs to Shapley–Sawyer Concentration Class VI, namely of intermediate density,^[1] and has been calculated to be 11.78 billion years old.^[6] There are a large number of binary stars in the system, as well as

blue stragglers, which are likely to have been formed by collisions and mergers of smaller stars. The NASA website "Astronomy Picture of the Day" notes that it holds over 100 thousand stars in a sphere about 100 light-years in diameter.^[8]

The apparent magnitude of the cluster is 5.4, so it can be seen with the unaided eye.^[7] However this depends on good viewing conditions with a minimum of light pollution.^[9] With binoculars it can be seen to cover an area three quarters the size of the full moon. It lies 1.5 degrees east of 5th magnitude Omega Pavonis.^[7] The nearest bright star is Peacock, which lies 3.25 degrees north and 9.25 degrees east.^[9]

Six X-ray sources have been identified in the cluster's core by the Chandra X-Ray Observatory.^[9]

2.91.1 Gallery

- NGC 6752 taken by the Wide Field Imager on the MPG/ESO 2.2-meter telescope.^[1]
 - Map showing location of NGC 6752
1. ^ "Low Sodium Diet Key to Old Age for Stars". *ESO Press Release*. Retrieved 30 May 2013.

2.91.2 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), "A Classification of Globular Clusters", *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), "The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters", *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Boyles, J. et al. (November 2011), "Young Radio Pulsars in Galactic Globular Clusters", *The Astrophysical Journal* **742** (1): 51, arXiv:1108.4402, Bibcode:2011ApJ...742...51B, doi:10.1088/0004-637X/742/1/51.
- [4] "SIMBAD Astronomical Database". *Results for NGC 6752*. Retrieved 2007-04-21.
- [5] Marks, Michael; Kroupa, Pavel (August 2010), "Initial conditions for globular clusters and assembly of the old globular cluster population of the Milky Way", *Monthly Notices of the Royal Astronomical Society* **406** (3): 2000–2012, arXiv:1004.2255, Bibcode:2010MNRAS.406.2000M, doi:10.1111/j.1365-2966.2010.16813.x. Mass is from MPD on Table 1.
- [6] Forbes, Duncan A.; Bridges, Terry (May 2010), "Accreted versus in situ Milky Way globular clusters", *Monthly Notices of the Royal Astronomical*

Society **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.

- [7] O'Meara, Stephen James (2013). *Deep-Sky Companions: Southern Gems*. Cambridge University Press. pp. 410–12. ISBN 1107015014.
- [8] Nemiroff, Robert; Bonnell, Jerry (5 July 2013). "Globular Star Cluster NGC 6752". *Astronomy Picture of the Day*. NASA. Retrieved 20 August 2013.
- [9] Mobberley, Martin (1999). *The Caldwell Objects And How to Observe Them*. Springer. pp. 194–95. ISBN 978-1-4419-0326-6.

2.91.3 External links

-
- NGC 6752 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- <http://seds.org/>

Coordinates:  19^h 10^m 51.8^s, −59° 58′ 54.7″

2.92 Caldwell 94

This article is about article is about the star cluster. For other uses, see [Jewel box](#).

The **Jewel Box**, **Kappa Crucis Cluster**, **NGC 4755**, is an open cluster in the constellation **Crux**, originally discovered by **Nicolas Louis de Lacaille** during 1751–1752. This famous cluster was later named the Jewel Box by **Sir John Herschel** when he described its telescopic appearance as “a casket of variously coloured precious stones.” It is easily visible to the naked eye as a hazy star some 1.0° southeast of the first-magnitude star **Beta Crucis**. This hazy star (the core of the cluster) was assigned the **Bayer star designation Kappa Crucis**, from which the cluster takes one of its common names. The modern designation **Kappa Crucis** has been assigned to one of the stars in the central A-shaped asterism of the cluster, the third brightest cluster star (HD 111973, HIP 62931, HR 4890), located at the base of the right leg of the A. This is a blue supergiant of spectral type B3Iae, shining at the apparent visual magnitude of 5.94. Two other cluster stars are brighter than κ Cru, namely, 5.77 magnitude star HD 111904 (HIP 62894), at the tip of the A, and HD 111613 (HIP 62732) at 5.75, which is 15 arc minutes beyond the asterism toward **Beta Crucis**.^[5]

This cluster is one of the youngest known, with an estimated age of 14 million years. It has a total integrated magnitude of 4.2, is located 6,440 light years from Earth, and contains around 100 stars.

2.92.1 Discovery and observation

The Jewel Box as a star cluster was first determined by **Nicolas Louis de Lacaille** while he was doing his **South African** astrometric observations for his star catalogue. He saw the object as a nebulous cluster due to the small aperture of his telescope, but was the first to recognize it as consisting of many stars.^{[6][7]} The name “Jewel Box” comes from **John Herschel**'s description of it: "...this cluster, though neither a large nor a rich one, is yet an extremely brilliant and beautiful object when viewed through an instrument of sufficient aperture to show distinctly the very different colour of its constituent stars, which give it the effect of a superb piece of fancy jewellery"^[6]

Herschel recorded the positions of 100 members of the cluster in 1834–1838.^[8]

2.92.2 Physical characteristics

The Jewel Box cluster is one of the youngest known open clusters. The mean radial velocity of the Jewel Box cluster is −21 kilometres per second (−13 mi/s).^[3] The brightest stars in the Jewel Box cluster are **supergiants**, and include some of the brightest stars in the **Milky Way galaxy**.^[9]

Calculating its distance is difficult due to the proximity of the **Coalsack Nebula**, which obscures some of its light.^[10]

2.92.3 Observation

The Jewel Box cluster is regarded as one of the finest objects in the southern sky.^[11] It is visible to the naked eye as a hazy object of the fourth magnitude.^[12] It can be easily located using the star **Beta Crucis** as a guide, and appears as a fourth magnitude object.^[13] It is impressive when viewed with binoculars or a small or large telescopes. The three brightest members of the cluster lie in a straight line known as the 'traffic lights' due to their varying colours.^[14]

2.92.4 Gallery

- Wide Field Image of the Jewel Box.
- Digitized Sky Survey 2 image of the Jewel Box.
- **Hubble** image of the Jewel Box.
- Putting the images in perspective.


2.92.5 References

- [1] “SIMBAD Astronomical Database”. *Results for NGC 4755*. Retrieved 2006-12-14.

- [2] “WEBDA Open cluster”. *Results for NGC 4755*. Retrieved 2007-01-12.
- [3] Kaltcheva, N.; Golev, V.; Moran, K. (2013). “Massive Stellar Content of the Galactic Supershell GSH 305+01-24”. [arXiv:1312.5592v1](https://arxiv.org/abs/1312.5592v1) [astro-ph.GA].
- [4] “Deepsky Observer Companion Database”. *Results for NGC 4755*. Retrieved 2013-06-08.
- [5] <http://www.southastrodel.com/Page002.htm>, NGC 4755 : The Jewel Box “The Jewel of the South” : Introduction
- [6] http://www.docdb.net/show_object.php?id=ngc_4755, DOCdb : Jewel Box
- [7] <http://www.southastrodel.com/Page004.htm>, History of the Jewel Box Part One : 1752-1834
- [8] Thackeray, A. D. (1949). “The Kappa Crucis Cluster”. *Monthly Notes of the Astronomical Society of South Africa* 8: 30. Bibcode:1949MNSSA...8...30T.
- [9] Burnham, Robert (1978). *Burnham’s Celestial Handbook: An Observer’s Guide to the Universe Beyond the Solar System*. New York: Dover Publications. p. 730. ISBN 978-0-486-23568-4.
- [10] Consolmagno, Guy; Davis, Dan (2005). *Turn left at Orion: a hundred night sky objects to see in a small telescope*. Cambridge, United Kingdom: University of Cambridge. p. 189. ISBN 0-521-78190-6.
- [11] Kaler, James B. (1989). *Stars and their spectra: an introduction to the spectral sequence*. University of Cambridge. p. 13. ISBN 978-0-521-58570-5.
- [12] Ridpath, Ian; Tirion, Wil (2007). *Stars and Planets*. p. 134. ISBN 978-0-691-13556-4.
- [13] Mobberley, Martin (2009). *The Caldwell Objects*. Springer. p. 196. doi:10.1007/978-1-4419-0326-6. ISBN 978-1-4419-0325-9.
- [14] Inglis, Mike (2004). *Astronomy of the Milky Way: The observer’s guide to the southern Milky Way*. Springer. pp. 78–79. ISBN 1-85233-709-5.

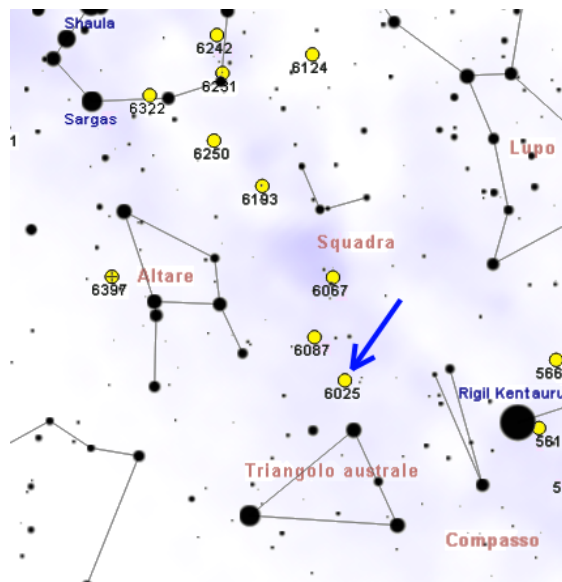
2.92.6 External links

- SEDS: NGC 4755, with a Copyright Anglo-Australian Observatory Image of NGC 4755
-
- The Jewel Box on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- A Copyright T. Warner Amateur Image of NGC4755

Coordinates:  12^h 53^m 42^s, −60° 22′ 00″

2.93 Caldwell 95

NGC 6025 is an open cluster located 2,700 light years away in the Triangulum Australe constellation. It was discovered by Abbe Lacaille in 1751 or 1752 during his South Africa tour.



Map showing location of NGC 6025

2.93.1 External links

- NGC 6025 at SEDS
- NGC 6025 at Messier45
-
- NGC 6025 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

2.93.2 References

Coordinates:  16^h 03^m 42^s, −60° 30′ 00″

2.94 Caldwell 96

NGC 2516 is an open star cluster in the southern sky in the constellation Carina discovered by Abbe Lacaille in 1751-1752. It is most commonly referred to as NGC 2516 but is also known as the **Sprinter**.^{[1][2]}

2.94.1 Description

This bright cluster itself is easily visible with the naked eye as a hazy patch, but is resolvable into stars using

binoculars. It contains two 5th magnitude **red giant stars** and three main **visual double stars**: HJ 4027, HJ 4031 and I 29. A small **telescope** would be required to split the double stars, which are all pairs of 8-9 magnitude and 1-10 arcseconds separation.^[3]

NGC 2516 and the recently discovered nearby **star cluster Mamajek 2** in **Ophiuchus** have similar age and **metallicity**. Recently, kinematic evidence was presented by E. Jilinski and coauthors that suggests that these two stellar groups may have formed in the same star-forming complex some 135 million years ago.^[4]

2.94.2 References

- [1] Papadopoulos, Leonidas (2014). "ESA's 'Mission: Impossible' Sees First Light: Gaia Opens Her Eyes to the Galaxy « AmericaSpace". *americaspace.com*. Retrieved 13 June 2014.
- [2] "Imaging the Southern Sky : An Amateur Astronomer's Guide" Chadwick, S., Cooper, I., pg.viii, Pub. Springer (2012)
- [3] Burnham (1978), Vol I p.458
- [4] Jilinski, E.; Ortega, V.G.; de la Reza, R.; Drake, N.A.; et al. (2009). "Dynamical Evolution and Spectral Characteristics of the Stellar Group Mamajek 2". *Astrophysical Journal* **691** (1): 212. Bibcode:2009ApJ...691..212J. doi:10.1088/0004-637X/691/1/212.


2.94.3 Bibliography

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2.94.4 External links

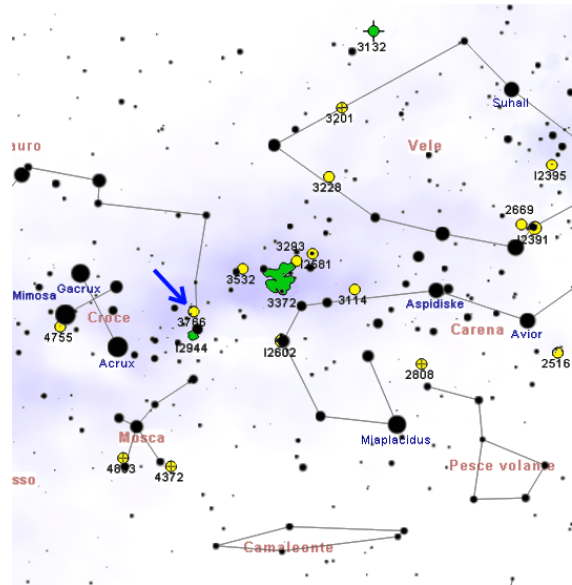
•

- NGC 2516 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  07^h 58^m 20^s, −60° 52′ 00″

2.95 Caldwell 97

NGC 3766 is an **open star cluster** in the southern constellation **Centaurus**. It is located in the vast star-forming region known as the Carina molecular cloud, and was discovered by Nicolas Louis de Lacaille during his astrometric survey in 1751–1752. At a distance of about 1745 pc,^[2] the cluster subtends a diameter of about 12 minutes of arc.^[3]



Map showing the location of NGC 3766

There are 137 listed stars, but many are likely non-members, with only 36 have accurate photometric data.^[4] Total apparent magnitude of 5.3 and integrated spectral type of B1.7.^[2] NGC 3766 is relatively young that is estimated as log (7.160) or 14.4 million years,^[3] and approaching us at $-14.8 \text{ km}\cdot\text{s}^{-1}$.^[2] This cluster contains eleven Be stars, two red giants and four Ap stars.^[4]

2.95.1 See also

- New General Catalogue


2.95.2 References

- [1] "New Kind of Variable Star Discovered". *ESO Press Release*. Retrieved 14 June 2013.
- [2] "SIMBAD Astronomical Dancg3766webdatabase". *Results for NGC 3766*. Retrieved 2013-06-13.
- [3] "WEBDA Astronomical Database". *WEBDA Page for NGC 3766*. Retrieved 2013-06-13.
- [4] "Webda Astronomical Database". *WEBDA Page for NGC 3766a*. Retrieved 2013-06-13.

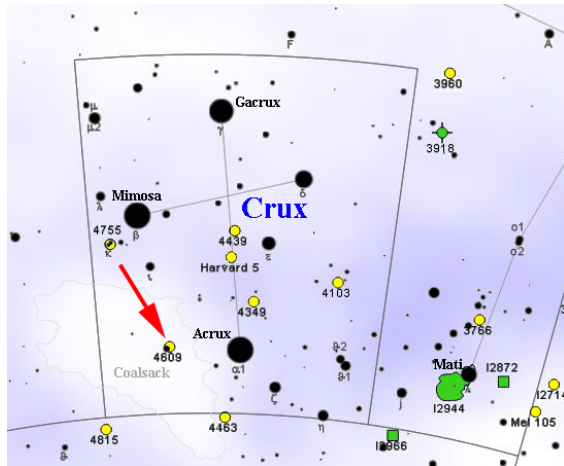
2.95.3 External links

- NGC 3766 at SEDS
- Astrophotograph Link
- WEBDA Data on NGC 3766 by Lynga
-

- NGC 3766 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  $11^{\text{h}} 36^{\text{m}} 06^{\text{s}}, -61^{\circ} 37' 00''$

2.96 Caldwell 98




Map showing the location of NGC 4609

NGC 4609 is an open cluster in the southern constellation of Crux.

2.96.1 External links

- NGC 4609 at WEBDA
-
- NGC 4609 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  $12^{\text{h}} 42^{\text{m}} 18^{\text{s}}, -62^{\circ} 59' 42''$

2.97 Caldwell 99

The **Coalsack Dark Nebula** (or simply the **Coalsack**) is the most prominent dark nebula in the skies, easily visible to the naked eye as a dark patch silhouetted against the southern Milky Way. It is located at a distance of approximately 600 light years away from Earth, in the constellation Crux.

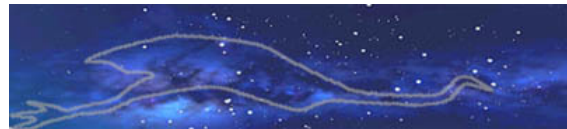
2.97.1 General information

The Coalsack Dark Nebula covers nearly 7° by 5° and overlaps somewhat into the neighbor constellations

Centaurus and Musca.^[1] The first observation was reported by Vicente Yáñez Pinzón in 1499. It was named “*il Canopo fosco*” (the dark Canopus) by Amerigo Vespucci and was also called “*Macula Magellani*” (Magellan’s Spot) or “*Black Magellanic Cloud*” in opposition to the Magellanic Clouds.

In 1970, Kalevi Mattila proved the Coalsack is not totally black. It has a very dim glow (10% of the brightness of the surrounding Milky Way), which comes from the reflection of the stars it obscures.

The Coalsack is not present in the New General Catalogue and in fact does not have an identification number (outside of the Caldwell Catalogue, in which it is **C99**).



A depiction of the Emu in the sky, which is an Australian Aboriginal constellation consisting of dark clouds rather than of stars. The European constellation on the right is Crux, or the Southern Cross, and on the left is Scorpius. The head of the emu is the Coalsack.

The Coalsack is important in Australian Aboriginal astronomy, and forms the head of the *Emu in the sky* in several Aboriginal cultures. Amongst the Wardaman people, it is said to be the head and shoulders of a *law-man* watching the people to ensure they do not break traditional law. According to a legend reported by W.E. Harney, this being is called *Utdjungon* and only adherence to the tribal law by surviving tribe members could prevent him from destroying the world with a fiery star.^[2]

In Inca astronomy this nebula was called *Yutu* meaning a *partridge-like southern bird*^[3] or *Tinamou*.^[4]

2.97.2 In fiction



The dark Coalsack Nebula can be seen as an obscuring smudge across the Milky Way.^[5] 1

The Coalsack is mentioned in the *Star Trek: The Original Series* episodes "The Immunity Syndrome" and "Let

"That Be Your Last Battlefield", as well as *2001: A Space Odyssey* by Arthur C. Clarke.

In the Solar Queen series by Andre Norton, several characters swear "...by the Coalsack's Ripcord!"^[6]

The Coalsack figures prominently in the Larry Niven and Jerry Pournelle's science fiction novel *The Mote in God's Eye* and its sequels, *The Gripping Hand* and *Outies*.^[7]

Also, Henry De Vere Stacpoole described the Coalsack in his novel, *The Blue Lagoon* (1908), as LeStrange observes it from the deck of the *Northumberland*, "In the Milky Way, near the Southern Cross, occurs a terrible circular abyss, the Coal Sack. So sharply defined is it, so suggestive of a void and bottomless cavern, that the contemplation of it afflicts the imaginative mind with vertigo. To the naked eye it is as black and dismal as death, but the smallest telescope reveals it beautiful and populous with stars. LeStrange's eyes travelled from this mystery to the burning cross, and ..." ^[8]

The Coalsack is mentioned in the *Futurama* episode "Hell Is Other Robots".^[9]

In the film *Night on the Galactic Railroad*, the character Campanella ends going to the Coalsack.

In the film, *The Chronicles of Riddick*, the character Imam convinces Riddick to help his people against the Necromongers, and says, "The Coalsack planets are gone." ^[10]

2.97.3 Gallery

- The Coalsack Nebula can be seen as the large dark region near the top of the photo.

2.97.4 References

- [1] Darling, David J. (2004). *The universal book of astronomy: from the Andromeda Galaxy to the zone of avoidance*. Hoboken, New Jersey: Wiley. p. 351. ISBN 0471265691.
- [2] Songs of the Songmen, 28-30.
- [3] p. 5, *The Hundred Greatest Stars*, James B. Kaler, New York, Copernicus Books, 2002.
- [4] A.F. Aveni, ed. (2010). *Archaeoastronomy in the New World : American primitive astronomy : proceedings of an international conference held at Oxford University, September, 1981*. Cambridge: Cambridge University Press. ISBN 0521125472.
- [5] "An Emu in the Sky over Paranal". www.eso.org. European Southern Observatory. Retrieved 1 October 2014.
- [6] <https://www.gutenberg.org/files/16921/16921-h/16921-h.htm>
- [7] http://www.amazon.com/Outies-Mote-Gods-Eye-3/dp/0615434142/ref=sr_1_cc_1?s=movie-tv&ie=UTF8&qid=1318736760&sr=1-1-catcorr


- [8] H. De Vere Stacpoole: 'The Blue Lagoon', London: Adelphi Terrace, 1908, T. Fisher Unwin Ltd., quote taken from 28th Impression (1923), p. 12, from pdf p. 28 at <http://archive.org/details/bluelagoonromanc00stacrich>

- [9] http://theinfosphere.org/Hell_Is_Other_Robots

- [10] http://www.script-o-rama.com/movie_scripts/c/chronicles-of-riddick-script-transcript.html

2.97.5 External links

- Starry Night Photography: Coalsack Dark Nebula
- Starry Night Photography: The Emu
- SIMBAD: Coal Sack Nebula

Coordinates:  12^h 52^m 19^s, −62° 25′ 28″

2.98 Caldwell 100

IC 2944, also known as the **Running Chicken Nebula** or the **Lambda Centauri Nebula**, is an **open cluster** with an associated **emission nebula** found in the constellation **Centaurus**, near the star **Lambda Centauri**. It features **Bok globules**, which are frequently a site of active star formation. However, no evidence for star formation has been found in any of the globules in IC 2944.^[2]

The ESO Very Large Telescope image on the right is a close up of a set of Bok globules discovered in IC 2944 by South African astronomer A. David Thackeray in 1950.^[3] These globules are now known as **Thackeray's Globules**.

2.98.1 Gallery

- Image from the Wide Field Imager on the MPG/ESO 2.2-metre telescope.^[1]
1. ^ "An Angry Bird in the Sky". *ESO Photo Release*. 21 September 2011. Retrieved 22 September 2011.

2.98.2 References

- [1] Thackeray, A. D.; Wesselink, A. J.: "A photometric and spectroscopic study of the cluster IC 2944", *MNRAS* 131,121, 1965 Abstract
- [2] *Astron. Astrophys.* 327, 1185, 1997
- [3] Thackeray A.D.: "Some southern stars involved in nebulosity", *MNRAS* 110,529, 1950. Abstract

2.98.3 External links

- SEDS: IC 2944
- IC 2944 at ESA/Hubble

2.99 Caldwell 101

NGC 6744 is an intermediate spiral galaxy about 30 million light-years away^[2] in the constellation Pavo. It is thought to be one of the most Milky Way-like spiral galaxies in our immediate vicinity, with flocculent (fluffy) arms and an elongated core. It also has at least one distorted companion galaxy (NGC 6744A) superficially similar to one of the **Magellanic Clouds**.^[3] A supernova was discovered in the galaxy in 2005.^[4]

2.99.1 Gallery

- Spiral Galaxy NGC 6744 as seen at SALT
- NGC 6744 by GALEX

2.99.2 See also

- NGC 1232

2.99.3 References

- [1] “NASA/IPAC Extragalactic Database”. *Results for NGC 6744*. Retrieved 2006-08-31.
- [2] “Distance Results for NGC 6744”. *NASA/IPAC Extragalactic Database*. Retrieved 2010-06-19.
- [3] “NASA/IPAC Extragalactic Database”. *Results for NGC 6744A*. Retrieved 2010-06-19.
- [4] Mobberley, Martin (1999). *The Caldwell Objects And How to Observe Them*. Springer. pp. 208–09. ISBN 978-1-4419-0326-6.

2.99.4 External links

-
- NGC 6744 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- NGC 6744, a Milky Way-like spiral galaxy
- NGC 6744 (Pav)
- June 4, 2010 – A Sibling of the Milky Way (Wise image of NGC 6744)
- A spiral galaxy that resembles our Milky Way (1 June 2011)
- Merrifield, Michael. “NGC 6744 The Milky Way’s Twin”. *Sixty Symbols*. Brady Haran for the University of Nottingham.



The open cluster IC 2602.

2.100 Caldwell 102

IC 2602, also known as the **Theta Carinae Cluster** or **Southern Pleiades**, is an open cluster in the constellation Carina. It was discovered by Abbe Lacaille in 1751 from South Africa. The cluster is at a distance of about 479 light-years away from Earth and can be seen with the naked eye. The Southern Pleiades (IC 2602) has an overall apparent magnitude of 1.9, which is 70% fainter than the Taurean Pleiades, and contains about 60 stars. Theta Carinae, the brightest star within the open cluster, is a third-magnitude star with an apparent magnitude of +2.74. All the other stars within the cluster are of the fifth magnitude and fainter. Like its northern counterpart in Taurus, the Southern Pleiades spans a sizeable area of sky, approximately 50 arcminutes, so it is best viewed with large binoculars or telescope with a wide-angle eyepiece. The cluster is thought to have the same age as the open cluster IC 2391,^[1] which has a lithium depletion boundary age of 50 million years old.^[2]

2.100.1 See also

- Theta Carinae star

2.100.2 References

- Space.com

- [1] Stauffer, J.R. et al. (1997). “Rotational Velocities and Chromospheric/Coronal Activity of Low-Mass Stars in the Young Open Clusters IC 2391 and IC 2602”. *Astrophysical Journal* **479** (2): 776. Bibcode:1997ApJ...479..776S. doi:10.1086/303930.
- [2] Barrado y Navascues, D., Stauffer, J.R., & Jayawardhana, R. (2002). “Spectroscopy of Very Low Mass Stars and Brown Dwarfs in IC 2391: Lithium Depletion and H α Emission”. *Astrophysical Journal* **614** (1): 386–397. arXiv:astro-ph/0406436. Bibcode:2004ApJ...614..386B. doi:10.1086/423485.

2.100.3 External links

- The Southern Pleiades @ SEDS IC objects pages
- Image Southern Pleiades(IC 2602)

Coordinates:  $10^{\text{h}} 42^{\text{m}} 56^{\text{s}}, -64^{\circ} 23' 42''$

2.101 Caldwell 103

The **Tarantula Nebula** (also known as **30 Doradus**) is an **H II region** in the **Large Magellanic Cloud (LMC)**. It was originally thought to be a **star**, but in 1751 **Nicolas Louis de Lacaille** recognized its **nebular nature**.

The Tarantula Nebula has an **apparent magnitude** of 8. Considering its distance of about 49 **kpc**^[2] (160,000 **light-years**), this is an extremely luminous non-stellar object. Its **luminosity** is so great that if it were as close to **Earth** as the **Orion Nebula**, the Tarantula Nebula would cast shadows.^[4] In fact it is the most active **starburst region** known in the **Local Group** of galaxies. It is also one of the largest such regions in the Local Group with an estimated diameter of 200 **pc**.^[3] The nebula resides on the leading edge of the LMC where **ram pressure stripping**, and the compression of the **interstellar medium** likely resulting from this, is at a maximum.

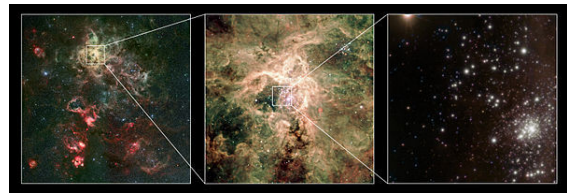
30 Doradus has at its centre the star cluster **NGC 2070** which includes the compact concentration of stars known as **R136**^[5] that produces most of the energy that makes the nebula visible. The estimated mass of the cluster is 450,000 solar masses, suggesting it will likely become a **globular cluster** in the future.^[6] In addition to **NGC 2070**, the Tarantula Nebula contains a number of other **star clusters** including the much older **Hodge 301**. The most massive stars of **Hodge 301** have already exploded in **supernovae**.^[7]

The closest **supernova** observed since the invention of the telescope,^[8] **Supernova 1987A**, occurred in the outskirts of the Tarantula Nebula.^[9] There is a prominent **supernova remnant** enclosing the open cluster **NGC 2060**, but the remnants of many other **supernovae** are difficult to detect in the complex **nebulousity**.^[10]

2.101.1 Gallery

- Hubble's Panoramic View of a Star-Forming Region in the super star cluster called **R136**.
- Brilliant star **VFTS 682** in the Large Magellanic Cloud. Credit ESO et al.
- Close-up of the Tarantula Nebula.
- The young cluster **RMC 136a**.

- Central region of the Tarantula Nebula – a mosaic of 15 **Hubble** images. Credit: **NASA/ESA/Danny LaCrue**.
- **LMC Region** near the Tarantula Nebula.
- Heart of the Tarantula Nebula: **R136** is located in the center of the image while **Hodge 301** is in upper right. Credit: **ESO**.
- Tarantula Nebula and its surroundings. Credit: **ESO**.
- Filaments in The Tarantula Nebula in the LMC. Credit: **ESO**.
- The nebula can be seen at the centre of this image.
- Tarantula nebula from the **Wide-field Infrared Survey Explorer (WISE)**.



The young cluster **RMC 136a**

Coordinates:  $05^{\text{h}} 38^{\text{m}} 38^{\text{s}}, -69^{\circ} 5.7' 0''$

2.101.2 References

- [1] “**SIMBAD Astronomical Database**”. *Results for Tarantula Nebula*. Retrieved 2006-12-22.
- [2] “**SEDS Students for the Exploration and Development of Space**”. *Results for Tarantula Nebula*. Retrieved 2007-05-08. 30 Doradus .. 49 kpc +- 3 kpc
- [3] Leboutteiller, V.; Bernard-Salas, J.; Brandl, B.; Whelan, D. G. et al. (June 2008). “Chemical Composition and Mixing in Giant H II Regions: NGC 3603, 30 Doradus, and N66”. *The Astrophysical Journal* **680** (1): 398–419. arXiv:0710.4549. Bibcode:2008ApJ...680..398L. doi:10.1086/587503.
- [4] <http://www.noao.edu/news/2011/pr1102.php>
- [5] Massey, P; Hunter, D. (January 1998). “Star Formation in R136: A Cluster of O3 Stars Revealed by Hubble Space Telescope Spectroscopy”. *The Astrophysical Journal* **493** (1): 180. Bibcode:1998ApJ...493..180M. doi:10.1086/305126.
- [6] Bosch, Guillermo; Terlevich, Elena; Terlevich, Roberto (2009). “Gemini/GMOS Search for Massive Binaries in the Ionizing Cluster of 30 Dor”. *Astronomical Journal* **137** (2): 3437–3441. arXiv:0811.4748. Bibcode:2009AJ....137.3437B. doi:10.1088/0004-6256/137/2/3437.

- [7] Grebel, Eva K.; Chu, You-Hua (2000). “Hubble Space Telescope Photometry of Hodge 301: An “Old” Star Cluster in 30 Doradus”. *Astronomical Journal* **119** (2): 787–799. arXiv:astro-ph/9910426. Bibcode:2000AJ....119..787G. doi:10.1086/301218.
- [8] “Tarantula Nebula’s Cosmic Web a Thing of Beauty”. SPACE.com. 2011-03-21. Retrieved 2011-03-26.
- [9] “Encyclopedia of Space”. Authors: Couper, Heather; Henbest, Nigel. Retrieved 2 January 2013.
- [10] Lazendic, J. S.; Dickel, J. R.; Jones, P. A. (2003). “Supernova Remnant Candidates in the 30 Doradus Nebula”. *The Astrophysical Journal* **596**: 287. doi:10.1086/377630.

2.101.3 External links

-
- Tarantula Nebula on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images
- APOD Images: 2003 August 23 & 2010 May 18
- SEDS Data: NGC 2070, The Tarantula Nebula
- Hubble Space Telescope Images of: The Tarantula Nebula
- European Southern Observatory Image of: The Tarantula Nebula
- The Scale of the Universe (Astronomy Picture of the Day 2012 March 12)
- Crowther, Paul. “Tarantula Nebula and Its Huge Stars”. *Deep Space Videos*. Brady Haran.

2.102 Caldwell 104

NGC 362 (Caldwell 104) is a globular cluster located in the constellation Tucana in the Southern Hemisphere, slightly north of the Small Magellanic Cloud. It was discovered on August 1, 1826 by James Dunlop.^[5] It is visible to the naked eye in dark skies, and is an impressive sight in a telescope, although it is somewhat overshadowed by its larger and brighter neighbour 47 Tucanae.^[6]

The stars of NGC 362 have an average metallicity higher than the stars in most globulars. This implies that NGC 362 is a relatively young globular cluster.^[6] It also has an overabundance of binary stars, and an exceptionally tight core 13 light-years in diameter.^[6] The orbit of NGC 362 is highly eccentric, taking it to within 3,260 light-years of the galactic center.^[6]

2.102.1 See also

- List of globular clusters

2.102.2 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astronomical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
- [3] Paust, Nathaniel E. Q. et al. (February 2010), “The ACS Survey of Galactic Globular Clusters. VIII. Effects of Environment on Globular Cluster Global Mass Functions”, *The Astronomical Journal* **139** (2): 476–491, Bibcode:2010AJ....139..476P, doi:10.1088/0004-6256/139/2/476.
- [4] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.
- [5] “NGC 362”. *SEDS*. Retrieved 28 June 2015.
- [6] O’Meara, Stephen James (2003). *Deep Sky Companions: The Caldwell Objects*. Cambridge University Press. pp. 409–412. ISBN 9780521827966.

2.102.3 External links

- SIMBAD: NGC 362
- Astrosurf: NGC 362
- Galactic Globular Clusters Database: NGC 362
- Galaxy Evolution Explorer Spies Band of Stars

2.103 Caldwell 105

NGC 4833 is a globular cluster discovered by Abbe Lacaille during his 1751-1752 journey to South Africa, and catalogued in 1755. It was subsequently observed and catalogued by James Dunlop and Sir John Herschel whose instruments could resolve it into individual stars.

The globular cluster is situated in the very southerly constellation Musca at a distance of 21,200 light years from Earth. It is partially obscured by a dusty region of the galactic plane. After corrections for the reddening by dust, evidence was obtained that it is in the order of 2 billion years older than globular clusters M5 or M92.

2.103.1 See also

- New General Catalogue

2.103.2 References

- [1] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
 - [2] Goldsbury, Ryan et al. (December 2010), “The ACS Survey of Galactic Globular Clusters. X. New Determinations of Centers for 65 Clusters”, *The Astrophysical Journal* **140** (6): 1830–1837, arXiv:1008.2755, Bibcode:2010AJ....140.1830G, doi:10.1088/0004-6256/140/6/1830.
 - [3] Boyles, J. et al. (November 2011), “Young Radio Pulsars in Galactic Globular Clusters”, *The Astrophysical Journal* **742** (1): 51, arXiv:1108.4402, Bibcode:2011ApJ...742...51B, doi:10.1088/0004-637X/742/1/51.
 - [4] “SIMBAD Astronomical Object Database”. *Results for NGC 4833*. Retrieved 2006-11-17.
 - [5] $\text{distance} \times \sin(\text{diameter_angle} / 2) = 42 \text{ ly. radius}$
 - [6] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.
1. CCD Photometry of the Globular Cluster NGC 4833 and Extinction Near the Galactic Plane, Melbourne et al., 25 September 2000, *Astrophysics Journal*

2.103.3 External links

- Discovery and early observations
- Basic information and data
- Photographed by the Antilhue amateur astronomical observatory
- Photometry applied to NGC 4833
- Position relative to nearby cluster NGC 4372
-
- NGC 4833 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  12^h 59^m 34.98^s, −70° 52′ 28.6″

2.104 Caldwell 106

47 Tucanae (NGC 104) or just **47 Tuc** is a **globular cluster** located in the **constellation Tucana**. It is about **16,700 light years** away from **Earth**, and **120 light years** across. It can be seen with the **naked eye**, with a visual **apparent magnitude** of **4.9**. Its number comes not from the **Flamsteed** catalogue, but the more obscure 1801 “Allgemeine Beschreibung und Nachweisung der Gestirne nebst Verzeichniss” compiled by **Johann Elert Bode**.

2.104.1 Characteristics

It is the second brightest globular cluster in the sky (after **Omega Centauri**), and is noted for having a very bright and dense core. It is also one of the most massive globular clusters in the Galaxy, containing millions of stars. The cluster appears roughly the size of the **full moon** in the sky under ideal conditions.

The core of 47 Tucanae was the subject of a major survey for **planets**, using the **Hubble Space Telescope** to look for **partial eclipses** of stars by their planets. No planets were found, though 10-15 were expected based on the rate of planet discoveries around stars near the Sun. This indicates that planets are relatively rare in globular clusters.^[8] A later ground-based survey in the uncrowded outer regions of the cluster also failed to detect planets when several were expected. This strongly indicates that the low **metallicity** of the environment, rather than the crowding, is responsible.

47 Tucanae’s dense core contains a number of exotic stars of scientific interest. Globular clusters efficiently sort stars by mass, with the most massive stars falling to the center.^[9] 47 Tucanae contains at least 21 **blue stragglers** near its core.^[10] It also contains hundreds of X-ray sources, including stars with enhanced **chromospheric** activity due to their presence in binary star systems, **cataclysmic variable** stars containing **white dwarfs** accreting from companion stars, and low-mass X-ray binaries containing **neutron stars** that are not currently accreting, but can be observed by the X-rays emitted from the hot surface of the neutron star.^[11] 47 Tucanae has 23 known **millisecond pulsars**, the second largest population of **pulsars** in any globular cluster.^[12] These pulsars are thought to be spun up by the **accretion** of material from binary companion stars, in a previous X-ray binary phase. The companion of one pulsar in 47 Tucanae, 47 Tucanae W, seems to still be transferring mass towards the **neutron star**, indicating that this system is completing a transition from being an accreting low-mass X-ray binary to a **millisecond pulsar**.^[13] X-ray emission has been individually detected from most millisecond pulsars in 47 Tucanae with the **Chandra X-ray Observatory**, likely emission from the neutron star surface,^[14] and gamma-ray emission has been detected with the **Fermi Gamma-ray Space Telescope** from its millisecond pulsar popula-

tion (making 47 Tucanae the first globular cluster to be detected in gamma-rays).^[15]

There is no evidence yet for the existence of any black holes in 47 Tucanae; Hubble Space Telescope data provides the strongest constraint on the mass of any possible black hole at its center, < 1500 times the mass of our Sun.^[16]

2.104.2 History

47 Tucanae was discovered by Nicolas Louis de Lacaille in 1751, who thought it was the nucleus of a bright comet.^[17] Its southern location had hidden it from European observers until then.

In December 2008, Ragbir Bhathal of the University of Western Sydney claimed the detection of a strong laser-like signal from the direction of 47 Tucanae.^[18]

In May 2015, the first observations of the process of mass segregation in this globular cluster were announced.^[19]

2.104.3 Gallery

- Evidence of multiple stellar populations^[1]
- Globular Cluster 47 Tuc. Credit ESO
- Play media

Sequence pans across a wide view of the region surrounding the SMC.

1. ^ “Hubble finds evidence of multiple stellar populations in globular cluster 47 Tucanae”. *Image Gallery*. ESA/Hubble. Retrieved 15 August 2013.

2.104.4 References

- [1] “Retirement in the suburbs”. Retrieved 12 June 2015.
- [2] Shapley, Harlow; Sawyer, Helen B. (August 1927), “A Classification of Globular Clusters”, *Harvard College Observatory Bulletin* (849): 11–14, Bibcode:1927BHarO.849...11S.
- [3] “SIMBAD Astronomical Database”. *Results for NGC 104*. Retrieved 2006-11-17.
- [4] “Distances, Ages, and Epoch of Formation of Globular Clusters”. *The Astrophysical Journal*. arXiv:astro-ph/9902086. Bibcode:2000ApJ...533..215C. doi:10.1086/308629. Retrieved 2008-11-12.
- [5] Marks, Michael; Kroupa, Pavel (August 2010), “Initial conditions for globular clusters and assembly of the old globular cluster population of the Milky Way”, *Monthly Notices of the Royal Astronomical Society* **406** (3): 2000–2012, arXiv:1004.2255, Bibcode:2010MNRAS.406.2000M, doi:10.1111/j.1365-2966.2010.16813.x. Mass is from MPD on Table 1.
- [6] $\text{distance} \times \sin(\text{diameter_angle} / 2) = 60 \text{ ly. radius}$
- [7] Forbes, Duncan A.; Bridges, Terry (May 2010), “Accreted versus in situ Milky Way globular clusters”, *Monthly Notices of the Royal Astronomical Society* **404** (3): 1203–1214, arXiv:1001.4289, Bibcode:2010MNRAS.404.1203F, doi:10.1111/j.1365-2966.2010.16373.x.
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2.104.5 External links

- 47 Tucanae at the ESA-Hubble website
- 47 Tucanae, Galactic Globular Clusters Database page
- 47 Tucanae at the Chandra X-ray Observatory website

2.105 Caldwell 107



Hubble Space Telescope image of the central region of NGC 6101

NGC 6101 is a globular cluster in the constellation Apus, which was discovered by James Dunlop and catalogued by him as $\Delta 68$. It requires a telescope of at least 20 cm (7.9 in) aperture to resolve individual stars.^[3]

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2.106 Caldwell 108

NGC 4372 is a globular cluster in the southern constellation of Musca.

2.106.1 References

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2.106.2 External links

- NGC 4372 at Wikisky
- NGC 4372 at Astrosurf
- NGC 4372 on WikiSky: DSS2, SDSS, GALEX, IRAS, Hydrogen α , X-Ray, Astrophoto, Sky Map, Articles and images

Coordinates:  12^h 26^m 00^s, −72° 40′ 00″

2.107 Caldwell 109

NGC 3195 is a planetary nebula located in the constellation Chamaeleon. It is the most southern of all the bright sizable planetary nebula in the sky, and remains invisible to all northern observers. Discovered by

Sir John Herschel in 1835, this 11.6 apparent magnitude planetary nebula is slightly oval in shape, with dimensions of 40×35 arc seconds, and can be seen visually in telescopic apertures of 10.5 centimetres (4.1 in) at low magnifications.

Spectroscopy reveals that NGC 3195 is approaching Earth at 17 kilometres per second (11 mi/s), while the nebulosity is expanding at around 40 kilometres per second (25 mi/s). The central star is listed as >15.3V or 16.1B magnitude. Stephen James O'Meara has seen it visually with a 20-inch telescope, but he is unaware of anyone else doing so.^[2] Distance is estimated at about 1.7 kpc.

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2.107.2 External links

- **The Hubble European Space Agency Information Centre** Hubble picture and information on NGC 3195

Chapter 3

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- **NGC 457** *Source:* https://en.wikipedia.org/wiki/NGC_457?oldid=660942282 *Contributors:* Bryan Derksen, Diderot, Jyrl, P.T. Aufrette, Joseph Dwayne, Rich Farmbrough, RjHall, A2Kafir, Danski14, Hégésippe Cormier, WilliamKF, Magister Mathematicae, Rjwilmsi, YGin-gras, YurikBot, Gaius Cornelius, Rayc, Miraculouschaos, Chris the speller, Bluebot, JoeBot, Cydebot, Headbomb, CielProfond, Xeno, STBot, Numbo3, VolkovBot, Rei-bot, Courtthree, Elphion, Latinquasar, PipepBot, XLinkBot, MystBot, Addbot, LaaknorBot, ArthurBot, Astrosigmaguy, Fotaun, LucienBOT, Tom.Reding, EmausBot, ZéroBot, H3llBot, Exoplanetaryscience, Monkbob, Jsaur and Anonymous: 10
- **Double Cluster** *Source:* https://en.wikipedia.org/wiki/Double_Cluster?oldid=653383396 *Contributors:* Jason Quinn, Petersam, RjHall, Chobot, Tianxiaozhang-enwiki, Eynar, Hu12, Robin Scagell, Cydebot, Nick Ottery, Tdvance, Alaibot, CielProfond, Escarbot, Rothorpe, Magioladitis, CommonsDelinker, SiliconDioxide, Fleebo, Ohms law, Amikake3, Elphion, SieBot, PlanetStar, Martarius, Roberto Mura, Addbot, Lightbot, John Belushi, Yobot, Ptboutgourou, FrescoBot, Originalwana, Alexchen4836, Roth ritter, RjwilmsiBot, H3llBot, Spork-Bot, Fa7ua-uva, Gallina3795, U-95, Khazar2, Rawastrodata, Exoplanetaryscience, Genuson, Spideratseds and Anonymous: 8
- **NGC 6826** *Source:* https://en.wikipedia.org/wiki/NGC_6826?oldid=677290530 *Contributors:* Bryan Derksen, Danski14, Melesse, FlaBot, SmackBot, Cydebot, Clh288, Thijs!bot, Headbomb, Bishzilla, TXiKiBoT, Rei-bot, Elphion, FKmailliW, Roberto Mura, MystBot, Addbot, LaaknorBot, BepBot, Numbo3-bot, John Belushi, Lucas-bot, Rubinbot, Analphabot, EmausBot, WikitanvirBot, ZéroBot, H3llBot, YFdyh-bot, Melonkelon, Exoplanetaryscience and Anonymous: 3
- **NGC 7243** *Source:* https://en.wikipedia.org/wiki/NGC_7243?oldid=669312854 *Contributors:* Auric, FlaBot, SmackBot, VirtualDave, Cydebot, Headbomb, AstroHurricane001, VolkovBot, TXiKiBoT, Elphion, Dana boomer, Roberto Mura, Addbot, LaaknorBot, S h i v a (Visnu), GrouchoBot, Telescopi, RedBot, EmausBot, WikitanvirBot, ZéroBot, H3llBot, Makecat-bot, Exoplanetaryscience, Egres73 and Anonymous: 4
- **NGC 147** *Source:* https://en.wikipedia.org/wiki/NGC_147?oldid=653384313 *Contributors:* DaMatriX, Jyrl, Trevor MacInnis, Rich Farmbrough, RjHall, El C, Ardric47, A2Kafir, Skatebiker, WilliamKF, SeventyThree, Smrgeog, MarSch, FlaBot, Chobot, YurikBot, Gadget850, Rayc, Calvin08, Mike Dillon, Reyk, Hurricane Devon, Bluebot, ZZZZZZZZZ, Newone, Lee937, Drinibot, Cydebot, Clh288, Thijs!bot, Headbomb, Escarbot, Bocianski.bot, Paperflight, VolkovBot, Rei-bot, Imasleepviking, Elphion, FKmailliW, KGyST, Lightmouse, Alexbot, Addbot, DOI bot, LaaknorBot, Numbo3-bot, Lucas-bot, Amirobot, TBIRD7777, AnomieBOT, Citation bot, DirlBot, GHJmover, Fotaun, Telescopi, Tom.Reding, EmausBot, H3llBot, Helpful Pixie Bot, Bibcode Bot, JYBot, CY17EPTEMA777, Kogge, Exoplanetaryscience, K9re11 and Anonymous: 8
- **NGC 185** *Source:* https://en.wikipedia.org/wiki/NGC_185?oldid=653384320 *Contributors:* Bryan Derksen, Looxix-enwiki, DaMatriX, Rursus, Jyrl, Joseph Dwayne, Trevor MacInnis, Rich Farmbrough, Aranel, RjHall, Huntster, Ardric47, WilliamKF, SeventyThree, YurikBot, Extraordinary Machine, NTBot-enwiki, Reyk, Hurricane Devon, Bluebot, ZZZZZZZZZ, Bless sins, Lee937, Drinibot, Cydebot, Clh288, Thijs!bot, Headbomb, Dr. Submillimeter, Winiar, Ohms law, VolkovBot, Elphion, FKmailliW, SieBot, Addbot, DOI bot, Numbo3-bot, Lucas-bot, Yobot, Amirobot, TBIRD7777, AnomieBOT, Citation bot, DirlBot, Quebec99, Fotaun, Rgocs, Telescopi, Citation bot 1, Tom.Reding, Full-date unlinking bot, Trappist the monk, Extra999, EmausBot, ZéroBot, H3llBot, Bibcode Bot, SamH112358, JYBot, CY17EPTEMA777, Georgij Michaliutin, Johndric Valdez, Exoplanetaryscience, NomolosX and Anonymous: 13
- **IC 5146** *Source:* https://en.wikipedia.org/wiki/IC_5146?oldid=653383460 *Contributors:* Netoholic, Rich Farmbrough, Rjwilmsi, FlaBot, Nfu-peng, Colonies Chris, VirtualDave, Cydebot, Sam Van Kooten, Headbomb, J.P.Lon, AstroHurricane001, Elphion, Mild Bill Hiccup, Hewholooks, Addbot, LaaknorBot, Numbo3-bot, John Belushi, Lucas-bot, ArthurBot, Xqbot, Fotaun, D'ohBot, Tom.Reding, Bitil Guilderstorne, Italia2006, H3llBot, Justincheng12345-bot, YFdyh-bot, OtterAM, Exoplanetaryscience, Monkbob and Anonymous: 6
- **North America Nebula** *Source:* https://en.wikipedia.org/wiki/North_America_Nebula?oldid=653383657 *Contributors:* Bryan Derksen, Dino, Saltine, Chuunen Baka, Robbot, Sverdrup, Jyrl, Netoholic, Curps, JamesHoadley, Joseph Dwayne, Tomruen, Rich Farmbrough, Worldtraveller, MattHaffner, Skatebiker, Kenyon, WilliamKF, Arnomane, MatthewDBA, Lzz, Chobot, YurikBot, Gadget850, Lt-wiki-bot, Scoutersig, Lviatour, SmackBot, Eskimbot, Bluebot, B00P, Snowmanradio, PrivateWiddle, Robofish, Hu12, OS2Warp, Jac16888, Cydebot, Clh288, Gnewf, Thijs!bot, IanOsgood, VoABot II, J.P.Lon, Bocianski.bot, CommonsDelinker, Skeptic2, 12dstring, Rochelimit, Philip tao, VolkovBot, Rei-bot, Elphion, Alexbot, Addbot, DOI bot, 41police, LaaknorBot, Numbo3-bot, Lightbot, Vedran V, Nhoss2, Lukas-bot, Pakos, The High Fin Sperm Whale, Citation bot, BG SpaceAce, ArthurBot, GrouchoBot, Fotaun, Originalwana, Citation bot 1, Tom.Reding, RedBot, TobeBot, EmausBot, Fabianney, ZéroBot, H3llBot, Eddiephlash, Danim, NOng WinZ, BattyBot, YFdyh-bot, The Herald, Exoplanetaryscience, K9re11 and Anonymous: 20
- **NGC 4449** *Source:* https://en.wikipedia.org/wiki/NGC_4449?oldid=645852962 *Contributors:* Bryan Derksen, Pmsyyz, RjHall, Tony1, Cydebot, Clh288, Thijs!bot, Headbomb, Dr. Submillimeter, WolfmanSF, CommonsDelinker, Svetovid, VolkovBot, Rei-bot, Elphion, AlleborgoBot, Dana boomer, Simon Villeneuve, Addbot, LaaknorBot, Numbo3-bot, Lightbot, Lucas-bot, Yobot, DirlBot, Fotaun, Tom.Reding, RedBot, EmausBot, ZéroBot, H3llBot, Bibcode Bot, U-95, YFdyh-bot, Dexbot and Anonymous: 2
- **NGC 7662** *Source:* https://en.wikipedia.org/wiki/NGC_7662?oldid=683405627 *Contributors:* Bryan Derksen, Danski14, FlaBot, SmackBot, AnarchyElmo, Friendlystar, Cydebot, Clh288, Headbomb, Dr. Submillimeter, VolkovBot, Rei-bot, Elphion, PlanetStar, El bot de la dieta, Arianewiki1, Addbot, Hermógenes Teixeira Pinto Filho, LaaknorBot, Numbo3-bot, John Belushi, Lucas-bot, Ulric1313, ArthurBot, SassoBot, Fotaun, HRoestBot, RedBot, Dinamik-bot, EmausBot, H3llBot, KingMunch, Makecat-bot, Exoplanetaryscience and Anonymous: 4
- **NGC 891** *Source:* https://en.wikipedia.org/wiki/NGC_891?oldid=675015680 *Contributors:* Bryan Derksen, Jyrl, Joseph Dwayne, Melikamp, Trevor MacInnis, N328KF, Rich Farmbrough, Aranel, RjHall, Ardric47, A2Kafir, WilliamKF, Smrgeog, Mike Peel, FlaBot,

- Jlam4911, YurikBot, Welsh, Uber nemo, Hurricane Devon, SmackBot, Bluebot, VirtualDave, Ryulong, Lee937, Rnickel, Friendlystar, Cydebot, Clh288, Kozuch, PKT, Thijs!bot, Headbomb, Helge Skjeveland, Kheider, Speciate, Rei-bot, Elphion, Hewholooks, Alexbot, Addbot, DOI bot, Bte99, Numbo3-bot, Lightbot, OIEnglish, Vedran V, Lucas-bot, Yobot, Amirobot, Citation bot, ArthurBot, Licquia, Telescopi, Sae1962, Citation bot 1, Tom.Reding, Jauhienij, EmausBot, ZéroBot, StringTheory11, H3llBot, Polisher of Cobwebs, Fjörgynn, MelbourneStar, Danim, Bibcode Bot, CitationCleanerBot, DPL bot, U-95, Hmainsbot1, Rfassbind, Rosebud&aRiver, Spideratseds, Platterseacatshome and Anonymous: 19
- **NGC 1275** *Source:* https://en.wikipedia.org/wiki/NGC_1275?oldid=673729449 *Contributors:* Bryan Derksen, Berek, Fxmastermind, Cyrius, ConradPino, Rich Farmbrough, RjHall, A2Kafir, JYolkowski, WilliamKF, SeventyThree, Rjwilmsi, Chobot, YurikBot, Mhardcastle, Kalsermar, SmackBot, Gary2863, Bluebot, Mguppy, JMK, Bubbha, Hoagssculptor, Friendlystar, Cydebot, Clh288, Kozuch, Thijs!bot, Headbomb, Escarbot, Dr. Submillimeter, WolfmanSF, Winar, Kheider, VolkovBot, Rei-bot, Elphion, Neparis, KGyST, Xioox, Roberto Mura, Addbot, Ka Faraq Gatri, LaaknorBot, Numbo3-bot, CraigJones, Lightbot, Lucas-bot, Amirobot, Citation bot, DirlBot, ClarketheK, GrouchoBot, SassoBot, Telescopi, Citation bot 1, Trappist the monk, EmausBot, Jmencisom, Italia2006, AvicBot, H3llBot, Pokbot, Bibcode Bot, BG19bot, U-95, K9re11, Jsaur and Anonymous: 18
 - **NGC 2419** *Source:* https://en.wikipedia.org/wiki/NGC_2419?oldid=654573961 *Contributors:* Zundark, SimonP, Stevan White, Joseph Dwayne, RjHall, El C, Ardrick47, A2Kafir, Danski14, Evil Monkey, WilliamKF, Arnomane, Miss Madeline, GregorB, Rjwilmsi, YurikBot, Kalsermar, SmackBot, Hibernian, Modest Genius, OrphanBot, CmdrObot, Friendlystar, Cydebot, Robertinventor, Thijs!bot, Dr. Submillimeter, Magioladitis, Bocianski.bot, CommonsDelinker, TXiKiBoT, Rei-bot, Elphion, Gn842, The2crowx, Alexbot, CarloscomB, Roberto Mura, MystBot, Addbot, DOI bot, LaaknorBot, Numbo3-bot, Lucas-bot, Yobot, Blacklans, Xqbot, GrouchoBot, Fotaun, Originalwana, Telescopi, Tom.Reding, Full-date unlinking bot, Canuck100, EmausBot, WikitanvirBot, H3llBot, Bibcode Bot, U-95, Kogge, Monkbot, Spideratseds and Anonymous: 6
 - **NGC 4244** *Source:* https://en.wikipedia.org/wiki/NGC_4244?oldid=635978920 *Contributors:* Friendlystar, Cydebot, Thijs!bot, Headbomb, AstroHurricane001, VolkovBot, Elphion, KGyST, PipepBot, Dana boomer, Addbot, LaaknorBot, Numbo3-bot, Lightbot, Lucas-bot, Amirobot, Fotaun, Telescopi, Tom.Reding, RedBot, Jauhienij, EmausBot, WikitanvirBot, Jmencisom, ZéroBot, H3llBot, YFdyh-bot and Anonymous: 2
 - **Crescent Nebula** *Source:* https://en.wikipedia.org/wiki/Crescent_Nebula?oldid=681901089 *Contributors:* Bryan Derksen, Prognatus, Lumos3, Mushroom, Netoholic, JamesHoadley, Rpyle731, Rich Farmbrough, Worldtraveller, Ardrick47, Keflavich, Rick Sidwell, Skatebiker, YurikBot, Sqkvii, Chris the speller, Bluebot, Ckatz, Cydebot, Clh288, Alaibot, Thijs!bot, Headbomb, Paulannis, IanOsgood, Kyle the bot, Rei-bot, Elphion, Ceranthor, PipepBot, Stargazer 7000-enwiki, Hewholooks, CarloscomB, Ladsgrupp, Raphael Frey, Addbot, LaaknorBot, SpBot, Numbo3-bot, John Belushi, Ben Ben, Yobot, Amirobot, Nallimbot, AnomieBOT, ArthurBot, Fotaun, RedBot, IVAN3MAN, EmausBot, WikitanvirBot, Wikipelli, ZéroBot, H3llBot, Bugnet, Drift chambers, YFdyh-bot, JYBot, Dberard, Exoplanetaryscience and Anonymous: 11
 - **NGC 752** *Source:* https://en.wikipedia.org/wiki/NGC_752?oldid=673289461 *Contributors:* SimonP, Adam Bishop, Jyril, Joseph Dwayne, Rich Farmbrough, RjHall, A2Kafir, WilliamKF, FlaBot, YurikBot, SmackBot, Bluebot, Colonies Chris, VirtualDave, Friendlystar, Cydebot, Irchans, Thijs!bot, Escarbot, Dr. Submillimeter, TheOtherSiguy, Xeno, Catgut, JaGa, VolkovBot, Rei-bot, Elphion, Coronel-lian-enwiki, ImageRemovalBot, CarloscomB, Addbot, LaaknorBot, Numbo3-bot, Lucas-bot, Yobot, Ulric1313, GrouchoBot, Telescopi, EmausBot, John of Reading, HiW-Bot, H3llBot, KingMunch, Exoplanetaryscience, K9re11, Spideratseds and Anonymous: 7
 - **NGC 5005** *Source:* https://en.wikipedia.org/wiki/NGC_5005?oldid=669782536 *Contributors:* RjHall, WilliamKF, Rjwilmsi, Rayc, SmackBot, VirtualDave, Cydebot, Thijs!bot, Escarbot, Dr. Submillimeter, VolkovBot, TXiKiBoT, Rei-bot, Elphion, Alexbot, Addbot, DOI bot, CarsracBot, Numbo3-bot, Lightbot, Lucas-bot, Citation bot, Fotaun, Tom.Reding, RedBot, EmausBot, Dondervogel 2, H3llBot, Helpful Pixie Bot, Bibcode Bot, YFdyh-bot, Grzegorznadolski and Anonymous: 1
 - **NGC 7331** *Source:* https://en.wikipedia.org/wiki/NGC_7331?oldid=674473491 *Contributors:* Bryan Derksen, Jyril, JamesHoadley, Bobblewik, N328KF, Bender235, RjHall, El C, Ziggurat, Skatebiker, WilliamKF, Rnt20, Rjwilmsi, Choess, Sreffler, Wjfox2005, YurikBot, NTBot-enwiki, Uber nemo, Hurricane Devon, Argo Navis, SmackBot, Srneć, Walter Nissen, Chris the speller, Bluebot, Ashkalb, Vanished User 0001, PrivateWiddle, Vina-iwbot-enwiki, Ckatz, George100, Friendlystar, Cydebot, Kozuch, Thijs!bot, Escarbot, Dr. Submillimeter, Kizit, Kheider, CommonsDelinker, Vedran8080, VolkovBot, Rei-bot, Elphion, ClueBot, Jsulman555, Stargazer 7000-enwiki, Aitias, Roberto Mura, Addbot, DOI bot, Numbo3-bot, Lightbot, Yobot, AnomieBOT, Citation bot, Anna Frodesiak, GrouchoBot, Telescopi, D'ohBot, Tom.Reding, Hellknowz, RedBot, Zbayz, EmausBot, Dondervogel 2, H3llBot, Ngc1535, Bibcode Bot, ChrisGualtieri, YFdyh-bot, Hmainsbot1, Monkbot and Anonymous: 7
 - **IC 405** *Source:* https://en.wikipedia.org/wiki/IC_405?oldid=679961418 *Contributors:* Rursus, Netoholic, Oneiros, Rich Farmbrough, Sandius, Rjwilmsi, Angusmclellan, FlaBot, Chobot, Malcolm, Iridescent, Friendlystar, Cydebot, JAnDbot, AstroHurricane001, Elphion, Hewholooks, Addbot, LaaknorBot, Numbo3-bot, John Belushi, Lucas-bot, Yobot, Xqbot, Fotaun, Telescopi, D'ohBot, Tom.Reding, Extra999, EmausBot, Sadalsuud, ZéroBot, Erasmus.new, H3llBot, Douggerman, YFdyh-bot, Monkbot and Anonymous: 3
 - **NGC 4631** *Source:* https://en.wikipedia.org/wiki/NGC_4631?oldid=672120562 *Contributors:* Bryan Derksen, Jni, AlexPlank, Jyril, Freakofnurture, Rdb, Aranel, RjHall, El C, Dark Shikari, WilliamKF, Trevor Andersen, FlaBot, Chobot, YurikBot, Chaos syndrome, Hurricane Devon, Bluebot, Mguppy, Lee937, Friendlystar, Cydebot, Clh288, Robertinventor, Thijs!bot, Escarbot, Dr. Submillimeter, STBot, VolkovBot, Rei-bot, Elphion, Anttler, Wuhwuzdat, Addbot, DOI bot, LaaknorBot, Numbo3-bot, Lightbot, HerculeBot, Lucas-bot, Amirobot, AnomieBOT, Citation bot, DirlBot, Cekli829, Telescopi, Smallmadtv-enwiki, Tom.Reding, RedBot, Jauhienij, EmausBot, ZéroBot, H3llBot, Helpful Pixie Bot, Bibcode Bot, YFdyh-bot, KasparBot and Anonymous: 8
 - **Veil Nebula** *Source:* https://en.wikipedia.org/wiki/Veil_Nebula?oldid=683007598 *Contributors:* Bryan Derksen, Topbanana, Warof-dreams, Jerzy, Rursus, Graeme Bartlett, Netoholic, JamesHoadley, Ceejayoz, Tomruen, Petersam, Ardrick47, Danski14, Hohum, WilliamKF, Fxer, YurikBot, Spacepotato, Bluebot, Ron E, Colonies Chris, Bowlhover, Jccowart0, Patrickkonsor, CmdrObot, Negadrive-enwiki, Friendlystar, Cydebot, Clh288, Kozuch, Thijs!bot, Headbomb, Eltanin, IanOsgood, Hanbrook, Mrmagoo2006, Xtifr, CommonsDelinker, Idioma-bot, MatP, Elphion, Rshida, Les Meloures, FKmailiW, PlanetStar, Lightmouse, Martarius, Jsulman555, ChandlerMapBot, Hewholooks, Alexbot, Alex Krainov, Addbot, Numbo3-bot, John Belushi, Zorrobot, Ben Ben, Lucas-bot, DirlBot, GrouchoBot, Fotaun, Archaeodontosaurus, Telescopi, Full-date unlinking bot, Jmencisom, H3llBot, Michał Rosa, OperaJoeGreen, MerllwBot, BG19bot, CuriousMind01, Astronomy, The Herald, Exoplanetaryscience, Rekowo and Anonymous: 6
 - **NGC 4889** *Source:* https://en.wikipedia.org/wiki/NGC_4889?oldid=673729910 *Contributors:* Rjwilmsi, Newone, Docceddi, Cydebot, Thijs!bot, Al Lemos, Headbomb, JAnDbot, Kheider, CommonsDelinker, AstroHurricane001, Ohms law, VolkovBot, Elphion, KGyST, Dana boomer, Roberto Mura, Addbot, Ukko, John Belushi, Lucas-bot, DirlBot, GrouchoBot, Tom.Reding, Rbrausse, RedBot, EmausBot,

- WikitanvirBot, ZéroBot, H3llBot, Rexprimoris, BG19bot, YFdyh-bot, Mogism, TwoTwoHello, Alberto ECJ, Johndric Valdez, SkyFlubler, Spideratseds, Idaho Astro and Anonymous: 10
- **NGC 4559** *Source:* https://en.wikipedia.org/wiki/NGC_4559?oldid=672120173 *Contributors:* Bryan Derksen, RJHall, FlaBot, VirtualDave, Cydebot, Clh288, Headbomb, Dr. Submillimeter, Darklilac, VolkovBot, Rei-bot, Elphion, Addbot, LaaknorBot, Numbo3-bot, Lightbot, Luckas-bot, DirlBot, Cekli829, RedBot, EmausBot, ZéroBot, H3llBot, YFdyh-bot and Anonymous: 1
 - **NGC 6885** *Source:* https://en.wikipedia.org/wiki/NGC_6885?oldid=569321923 *Contributors:* Cydebot, Headbomb, AstroHurricane001, VolkovBot, Elphion, Dana boomer, Roberto Mura, Addbot, Numbo3-bot, Luckas-bot, DirlBot, GrouchoBot, Kakashi12309, Telescopi, EmausBot, WikitanvirBot, H3llBot, YFdyh-bot and Anonymous: 2
 - **NGC 4565** *Source:* https://en.wikipedia.org/wiki/NGC_4565?oldid=672120234 *Contributors:* Zaslav, Petersam, RJHall, Nightstallion, WilliamKF, Angr, Rjwilmsi, FlaBot, Chobot, YurikBot, Chaos syndrome, Hurricane Devon, Bluebot, VirtualDave, JorisvS, Friendlystar, Cydebot, Kozuch, Thijs!bot, Headbomb, Lars Lindberg Christensen, Winiar, Kheider, Vedran8080, TXiKiBoT, Rei-bot, Elphion, SieBot, Jsbulman555, Addbot, DOI bot, LaaknorBot, Lightbot, HerculeBot, Luckas-bot, Yobot, Amirobot, Anna Frodesiak, Cekli829, Telescopi, Citation bot 1, Tom.Reding, RedBot, Canuck100, EmausBot, Jmencisom, ZéroBot, Bibcode Bot, U-95, YFdyh-bot, The Herald, Monkbot, Scarlettail, Helperbot3 and Anonymous: 13
 - **Eskimo Nebula** *Source:* https://en.wikipedia.org/wiki/Eskimo_Nebula?oldid=667613426 *Contributors:* Bryan Derksen, Danny, Infrogmation, Ahoerstemeier, Charles Matthews, AlexPlank, Merovingian, JyriL, JamesHoadley, Eequor, Joseph Dwayne, RJHall, Efedindoess, Gene Nygaard, WilliamKF, Magister Mathematicae, FlaBot, Lzz, YurikBot, Spacepotato, Gadget850, Eskimbot, Chris the speller, Bluebot, Ckatz, TFNorman, Friendlystar, Cydebot, Herd of Swine, Clh288, UberScienceNerd, Thijs!bot, Headbomb, North Shoreman, Altamel, Xtifr, Kheider, 12dstring, Vedran8080, Rei-bot, Elphion, AlleborgoBot, SieBot, Martarius, Jsbulman555, Excirial, Alexbot, Roberto Mura, DumZiBoT, Addbot, DOI bot, Numbo3-bot, Zorrobot, Luckas-bot, Implovius, Citation bot, Xqbot, Anna Frodesiak, GrouchoBot, Fotaun, Jk85212, Telescopi, Tom.Reding, Full-date unlinking bot, EmausBot, H3llBot, ChuispastonBot, ClueBot NG, Bibcode Bot, AdventurousSquirrel, YFdyh-bot, Hmainsbot1, Kogge, Exoplanetaryscience and Anonymous: 29
 - **NGC 3626** *Source:* https://en.wikipedia.org/wiki/NGC_3626?oldid=604847440 *Contributors:* FlaBot, Colonies Chris, Cydebot, Thijs!bot, Headbomb, AstroHurricane001, VolkovBot, Elphion, Arjayay, Dana boomer, Addbot, Lightbot, HerculeBot, Luckas-bot, Amirobot, Khutuck Bot, Telescopi, EmausBot, H3llBot, BattyBot, YFdyh-bot, Chanctonbury and Anonymous: 3
 - **Hyades (star cluster)** *Source:* [https://en.wikipedia.org/wiki/Hyades_\(star_cluster\)?oldid=682489583](https://en.wikipedia.org/wiki/Hyades_(star_cluster)?oldid=682489583) *Contributors:* Paul Drye, Bryan Derksen, Zimriell, Tucci528, Nealmcb, Arpingstone, Alfio, Kosebame, Looxix-enwiki, Ahoerstemeier, TUF-KAT, Robbot, Rursus, Geogre, UtherSRG, DocWatson42, Bradeos Graphon, Niteowlnels, Mamgeorge, Bender235, Kwamikagami, Kross, A2Kafir, Woohookitty, Palica, JamesBurns, Ketiltrout, Rjwilmsi, Mike s, Margosbot-enwiki, Chobot, YurikBot, Sir48, Jkelly, Jack Upland, SmackBot, Betacommand, Bluebot, Nima Baghaei, JorisvS, YannzgoB-enwiki, Twas Now, Friendlystar, Cydebot, Tdvance, Thijs!bot, Headbomb, Dantheman531, Deflective, IanOsgood, Rothorpe, J.P.Lon, Gazurtoid, AstroHurricane001, Potatoswatter, STBotD, VolkovBot, TXiKiBoT, Elphion, BotKung, Iwfi, Gerakibot, Flyer22, Msrasnw, Martarius, Arthegall, BobKawanaka, Scog, CarloscomB, Arianewiki1, Addbot, DOI bot, Luckas-bot, Easy n, AnomieBOT, Thuvan Dihh, Citation bot, MauritsBot, Xqbot, Anonymous from the 21st century, Omnipaedista, Dave3457, Tom.Reding, RedBot, MastiBot, EmausBot, John of Reading, ZéroBot, Noblepa, Alexander Meleg, H3llBot, SporkBot, Brandmeister, ChuispastonBot, ClueBot NG, Bibcode Bot, Praemonitus, Kogge, Monkbot, Spideratseds and Anonymous: 39
 - **NGC 7006** *Source:* https://en.wikipedia.org/wiki/NGC_7006?oldid=673730092 *Contributors:* RJHall, FlaBot, CmdrObot, Friendlystar, Cydebot, Clh288, Headbomb, Magioladitis, Robby, Rei-bot, Elphion, PipepBot, Alexbot, InternetMeme, Addbot, LaaknorBot, Numbo3-bot, John Belushi, Luckas-bot, Xqbot, Telescopi, EmausBot, Jmencisom, ZéroBot, Dondervogel 2, H3llBot, Bibcode Bot, YFdyh-bot, Makecat-bot, Pietro13 and Monkbot
 - **NGC 7814** *Source:* https://en.wikipedia.org/wiki/NGC_7814?oldid=668450723 *Contributors:* Bryan Derksen, Phe, Rich Farmbrough, RJHall, Ardric47, WilliamKF, Rjwilmsi, FlaBot, YurikBot, Hurricane Devon, SmackBot, Bluebot, Mgunpy, Drinibot, Friendlystar, Cydebot, Clh288, Thijs!bot, VolkovBot, TXiKiBoT, Rei-bot, Elphion, Hewholooks, Addbot, DOI bot, LaaknorBot, Lightbot, Luckas-bot, Citation bot, Xqbot, GrouchoBot, Fotaun, Telescopi, Tom.Reding, RedBot, FoxBot, EmausBot, Jmencisom, Burbscope, H3llBot, Bibcode Bot, Makecat-bot, Monkbot and Anonymous: 2
 - **NGC 7479** *Source:* https://en.wikipedia.org/wiki/NGC_7479?oldid=673613846 *Contributors:* Bryan Derksen, JyriL, N328KF, RJHall, WilliamKF, YurikBot, Hurricane Devon, SmackBot, Bluebot, Cydebot, Clh288, Thijs!bot, Escarbot, Ste4k, Kheider, CommonsDelinker, VolkovBot, Rei-bot, Elphion, Jsbulman555, Hewholooks, Roberto Mura, Addbot, LaaknorBot, Numbo3-bot, Lightbot, Luckas-bot, Anna Frodesiak, Fotaun, RedBot, EmausBot, Jmencisom, H3llBot, YFdyh-bot and Anonymous: 3
 - **NGC 5248** *Source:* https://en.wikipedia.org/wiki/NGC_5248?oldid=669866075 *Contributors:* VirtualDave, Cydebot, VolkovBot, Elphion, Addbot, 717, Fotaun, RedBot, EmausBot, WikitanvirBot, ZéroBot and YFdyh-bot
 - **NGC 2261** *Source:* https://en.wikipedia.org/wiki/NGC_2261?oldid=673729620 *Contributors:* Bryan Derksen, Netoholic, FlaBot, SmackBot, Cydebot, Clh288, Thijs!bot, Headbomb, Rei-bot, Elphion, PlanetStar, Niceguyedc, Alexbot, Roberto Mura, Vigormaster, Eik Corell, Addbot, LaaknorBot, John Belushi, HerculeBot, Luckas-bot, Amirobot, Ulric1313, Xqbot, Psak-enwiki, Fotaun, Dogbert66, Wikielwikingo, EmausBot, Look2See1, ZéroBot, H3llBot and Anonymous: 2
 - **NGC 6934** *Source:* https://en.wikipedia.org/wiki/NGC_6934?oldid=656138036 *Contributors:* RJHall, FlaBot, Gurch, CmdrObot, Friendlystar, Cydebot, Clh288, Headbomb, WolfmanSF, JaGa, CommonsDelinker, TXiKiBoT, Rei-bot, Elphion, PipepBot, Addbot, Numbo3-bot, Vedran V, Luckas-bot, GrouchoBot, Fotaun, Telescopi, EmausBot, Jmencisom, ZéroBot, Dondervogel 2, H3llBot, Bibcode Bot, Justincheng12345-bot, Makecat-bot, Monkbot and Anonymous: 2
 - **NGC 2775** *Source:* https://en.wikipedia.org/wiki/NGC_2775?oldid=670291074 *Contributors:* Rjwilmsi, VirtualDave, Cydebot, Elphion, Addbot, Luckas-bot, RedBot, C messier, FoxBot, EmausBot, WikitanvirBot, Wildemokid1235, ClueBot NG, Alex Nico, Hogg 22, Justincheng12345-bot, YFdyh-bot and Zhabion
 - **Rosette Nebula** *Source:* https://en.wikipedia.org/wiki/Rosette_Nebula?oldid=682734928 *Contributors:* Bryan Derksen, Arpingstone, Poor Yorick, Awolf002, Netoholic, Curps, JamesHoadley, Joseph Dwayne, Geni, Blankfaze, Tomruen, Neckelmann, Rich Farmbrough, Petersam, Worldtraveller, Timl, Ardric47, WilliamKF, Arnomane, Luh-e, Chobot, DVdm, YurikBot, Lt-wiki-bot, Kalsermar, Chris the speller, AstroMalasorte, Bluebot, OODDD, Hu12, Paul venter, Unmitigated Success, Cydebot, Clh288, Thijs!bot, J.P.Lon, Kheider, CommonsDelinker, VolkovBot, Rei-bot, Elphion, Wingedsubmariner, AlleborgoBot, Nwright6302, Keownrkw, Lightmouse, Anyeverybody, Martarius, XLinkBot, Ladsgroup, SilvononBot, Addbot, DOI bot, CanadianLinuxUser, LaaknorBot, John Belushi, Luckas-bot, Yobot, Rubinbot, Citation bot, ArthurBot, Xqbot, Gap9551, GrouchoBot, Fotaun, LucienBOT, Tom.Reding, FoxBot, EmausBot, Fabianneyer, Syerby, H3llBot, ChuispastonBot, ClueBot NG, Helpful Pixie Bot, Tauhidaerospace, FloAcer-enwiki, Karenthagangsta, YFdyh-bot, Rawastrodata, OtterAM, Francescodib, Spideratseds and Anonymous: 13

- **NGC 2244** *Source:* https://en.wikipedia.org/wiki/NGC_2244?oldid=673729603 *Contributors:* Bryan Derksen, Rnbc, MisfitToys, FlaBot, Modest Genius, Mgianteus1, Cydebot, Clh288, Thijs!bot, Headbomb, Dr. Submillimeter, Rei-bot, Elphion, Martarius, Dalibor Bosits, Simon Villeneuve, Addbot, LaaknorBot, Luckas-bot, Ulric1313, Spark802, Xqbot, DSisyphBot, GrouchoBot, Fotaun, Rbrausse, Dinamik-bot, EmausBot, ZéroBot, H3llBot, SporkBot, Rezabot, U-95, ChrisGualtieri, Peruchevere and Anonymous: 3
- **IC 1613** *Source:* https://en.wikipedia.org/wiki/IC_1613?oldid=640958770 *Contributors:* Bryan Derksen, Fubar Obfusco, DaMatriX, Chuunen Baka, JamesHoadley, RJHall, Ardic47, WilliamKF, Angusmcclellan, FlaBot, YurikBot, Ospalh, Uber nemo, Reyk, Chris the speller, Bluebot, Abdomination, Lee937, Jonschwarz, Friendlystar, Cydebot, Thijs!bot, LordAnubisBOT, Elphion, FKmailliW, Addbot, DOI bot, Numbo3-bot, Lightbot, Luckas-bot, Citation bot, Xqbot, Telescopi, Citation bot 1, Tom.Reding, EmausBot, H3llBot, Philos2000, Bibcode Bot, YFdyh-bot, JYBot and Anonymous: 7
- **NGC 4697** *Source:* https://en.wikipedia.org/wiki/NGC_4697?oldid=672120726 *Contributors:* VirtualDave, Cydebot, VolkovBot, Elphion, Alexbot, Addbot, Tassedethe, Luckas-bot, Khutuck Bot, Cekli829, RedBot, Wikielwikingo, EmausBot and YFdyh-bot
- **NGC 3115** *Source:* https://en.wikipedia.org/wiki/NGC_3115?oldid=679429368 *Contributors:* Timwi, Aranel, RJHall, Ardic47, JYolkowski, WilliamKF, FlaBot, YurikBot, Joshdboz, Tony1, Kalsermar, SmackBot, Onebravemonkey, Bluebot, Only, VirtualDave, Ice-maja, CmdrObot, Friendlystar, Cydebot, Kozuch, Thijs!bot, Headbomb, Rhelmerichs, Dr. Submillimeter, Bocianski.bot, Rei-bot, Elphion, Jcb1976, Astabada, Alexbot, Addbot, Mohamed Osama AlNagdy, DOI bot, Cuaxdon, Numbo3-bot, Lightbot, Luckas-bot, Citation bot, DirlBot, GrouchoBot, LucienBOT, Telescopi, Tom.Reding, RedBot, Full-date unlinking bot, EmausBot, WikitanvirBot, H3llBot, Sven Manguard, Bibcode Bot, Justincheng12345-bot, YFdyh-bot, Rfassbind, Spideratseds, KasparBot and Anonymous: 12
- **NGC 2506** *Source:* https://en.wikipedia.org/wiki/NGC_2506?oldid=673729681 *Contributors:* VirtualDave, Cydebot, Headbomb, Elphion, Arianewiki1, Addbot, KamikazeBot, LilHelpa, Xqbot, GrouchoBot, Khutuck Bot, Fotaun, RedBot, Wikielwikingo, WikitanvirBot, Vagobot and YFdyh-bot
- **Saturn Nebula** *Source:* https://en.wikipedia.org/wiki/Saturn_Nebula?oldid=669294851 *Contributors:* Bryan Derksen, SimonP, JamesHoadley, Joseph Dwayne, Moverton, Ardic47, WilliamKF, Mandarax, Mike s, FlaBot, Chobot, YurikBot, Spacepotato, Spondoolicks, SmackBot, Skizzik, Chris the speller, Bluebot, Kaliumfredrik, OrphanBot, VirtualDave, Friendlystar, Cydebot, Clh288, Thijs!bot, Barticus88, Escarbot, Rotherpe, CommonsDelinker, VolkovBot, Rei-bot, Elphion, Arjun024, Caltas, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, BepBot, Numbo3-bot, John Belushi, Luckas-bot, Yngvadottir, Citation bot, ArthurBot, Xqbot, Telescopi, Citation bot 1, Tom.Reding, RedBot, MondalorBot, Trappist the monk, EmausBot, H3llBot, Bibcode Bot, Hmainsbot1, Makecat-bot, Brianelectro, Audrey Schneidt, Spideratseds and Anonymous: 14
- **NGC 246** *Source:* https://en.wikipedia.org/wiki/NGC_246?oldid=673729660 *Contributors:* Bryan Derksen, Rich Farmbrough, RJHall, Ardic47, Sl, Gene Nygaard, WilliamKF, YurikBot, Reyk, Argo Navis, SmackBot, Bluebot, VirtualDave, Mguppy, TheTito, Cydebot, Clh288, Thijs!bot, Headbomb, J.P.Lon, Kheider, R'n'B, Elphion, AlleborgoBot, PipepBot, Hewholooks, CarloscomB, Simon Villeneuve, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, John Belushi, PlankBot, Luckas-bot, Yobot, KamikazeBot, Xqbot, Mnmngb, Fotaun, EmausBot, ZéroBot, H3llBot, Ego White Tray, ChuispastonBot, Nge1535, BG19bot, Irvan Ary Maulana, Mogism, Deryni, Mondoman712 and Anonymous: 7
- **NGC 6822** *Source:* https://en.wikipedia.org/wiki/NGC_6822?oldid=683406183 *Contributors:* Lumos3, Jyrl, Curps, JamesHoadley, RJHall, Ardic47, WilliamKF, Mangojuice, YurikBot, NTBot-enwiki, Gadget850, Uber nemo, Chaos syndrome, Hurricane Devon, Kalsermar, Chris the speller, Bluebot, Chr.K., Ohconfucius, Barbov, Smith609, Lee937, Courcelles, CmdrObot, Robin Scagell, Drinibot, Friendlystar, Cydebot, Clh288, Kozuch, Thijs!bot, Headbomb, Dr. Submillimeter, Magioladitis, Winiar, Xtifr, Rei-bot, Elphion, The Mad Genius, SITCK-enwiki, El bot de la dieta, Roberto Mura, Addbot, Wang Ivan, LaaknorBot, Numbo3-bot, Lightbot, Rubinbot, Hunnjazal, Citation bot, Analphabot, GrouchoBot, Originalwana, Telescopi, Citation bot 1, Citation bot 4, Tom.Reding, Zidanie5, EmausBot, Jmencisom, Italia2006, ZéroBot, H3llBot, Bibcode Bot, DulceMarie94, Exoplanetaryscience, K9re11 and Anonymous: 6
- **NGC 2360** *Source:* https://en.wikipedia.org/wiki/NGC_2360?oldid=670777836 *Contributors:* Wetman, Chuunen Baka, Jyrl, Edcolins, Joseph Dwayne, A2Kafir, Saga City, FlaBot, YurikBot, SmackBot, VirtualDave, JMK, Friendlystar, Cydebot, Casliber, Thijs!bot, Bocianski.bot, CommonsDelinker, Idioma-bot, VolkovBot, TXiKiBoT, Rei-bot, Elphion, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, Luckas-bot, Yobot, Pakos, AnomieBOT, JackieBot, Khutuck Bot, Fotaun, Telescopi, Tom.Reding, Extra999, EmausBot, H3llBot, SporkBot, Bibcode Bot, Kogge and Anonymous: 1
- **NGC 3242** *Source:* https://en.wikipedia.org/wiki/NGC_3242?oldid=673729796 *Contributors:* Bryan Derksen, Charles Matthews, Rursus, Peter Ellis, Danski14, FlaBot, Chobot, Shawn81, SmackBot, Newone, Cydebot, Clh288, Thijs!bot, Headbomb, Altamel, Rei-bot, Elphion, Martarius, Jschulman555, Excirial, Simon Villeneuve, DumZiBoT, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, Tide rolls, Lightbot, John Belushi, Luckas-bot, ArthurBot, Fotaun, Tom.Reding, RedBot, Full-date unlinking bot, EmausBot, Yedogawa, H3llBot, ChuispastonBot, -revi, Ic2779, YFdyh-bot, Stas1995 and Anonymous: 4
- **Antennae Galaxies** *Source:* https://en.wikipedia.org/wiki/Antennae_Galaxies?oldid=677259813 *Contributors:* Bryan Derksen, XJaM, Fxmastermind, Michael Hardy, Cherkash, Cyrius, Nroose, JamesHoadley, Neilc, MisfitToys, RetiredUser2, Jason Carreiro, Jkl, RJHall, El C, CDN99, Circeus, A2Kafir, Spangineer, Deror avi, Stemonitis, WilliamKF, Woohookitty, Riffsyphon1024, Mangojuice, SeventyThree, Sharkface217, WriterHound, YurikBot, Mikeblas, Shyam, Hurricane Devon, SmackBot, Ashill, Kintetsubuffalo, Gary2863, Bluebot, Aerobird, DaveRusin, Mgianteus1, Zzzzzzzzzz, Soulkeeper, Aaronp808, Slicedoranges, Drinibot, Albester, Cydebot, Clh288, Casliber, JustAGal, Escarbot, Dr. Submillimeter, ThoHug, STBot, Bocianski.bot, CommonsDelinker, VolkovBot, Elphion, Greswik, AlleborgoBot, Cosmo0, ClueBot, Wwheaton, Hiwatsup, NuclearVacuum, Ktr101, Gtstricky, Maniago, BOTarate, CarloscomB, Antti29, Arianewiki1, Addbot, DOI bot, Oednctx, Numbo3-bot, Mpfiz, Lightbot, مان ي, Yobot, TaBOT-zerem, Nallimbob, Rubinbot, Citation bot, ArthurBot, Marshallsumter, Grim23, Clammybells, Mnmngb, Fotaun, Telescopi, Elockid, Tom.Reding, Jauhienij, Spooner One-13, DASHBot, Jmencisom, Rafeu de Provença, H3llBot, ClueBot NG, tãññ, MerllwBot, Helpful Pixie Bot, ALH, The Quirky Kitty, The Herald, YiFeiBot, K9re11 and Anonymous: 30
- **NGC 247** *Source:* https://en.wikipedia.org/wiki/NGC_247?oldid=622894437 *Contributors:* Bryan Derksen, DaMatriX, Evercat, Rich Farmbrough, RJHall, WilliamKF, RussBot, Cydebot, Clh288, Thijs!bot, Headbomb, Dr. Submillimeter, DelusionOfGrandeur, Rei-bot, Elphion, AlleborgoBot, Erythromycin, Arianewiki1, Addbot, DOI bot, AndersBot, Numbo3-bot, Lightbot, Luckas-bot, Yobot, KamikazeBot, Citation bot, DirlBot, Xqbot, SassoBot, Fotaun, FrescoBot, Telescopi, Pmokeefe, Jauhienij, EmausBot, Jmencisom, H3llBot, AMan-WithNoPlan, Robin Andersson, Bibcode Bot, Jsaur and Anonymous: 2
- **Helix Nebula** *Source:* https://en.wikipedia.org/wiki/Helix_Nebula?oldid=667931014 *Contributors:* Bryan Derksen, Arpingstone, Looxix-enwiki, Poor Yorick, Wikiborg, Zandperl, Hadal, Cyrius, Fabiform, DocWatson42, Chrisdolan, Wwoods, JamesHoadley, Beta m, Joseph Dwayne, Flex, Moverton, Rich Farmbrough, Murtasa, Petersam, Ardic47, Skatebiker, Gene Nygaard, Kazvorpall, Adrian.benko,

- WilliamKF, 222222, Magister Mathematicae, Drbogdan, FlaBot, SkeezerPumba, Gurch, Startaq, Chobot, DVdm, Roboto de Ajvol, YurikBot, Spacepotato, Jimp, Icarus3, Srrikanth05, Morphh, UCaetano, Marcog, Gadget850, Kier07, Hurricane Devon, GrinBot-enwiki, Hardscarf, SmackBot, Chris the speller, AstroMalasorte, Bluebot, Caterpillar 36, VirtualDave, TFNorman, Flibble, Twas Now, Trialsanderrors, Hoagssculptor, Drinibot, Friendlystar, Cydebot, Clh288, Lars Lindberg Christensen, SOADLuvr, JAnDbot, Kaobear, IanOsgood, TheOtherSiguy, J.P.Lon, Soulbot, J.delanoy, P4z, Aleph85, Belovedfreak, Dorftrottel, Idioma-bot, VolkovBot, Shakey-Lo, JCP2121, Elphion, TheHorus, SieBot, Lightmouse, Nergaal, Njardarlogar, Arianewiki1, XLinkBot, Addbot, DOI bot, NjardarBot, LaaknorBot, Seeker alpha806, Dayfield, Luckas-bot, Yobot, TaBOT-zerem, Amirobot, AnomieBOT, Rubinbot, Citation bot, Xqbot, Δζ, Gospodar svemira, Cyphoidbomb, Lithopsian, GrouchoBot, MaxAf, Fotaun, Originalwana, Telescopi, Citation bot 1, Tom.Reding, Calmer Waters, MondalorBot, Forward Unto Dawn, Trappist the monk, Extra999, EmausBot, Jmencisom, H3llBot, ClueBot NG, Bibcode Bot, Wc620, Dr.emmy92, 22222, BattyBot, Dan211210, Stas1995, The Herald, Kogge, Spideratseds, Toolmak3 and Anonymous: 67
- **NGC 2362** *Source:* https://en.wikipedia.org/wiki/NGC_2362?oldid=673729645 *Contributors:* SimonP, Adam Bishop, Jyrl, Joseph Dwayne, RJHall, A2Kafir, FlaBot, YurikBot, VirtualDave, Friendlystar, Cydebot, Thijs!bot, Headbomb, JAnDbot, Bocianski.bot, VolkovBot, Rei-bot, Elphion, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, Luckas-bot, JackieBot, Citation bot, DirlBot, GrouchoBot, Kakashi12309, Fotaun, Micasta, Telescopi, Alexchen4836, Tom.Reding, RjwilmsiBot, EmausBot, GoingBatty, ZéroBot, H3llBot, SporkBot, Bibcode Bot, YFdyh-bot, Hmainsbot1, Monkbot, Spideratseds and Anonymous: 4
 - **Sculptor Galaxy** *Source:* https://en.wikipedia.org/wiki/Sculptor_Galaxy?oldid=667624700 *Contributors:* Bryan Derksen, SimonP, Fx-mastermind, DocWatson42, Jyrl, Curps, JamesHoadley, Joseph Dwayne, DragonflySixtyseven, Bender235, Aranel, RJHall, WilliamKF, CWitte, Palica, Rjwilmsi, YGingras, YurikBot, NTBot-enwiki, Reyk, Shyam, Hurricane Devon, Chris the speller, Bluebot, PeterJeremy, Cydebot, Clh288, Kozuch, Thijs!bot, Lars Lindberg Christensen, Dr. Submillimeter, IanOsgood, J.P.Lon, Kheider, STBot, VolkovBot, Rei-bot, Elphion, Bayo, SieBot, Jim77742, Dravecky, Petzl, Jsbulman555, Hewholooks, Arianewiki1, Addbot, Poco a poco, DOI bot, AndersBot, Numbo3-bot, Lightbot, Zorrobot, Luckas-bot, Yobot, AnomieBOT, Hunnjazal, Citation bot, Xqbot, Thetrue luckyone, Anna Frodesiak, Ataleh, SassoBot, Fotaun, Billyoffland, LucienBOT, Telescopi, Citation bot 1, Tom.Reding, RedBot, Jauhienij, Fracai, Steve03Mills, EmausBot, Jmencisom, Winner 42, Italia2006, ZéroBot, Jack Sebastian, H3llBot, Sunfishtommy, CocuBot, Nickholbrook, Helpful Pixie Bot, Bibcode Bot, CitationCleanerBot, Minsbot, U-95, Praemonitus, Kogge, Brynaw, Monkbot and Anonymous: 18
 - **NGC 5694** *Source:* https://en.wikipedia.org/wiki/NGC_5694?oldid=673729940 *Contributors:* Chuunen Baka, RJHall, ErikHaugen, VirtualDave, Cydebot, Headbomb, Magioladitis, Elphion, Arianewiki1, Addbot, LaaknorBot, 222, Luckas-bot, RedBot, Wikielwikingo, Ripchip Bot, EmausBot, ZéroBot, Bibcode Bot, U-95, Brianelectro, Kogge, Monkbot, Jsaur and Anonymous: 1
 - **NGC 1097** *Source:* https://en.wikipedia.org/wiki/NGC_1097?oldid=680653992 *Contributors:* Bryan Derksen, XJaM, Jyrl, N328KF, RJHall, WilliamKF, SeventyThree, Ketilrout, FlaBot, YurikBot, Howcheng, Poppy, Chaos syndrome, Hurricane Devon, Kalsermar, Smackflux, Xaosflux, Schmittey, Bluebot, VirtualDave, DI2000, Friendlystar, Cydebot, Clh288, Q43, Casliber, Thijs!bot, Headbomb, Lars Lindberg Christensen, MER-C, J.P.Lon, Winiar, CommonsDelinker, VolkovBot, Elphion, Mzmadmike, Alexbot, Ark25, Arianewiki1, Addbot, LaaknorBot, CarsracBot, AndersBot, Lightbot, Luckas-bot, MaterialsScientist, DirlBot, SassoBot, Paine Ellsworth, Telescopi, Jauhienij, Wikielwikingo, EmausBot, Jmencisom, H3llBot, CocuBot, Die Houck Die, Pine, DPL bot, Zedshort, Irvan Ary Maulana, CuriousMind01, Exoplanetaryscience, Dretler, Smallsmoke and Anonymous: 9
 - **NGC 6729** *Source:* https://en.wikipedia.org/wiki/NGC_6729?oldid=669574533 *Contributors:* Netoholic, Woohookitty, VirtualDave, Cydebot, Casliber, Elphion, Arianewiki1, MystBot, Addbot, Luckas-bot, GrouchoBot, Khutuck Bot, Rbrausse, Wikielwikingo, EmausBot, Jmencisom, ZéroBot, Justincheng12345-bot and YFdyh-bot
 - **NGC 6302** *Source:* https://en.wikipedia.org/wiki/NGC_6302?oldid=661080166 *Contributors:* Dino, Twang, Rich Farmbrough, Che090572, Ardric47, WilliamKF, Skushnir, SeventyThree, Rjwilmsi, Koavf, YurikBot, RussBot, Gaius Cornelius, Howcheng, Gadget850, SmackBot, Bluebot, Only, Mirgolth, IronGargoyle, Mguppy, Newone, Twas Now, CmdrObot, Banedon, Basawala, Friendlystar, Cydebot, Thijs!bot, Wikid77, Dr. Submillimeter, JEH, FaerieInGrey, Mgmirkin, J.P.Lon, Aconcagua, Tubbs334, Thegreenj, Richard New Forest, Seattle Skier, Rei-bot, Njwright, Elphion, Nwright6302, El bot de la dieta, Roberto Mura, Arianewiki1, Addbot, Numbo3-bot, John Belushi, Zorrobot, Luckas-bot, KamikazeBot, GrouchoBot, Höstblomma, Mnmngb, Fotaun, Atreyamit, Tom.Reding, Lithium cyanide, RedBot, MastiBot, Full-date unlinking bot, RjwilmsiBot, EmausBot, Racex11, Amir136990, H3llBot, Mjbmrbot, ClueBot NG, Weeners, Bibcode Bot, Zedshort, Kogge and Anonymous: 16
 - **NGC 300** *Source:* https://en.wikipedia.org/wiki/NGC_300?oldid=680166791 *Contributors:* Bryan Derksen, Nv8200pa, Phoebe, Fredrik, Jyrl, Joseph Dwayne, Blankfaze, N328KF, Rich Farmbrough, Aranel, RJHall, Worldtraveller, Tom, Ardric47, Redf0x, A2Kafir, WilliamKF, SeventyThree, Rjwilmsi, YurikBot, NTBot-enwiki, Gadget850, Hurricane Devon, Bluebot, Newone, Friendlystar, Cydebot, ST47, Kozuch, Thijs!bot, Headbomb, Lars Lindberg Christensen, Dr. Submillimeter, MER-C, J.P.Lon, Kheider, Bocianski.bot, R'n'B, VolkovBot, TXiKiBoT, Elphion, FKmailliW, AlleborgoBot, Arianewiki1, Addbot, DOI bot, LaaknorBot, Lightbot, HerculeBot, Amirobot, Citation bot, DirlBot, GnawnBot, Quebec99, GrouchoBot, Fotaun, LucienBOT, Telescopi, D'ohBot, D A R C 12345, Citation bot 1, Tom.Reding, Jauhienij, Earthandmoon, EmausBot, Marcosm21, Jmencisom, Luisalcada, ZéroBot, H3llBot, Fjörgynn, Kasirbot, Bibcode Bot, Stas1995, Tetra quark and Anonymous: 9
 - **NGC 2477** *Source:* https://en.wikipedia.org/wiki/NGC_2477?oldid=640701348 *Contributors:* SimonP, Jyrl, Joseph Dwayne, A2Kafir, Mike s, Skyfiler, YurikBot, Gaius Cornelius, Friendlystar, Cydebot, LoneWolfJack, Thijs!bot, Bocianski.bot, Rei-bot, G.abramson, Elphion, DumZiBoT, Arianewiki1, Addbot, Numbo3-bot, Luckas-bot, KamikazeBot, AnomieBOT, GrouchoBot, Khutuck Bot, Fotaun, Telescopi, EmausBot, Italia2006, H3llBot, BG19bot, YFdyh-bot, Hmainsbot1, Faizan, Spideratseds and Anonymous: 1
 - **NGC 55** *Source:* https://en.wikipedia.org/wiki/NGC_55?oldid=673830661 *Contributors:* Bryan Derksen, DaMatriX, Fredrik, Xerxes314, Joseph Dwayne, Blankfaze, Trevor MacInnis, N328KF, Rich Farmbrough, Aranel, RJHall, Ardric47, A2Kafir, WilliamKF, FlaBot, YurikBot, Extraordinary Machine, Hurricane Devon, Bluebot, Vina-iwbot-enwiki, Newone, Drinibot, Myasuda, Cydebot, Kozuch, Headbomb, Lars Lindberg Christensen, Dr. Submillimeter, MER-C, Kheider, VolkovBot, Kaffi, Rei-bot, Elphion, Fbs. 13, SieBot, KGyST, Alexbot, Arianewiki1, Addbot, DOI bot, SamatBot, Numbo3-bot, Lightbot, HerculeBot, Luckas-bot, Amirobot, Nallimbot, AnomieBOT, Citation bot, ArthurBot, DirlBot, DSisyphBot, GrouchoBot, GHJmover, Telescopi, Citation bot 1, Jonesey95, Tom.Reding, RedBot, ContributorJohnW, Jauhienij, EmausBot, H3llBot, Frietjes, Helpful Pixie Bot, Bibcode Bot, Exoplanetaryscience, Monkbot, Jsaur and Anonymous: 8
 - **NGC 1851** *Source:* https://en.wikipedia.org/wiki/NGC_1851?oldid=602291645 *Contributors:* Bryan Derksen, RJHall, Xoloz, Ruslik0, Cydebot, Clh288, Magioladitis, VolkovBot, Rei-bot, Elphion, Bgvr, Dana boomer, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, Luckas-bot, ArthurBot, Joaquim™ Filho, MondalorBot, TjBot, EmausBot, WikitanvirBot, H3llBot, Bibcode Bot, YFdyh-bot, Kogge, Monkbot and Anonymous: 1

- **NGC 3132** *Source:* https://en.wikipedia.org/wiki/NGC_3132?oldid=673729785 *Contributors:* JamesHoadley, Bender235, Gene Nygaard, WilliamKF, SeventyThree, Mike s, MariusStrom, FlaBot, YurikBot, Argo Navis, Kalsermar, SmackBot, Ewok Slayer, Chris the speller, Bluebot, Cydebot, Thijs!bot, Headbomb, MER-C, Rei-bot, Elphion, Alexbot, NuclearWarfare, Njardarlogar, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, John Belushi, Zorrobot, TaBOT-zerem, Xqbot, XZeroBot, GrouchoBot, Fotaun, RedBot, EmausBot, WikitanvirBot, GoingBatty, H3llBot, BG19bot and Anonymous: 6
- **NGC 6124** *Source:* https://en.wikipedia.org/wiki/NGC_6124?oldid=673729971 *Contributors:* Chuunen Baka, Trevor MacInnis, Bender235, VirtualDave, Cydebot, Headbomb, Elphion, Martarius, Arianewiki1, Addbot, Numbo3-bot, ￼￼, AnomieBOT, Zxabot, Khutuck Bot, Telescopi, HRoestBot, EmausBot, WikitanvirBot, H3llBot, YFdyh-bot, عاصم and Spideratseds
- **NGC 6231** *Source:* https://en.wikipedia.org/wiki/NGC_6231?oldid=673730005 *Contributors:* Bobblewik, Trevor MacInnis, A2Kafir, SeventyThree, FlaBot, Skyflier, YurikBot, Bluebot, VirtualDave, Hu12, Bay Flam, Friendlystar, Cydebot, Thijs!bot, Headbomb, Auke Slotegraaf, Escarbot, Tkirkman, Rei-bot, Elphion, Roberto Mura, Arianewiki1, Addbot, Numbo3-bot, Yobot, GrouchoBot, Khutuck Bot, FrescoBot, Telescopi, Cosmospup, Tom.Reding, Jero Smith Ju, EmausBot, H3llBot, SporkBot, ChuispastonBot, U-95, YFdyh-bot, K9re11, Spideratseds and Anonymous: 5
- **Centaurus A** *Source:* https://en.wikipedia.org/wiki/Centaurus_A?oldid=682950635 *Contributors:* Bryan Derksen, SimonP, Rl, Sverdrup, Auric, Jyrl, JamesHoadley, Joseph Dwayne, Peter Ellis, Blankfaze, HorsePunchKid, Discospinster, Svanimpe, Aranel, RJHall, Worldtraveller, Jleous, Giraffedata, Count Iblis, WilliamKF, Rjwilmsi, FlaBot, Chobot, YurikBot, Conscious, Shawn81, Nick, Zwobot, Uber nemo, Reyk, Hurricane Devon, Caco de vidro, Stepa, Gilliam, Chris the speller, Bluebot, Colonies Chris, Zzzzzzzzzzz, CmdrObot, Drinibot, Ruslik0, Friendlystar, Albestor, Cydebot, Clh288, Kozuch, Casliber, Headbomb, Lars Lindberg Christensen, Davidhorman, Hcobb, Auke Slotegraaf, Escarbot, Eleuther, Nixon, Dr. Submillimeter, MortimerCat, WolfmanSF, Kheider, MartinBot, Uriel8, CommonsDelinker, VolkovBot, TXiKiBoT, Rei-bot, Elphion, Taggard, Martarius, Wwheaton, Roberto Mura, Arianewiki1, MystBot, Addbot, DOI bot, LaaknorBot, AndersBot, Lightbot, Luckas-bot, Yobot, Amirobot, Citation bot, Xqbot, GrouchoBot, Fotaun, FrescoBot, Originalwana, Telescopi, Tom.Reding, RedBot, Jauhienij, FoxBot, TobeBot, Earthandmoon, OlivierHainaut, EmausBot, John of Reading, Jmencisom, Luisalcada, Italia2006, ZéroBot, H3llBot, Brandmeister, ClueBot NG, Old wombat, Braincricket, Danim, Helpful Pixie Bot, Lolm8, Bibcode Bot, Pine, AhMedRMaaty, Gallina3795, Samwalton9, BattyBot, YFdyh-bot, EuroCarGT, Dexbot, Mr Morden76, Stas1995, Epicgenius, Jackmcbarn, NomolosX, Bennybuffins, Spideratseds, Tetra quark and Anonymous: 28
- **NGC 6541** *Source:* https://en.wikipedia.org/wiki/NGC_6541?oldid=673730027 *Contributors:* Chuunen Baka, Bearcat, RJHall, Rjwilmsi, Malcolm, Casliber, Headbomb, Auke Slotegraaf, Elphion, Arianewiki1, Moosemanuk, Alex Nico, Bibcode Bot, DPL bot, Kogge, Monkbob and Anonymous: 1
- **NGC 3201** *Source:* https://en.wikipedia.org/wiki/NGC_3201?oldid=670043741 *Contributors:* RJHall, WilliamKF, Rjwilmsi, FlaBot, Durval, SmackBot, VirtualDave, Vyznev Xnebara, Friendlystar, Cydebot, Headbomb, Auke Slotegraaf, Magioladitis, Rei-bot, Elphion, ImageRemovalBot, Arianewiki1, Addbot, LaaknorBot, Numbo3-bot, GrouchoBot, Mnmngb, Fotaun, Telescopi, Tom.Reding, RedBot, Joaquim™ Filho, FoxBot, EmausBot, H3llBot, Alex Nico, Bibcode Bot, YFdyh-bot, Kogge, Monkbob and Anonymous: 1
- **Omega Centauri** *Source:* https://en.wikipedia.org/wiki/Omega_Centauri?oldid=682200101 *Contributors:* Bryan Derksen, Wayne Hardman, Stevan White, AugPi, Furrykef, Nickshanks, Sverdrup, Rursus, Jyrl, Curps, Neile, Ato, Neurophyre, RJHall, Marco Castellani, Ardric47, Tablizer, Avenue, Pauli133, Sleigh, WilliamKF, Woohookitty, Effeetsanders, Rjwilmsi, FlaBot, Lmatt, YurikBot, NawlinWiki, SAE1962, Chaos syndrome, Reyk, Hurricane Devon, SmackBot, WilyD, Bluebot, MalafayaBot, Robogun, Snowmanradio, Xiner, Thor Dockweiler, VirtualDave, JorisvS, Zzzzzzzzzzz, Meco, Mguppy, Kostya30-enwiki, Skalman, Tawkerbot2, Markjoseph125, Lavateraguy, Van helsing, Friendlystar, Cydebot, Clh288, DmitTrix, The Proffesor, CielProfond, Northumbrian, Jozef-k-enwiki, Dr. Submillimeter, IanOsgood, Rothorpe, Raindreamer, Philip tao, VolkovBot, Craigheinke, Rei-bot, Elphion, Wikiisawesome, SieBot, Fredelige, Bad-boy47, K. Takeda-enwiki, Mbrubeck, Le Pied-bot-enwiki, SITCK-enwiki, Martarius, DumZiBoT, Arianewiki1, Ladsgroup, Addbot, DOI bot, Mrchutney, LaaknorBot, SpBot, 84user, Craigsjones, ComputerHotline, Zorrobot, Luckas-bot, Easy n, Yobot, Amirobot, Nallimbot, AnomieBOT, Thuvan Dihh, Icalanise, Citation bot, Xqbot, Gap9551, GrouchoBot, Raul5001, 1211Beckett, Fotaun, EmilTyf, Citation bot 1, Tom.Reding, RedBot, Joaquim™ Filho, Shamsensei, Puzl bustr, Earthandmoon, RjwilmsiBot, Androstachys, EmausBot, Chermundy, Jmencisom, Italia2006, H3llBot, Sainsf, CocuBot, ReecyBoy42, HazelAB, Vpereziii, Bibcode Bot, Yanthor, Stas1995, Praemonitus, CaringtonEnglish, Kogge, AviLoeb, Monkbob, Clayhasavirus, UforF, McDonald of Kindness and Anonymous: 44
- **NGC 6352** *Source:* https://en.wikipedia.org/wiki/NGC_6352?oldid=601548238 *Contributors:* RJHall, Cydebot, Headbomb, Magioladitis, Elphion, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, John Belushi, EmausBot, ZéroBot, Bibcode Bot, KingMunch, Makecat-bot, Kogge and Monkbob
- **NGC 6193** *Source:* https://en.wikipedia.org/wiki/NGC_6193?oldid=673729992 *Contributors:* Zundark, Woohookitty, SmackBot, Colonies Chris, VirtualDave, Cydebot, Thijs!bot, Headbomb, JaGa, Elphion, Martarius, CarloscomB, Arianewiki1, MystBot, Addbot, Fluffernutter, Numbo3-bot, Bunnyhop11, AnomieBOT, Ulric1313, Zxabot, ArthurBot, Khutuck Bot, HRoestBot, EmausBot, Jmencisom, H3llBot, SporkBot, KingMunch, YFdyh-bot and Anonymous: 2
- **NGC 4945** *Source:* https://en.wikipedia.org/wiki/NGC_4945?oldid=672121026 *Contributors:* Bryan Derksen, Jyrl, RJHall, WilliamKF, YurikBot, Hurricane Devon, Bluebot, Mguppy, Newone, Drinibot, Friendlystar, Cydebot, Clh288, Kozuch, Thijs!bot, Escarbot, Dr. Submillimeter, J.P.Lon, CommonsDelinker, Rei-bot, Elphion, VVVBot, KGyST, Martarius, Simon Villeneuve, Arianewiki1, Addbot, DOI bot, Numbo3-bot, Lightbot, HerculeBot, Luckas-bot, Amirobot, AnomieBOT, Citation bot, Cekli829, D'ohBot, Tom.Reding, RedBot, Henrik Rosenørn, EmausBot, WikitanvirBot, Jmencisom, Luisalcada, ZéroBot, EricHS211, H3llBot, Bibcode Bot, AvvocatoBot, MrBill3, Justincheng12345-bot, YFdyh-bot, Hmainsbot1, Johndric Valdez, KasparBot and Anonymous: 5
- **NGC 5286** *Source:* https://en.wikipedia.org/wiki/NGC_5286?oldid=669866864 *Contributors:* Chuunen Baka, Bearcat, RJHall, Rjwilmsi, Malcolm, VirtualDave, Elphion, Moosemanuk, Fotaun, Bibcode Bot, DPL bot, Praemonitus, Kogge and Monkbob
- **IC 2391** *Source:* https://en.wikipedia.org/wiki/IC_2391?oldid=673729579 *Contributors:* Edital, Hmains, Betacommand, Wazronk, OrphanBot, Cydebot, Thijs!bot, Headbomb, Xen0, J.P.Lon, TXiKiBoT, Elphion, FKmailliW, SieBot, PlanetStar, ImageRemovalBot, MenoBot, Addbot, DOI bot, LaaknorBot, Numbo3-bot, John Belushi, Rubinbot, Citation bot, ArthurBot, Tom.Reding, TobeBot, EmausBot, H3llBot, SporkBot, Bibcode Bot, Exoplanetaryscience, Spideratseds and Anonymous: 5
- **NGC 6397** *Source:* https://en.wikipedia.org/wiki/NGC_6397?oldid=660827398 *Contributors:* Bryan Derksen, DrBob, Stevan White, Nikai, Vespriano, Awolf002, JamesHoadley, Joseph Dwayne, Urhixidur, RJHall, A2Kafir, Evil Monkey, WilliamKF, SeventyThree, Allen3, BD2412, FlaBot, Lmatt, Chobot, YurikBot, Raskolnikov The Penguin, Chris the speller, Colonies Chris, Beyazid, Cydebot, Clh288, Thijs!bot, Sojourner001, Winiar, Knulclunk, Rei-bot, Elphion, DragonBot, Addbot, LaaknorBot, Luckas-bot, Yobot, Ulric1313, ArthurBot, Fotaun, EmausBot, H3llBot, Bibcode Bot, AtelierMonpli, KingMunch, YFdyh-bot, Kogge, Monkbob and Anonymous: 1

- **NGC 1261** *Source:* https://en.wikipedia.org/wiki/NGC_1261?oldid=626950627 *Contributors:* RjHall, Marco Castellani, GregorB, BD2412, Rjwilmsi, Zafiroblue05, Cydebot, Headbomb, VolkovBot, Elphion, Addbot, Numbo3-bot, Luckas-bot, ArthurBot, Xqbot, GrouchoBot, Kaoskiller34, Joaquim™ Filho, EmausBot, AvicBot, H3llBot, Mjbmrbot, Bibcode Bot, Reichart2, Kogge, Monkbob and Anonymous: 1
- **NGC 5823** *Source:* https://en.wikipedia.org/wiki/NGC_5823?oldid=669772883 *Contributors:* Chuunen Baka, Bearcat, RjHall, Malcolm, VirtualDave, BobQQ, Headbomb, Elphion, Mild Bill Hiccup, Arianewiki1, Moosemanuk and DPL bot
- **NGC 6087** *Source:* https://en.wikipedia.org/wiki/NGC_6087?oldid=673729957 *Contributors:* FlaBot, VirtualDave, Friendlystar, Cydebot, Clh288, Thijs!bot, Headbomb, VolkovBot, Rei-bot, Elphion, Ilafra, Arianewiki1, Addbot, Numbo3-bot, Luckas-bot, Khutuck Bot, Telescopi, D'ohBot, Extra999, EmausBot, ZéroBot, StringTheory11, H3llBot, SporkBot, Bibcode Bot, YFdyh-bot and Anonymous: 2
- **NGC 2867** *Source:* https://en.wikipedia.org/wiki/NGC_2867?oldid=673729700 *Contributors:* Bryan Derksen, FlaBot, SmackBot, Cydebot, Clh288, Thijs!bot, Headbomb, VolkovBot, Rei-bot, Elphion, Lucasbfrbot, PipepBot, STAI2DUST, Arianewiki1, Addbot, LaaknorBot, John Belushi, Luckas-bot, JackieBot, Alexchen4836, RedBot, Extra999, EmausBot, H3llBot, YFdyh-bot and Halfhat
- **NGC 3532** *Source:* https://en.wikipedia.org/wiki/NGC_3532?oldid=660942429 *Contributors:* RjHall, Ardrich47, A2Kafir, BD2412, Rjwilmsi, FlaBot, YurikBot, Ospalh, Aelfthrytha, Bluebot, Me.johnnyb, Reg Carter, Friendlystar, Cydebot, JamesAM, Auke Slotegraaf, Bocianski.bot, VolkovBot, Rei-bot, Elphion, Flyer22, Roberto Mura, Arianewiki1, Addbot, LaaknorBot, OIEnglish, Luckas-bot, Yobot, DemocraticLuntz, Fabian RRRR, Khutuck Bot, Telescopi, Tom.Reding, Hellknowz, Rbrausse, RedBot, EmausBot, H3llBot, SporkBot, Alex Nico, Bibcode Bot, YFdyh-bot, Cerabot-enwiki, Kogge, Exoplanetaryscience, K9re11, Lordpeter68, Monkbob and Anonymous: 7
- **Carina Nebula** *Source:* https://en.wikipedia.org/wiki/Carina_Nebula?oldid=677892214 *Contributors:* Bryan Derksen, SimonP, Bdesham, Sannse, RI, SD6-Agent, Babbage, Jyrl, Netoholic, JamesHoadley, Joseph Dwayne, Beland, MisfitToys, Discospinster, RjHall, El C, World-traveller, Shereth, Stephen Bain, Tablizer, Keflavich, Avenue, Velella, Mahanga, Firsfron, Woohookitty, Ketiltrot, Rjwilmsi, JHMM13, Mike s, Sumanch, Chobot, DVdm, Bgwhite, YurikBot, Janke, Chesnok, Prvc, Davepape, Chris the speller, Bluebot, MalafayaBot, Delink, Abyssal, OrphanBot, Sephiroth669, Geologyguy, Newone, Ü, Friendlystar, Alton, Cydebot, Clh288, A Softer Answer, Headbomb, Lars Lindberg Christensen, Luna Santin, StantheGarbageMan, Fedaro, Rothorpe, CommonsDelinker, KylieTastic, VolkovBot, Tomer T, TXiKiBoT, Rei-bot, Elphion, Billingham, AlleborgoBot, SieBot, Jespdj, Moonraker12, Lightmouse, OKBot, Martarius, Ellassint, Solar-Wind, Excirial, Alexbot, Roberto Mura, Arianewiki1, Addbot, Cuaxdon, LaaknorBot, AndersBot, John Belushi, Luckas-bot, Yobot, Castagna, AnomieBOT, Rubinbot, Galoubet, The High Fin Sperm Whale, Corbon, Lithopsian, GrouchoBot, Mnmngb, S. Korotkiy, Fotaun, FrescoBot, Originalwana, OgreBot, Rbrausse, Double sharp, Extra999, TjBot, Bitil Guilderstrone, EmausBot, Jmencisom, Luiscalcada, ZéroBot, StringTheory11, H4haniah98, H3llBot, Brandmeister, Gut Monk, Donner60, ClueBot NG, Satellizer, SSSheridan, Ollieinc, BattyBot, GoShow, Ekren, Dexbot, ALH, Mogism, Stas1995, The Herald, Johndric Valdez, K9re11, Monkbob, Thibaut120094, SkyFlubbler, Spideratseds, Sdgedfegw, Deneb in Cygnus and Anonymous: 46
- **NGC 6752** *Source:* https://en.wikipedia.org/wiki/NGC_6752?oldid=673730038 *Contributors:* RjHall, FlaBot, Edgar181, OrphanBot, VirtualDave, CmdrObot, Friendlystar, Cydebot, Clh288, Casliber, Thijs!bot, Headbomb, Duncan7670, CommonsDelinker, Rei-bot, UserDoe, CarloscomB, Arianewiki1, Addbot, LaaknorBot, AndersBot, Numbo3-bot, Luckas-bot, GrouchoBot, Clammybells, Asfarer, Fotaun, Telescopi, HRoestBot, EmausBot, Jmencisom, ZéroBot, H3llBot, Bibcode Bot, Soerfm, YFdyh-bot, Stas1995, Kogge, Lordpeter68, Monkbob and Anonymous: 1
- **Jewel Box (star cluster)** *Source:* [https://en.wikipedia.org/wiki/Jewel_Box_\(star_cluster\)?oldid=668261463](https://en.wikipedia.org/wiki/Jewel_Box_(star_cluster)?oldid=668261463) *Contributors:* SimonP, Chris 73, Curps, Joseph Dwayne, B.d.mills, Bender235, Ardrich47, A2Kafir, Evil Monkey, Skatebiker, WilliamKF, Kanthoney, Chobot, YurikBot, Spacepotato, RussBot, GunnarRene, Gadget850, Doncram, Uber nemo, Reyk, Umbrae, Melchoir, Chris the speller, Bluebot, Silent Wind of Doom, 81120906713, Makyen, Quaeler, Friendlystar, Cydebot, Clh288, Thijs!bot, Headbomb, Auke Slotegraaf, Escarbot, Belg4mit, Rothorpe, 28421u2232nfencenc, Erectus-enwiki, Just James, VolkovBot, TXiKiBoT, Rei-bot, Elphion, Wikiisawesome, Mild Bill Hiccup, Niceguyedc, Alexbot, DumZiBoT, Arianewiki1, XLinkBot, MystBot, Albambot, Addbot, LaaknorBot, Numbo3-bot, Lightbot, The Jewel Box, AnomieBOT, Rubinbot, Citation bot, Capricorn42, Lithopsian, LucienBOT, Originalwana, Telescopi, Alexchen4836, Tom.Reding, RedBot, Mylotian, RjwilmsiBot, EmausBot, WikitanvirBot, ZéroBot, H3llBot, SporkBot, AManWithNoPlan, Gcjdavid, ClueBot NG, Theopolisme, Helpful Pixie Bot, Bibcode Bot, YFdyh-bot, Exoplanetaryscience, Monkbob, Spideratseds, McDonald of Kindness and Anonymous: 12
- **NGC 6025** *Source:* https://en.wikipedia.org/wiki/NGC_6025?oldid=673729945 *Contributors:* Chuunen Baka, Trevor MacInnis, VirtualDave, Cydebot, Thijs!bot, Headbomb, Addbot, Numbo3-bot, Zxabot, Khutuck Bot, Fotaun, Telescopi, EmausBot, ZéroBot, H3llBot, YFdyh-bot, Georgij Michaliutin, Exoplanetaryscience and Spideratseds
- **NGC 2516** *Source:* https://en.wikipedia.org/wiki/NGC_2516?oldid=663215347 *Contributors:* Topbanana, Carlossuarez46, Trevor MacInnis, RjHall, Ardrich47, A2Kafir, FlaBot, YurikBot, Argo Navis, Skizzik, Bluebot, Ohconfucius, Reg Carter, Friendlystar, Cydebot, Headbomb, Theroadslong, Bocianski.bot, Rei-bot, PipepBot, JonPowles, SchreiberBike, Arianewiki1, Addbot, AndersBot, Numbo3-bot, Luckas-bot, Yobot, KamikazeBot, Citation bot, Unimath, GrouchoBot, Khutuck Bot, Clusterpuck, Telescopi, Tom.Reding, Rbrausse, RedBot, Extra999, EmausBot, WikitanvirBot, ZéroBot, H3llBot, SporkBot, Alex Nico, BG19bot, YFdyh-bot, Lordpeter68 and Anonymous: 3
- **NGC 3766** *Source:* https://en.wikipedia.org/wiki/NGC_3766?oldid=673729815 *Contributors:* Zundark, Trevor MacInnis, Ardrich47, A2Kafir, Gene Nygaard, SeventyThree, FlaBot, Kolbasz, YurikBot, Bluebot, VirtualDave, Reg Carter, Zack3rdbb, Friendlystar, Cydebot, Thijs!bot, Headbomb, Auke Slotegraaf, Bocianski.bot, Rei-bot, Elphion, Killing sparrows, Arianewiki1, MarmotteNZ, Rror, Addbot, Numbo3-bot, Luckas-bot, Yobot, AnomieBOT, GrouchoBot, Khutuck Bot, Telescopi, Jckowal, Rbrausse, EmausBot, Jmencisom, H3llBot, SporkBot, Alex Nico, Stas1995, Spideratseds and Anonymous: 3
- **NGC 4609** *Source:* https://en.wikipedia.org/wiki/NGC_4609?oldid=672120424 *Contributors:* Chuunen Baka, Bearcat, RjHall, Malcolm, VirtualDave, Addbot, Moosemanuk, Cekli829, EmausBot, Coffins and Jsaur
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