



# Stellafane Observing Olympics – 2025

## "A Little Bit of Everything"

### Observing Pins Awarded for 15 Observations



<u>Name</u>	<u>Coordinates, J2000</u>	<u>Const.</u>	<u>Type</u>	<u>Mag.</u>	<u>Size</u>	<u>Class.</u>	<u>Distance</u>	<u>Uran 1</u>
<b>Galaxy's:</b>								
☐ <b>Draco Dwarf:</b>								
NGC5981, UGC9948	15 37 53.3 +59 23 29	Dra	Gal	13.9	3.1' x 0.6'	Sc? Sp	82.2 MLYrs	U51
NGC5982, UGC9961	15 38 39.8 +59 21 21	Dra	Gal	12.0(B)	2.5' x 1.8	E3	135.2 MLYrs	U51
NGC5985, UGC9969	15 39 37.1 +59 19 55	Dra	Gal	11.9(B)	5.5' x 2.9'	SAB(r)b	114.9 MLYrs	U51
☐ NGC6822, IC4895	19 44 56.5 -14 48 11	Sgr	Gal	9.3(B)	15.6' x 13.5'	IB(s)m	1.2 MLYs	U297
Hubble V	19 44 42.2 -14 43 08	Sgr	E Neb	10.0(B)	34.7" x 21.0"	OB A	--	U297
Hubble VII	19 44 55.8 -14 48 56	Sgr	G.C.	15.04(V)	7.5 x 7.5	G.C.	--	U297
Hubble X, IC1308	19 45 05.5 -1443 14	Sgr	E Neb	9.7(B)	31.0" x 20.0"	OB A	--	U297
☐ NGC7793, ESO 349-12	23 57 49.4 -32 35 30	Scl	Gal	9.28(V)	10.0' x 6.5'	SA(s)d	12.7 MLYrs	U350
☐ NGC134, ESO 350-23	00 30 22.2 -33 14 44	Scl	Gal	10.3(V)	7.6' x 1.7'	SAB(s)bc	74.6 MLYrs	U351
☐ NGC613, ESO 413-11	01 34 17.5 -29 24 58	Scl	Gal	10.7(B)	5.5' x 4.1'	SB(rs)bc	60.0 MLYrs	U352
☐ NGC772, UGC1466	01 59 19.9 +19 00 30	Ari	Gal	10.31(V)	7.2' x 4.2'	SA(s)b	114.3 MLYrs	U129
☐ NGC4261, 3C 270	12 19 23.3 +05 49 33	Vir	Gal	12.87(B)	4.3' x 3.5'	LINER	102.9 MLYrs	U193
<b>Globular Clusters:</b>								
☐ NGC6144	16 27 14.1 -26 01 29	Sco	G.C.	13.4(V)	7.4' x 7.4'	Cl	29 KLYs	U336
☐ NGC6284	17 04 28.8 -24 45 53	Oph	G.C.	--	6.2' x 6.2'	IX	43.0 KLYs	U337
☐ NGC6712	18 53 04.3 -08 42 22	Sct	G.C.	8.1	9.8' x 9.8'	--	43 KLYs	U295
<b>Open Clusters:</b>								
☐ Messier 11, NGC6705	18 51 06.0 -06 16 00	Sct	G.C.	5.8	22.8' x 22.8'	I 2 r	6,120 LYrs	U295
☐ NGC6819, Cr403	19 41 16.2 +40 11 32	Cyg	O.C.	7.3	5.0' x 5.0'	I 1 r	7,050 LYrs	U84
☐ NGC7128, Cr 440	21 44 00.0 +53 43 00	Cyg	O.C.	9.7	3.1' x 3.1'	I 3 m	13,000 LYrs	U57
<b>Quasars:</b>								
☐ Mrk 205, PGC39975	12 21 44.4 +75 18 39	Dra	QSO	15.24(V)	Stellar	QSO	1.2 BLYrs	U9
☐ 3C 273, PGC41121	12 29 06.7 +02 03 09	Vir	QSO	14.83(V)	Stellar	--	2.4 BLYrs	U238
☐ BL Lacerta, 2200+420	22 02 43.3 +42 16 40	Lac	QSO	14.72(V)	Stellar	Blazer	0.9649 BLYrs	U87
<b>Planetary Nebulae:</b>								
☐ NGC6563, PK 358-7.1	18 12 02.5 -33 52 06	Sgr	P.N.	10.0(V)	50.0" x 38.0"	3a	5,370 LYrs	U377
☐ NGC6537, PK 10+0.1	18 05 13.1 -19 50 35	Sgr	P.N.	13.5(V)	10.0" x 10.0"	2a+6	6,000 LYrs	U339
☐ NGC6881, PK 74+2.1	20 10 52.5 +37 24 41	Cyg	P.N.	13.2(V)	4.0" x 4.0"	2a+3	5,200 LYrs	U119
<b>Emission Nebulae:</b>								
☐ NGC6559	18 09 53.0 -24 04 30	Sgr	E Neb	--	8.3' x 4.2'	E	5,000 LYrs	U339
☐ NGC6726 - NGC6727	19 01 42.0 -36 53 00	CrA	E Neb	--	5.0' x 5.0'	R	420 LYrs	U379
NGC6729	19 01 55.1 -36 57 21	CrA	E Neb	--	1.0' x 1.0'	E+R	--	U379
☐ NGC6992, E. Veil Neb.	20 57 00.0 +31 30 00	Cyg	S.N.	--	80.0' x 26.0'	E	3,260 LYrs	U120
☐ NGC6960, W. Veil Neb.	20 45 54.0 +30 43 00	Cyg	S.N.	--	60.0' x 9.0'	E	3,260 LYrs	U120
☐ NGC7000	20 58 00.0 +44 20 00	Cyg	E Neb	--	120.0' x 120.0'	E	2,590 LYrs	U85
<b>Dark Nebulae:</b>								
☐ B 68, LDN 57	17 22 38.0 -23 50 12	Oph	D Neb	--	4.0' x 4.0'	K G	408 LYrs	U338
☐ B 72, The Snake Neb	17 23 50.0 -23 41 51	Oph	D Neb	--	5.0° x 3.0°	--	650 LYrs	U338
☐ B142, TGU K367	19 39 42.0 +10 31 00	Aql	D Neb	--	--	--	2,400 LYrs	U207
☐ B143, LDN 694	19 41 06.2 +10 54 17	Aql	D Neb	--	--	--	2,400 LYrs	U207

**Good Luck - Clear and Steady Skies,**  
*Larry Mitchell - Eileen Myers*

Distance: 70 km.sec<sup>-1</sup> kpc<sup>-1</sup>

KLYrs – Thousands of light years

Mlyrs – Millions of light years

BLYrs – Billions of light years

<b><u>Type:</u></b>	<b><u>Nebulae:</u></b>	<b><u>Planetary Nebulae:</u></b>
G.C. – Globular Cluster	D – Dark Nebulae	2a+3: Brighter toward the center, irregular disk
Gal – Galaxy	E – Emission Nebulae	2a+6: Brighter toward the center, abnormal form
E Neb – Emission Nebula	R – Reflection Nebulae	
D Neb – Dark Nebula		
O.C. – Open Cluster	<b><u>Open Clusters-Trumpler</u></b>	<b><u>Galaxies</u></b>
P.N. – Planetary Nebulae	I: Detached, Strong central region	B – Barred galaxy
QSO – Quasar	II: Detached, Little central region	E – Elliptical galaxy
S.N. – Supernova	III: Detached, No noticeable region	I – Irregular galaxy
	1: Stars similar brightness	S – Spiral Galaxy, normal
	2: Stars moderate brightness range	SA – Unbarred Spiral galaxy
	3: Stars bright and Faint	SB – Barred Spiral galaxy
	p: Poor cluster, < 50 stars	SAB – Intermediate Spiral, Barred & Non-barred
	m: Moderate cluster, 50-100 stars	b – Intermediate Wound arms
	r: Rich cluster >100 stars	bc – Loosely Wound Spiral Arma
	n: Nebulosity present	c – Loose clumpy arms
		d – Loosely Wound, Disorganized
		m – Defines Irregular or Peculiar galaxies
		r – Ring like structure
		s – Without Ring structure
		rs – Transition Eing structure

This year we have tried to provide a listing of different types of deep sky objects which leads to the title “A Little Bit of Everything”. All of the objects listed should be readily visible in small to medium sized telescopes, weather permitting. This also includes the quasars, which are billions of light years away. In fact, we would not be too surprised if several people do not successfully view ALL of the objects. The list includes objects which are not regularly observed by most visual observer. However, an exception to this is Messier 11, which is just too beautiful to ignore when one is chasing open star clusters. The quasar at the end of the handout, APM8279+5255 (not on the list), is reserved for large telescope operators who wish to visually see with their own eyes something truly extraordinary - Something halfway to the edge of the known universe, which is a mind blowing 46 billion light years away.

Stellafane is a magical place where amateur astronomy began over a hundred years ago. The Stellafane Convention will always be, first and foremost, a telescope making conference. The Observing Olympics hopefully provides a wide-ranging pathway for visual observers to enjoy the product of their endeavors. We hope you enjoy observing this list as much as we have enjoyed providing it.



Clear and Steady Skies-

Larry and Eileen

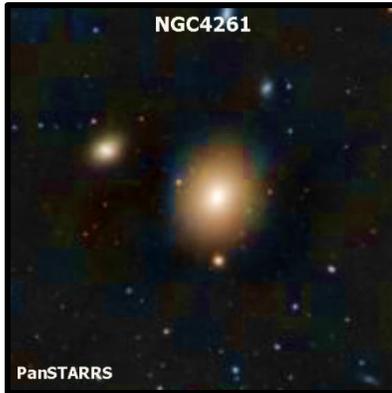
July 24 – 27, 2025



# Stellafane Observing Olympics, 2025 "A Little Bit of Everything"

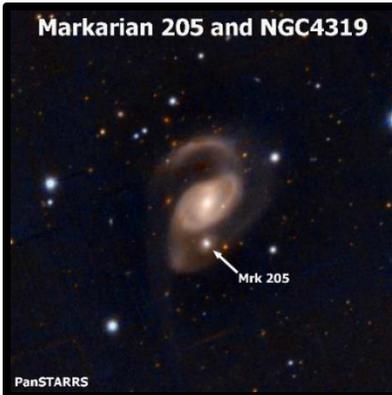
## Handout in Right Ascension Order

### Observing Pins Awarded for 15 Successful Observations



**NGC4261** is an elliptical galaxy with a morphological classification of E2, which is located around 100 million light-years away, and was discovered by the German-born astronomer Sir William Herschel. The galaxy is estimated to be about 60 thousand light-years across. The stellar population of NGC4261 is old, which is typical of elliptical galaxies as star formation has ceased in these galaxies long ago. NGC4261 is the cD, or central dominant galaxy in a gravitationally bound galaxy cluster known as the NGC4261 Group, however there are no indications of recent mergers or interactions with other members within the group. Large scale isophotes of the galaxy are generally boxy in appearance with no irregularities which suggest no disruptive interaction within the last billion years. A dust lane is located along the north-south axis and a circumstellar disk of dust is situated around the nucleus. The nucleus is an active galactic nucleus (AGN) consisting of a supermassive black hole with a mass of  $1.62 \times 10^9$  solar masses. It is somewhat offset from the center of the core which is very interesting. Radio bands reveal two prominent jets emanating from the nucleus, which extend about 88 thousand light years from the nucleus.

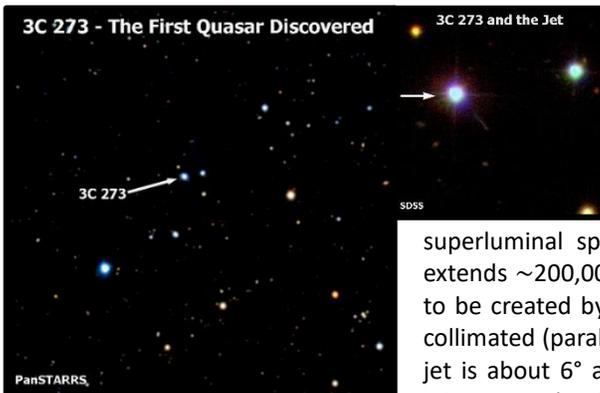
**NGC4261, 3C 270:** 12h 19m 23.3s +05° 49' 33"



**Markarian 205** is a low luminosity, radio quiet quasar that is visually located only 40 arcseconds south of the nucleus of NGC4319. This equates to only 10,000 – 16,000 light years (3 – 5 kpc) from the larger galaxy, but this is an illusion. There has been a lot of controversy over these two objects as to whether they are physically connected to each other, or merely are a chance alignment of sight. In 1971 Halton Arp showed there appeared to be an optical "light bridge" between Mrk 205 and NGC4319 and proposed the theory the quasar was newly created mass and energy that has been expelled from the heart of the active galaxy, NGC4319. Therefore, he surmised both objects were at the same relative distance from Earth. Arp and others followed this up with the idea that the redshift has nothing to do with distance, but rather is an indication of youth, where matter and energy are being newly created. These ideas were pretty radical and flew in the face of most conventional astronomical theories. Arp never backed down however and took his ideas with him to the grave, stating he expected to be eventually proven right. Today we know this "light bridge" is really due to the quasar shining through part of a spiral arm of NGC4319. Arp's theory, at least about these two objects, has been dis-regarded. NGC4319 is a face-on barred spiral galaxy located

**Mrk 205:** 12h 21m 44.4s +75° 18' 39"

63.2 - 80.0 million light years away. Markarian 205 is now thought to lie some 15 times more distant than NGC4319, at about 1.2 billion light years and it is usually classed as a Seyfert object with a bright active nucleus which is probably a low luminosity quasar. Markarian 205 is relatively close to Earth for a quasar, and deep CCG images show a slightly extended envelope of surrounding gas and stars which is the host galaxy.



**3C 273** is the brightest quasar in the sky at a Vmag. of 14.83, and it was the first quasar to be identified in 1970. The quasar lies at the heart of a giant type E4 elliptical galaxy, with an apparent V mag. of 16.0, and a size of 30 arc-seconds. It is located at a distance of 2.4 billion light years ( $z = 0.158$ ). 3C 273 is a radio loud quasar and is a well-known superluminal source, with more than 10 radio components having been detected moving away from the nucleus with different superluminal speeds and position angles. The quasar also has a large-scale visible jet, which extends ~200,000 light-years long, with an apparent size of 23 arc-seconds. Such jets are believed to be created by the interaction of the central black hole and the accretion disk. The inner jet is collimated (parallel light) but later the jet expands into a conical structure. The viewing angle of the jet is about  $6^\circ$  as seen from Earth and the jet was observed to abruptly change direction by an intrinsic angle of  $2^\circ$  in 2003. Superluminal motion is an apparent faster than light movement seen

**PGC41121:** 12h 29m 06.7s +02° 03' 09" in some very energetic objects such as quasars and BL Lacs, which contain massive black holes. However, it is only an illusion of faster than light movement. 3C 273 is nearby for a quasar and is one of the most luminous quasars known with an absolute magnitude of  $-26.7$ . If the quasar were only as distant as the star Pollux ( $\sim 10$  parsecs or 32.6 light years) it would appear nearly as bright in the sky as the Sun, and night-time astronomy as we know it would not exist. The quasar is over 4 trillion times more luminous than the Sun at visible wavelengths and the luminosity is variable at nearly every wavelength, from radio waves to gamma rays, and on timescales of a few days to decades.



**The Draco Trio:** encompasses an area no larger than a half-moon, and the three galaxies have different morphologies and appearances. **NGC5981** is an edge on class SB spiral dwarf galaxy, with a prominent dust lane. It is the closest of the three galaxies, yet it is visually the faintest of the three objects. It appears smaller than it should and may have a large dark matter halo which has truncated star formation at larger radii. **NGC5982** was discovered by Sir William Herschel in 1788, and is a class E3 elliptical shell-galaxy which is slowly rotating. Although it looks quiescent, deep images reveal multiple surrounding shells which are the results of a merger with another galaxy about a billion years ago. NGC5982 may also be an active galaxy hiding a supermassive black hole. Although it is an elliptical galaxy it also contains a young population of stars, perhaps as a result of the merger. The luminosity of this massive galaxy comes from very old stars (>5 Gyr). A significant amount of cold dust is also present. **NGC5985**

**Draco Dwarf: 15h 39m 37.1s +59° 19' 55"**

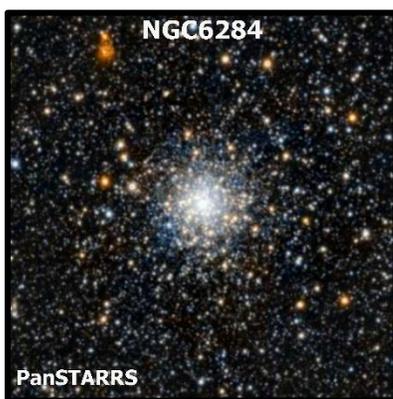
is a large face-on SBb spiral galaxy and a massive active Seyfert galaxy with a diameter measuring 246,000 light years. For comparison our Milky Way galaxy is 185,000 light years in diameter. The galaxy has two main arms which are thin and well defined, with one splitting into two parts toward the west. The rotation curve is symmetric reaching a plateau of 185 miles per second at about 50 arc-seconds from the center. Halton Arp featured this galaxy in his redshift controversy, as 5 quasars are located nearby, and Seyfert galaxies are known to eject material. The three galaxies all lie between 100 and 140 million light-years from Earth, and are part of a larger group of galaxies known as the NGC5982 Cluster. They are probably not related and reside at large different distances so the triplet is purely a line-of-sight effect.



**NGC6144** is located 1 degree away from the much brighter globular cluster, M4 and 30 arc-minutes to the northwest of Antares in the Scorpius constellation. It is partially obscured by the Rho Ophiuchi dust cloud complex, Sharpless 2-9 and therefore suffers from significant reddening. Compared to its bright neighbor, M4, it appears fairly faint, but the magnitude of its stars at the V-tip (the brightest stars in the cluster) is 13.4 so it is readily visible in small to medium sized telescopes. The cluster is loosely structured with empty space seen between core members and is unusual as it has a very low core stellar density for a globular cluster. It harbors six X-ray sources, but four of these are suspected to be background sources. This number is higher than the prediction based upon the mass of the cluster and the number of sources. The emissions are thought to be the result of cataclysmic variable stars. The high stellar densities in globular cluster cores make secure optical identifications of X-ray sources difficult. However, the high spatial resolution of Chandra allows us to determine X-ray source positions to sub-arcsecond levels. CCD photometry of NGC6144 shows the horizontal branch is predominantly blueward of the RR Lyrae instability strip, while the red giant branch is

**GC6144: 16h 27m 14.1s -26° 01' 29"**

relatively steep, signifying a low-to-intermediate metal abundance ([Fe/H]=-1.81]. Also, three candidate post-asymptotic giant branch (PAGB) stars are present within 3 arc-mins. of the center, with Vmags. of 11.85, 16.74 and 19.30, and these are likely to be actual cluster members.



**NGC6284** was discovered by William Herschel on May 22, 1784. Its distance from the Sun, as of 2023, is 43,032 light years. According to the Shapley-Sawyer globular cluster Concentration morphological classification scheme NGC6284's density profile is rated IX, with XII being the densest possible. The cluster is old at 13.3 billion years, with a low metallicity [Fe/H] = -1.36, and is associated with the thick Galactic disk and located in the background of the Galactic bulge. From our perspective in projection in the sky, it appears north of the bulge. NGC6284 has an unusual orbit around the Galaxy which extends up to ~17,900 light years above the Galactic plane, with a highly elliptical orbit with a perigalactic distance of 20,600 light years from the Galactic center. NGC6284 may not have originated within the Milky Way Galaxy, and there are indications it was accreted from the Gaia-Enceladus Sausage, a dwarf galaxy cannibalized by the Milky Way. It is not thought to be associated with the Sagittarius dwarf spheroidal galaxy which is currently merging with the Milky Way Galaxy. NGC6284's density profile shows a very steep central brightening which

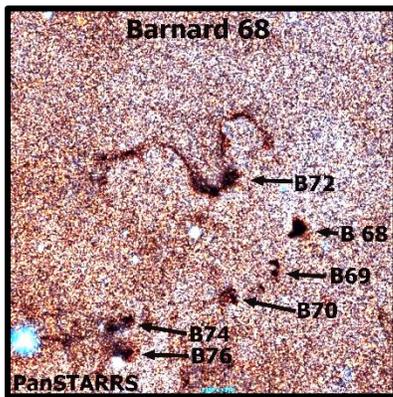
**NGC6284: 17h 04m 28.8s -24° 45' 53"**

suggests that NGC6284 is a post-core collapse (PCC) cluster. The PCC state is the most advanced phase of internal dynamical evolution of collisional systems. Recurrent stellar encounters within the cluster cause kinetic-energy exchanges among stars, with the most massive objects sinking towards the system's center. This results in a progressive contraction of the core leading to a core collapse and a substantial, almost violet, increase in central density. Approximately 20% of the GCs in the Galaxy are currently in this dynamical evolutionary stage. The nearby metal-poor star HD 194598 may be a recent runaway from NGC6284.



GC6563: 17h 12m 02.5s -33° 52' 06"

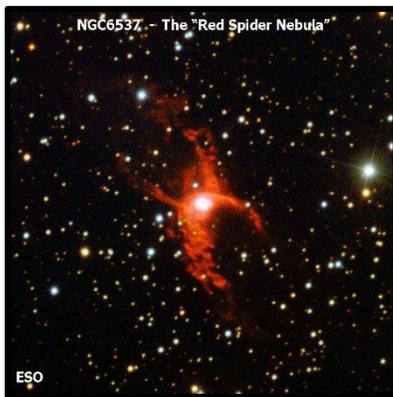
**NGC6563** was discovered by the Scottish astronomer James Dunlop in 1826 and Stephen James O'Meara has described it as a "hidden treasure". Its distance is variously listed as close as 5,370 light years to as much as 6,086 light years. Distances to planetary nebulae are always difficult because their central stars are very different from 'normal' stars. The apparent size of the nebula is 48 arc-seconds, which given various distance calculation, results in an actual diameter of 0.795 to 1.26 light years. If the most distant figure of 6,086 light years is employed and with an expansion velocity of  $11 \text{ km s}^{-1}$ , then a dynamical age of 17,800 years is reached. NGC6563 has an intense and extended molecular emission structure. NGC6563 appears as a standard elliptical planetary nebula with brightening at the ends of the minor axis (photo). The expanding carbon monoxide (CO) shell is distributed around the minor axis waist or the Torus but it is fragmented. The nebula is tilted to the plane of the sky and the shell also appears fragmented into a series of condensations which are mostly unresolved in telescopes. The visual magnitude of the central star is 17.49, and its mass is estimated at 2.932 solar masses, meaning it was a much larger star than the Sun when it was on the main sequence. Its surface temperature reaches 123,000 K and its luminosity is equal to 69 times that of the Sun. NGC6563 exhibits an overall low electron density which is evidence of a relatively evolved object.



B68, LDN 57: 17h 22m 38.0s -23° 50' 12"

**Barnard 68 and Barnard 72, The "Snake Nebula"**, are Dark Nebulae and two of the most well defined low-mass starless dense cores. **B68** is relatively isolated and a starless Bok globule, which is a star forming region. A Bok globule is a very dense and cold environment consisting largely of dust which is gravitationally collapsing into stars. It is conveniently situated against the backdrop of Galactic bulge (giant) stars and is one of 370 dark marking in the sky cataloged by Edward E. Barnard in the early 20<sup>th</sup> century. The whole region is a beautiful area to scan in a wide-field telescope or large binoculars. Measurements of the kinematic temperature of the core of B68 range from 8 K to 16 K, and at these temperatures' oxygen, nitrogen, sulfur, and complex organic molecules are subject to ice chemistry. It is thought 1% to 10% of this ice mass is sublimated and for this reason the lifetime for starless cores likely does not exceed 1 million years. One estimate of the distance places B68 is 85 – 100 pc or 277 to 408 light years and it is possible the outer layer of B68 is pulsating. The mass of B68 is 2.1  $M_{\odot}$  at the assumed distance of 408 light years. **The Snake, B72**, was originally called the "S" nebula and is a non-thermal filament in the Galactic center, and

its presence in such a volatile environment is one of the great mysteries. B72 is 650 light years away and in the night sky is located at the top of the Pipe Nebula, which is a large cloud spanning 5 degrees in length and over 3 degrees in width. It spans a total of 5 light years. The Pipe Nebula is large enough to be seen with the naked eye, and together the Snake and the Pipe are part of a large nebular complex called the Dark Horse Nebula which covers a huge  $10^{\circ} \times 10^{\circ}$  area of the sky. A dark nebula is made up of interstellar dark clouds of obscuring gas and dust which could potentially form stars in the future. They have no form of illumination, so the only way that we can observe these objects is when, as foreground objects, they obscure the light of objects behind them. The Pipe Nebula is best observed in binoculars as it is very large in size.



NGC6537: 18h 05m 13.1s -19° 50' 35"

**NGC6537, The "Red Spider Nebula"**, is a planetary nebula located near the heart of the Milky Way. It has a prominent two-lobed shape, probably due to a companion to the central white dwarf and its magnetic fields. The bipolar lobes have an S-shaped symmetry and appear similar, but are apparent only in large amateur telescopes. The gas walls of the two lobed structures are not smooth, but rather are rippled in a complex way. The central white dwarf is the remaining compact core of the original star which produces a powerful and hot ( $\approx 10,000 \text{ K}$ ) wind blowing at a speed of 200 miles per second. This has generated ripples or waves which are generated by supersonic shocks formed when the local gas is compressed and heated in front of the rapidly expanding lobes. Atoms caught in the shocks radiate as visible light and this is what we are seeing. These winds are what give this nebula its unique 'spider' shape and also contributes to the expansion of the nebula. The central star is surrounded by a dust shell making its exact properties hard to determine. Its surface temperature is probably 150,000–250,000 K, although a temperature of 340,000 K or even 500,000 K is not ruled out, making it among the hottest white dwarf stars

known. Its core mass is  $\approx 0.70.9 M_{\odot}$ , meaning its progenitor mass was in the range of 3.0 – 7.0  $M_{\odot}$  and its luminosity is 1,000  $L_{\odot}$ . Its distance has been variously estimated as 3,000–8,000 light-years and its age is approximately 1,600 years. NGC6537 is an extremely high excitation planetary nebula yet it fosters a rich molecular environment, which is unusual in highly energetic objects. These results, coupled with past observations, suggest that molecular abundances in PNe are governed principally by the physical and chemical properties of the individual object and its progenitor star, rather than nebular age.



**NGC6559: 18h 09m 53.0s -24° 04' 30"**

is the closest major spiral inward from the Sun. It is the host of several prominent massive star forming regions, including M8, M16, M20 and several others, all at the same distance.

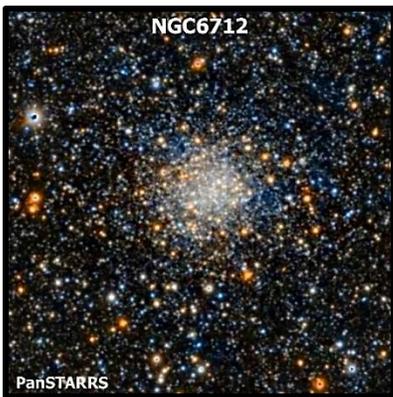
**NGC6559** is a star-forming region located about a degree to the east of Messier 8, the famous Lagoon Nebula. NGC6559 was discovered on July 1, 1826 by John Herschel with his 48-centimeter telescope. The nebula is about 5,000 light-years from Earth, and shows both reddish emission and bluish reflection regions. The reddish emission nebula is composed of hydrogen which emits ionized light in the H $\alpha$  line, and is illuminated by hot massive young stars. The bluish reflection nebulae are dark absorption regions of dust which shine only by reflected light and are not energized sufficiently to become ionized. The jet-black dark nebulae are tendrils of dust which block out all light from the background. The arc-shaped emission nebula is the product of the energetic binary star system 11 Sgr. seen to the upper right in the photo. The first massive type O and B stars which form from the dense gas, will emit energetic light and winds that erode, fragment, and sculpt their birthplace. And then they explode, which can dissipate the cloud and retard subsequent star formation within the nebula. The resulting morass can be as beautiful as it is complex. After tens of millions of years, the dust boils away, the gas gets swept away, and all that is left is a naked open cluster of stars. NGC6559 is a member of the Sagittarius Galactic Arm which



**M 11: 18h 51m 06.0s -06° 16' 00"**

Alpha process elements. Alpha elements (C, O, Ne, Mg, Si, S) are synthesized through the successive fusion of Helium nuclei in stars. They are produced in very massive stars which have a higher abundance of heavy elements relative to iron, and these stars end their existence as supernovae. This shows M11 contains very massive stars and this enrichment is possibly due to an enhancement of its birth molecular cloud by a nearby Type II supernova explosion. At least nine variable star members have been identified with high probability, which includes two eclipsing binary star systems, plus another 29 lower probability members.

**Messier 11** is also known as the "Wild Duck cluster" is perhaps visually the most beautiful open cluster. It contains Approximately 2900 stars and can be seen with the naked eye. Its overall triangular shape resembles a flock of ducks in flight. It was discovered by Gottfried Kirch in 1681 and Charles Messier included it in his catalog of diffuse objects in 1764. The cluster is located just to the east of the Scutum Star Cloud and located 6,120 light years from Earth. It is located 22,000 light years (6.8 kpc) from the Galactic Center and close to the galactic plane. Messier 11 is one of the richest and most compact of all the known open clusters. It therefore is one of the most massive open clusters known, and has been extensively studied. Its age is estimated to about 316 million years so it is not far from its birthplace. The core radius is 4.01 light years (1.23 pc) while the overall tidal radius is 95 light years. Estimates for the cluster's mass range from 3,700 M $\odot$  to 11,000 M $\odot$ , depending on the method chosen. The brightest cluster member has a visual magnitude of 8.0, and M11 has 870 members of at least magnitude 16.5, so it is easily seen. The cluster is with an iron abundance of [Fe/H] = 0.17. Despite its youth, M11 shows an excess of alpha



**NGC6712: 18h 53m 04.3s -08° 42' 22"**

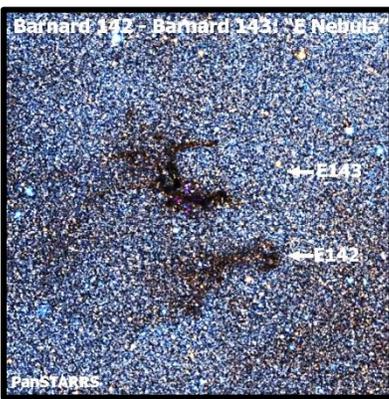
age, PSR J1853-0842A is accelerating. A pulsar is a highly magnetized rotating neutron star that emits beams of electromagnetic radiation out of its magnetic poles.

**NGC6712** is a globular cluster that was probably first discovered by Le Gentil on July 9, 1749 when investigating the Milky Way star cloud in Aquila. He described it as a "true nebula," in contrast to the open star cluster M11. William Herschel Independently discovered it on June 16, 1784 and cataloged as H I.47, and he also first classified it as a round nebula. This gives an indication of the quality of 18<sup>th</sup> century speculum mirrors. John Herschel was the first to describe it as a globular star cluster during his observations in the 1830s. NGC6712 appears to be about 12 billion years old and like most globular clusters it probably was initially significantly more massive having undergone significant mass loss due to repeated passes through the galactic disk. Most globular clusters are metal poor due to their great age, but NGC 6712 is somewhat metal-rich. This possible is due to its formation in a relatively metal rich molecular cloud. NGC 6712 is home to a "black widow" pulsar named PSR J1853-0842A. Such systems involve an extremely rapidly rotating pulsar, accompanied by a low-mass star or brown dwarf, which it is devouring. The high amount of radiation emitted from the pulsar contributes to the evaporation of the low-mass companion, which has a mass between 0.018 and 0.036 solar masses. Although pulsars rotate more slowly with



**NGC 6726, also known as NGC6727** in Corona Australis is a beautiful star forming region located about 420 light years away in the constellation Corona Australis, the Southern Crown. This area contains many outstanding nebula and unusual objects and is one of the more dynamic and colorful areas in the southern sky. This is a prime location for star formation and many young stars and protostars are present. NGC 2726-27 is a blue reflection nebula which are clouds of interstellar dust particles which are lit up by bright nearby stars. The nearby IC4812 is another similar object, although it is located about 100 light years closer to Earth. NGC6729 is the small diamond shaped object (Photo) which is both an Emission and a Reflection nebula, hence its different color. It is also referred to as an a variable nebula and is illuminated by the variable star R CrA. The region around NGC6726-27 contains many other fascinating objects. These include NGC6723 a globular cluster, dark nebulae (Barnes 157 and SL 41) which are dense enough to block light from behind, and variable stars and Herbig Haro Objects (HH). HH objects are jets of gas and matter ejected at

**NGC6726/27: 19h 01m 42.0s -3°6 53' 00"** enormous speeds by young stars which create visible shock waves when they encounter dense material. These are difficult visual objects.



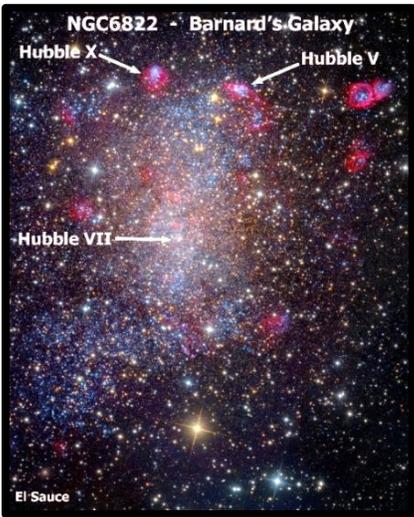
**Barnard 142 and 143, or Barnard's "E"** are best observed with binoculars, and a dense background of stars facilitates viewing. It is easy to find the "E" in the northern constellation of Aquila. Just center 4th magnitude Tarazed or Gamma (Y) Aquilae in the binoculars. Barnard's E lies 1.6° west-northwest of the star and spans about a degree on the sky, which is roughly twice the size of the Moon. Its size is why it is best observed with binoculars or a very wide field telescope. Barnard's E is about 2,000 light years from Earth. At higher powers some subtle structures are visible within the "E". **Barnard 143** is the darker of the two nebulae and its most visible part is a narrow bar about 1.4° long which stretches east to west. A second bar of the same length connects its east end and heads northward. At the end of the bar is a third nebula which parallels the first one. The combination of these three forms a C-shape whose open-end points west. **Barnard 142** lies just south of B143 but it is not as dark as B143 and is less defined, so it is more difficult to see. These are dark nebulae which are combinations of dust and cold gas (mostly molecular hydrogen) that

**B142 E Nebula: 19h 39m 42.0s +10° 31' 00"** emit no light and reflect no starlight. We see them only because they are in front of more distant bright backgrounds. They may form stars in the future. However, the temperature of the hydrogen in dark nebulae must be just 18 degrees F above absolute zero or less. If the cloud is warmer the atoms will be moving too fast to merge when they collide and stars will not form.



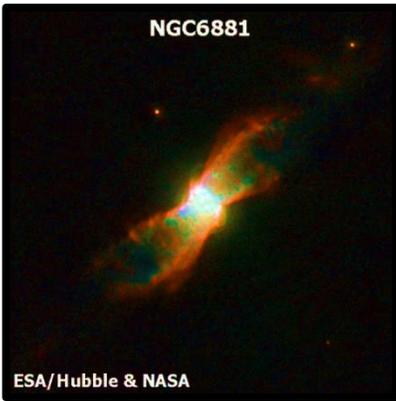
**NGC6819, the Foxhead Cluster**, is an open cluster located on the boundary of Cygnus and Lyra. It was discovered by Caroline Herschel on 12 May 1784. It contains roughly two dozen stars of Vmagnitude 10 to 12, with many fainter members. NGC6819 was studied by the NASA Kepler spacecraft from 2009 to 2013 and discovered a number of oscillating red giant stars. The age of NGC6819 is estimated to be  $\sim 2.5 \pm 0.5$  billion years, roughly half the age of the Sun, or 4.5 billion years, and is relatively old for an open cluster. Since the cluster is younger than the Sun, most stars at the cluster's main-sequence turnoff are somewhat more massive than the Sun, around 1.6  $M_{\odot}$ . Its distance is calculated to be 7,050 - 8,000 light years. NGC6819 contains blue straggler stars (BSS) and most of these massive stars appear to be bunched in the center of the galaxy, while the red giant branch population is not as tightly bunched. Therefore, NGC6819 shows signs of a moderate mass segregation, where the most massive stars are concentrated toward the center of the star cluster. Interactions within and between binary stars in open clusters can produce stars that differ from the

**NGC6819: 19h 41m 16.2s +40° 11' 32"** standard picture of single star evolution. The most well-known of these alternative stellar evolution products are the blue straggler stars (BSS). They were first observed in the globular cluster M3 by Sandage (1953) and given their present name by Burbidge & Sandage (1958). The BSSs are stars that are bluer or brighter than the main-sequence (MS) turnoff in a cluster color-magnitude diagram (CMD). These stars are thought to be the product of two stars merging, which mimic young stars, when the resulting star is still ancient. A total of 5 blue stragglers are known in NGC6819 and all show multimode brightness variability. The cluster also contains an active highly energetic X-ray binary star, which is a star that is luminous in energetic X-rays. These are double stars where the X-rays are produced by matter falling from one star, the donor, to the companion stars, the accretor, which can be a white dwarf, a neutron star or a black hole.



NGC6822: 19h 44m 56.5s -14° 48' 11"

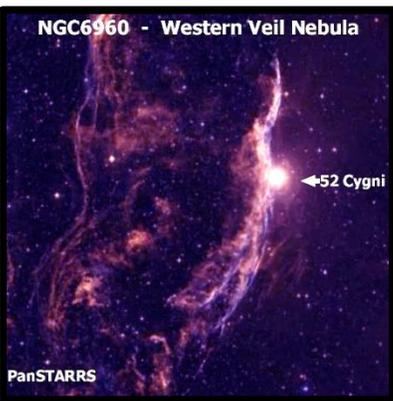
**NGC6822, Barnard's Galaxy, IC4895**, is a large low surface brightness barred irregular galaxy, located only 1.545 million light years from Earth and therefore is a member of the Local Group of Galaxies. It is small at only 7,000 light years in diameter and similar in structure and composition to the Small Magellanic Cloud. After the Magellanic Clouds, NGC6822 is the closest dwarf irregular galaxy to the Milky Way, but it is not gravitationally associated with either the Milky Way or with M31. Eight-star clusters are known to exist within NGC6822 while more have been suspected. Additionally, a total of 157 H II regions have been located along with 26 planetary nebulae candidates and one supernova remnant, all of which are surprising for such a small host. A total of 8 globular clusters are known to exist within NGC6822. The globular cluster Hubble VII was originally discovered by Hubble in 1925 and for a long time was considered the only globular cluster within NGC6822. However, this changed in 2011 when Hwang et al. discovered four new globular clusters. The clusters are arranged in an almost linear configuration and are oriented closely with the major axis (NE-SW) of the spheroid. They range from 16.35 to 19.23 Vmags, although most appear brighter. Most have ages in excess of 9 billion years, and exhibit a range of metallicities from  $[Fe/H] = -1.6$  to  $-0.4$ . Paul Hodge has catalogued 157 H II regions inside NGC6822 which is considered a very large number of H II regions for such a small galaxy. A single supernova remnant (SNR) has been found and 26 planetary nebulae candidates have been identified.



NGC6881: 20h 10 m52.5s +37° 24' 41"

**NGC6881** is a planetary nebula located 3.5 degrees southwest of Gamma Cygni also known as Sadr. in Cygnus. It contains an inner nebula which is estimated to be about one-fifth of a light year in diameter. Additionally, a symmetrical structure or lobes spreads out about one light year from one tip to another, and this bipolar symmetry is probably due to a binary star in the center of the nebula. The distance is estimated at 5,200 light years and its Vmag is 13.7. The central star has about 60% of the mass of the Sun and the star is still heating up. Currently there are three values for the brightness of the central star. A visual mag. of 16.7 gives a core temp. of 77,000 K. Another Vmagnitude of 18.4 results in a 120,000 K temp, while a Vmag. of 20.5 gives a 143,000 K, but this is probably not realistic. The 16.7 Vmagnitude which appears to be more realistic suggests a stellar luminosity around 7,000 Suns and a core mass slightly over 0.6 solar. The disk structure is 5 arc seconds in diameter and about 0.2 light years across and contains three pairs of flat central rings. Enriched helium is present in the nebula in this area. NGC6881 displays optical quadrupolar lobes consisting of two pairs of highly collimated bipolar lobes aligned along different directions.

These formed at different phases of the nebular evolution. Molecular hydrogen or  $H_2$  (2 Hydrogen atoms combined) emission is predominantly shock excited in NGC6881 and is detected mainly in the equatorial region and in the wide hourglass bipolar lobes that are much more extended than the ionized bipolar lobes. The  $H_2$  bipolar lobes represent an early ejection that occurred before the formation of the two pairs of ionized bipolar lobes, which is why the outermost regions are  $H_2$  dominated. The  $H_2$  lobes share the same orientation as the ionized lobes, but are less collimated and display a distinct hourglass shape. The Northern  $H_2$  lobe extends 5 times farther out than the ionized lobes, but the Southern  $H_2$  lobe has a reduced extension. This asymmetry suggests the interaction of the nebula with an inhomogeneous interstellar medium. The very different morphologies of the ionized and molecular bipolar lobes of NGC6881 imply different bipolar ejection events at different times.



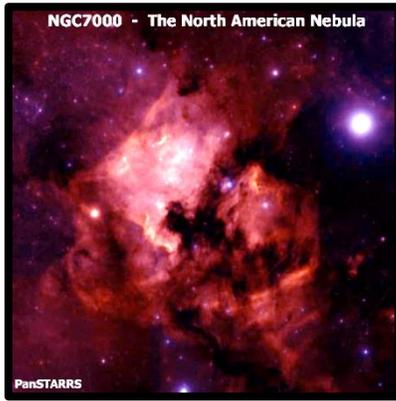
NGC6960, W. Vail: 20h 45m 54.0s +30° 43' 00" about 930,000 miles per hour. The Hubble Space Telescope between 1997 and 2015 directly measured this expansion at 0.03 arc-seconds per year. The visual rope-like filaments are less than 1/100,000 of the filament diameter which is twice the distance from the Earth to Pluto.

**NGC6960** is also known as the "Witches Broom" and is the western part of the Veil Nebula. The bright Vmag. star 52 Cygni is an orange-colored star located about 291 light years away and appears to illuminate the nebulosity. However, it is a foreground object and has no affiliation with the nebula which is nearly ten times farther away. It is a G9 spectral class star which means it is a giant star that is cooler and larger than our Sun. It is also a double star with a faint companion star located about 6.0 arc-seconds away which is visible in amateur telescopes. NGC6960 is only part of the Veil Nebula which is a core collapse supernova remnant of heated and ionized gas. The source was a star ~20 times more massive than the Sun which exploded between 10,000 and 20,000 years ago. The explosion occurred in a cavity evacuated by the progenitor star, and the star has never been discovered, and probably no longer exists. The supernova would have appeared brighter than Venus in the day sky. The remnants have since expanded to cover an area of the sky roughly 3 degrees in diameter which is about 6 times the diameter of the full Moon. The distance from Earth is roughly 3,260 light-years and its overall diameter is 130 lightyears, with an expansion velocity of



**NGC6992: 20h 57m 00.0s +31° 30' 00"**  
light is emitted at this wavelength.

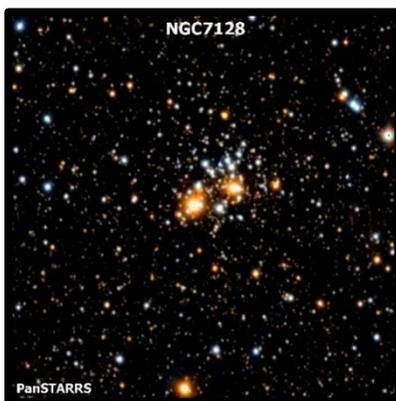
**NGC6992** is the brightest portion of the Eastern region of the Veil Nebula and is also known as the “**Network Nebula**”. The Veil Nebula was discovered by William Herschel in 1784. Based on the distance of two stars located within the remnant, the distance to the center of the Cygnus Loop is estimated to be approximately 2,400 light years. The Cygnus Loop exhibits a large northern circular shell, which is composed of two bright partial shells and a central filament, plus a bubble-like shell located in the southern region. The nature of this very peculiar morphology is still debated, but one theory for the two main shells of the Cygnus Loop proposed two interacting supernovae. NGC6992 has a higher magnetic field and a harder radio spectrum than the entire rest of the supernova remnant. NGC6992 also has strong X-ray and infrared emissions, plus elevated H $\alpha$  and OIII optical lines which are faint or completely absent along the southern region or shell. This indicates NGC6992 has different environmental conditions from other regions. The reasons for this are unclear. These regions are rich in molecular gasses, which shine in the light of excited Hydrogen, Oxygen and Sulfur. A visual observer can best see the Veil using an O-III nebula filter, as almost all the



**NGC7000: 20h 58m 00.0s +44° 20' 00"**

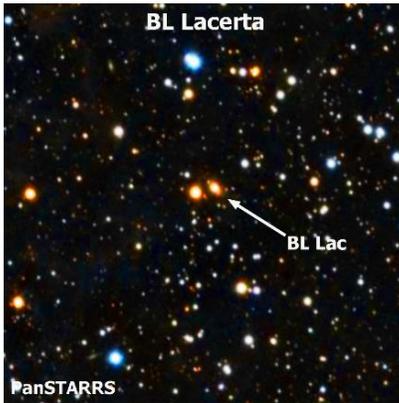
**The North America Nebula (NGC 7000 or Caldwell 20)** is an emission nebula in Cygnus, close to Deneb and was discovered by William Herschel on October 24, 1786. In 1890, the German astrophotographer Max Wolf noticed this nebula's shape on a long-exposure photograph, and dubbed it the North America Nebula. The North America Nebula is part of the same interstellar cloud of ionized hydrogen (H II region) as the Pelican Nebula and is separated by a dark band of dust. The two nebulae together are cataloged as Sh2-117. American astronomer Beverly T. Lynds catalogued the obscuring dust cloud as L935 in her 1962 compilation of dark nebulae. The North America Nebula covers a region more than ten times the area 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 ( $\sim 3^\circ$ ) will show it as a foggy patch of light under sufficiently dark skies. However, using a nebula filter, it can be seen without magnification under dark skies. The portion of the nebula resembling Mexico and Central America is known as the Cygnus Wall (Photo). This region exhibits the most concentrated star formation. At optical wavelengths, the North America Nebula and the Pelican Nebula (IC 5070) appear distinct as they are separated by the dark band of

interstellar dust L935. In 2020, the Gaia astrometry spacecraft measured the distances to 395 stars lying within the HII region, giving the North America and Pelican nebulae a distance of 2,590 light years. The entire HII region Sh2-117 is estimated to be 140 light years across, and the North America nebula stretches 90 light years north to south. HII regions shine because their hydrogen gas is ionized by the ultraviolet radiation from a hot star. Deneb has been ruled out as the ionizing star as it is not hot enough. Another star catalogued J205551.3+435225, is located right in the center of Sh2-117 and has a temperature of over 40,000 K. It is almost certainly the ionizing star for both the North America and Pelican nebulae. It is a spectral type O3.5 massive star and has a hot companion (type O8), so both are very hot stars. It is located just off the “Florida coast” of the North America Nebula, so it has been conveniently nicknamed the “Bajamar Star”. *Islas de Bajamar* was the original Spanish name for the Bahama Islands. This star shines with a Vmag. of 13.2 even though it is dimmed by 9.6 magnitudes. If we saw this star undimmed, it would shine at magnitude 3.6, almost as bright as Albireo, the star marking the swan's head.



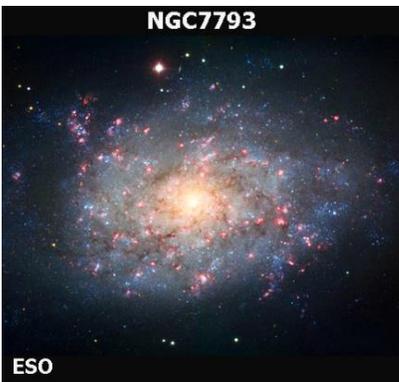
**NGC7128: 21h 44m 00.0s +53° 43' 00"**

**NGC7128** is a medium rich open cluster with a Trumpler classification of III 3m. It is located in Cygnus and was discovered by William Herschel on October 14, 1787. Even though it is highly reddened by foreground dust, it is one of the finest visual clusters in the original Herschel 400 list. The distance to NGC7128 has usually been put at about 7500 light years, but a well-researched recent paper indicates it is closer to 13,000 light years away. This puts it on the edge of the Perseus arm of our galaxy rather than between arms. It is a rather young cluster, around 10 million years of age. Dreyer's description indicated it contained a ruby star, but NGC7128 contains two bright orange stars plus a third fainter one. It is unclear which star Dreyer mentioned. Three emission stars in NGC7128 have proven to be “Be stars”, which are non-supergiant B-type stars. These are main sequence variable stars which have ejected material resulting in a shell-like gaseous disk. One star (V1814 Cyg) is an irregular variable star while another (V1481 Cyg) is an eclipsing binary star. NGC7128 is a great visual cluster due to the color contrast of those giant K stars which stand in contrast to the blue A and B type stars it contains.



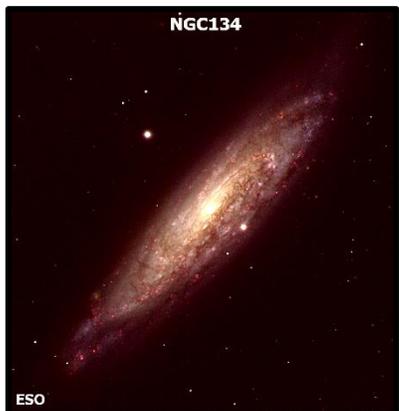
**BL Lacerta, or BL Lac** is a type of galaxy with a very energetic and active nucleus called an active galactic nucleus (AGN). In contrast to other types of AGNs, BL Lacerta and BL Lacs as a group are characterized by rapid and large-amplitude flux variability and significant optical polarization. Because of these properties, the prototype of the class BL Lacerta was originally thought to be a variable star. When compared to the more luminous active nuclei (quasars) with strong emission lines, BL Lacerta and BL Lac objects have spectra dominated by a relatively featureless non-thermal emission continuum over the entire electromagnetic range. This lack of spectral lines historically hindered identification of the nature and distance of such objects. BL Lacs have their relativistic jet closely aligned to the line of the observer, which is why they are so bright. This is also why they are called “Blazars”. BL Lacs are hosted by low-power massive elliptical radio galaxies with active nuclei and a super massive black hole which powers powerful jets of material. BL Lacerta is located about 900 million light years away, but despite its distance it can be as visually bright as some solar system

objects. It is characterized by rapid and large amplitudes of brightness variations, sometimes by several magnitudes within days or weeks, with strong optical polarization. While BL Lacerta possess the featureless spectrum which distinguishes its objects from quasars and other types of AGNs, it has still often been called a quasar. In reality the term “BL Lacerta Object”, “BL Lacs” and “blazar” are often used interchangeably.



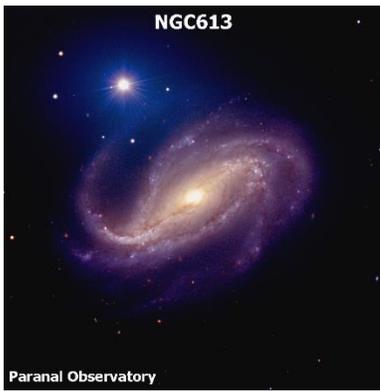
**NGC7793** is a flocculent spiral galaxy in the southern constellation of Sculptor, the nearest constellation of galaxies outside our Local Group, and it is one of the five brightest galaxies within the Sculptor Group. It was discovered on July 14, 1826, by Scottish astronomer James Dunlop. This nearby galaxy is located at a distance of only 12.7 million light years and is receding with a heliocentric radial velocity of 227 km/sec. Its estimated stellar mass is only  $3.2 \times 10^9 M_{\odot}$ . The morphological class of NGC7793 is SA(s)d, indicating it is an unbarred spiral galaxy (SA) with no inner ring structure (s) and the arms are loosely wound and disorganized (d). It is flocculent in appearance with a very small bulge and a nuclear star cluster is located in the core. The galactic disk is inclined at an angle of  $53.7^{\circ}$  to the line of sight from Earth and it has an overall elliptical shape with an angular size of  $9.3' \times 6.3'$ . There are two nearby dwarf galaxy companions. NGC7793 is host to an ultra-luminous X-ray pulsar (ULXP), which consists of a 0.42-second pulsar in a 64-day orbit with an 18–23 solar mass. The bulgeless galactic characteristic, along with its moderate stellar mass, makes it a controversial and unusual object to fuel such a massive black hole (MBH) and to

contain large volumes of hot gas. This galaxy is famous for harboring a powerful microquasar which ejects collimated jets strong enough to inflate a fast-expanding bubble spanning  $\sim 980$  light years in diameter. Deep JWST observations have shown that its H $\alpha$  and neutral hydrogen emission easily extend 1.5 times the optical diameter of the galaxy. This diffuse ionized gas accounts for  $\sim 40\%$  of its H $\alpha$  emission, making the H II disk of this galaxy one of the largest ever observed among the non-active late-type systems. All of these features are considered unusual for such a loosely structured galaxy. This indicates star formation throughout the galaxy and supports the inside-out growth formation scenario of galaxies. One supernova has been observed in NGC 7793, SN 2008bk (type II-P, mag. 12.6) which reached an apparent magnitude of 12.5, making it the second-brightest supernova of 2008.

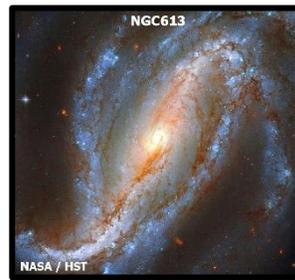


**NGC134** is a barred spiral galaxy which resembles the Milky Way with loosely wrapped spiral arms around a bright bar-shaped central region, typical of a Hubble-type Sbc galaxy. The discovery of NGC134 is often attributed to Sir John Herschel at the Cape of Good Hope, but he did note that it might have been the 590th object discovered by James Dunlop in his 1828 publication, six years prior to Herschel's observations. NGC134 is 60 million light years away and part of the Sculptor group. The Very Large Telescope (VLT) image of the galaxy reveals a prominent warped disc, as the ‘wings’ appear slightly tilted. Many edge-on galaxies share this phenomenon. A trail of gas is also stripped from the top edge of the disk. The warped disk and the trail of expelled gas indicate that NGC134 has interacted with another galaxy sometime in the past, but this remains unproven. The galaxy has an abundance of ionized hydrogen regions along its spiral arms where stars are forming, and it also features many dark lanes of dust that occlude much of its starlight. A barred spiral galaxy is a spiral galaxy with a central bar-shaped structure composed of stars. Bars are found in about two thirds of all spiral galaxies in the local universe. Bars generally affect both the motions of stars and interstellar gas within spiral galaxies and can also affect spiral arms. The bar structure is believed to act as a type of stellar nursery, channeling gas inwards from the spiral arms through orbital resonance, fueling star birth in the vicinity of its center. This process is also thought to explain why many barred spiral galaxies have active galactic nuclei. Bars are thought to be temporary phenomena in the lives of spiral galaxies as the bar structure decays over time, transforming galaxies from barred spirals to more “regular” spiral patterns. A Type IIb supernova (SN 2009g) was discovered in 2009.

**NGC134: 00h 30m 22.2s -33° 14' 44"**



**NGC613** is a barred spiral galaxy located 70.3 million light years away in the southern constellation of Sculptor. It was discovered by William Herschel by an angle of 37° to the line of morphological classification of it is a spiral galaxy with a bar inner ring structure circling the wound spiral arms (bc). The bar profile with dust lanes located



galaxy located 70.3 million light years away in the southern constellation of Sculptor. It was discovered by William Herschel by an angle of 37° to the line of morphological classification of it is a spiral galaxy with a bar inner ring structure circling the wound spiral arms (bc). The bar profile with dust lanes located

**NGC613: 01h 34m 17.5s -29° 24' 58"**

velocity dispersion of  $136 \pm 20$  km/sec. The nucleus is a source of radio emission consisting of an inner ring with a radius of about 1,100 light years (350 pc) and a linear feature that is perhaps perpendicular to it as discovered in 20<sup>th</sup> century radio telescopes. This linear feature consists of three discrete blobs spanning approximately 2,000 light years. A super massive black hole resides in the core with varying mass ranges of  $1.9\text{--}9.6 \times 10^7$  M<sub>☉</sub>. Supernova SN2016gkg was discovered just as it was starting to erupt and was a type IIb supernova. Type IIb types initially show a hydrogen envelope like a type II supernova, but later loses the hydrogen lines in its spectrum. The progenitor star was likely a yellow supergiant, and was identified in Hubble Space Telescope images before its collapse.

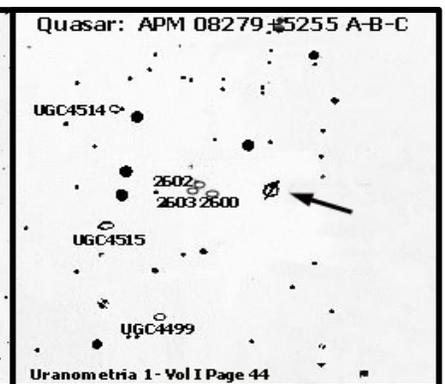
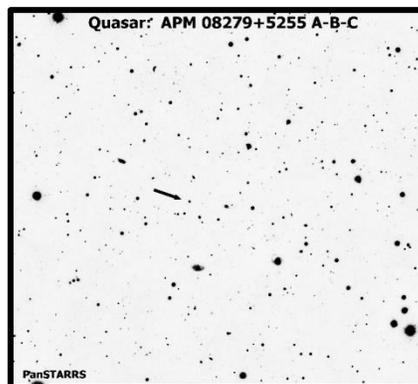


**NGC772 (also known as Arp 78 or the Fiddlehead Galaxy)** is a large unbarred luminous spiral galaxy approximately 114.3 million light-years away in the constellation of Aries. It is conveniently inclined by 54 degrees which facilitates viewing. It was discovered on November 29, 1785 by William Herschel. At around 200,000 light years in diameter, NGC772 is larger than the Milky Way Galaxy and is surrounded by three satellite galaxies – including the dwarf low-luminosity elliptical, NGC770 located 97,800 light years away. These tidal forces on NGC772 have likely caused the emergence of a single elongated outer spiral arm that is much more developed and stronger than the other arms. This give the galaxy a one-sided spiral arm-like morphology that appears to be a tidally driven structure. The star-forming sites in the outer arm contains several H II regions and stars are younger than ~15 million years. Halton Arp includes NGC772 in his Atlas of Peculiar Galaxies as Arp 78, where it is described as a "Spiral galaxy with a small high-surface brightness companion". Three supernovae have been observed in NGC772: SN 2003hl (Type II, mag. 16.5), SN 2003iq (Type II, mag. 16.4), SN 2022qze (type II-P, mag. 19.89).

**NGC772: 01h 59m 19.9s +19° 00' 30"**

### **For those of You with Large Telescopes who Love a Challenge – NOT on the Observing List.**

**APM 8279+5255 A,B,C: 08h 31m 41.6h +52° 45' 18"**, Lynx - In 1999 this was proclaimed the most luminous object in the known universe with an apparent Vmag. of 15.2 and a redshift of  $z = 3.911$ . It is a lensed quasar with three images showing. It formed 1.591 billion years after the Big Bang event and the light has been travelling to Earth for 12.051 billion years (Light Travel Time). During this 12.051 Gyrs the universe expanded, so the QSO's true comoving radial distance is 23.527 billion light years from Earth, not 12.051 GLyrs as some incorrectly think. This is an astounding number (Ned Wright:  $z=3.911$ ,  $H_0=70$ , Flat Univ.), as **this is over half the distance to the edge of the known universe** (45.5 GLyrs). Yet the quasar is visible in amateur's instruments. The huge apparent bolometric luminosity of  $5 \times 10^{15}$  L<sub>☉</sub>, is initiated by a jet of hot material moving towards the Earth, which easily makes it among the brightest and most luminous objects known. K-band infrared images show this system consists of three lensed components. Components A and B have shown a slight increase in brightness, possibly a microlensing event, while component C has remained constant. A molecular cloud of dust and gas are in the nuclear disk at a radius of 300 – 880 light years around the quasar.



to better appreciate these vast distances: A million seconds of time is about 11 days. A billion seconds is over 31 years.

**Aren't We Lucky to be Astronomers - Clear and Steady Skies**

**Larry Mitchell - Eileen Myers**