The Texas Star Party - Advanced Observing Program - 2021

The Best of the Rest of the Advanced Observing Programs

This year, 2021 gets us back under the stars at night, but the star party functions are conducted virtually as the in-person gathering at the Prude Ranch has been cancelled due to Covid-19. This year's Advanced Observing Program will be conducted from an observing site of your choosing - Details will follow below. The observing program is a continuation of the twentieth year of the advanced visual observing programs of the Texas Star Party. Normally I would not present one, and certainly not two "Best-of" programs as they only cover ground previously trodden, but two years ago I got talked into it and everybody seemed to enjoy the variety of targets presented. Therefore, for this year's abbreviated star party I am going with the *Best of the Rest, of the Advanced Observing programs*, or as some would say, *The Best of the Advanced Observing Programs - Part II.* This year highlighted are 40 of some of the brighter and more interesting objects that have been listed over the previous years. This is - by far - the EASIEST Advanced TSP list ever published, and will provide some "eye-candy" as a reward for those of you who may have experienced "retinal torture" in the past. With just a little extra effort and a good sky, an advanced observer may be able to visually see ALL of the objects using only a modest aperture telescope. In planning your observations, pay attention to both the listed magnitudes and the object size, which will give an indication of the surface brightness of each object. Also try to observe the target when it is high up in the sky, as close to its transit point as possible. As we visual observers know all too well, the only way to know for sure if something is visible, on that particular night and with those specific optics, is to LOOK for YOURSELF. Adopt the theory, that within reason anything may be seen, until you have visually proven otherwise, which may require more than one night of trying. Remember, everything requires effort - the only thing you can achieve without it is failure.

The Advanced Observing Program was initiated to educate and challenge observers to locate and observe those objects they might have considered too difficult, if not impossible to find and/or see visually. Too often observers stop at the *"Messier Limit"* or the *"NGC Limit"* and never try to locate objects that begin with names like *Arakelian, Minkowski, Palomar or Sanduleak*. The listed objects are best located and observed by careful and precise star-hopping. It is most imperative that the observer know *exactly* where in the field to look once the field is located, especially if some item turns out to be truly "light challenging". By using various magnifications and a combination of averted and direct vision along with a large helping of patience - eventually the object will be seen. Give the sky a chance and it will come to you. The standard observing rule is if you think you see the object at least three-times, then you probably Really Did See It, so log it and proceed onward.

Only 20 objects out of the 40 listed are required to obtain a twenty-year observing pin, but I would encourage everybody to try and observe the entire list as there are some real visual gems present. To get a TSP Advanced Observing Pin all objects must be observed during End of Twilight June 5 – Dawn June 13, 2021 your local time and your location. I also have a good supply of special Advanced Observer T-shirts which are reserved for the 'Best-of-the Best', those of you who have received a pin for every year of the program's existence, which of course includes this year. These will be handed out at next year's TSP (2022) with supporting documentation.

Requirements:

1. **Any telescope may be used or any combination of telescopes, from any observing location of your choosing.**
2. **An Advanced Observing Pin will be awarded to the first 95 who observe any 20 of the 40 objects.**
3. **Observations are limited to End of Twilight June 5 – Dawn June 13, 2021 your local time and your location.**
4. **Every successful observer will also receive an Advanced Observer Certificate.**
5. **Location by Star Hopping is Preferred but Not Mandatory. The only way to know where an object truly is located is to go and find it. "*Star Hop and be Educated*". Maybe you can then locate it without a chart, from memory – Always Best.**
6. **Submitted Observing Logs must Contain:**
    - **A. The physical location of the Observation.**
    - **B. Date and Time of the Observation.**
    - **C. The aperture of the telescope (s) used for the observation.**
    - **D. A general indication of sky conditions – Seeing (Excellent – Poor) and Transparency (1 – 6 Best).**
    - **E. The observers primary mailing address for mailing observing pins and certificates.**
7. **Submit Advanced Observing Logs to Steve and Amelia Goldberg at advanced-challenge@TexasStarParty.org**
8. **Larry Mitchell will approve all observations and mail observing pins.**
9. **Certificates will be provided by either download link and/or attached to a confirmation email.**

The Texas Star Party Advanced Observing Program – 2021
The Best of the Rest of the Advanced Observing Programs - 20th Year

Observe ANY 20 of the 40 Objects During End of Twilight June 5 – Dawn June 13, 2021 your local time and your location
The First 95 Successful Observers will Receive a 20 Year Pin

Object		Type	Coord J2000	Const	Mag.	Size	Dist LY	TSP Year	Observer Date/Time
☐Double Quasar	0957+561 A/B	Grav Lens	10 01 21.1 +55 53 57	Uma	16.7(V)	Stellar-	8.7 Bill	2001	/
☐Sextans A	DDO 75	Gal	10 11 00.5 –04 41 57	Sex	11.5	5.7 x 5.1’	4.73 m	2008	/
☐NGC3190 Cluster	Hickson 44	Gal Clstr	10 18 05.7 +21 49 57	Leo	11.15(V)	4.4’ x 1.2’	72.4 m	2007	/
☐ NGC3226/	UGC5617	Gal Pair	10 23 27.0 +19 53 53	Leo	13.33(V)	3.3’ x 2.5’	61.6 m	2005	/
NGC3227	Arp 94	Gal Pair	10 23 30.6 +19 51 55	Leo	11.79(V)	5.2’ x 4.0’	53.3 m	2005	/
☐NGC3690/	Mark 171A	H II Gal	11 28 31.3 +58 33 42	Uma	12.86(V)	1.5’ x 1.0’	141.3 m	2015	/
IC694	Mark 171B	H II Gal	11 28 30.6 +58 33 29	Uma	12.1	1.1’ x 0.9’	145.9 m	2015	/
☐Copelands Septet	Hickson 57	Gal Clstr	11 37 54.0 +21 58 51	Leo	13.6-16.0(V)	6.2 x 3.3’	425.0 m	2002	/
☐NGC3786/	Mark 744	Sy 1.8 Gal	11 39 42.4 +31 54 33	Uma	13.74(V)	2.2’ x 1.2’	124.1 m	2002	/
NGC3788	UGC6623	Gal	11 39 44.7 +31 55 51	Uma	12.50(V)	1.7’ x 0.6’	120.6 m	2015	/
☐NGC4151	UGC7166	Sy 1 Gal	12 10 32.5 +39 24 21	CVn	11.48(V))	6.5’ x 5.0’	44.5 m	2001	/
☐Hickson 61	The “Box”	Gal Clstr	12 12 18.5 +29 10 47	Com	12.2-17.5(V)	7.1 x 3.2’	180.0 m	2002	/
☐NGC4183	UGC7222	SThin Gal	12 13 17.2 +43 41 48	CVn	12.9b	6.3’ x 0.8’	52.0 m	2010	/
☐NGC4298/	UGC7412	Gal pair	12 21 33.0 +14 36 11	Com	11.3(V)	3.0 x 1.8’	53.1 m	2002	/
NGC4302	UGC7418	LINER	12 21 42.4 + 14 35 39	Com	11.6(V)	5.8 x 0.7’	51.8 m	2002	/
☐NGC4449	UGC7592	Neb/Gal	12 28 11.4 +44 05 40	CVn	9.64(V)	6.1 x 4.3’	12.5 m	2006	/
☐3C 273	B1226+0219	QSO	12 29 06.4 +02 03 09	Vir	13.0	Stellar	2.4 Bill	2001	/
☐NGC4567/	Siamese Twins	Gal pair	12 36 32.8 +11 15 31	Vir	12.1(B)	3.3 x 2.0’	105.7 m	2002	/
NGC4568	VCC 1676		12 36 34.2 +11 14 24	Vir	11.7(B)	4.8 x 2.0’	103.5 m	2002	/
☐NGC4676 A/B	The “Mice”	Gal pair	12 46 10.6 +30 44 39	Com	13.1-13.8(V)	1.9 x 1.4’	301.9 m	2002	/
☐Centaurus Clstr	Abell 3526	Gal Group	12 48 49.2 –41 18 40	Cen	11.4	180.0’	150.0 m	2009	/
☐Coma Cluster	Abell 1656	Gal Group	12 59 48.0 +27 58 00	Com	12.0	224.0’	300.0 m	2009	/
☐N5350/53/54	Hickson 68	Gal Clstr	13 53 21.5 +40 21 49	CVn	11.3(V)	3.3 x 2.4	112.4 m	2002	/
☐NGC5426/	Arp 271	Gal Pair	14 03 25.0 –06 04 10	Vir	12.6b	3.0 x 1.6’	130.4 m	2002	/
NGC5427	UGCA 381		14 03 26.1 –06 01 53	Vir	11.99B0	3.2 X 2.3’	130.3 m	2002	/
☐Abell 37	PK326+42.1	P.N.	14 04 25.9 –17 13 40	Vir	13.9v	54” x 54”	6,000LY	2012	/
☐Arp 220	IC4553	Sy 2 Gal	15 34 57.3 +23 30 11	Ser	13.88(V)	1.5 x 1.2’	255.0 m	2001	/
☐Seyfert’s Sextet	NGC6027	Gal Clstr	15 59 12.5 +20 45 48	Ser	13.5-15.9	2.0 x 1.0’	200.0 m	2002	/
☐Hercules Cluster	Abell 2151	Gal Group	16 05 12.0 +17 44 40	Her	13.5(10th)	56.0’	500 m	2009	/
☐IC4593	PK25+40.1	P.N.	16 11 44.5 +12 04 17	Her	10.84(V)	30.0”	7,500LY	2003	/
☐Terzan 3	ESO390-SC6	G.C.	16 28 40.0 –35 21 13	Sco	12.0	3.0’	27,000LY	2004	/
☐IC4617	LEDA2085077	Sy 2 Gal	16 42 08.1 +36 40 59	Her	15.5	1.2 x 0.4’	550.0 m	2011	/
☐NGC6309	“Box” Nebula	P.N.	17 14 04.5 –12 54 41	Oph	11.6(V)	16.0”	6,500LY	2003	/
☐NGC6337	The “Cheerio”	P.N.	17 22 15.6 –38 29 02	Sco	12.0(V)	51.0”	5,200LY	2000	/
☐The “Dragon”	M8 - Lagoon	Bok Glob	18 04 45.6 -24 29 56	Sgr	--	180” X 25”	5,475LY	2006	/
☐Barnard 90	LDN108	Dark Neb	18 10 17.4 -28 18 00	Sgr	14.5	3.0’ x 2.0’		2018	/
☐T Lyrae	18306+3657	CarbonStar	18 32 20.1 +36 59 56	Lyr	--	Stellar	2,500LY	2014	/
☐NGC6645	“Little Circlet”	O.C.	18 32 36.0 –16 53 00	Sgr	8.5(V)	10.0’	3,200LY	2017	/
☐Palomar 8	ESO591-12	G.C.	18 41 29.9 –19 49 33	Sgr	11.2 5.2’		41,700LY	2004	/
☐Berkeley 82		O.C.	19 11 20.0 +13 07 06	Aql	--	2.0’	3,200LY	2017	/
☐NGC6781	PK 41-2.1	P.N.	19 18 28.2 +06 32 15	Aql	11.8p	1.8’ x 1.8’	3,100LY	2014	/
☐PC 22	PK 51-4.1	P.N.	19 42 03.6 +13 50 35	Aql	14.4p	24” x 18”	17,200LY	2003	/
☐NGC6818	Little Gem	P.N.	19 43 57.8 –14 09 10	Sgr	9.3(V)	48.0”	5,000LY	2018	/
☐NGC6888	Crescent Neb	Wolf Ray	20 12 01.0 +38 23 00	Cyg	--	18’ x 8’	5,000LY	2001/06	/
☐IC4996	MWSC3297	O.C.	20 16 30.0 +37 38 00	Cyg	7.3	5.0’	6,500LY	2017	/
☐French 1	“Toadstool”	Asterism	21 07 26.4 +16 18 17	Del	--	13.0’	Varies	2017	/

TSP ADVANCED OBSERVING PROGRAMS

2000: "Rings Over TSP"
2001: "Explosions Over TSP"
2002: "Interactions"
2003: "G.D. Planetaries"
2004: "Globular Clusters"
2005: "Arp Peculiar Galaxies"
2006: "Nebulae"
2007: "ABCs of Galaxies"
2008: "Local Group"
2009: "Galaxy Groups"
2010: "Superthin Galaxies"
2011: "Proximity – Friends of Friends"
2012: "Anything Abell"
2013: "Illusions"
2014: "Seeing Red"
2015: "Markarian Galaxies"
2016: "The Science of Byurakan"
2017: "Open Clusters and Asterisms"
2018: "Edward Emerson Barnard, The Man, Science & Times"
2019: "Best of the TSP Obscure Universe, 20th Year" – 1
2021: "Best of the Rest-The TSP Advanced Programs, 20 Years"– II

Bill – Billion
Bok Glob – Bok Globule
Dark Neb – Dark Nebula
DistLY – Distance in Light Years
Gal – Galaxy
Gal Clstr – Galaxy Cluster
G.C. – Globular Cluster
Grav Lens – Gravitational Lens
LY – Light Year
m – Million
Neb/Gal – Nebula in Galaxy
O.C.– Open Cluster
P.N. – Planetary Nebula
QSO – Quasar
Ring Gal – Ring Galaxy
SThin Gal – Super Thin Galaxy
Sy – Seyfert
Wolf Ray – Wolf Rayet

Distances are Based Upon Radial Velocities: H_o = 70 km s^{-1} Mpc^{-1}
Observing List and All Textual Material - Unless Specified Otherwise.

As astronomers, we are very privileged to get to view far-away, massive fascinating objects that most people do not know even exists. With patience and good sky conditions this relatively easy list is certainly well within the range of all observers, beginner or advanced, with small or large telescopes.

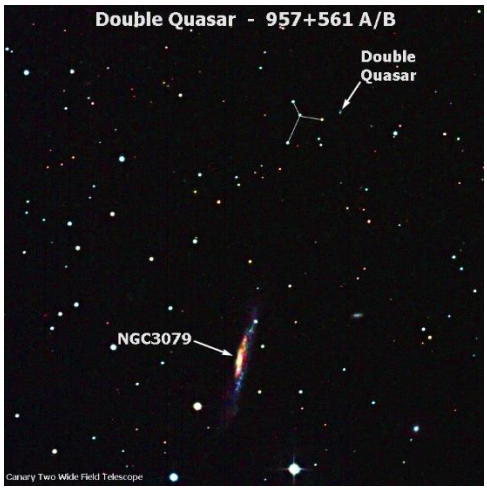
I hope you enjoy this challenge as much as I have in presenting it and that it gives you a new sense of Enjoyment and Confidence in your Abilities to Successfully View Natures Grandest Arena Our Magnificent Universe – With Your Own Eyes.

A Special Thank-You to Steve and Amelia Goldberg.

Good Luck and Clear Skies,

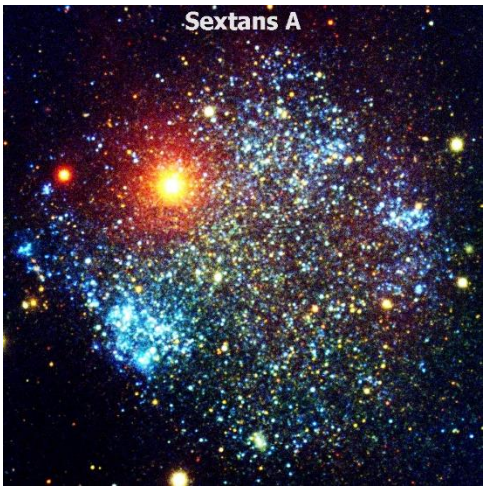
Larry Mitchell

Chairman – TSP Advanced Observing Program – 2021
The Best of the Rest of the TSP Advanced Observing Programs, 20th Year - Part II



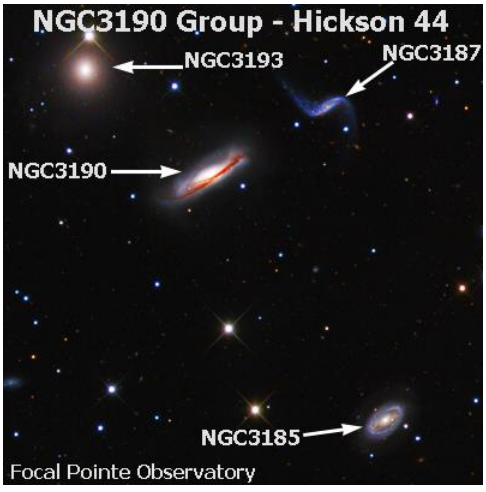
The Double Quasar, located only 10 arc-minutes north of the bright galaxy NGC3079 was the first Gravitational Lens discovered, and the first for which an accurate lensing time delay was measured. It was initially discovered as a radio source, and then in 1979 it was detected on photographic plates. It quickly became a popular item with astronomers, as it was the first visible confirmation of a gravitational mirage, which was predicted by Albert Einstein in 1915 in his Theory of General Relativity, proving that gravity really does bend space. We see the twin quasar because the gravitational field of a large foreground galaxy at 3.7 billion light years distance, bends and concentrates the light from the distant quasar, located 8.7 billion light years away, into two separate images separated by 6 arc-seconds.

VISUAL: The key to locating the quasar is to first locate the galaxy NGC3079, then locate the "Y" asterism to the north. In large telescopes, both components of the quasar are readily detected as separate, faint stellar objects. The binary nature of the two stellar images is not difficult. In a 20-inch f/5 telescope it was best seen at higher powers of 423X and 564X, as a single object, and success is highly dependent upon sky conditions. 20-inch f/5 telescope



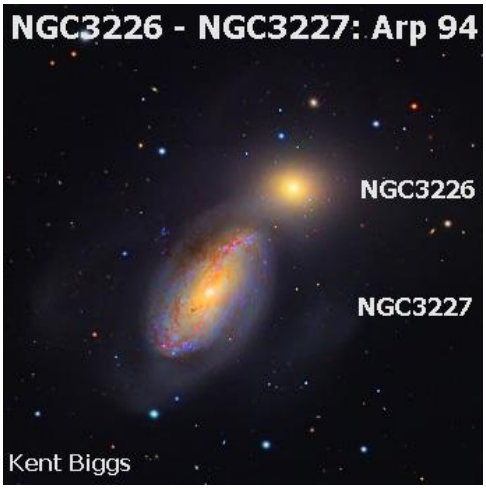
Sextans A is possibly the best example there is of a dwarf irregular galaxy. It is best known for its very low metal content, [Fe/H] = ~-1.85 to -1.40, which is lower than all of the other Local Group galaxies. Low-metallicity galaxies provide an excellent laboratory for exploring massive stars under conditions close to those of the early universe, when few elements existed heavier than hydrogen and helium. Sextans A contains one huge stellar association located on the eastern side of the rectangular shaped galaxy. Its distance is 4.3 to 4.7 million light years, which makes its membership within the Local Group (Diameter ~10 million LYrs) somewhat controversial. Sextans A contains a very old stellar population which formed over 10 billion years ago, and a much younger blue population, which formed during the past 2.5 billion years. In the past few billion years the star formation rate (SFR) has increased dramatically from a largely quiescent period between 2.5 and 10 billion years ago, to a sudden burst in star formation which began 1 to 2.5 billion years ago. A more recent large star formation event occurred over the past 50 - 60 million years, and some stars are as young as 10 million years of age. The largest H II region with a diameter of 81.5 light years has been actively making stars for the past 200 million years, and is still active.

VISUAL: This is a large and very faint diffuse galaxy, with no central brightening. Depending upon sky seeing conditions, the H II region located on the southeast side of the galaxy could be faintly seen about 50% of the time as a non-stellar object, while at other times it could be held with steady vision all of the time. When seen the H II region is obvious and not questionable. 20-inch telescope, f/5.



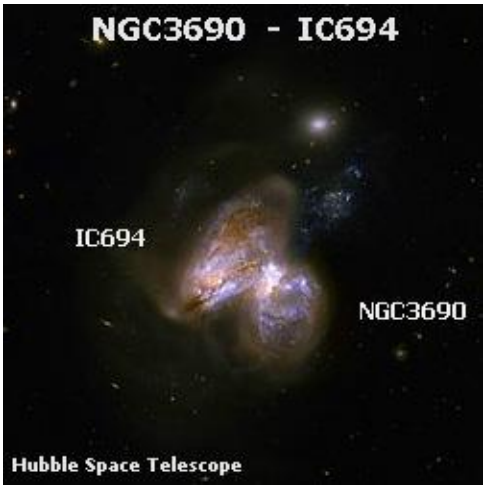
Hickson 44 is a visually pleasing small galaxy group located the "neck" of Leo the Lion. The NGC3190 group is located at a distance of approximately 80 million light years, and consists of four galaxies of varying magnitude within an area 15 x 15 arc-minutes^2, although the group membership of some objects is questionable. The two central galaxies NGC3190 and NGC3187 show signs of tidal interactions, even though their radial velocity redshifts places them over 10 million light years apart. A faint H I bridge connects NGC3190 and NGC3187, and this is the only gas detected outside the galaxies, a typical situation found in Hickson galaxy clusters which often are largely devoid of gas. Since 2010 there has been some controversy as to whether these four galaxies are all really at the same distance, as only three of the galaxies have similar radial velocities. The radial velocity of NGC3193, the elliptical galaxy, relative to the other three seems to be too large for such a small group. Its radial velocity places it at 110 million light years away much farther than the other three members' average distance of 77 million light years so its Hickson 44 membership is questionable. Galaxies in the NGC3190 group are all gas poor relative to similar objects in the field, due to tidal stripping in the confined field.

VISUAL: All of the galaxies are easily seen in a 20-inch telescope at a lower power of 150X with a 29 arc-minute field of view, which gives a good view of the galaxies in the same field. The dust lane of NGC3190 is very visible as a sharp edge to the galaxy, while NGC3193 looks very much like the elliptical galaxy that it is, and NGC3185 does not visually resemble a ring galaxy. NGC3187 is visually the most challenging and may require good sky conditions. At lower powers all four galaxies should be visible in the same field of view, which visually is very satisfying. 20-inch f/5 telescope



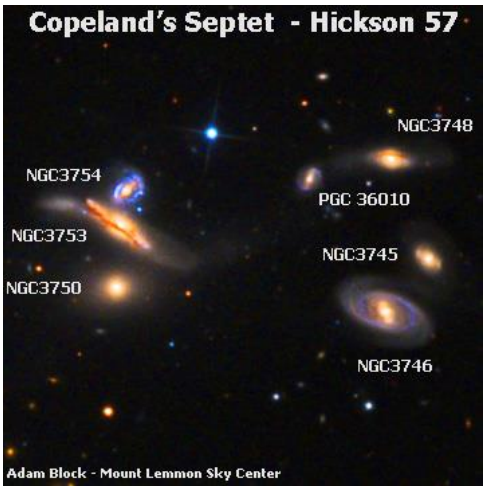
Arp 94: This galaxy pair is located only 50 arc-minutes east of Algeiba or ϒ-Leonis, a double star. Both objects lie within a complex web of stellar and neutral H I filaments, sometimes referred to as "ripples". The galaxy pair are located 50 - 60 million light years from the Sun. NGC3226 is a dwarf early type elliptical galaxy that is interacting with the larger Seyfert type 1.5 spiral galaxy NGC3227. NGC3226 is a low luminosity active galaxy with a Low-Ionization-Nuclear Emission-Line regions, often referred to as a LINER or sometimes as a Seyfert type 3 galaxy. Some astronomers think LINERS are the result of intense star formation regions, or H II regions while others think LINERS are powered by active galactic nuclei (AGN) containing super massive black holes, but the central engine is tilted from our line of sight and obscured by dust and other material, so we only see a reduced amount of emission structure. NGC3227, is a disturbed type 1.5 Seyfert barred spiral galaxy that varies in brightness by nearly a magnitude and contains a central black hole with a mass of 40 million solar masses.

VISUAL: Arp 94 is a beautiful object and both galaxies are bright and easily seen, with a high surface brightness. Both have noticeably brighter non stellar nuclei, but occasionally a stellar object is seen popping in and out of view in NGC3226, which has an easily seen round halo. NGC3227 has an elongated central brightening with an equally bright extended halo, and a stellar-like nucleus which is bright and dominates the galaxy. 20-inch f/5 telescope



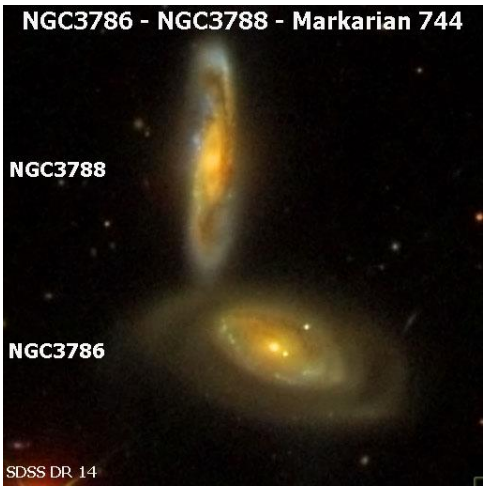
NGC3690 - IC694: Both of the galaxies involved in the collision are barred irregular types in the early stage of merging, but still separated. The NGC3690/IC694 pair are also known as Markarian 171 and Arp 299, and in some places as NGC3690E and NGC3690W (East and West). There is confusion for the Markarian 171 galaxy identification, as Simbad lists NGC3690 as one object but separated by east and west denominations. MegaStar lists NGC3690 as the eastern member of the pair and IC694 as the western member. However, in most papers, the eastern member of the merging galaxy pair has been designated IC694 while the western member as NGC3690. NGC3690 is a highly disturbed barred galaxy classified as peculiar with multiple nuclei. NGC3690 is possibly the remnant of a retrograde spiral galaxy and it is interacting strongly with IC694 and the two share similar redshifts. IC694 has a more disturbed structure and also contains multiple nuclei. From our perspective there is some overlap in the two galaxies where they appear to be closest.

VISUAL: NGC3690 has the brighter, mostly stellar nucleus and appears as a small nearly round object. IC694 is larger, more diffuse and more elongated and has the fainter nucleus, also stellar in appearance. After study the two galaxies can be separated into two separate and distinct objects with dark space in between. At 423X the brightest area is an elongated patch on the eastern side of NGC3690 appearing as a bright mottled string in a north-south trajectory. This undoubtedly is a large H II region formed by the interaction. The galaxy pair has a fairly high surface brightness and may be easily seen, and presents lots of detail to those who will devote the necessary time to study. It is always great to visually see objects in other galaxies. 20-inch f/5 telescope



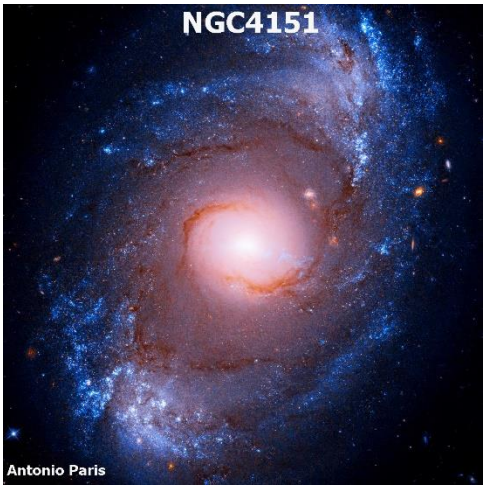
Copeland's Septet is a compact galaxy cluster in Leo located about 420 million light years away and is contained within only a 5 arc-minute circle. A septet is anything containing seven members, yet there are eight Hickson members in Copeland's Septet. NGC3751 is 2 arc-minutes to the south of the cluster, and not pictured. However, only five are at the same distance (accordant). While most of the Hickson galaxy clusters are deficient in H I gas, Hickson 57 is among the most H I deficient of the Hickson galaxy groups, but it contains large amounts of warm molecular hydrogen. Within the group, Galaxies NGC3754, NGC3753 and NGC3750 all sit within a common, faint envelope. In the northern grouping, NGC3745 and NGC3746 also have a common envelope. Interestingly the brightest three galaxies are spiral-types, which are usually not as prevalent in tight groupings of galaxies, where ellipticals and lenticulars tend to dominate. There are 100 Hickson Galaxy Groups and all are compact and relatively isolated systems of four to eight galaxies in close proximity to one another.

VISUAL: This is a very small galaxy group and all of the members are faintly seen with direct vision as separate objects and looking pretty much like the photo. The cluster is centered around a bright 11.7 magnitude star which interferes with the observation. The Septet is best viewed at high power and it is nice to see so well objects approximately 400 million light years away. 20-inch f/5 telescope.



NGC3786 - NGC3788: Both galaxies are clearly interacting, are separated by 1.5 arc-minutes, and are located about 120 million light years (43.6 Mpc) away. The high inclination angle of NGC3786 is probably why it is classified as a Seyfert (Sy) 1.8 type galaxy, while a more face on appearance might have indicated a higher degree of Seyfert activity. A Seyfert type 1.8 galaxy has very weak broad lines in Hβ and Hα. Dust obscuration from NGC3786 is particularly prevalent in this high-inclination system. X-ray emission has been detected in the form of a "warm absorber", thought to be hot dust related to the dusty torus which is absorbing an excess amount of X-ray emission, which becomes visible as UV absorption lines. NGC3786 is classified as SAB(rs)a pec, and sharp images show a bright nuclear region and a faint adjacent broad feature that may resemble a bar structure. The companion galaxy, NGC3788, has a similar classification, SAB(rs)ab pec and also hints at a bar-like structure, but it has a more edge-on orientation. NGC3788 has a brighter nucleus and inner region than NGC3786 and internally it is very similar to NGC3786 in that both contain an inner S-shaped ring-like structure. The arms of NGC3788 appear to be more massive than those of its neighbor, but this may be an orientation effect.

VISUAL: This is a very nice visual object - A real showpiece as both galaxies are easily seen. NGC3786 has a brighter center that is not quite stellar, and is definitely the brighter of the two galaxies. NGC3786 appears to be more oval shaped and definitely does not have the length of NGC3788. NGC3788 is a very elongated object and the central brightening also appears elongated. 20-inch f/5 telescope

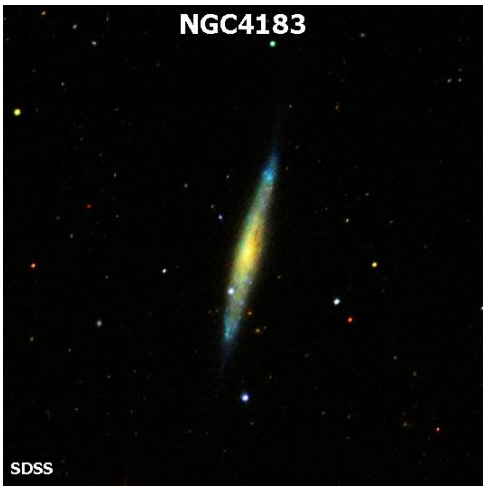


NGC4151, the "Eye of Sauron" is the brightest member of the most energetic class of Seyfert galaxies, a Seyfert 1, which is characterized by very large and usually bright energy sources in their centers, which visually appear star-like. It is one of the closest galaxies that is actively growing a massive and active black hole. In NGC4151, this feature gives it its nickname, based upon the evil character in "The Lord of the Rings". The nucleus harbors a massive black hole with a mass 46 million times that of the Sun. It is possible a second black hole exists, with a mass of around 10 million solar masses, and an orbital period of 15.8 years, but this is still a topic for debate. In comparison, the massive black hole in the center of the Milky Way Galaxy, dubbed Sagittarius A* (A-star), has a mass of only 4.1 million solar masses, with a diameter of about 17 light hours, which is larger than the diameter of the solar system. NGC4151 is a large barred spiral galaxy, with faint outer arms that are unusually gas-rich with a large inflow of gas along the bar, which is concentrated in narrow regions which originate in bar shocks.

VISUAL: The core is small and round with a very faint halo of material and is best seen at 218X. The nucleus is very bright and dominates the galaxy, almost giving the impression of a reflection nebula surrounding a very bright star. The halo itself is very faint, small in appearance and almost non-existent and certainly does not appear to be anywhere near the size of the spiral arms as seen in photographs. 20-inch f/5 telescope

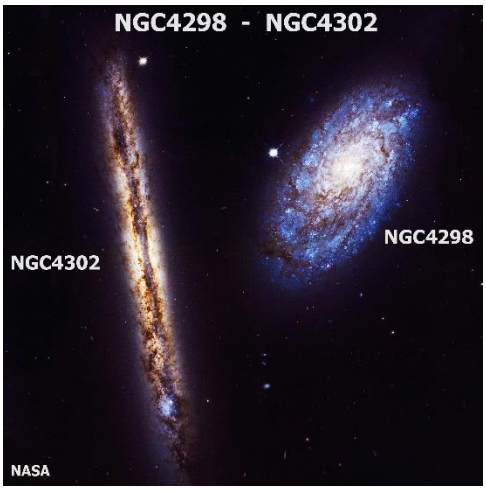
Hickson 61, the "Box" is commonly known as the "*Box*" from its near perfect rectangular appearance and is part of a collection of compact galaxy groups assembled by the Canadian astronomer Paul Hickson in 1982. The cluster is a tight grouping of four galaxies which are contained within a field of only 3.7 arc-minutes. The mass to light (M/L) ratio is 14.5 meaning the group is only moderately dark matter dominated when compared to some of the other Hickson Galaxy Clusters. Hickson 61 is actually only a triplet, as the larger galaxy, NGC4173 (also known as NGC4171 and NGC4170), has a redshift much lower than the other galaxies placing it around 50 million light years distant, while the other three members are about 180 million light years away. Morphologically the accordant members, NGC4169 - HCG61A, NGC4175 - HCG61C & NGC4174 - HCG61D have a few peculiarities. NGC4169 has a faint H II emission in an unusual place, NGC4174 has a polar ring and NGC4175 has a truncated gas disk.

VISUAL: All four galaxies comprising the "Box" are easily seen. Hickson 61 is a very pleasing visual galaxy cluster which becomes much better the more time one spends observing and studying it. NGC4173 is the most difficult visual object and oddly the nearest to Earth. With time all of the galaxies look exactly like the photograph. This is exciting and why we do visual astronomy. 20-inch f/5 telescope.



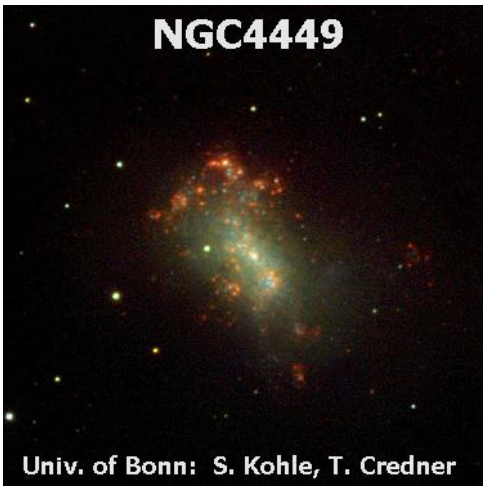
NGC4183 is a type SA(s)cd galaxy meaning it is without a bar (SA), and also without a ring-like structure (s). The "cd" reference means the galaxy is a late type spiral galaxy which is a combination between a type-c and type-d galaxy, based upon Hubble's famous tuning fork diagram. These late type galaxies have very loosely wound spiral arms and if they have an edge-on orientation with no central bulge they are known as "Superthin Galaxies", a good description of NGC4183. Superthin galaxies ae generally isolated and star formation in these late type spiral galaxies is lower by factors of ten than in earlier type Sa and Sb spiral galaxies. NGC4183 appears as a smooth, apparently undisturbed galaxy located near the plane of the Local Supercluster, at a distance of 52 - 55.4 million light years. Despite its smooth appearance NGC4183 clearly shows evidence of structural peculiarities suggesting past disturbances. Dust is visible all over the galactic plane, as dark intricate filaments blocking visible light from the core, and despite its classification there is evidence of a bar-like structure.

VISUAL: NGC4183 is very elongated and thin with only a slight thickening in the center and is easily seen with direct vision without much difficulty. No central brightening is evident nor is there a nucleus visible, probably due to the dust. A faint stellar object is located on the northern tip of the galaxy and has the visual appearance of a star, but may in fact be an H II region. 20-inch f/5 telescope.



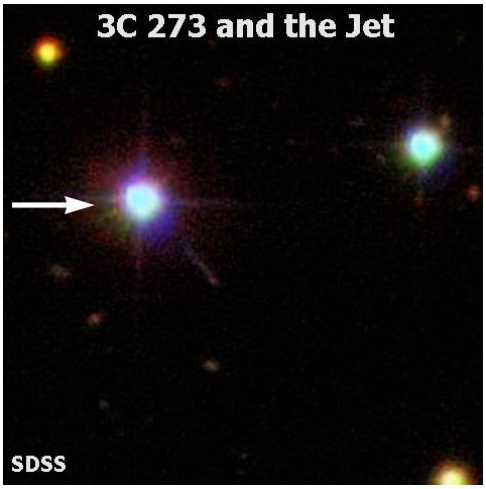
NGC4298 - NGC4302: This visually is a magnificent pair of galaxies. The angular separation between the two is 2.4 arc-minutes with a projected linear separation of only 5,000 light years (1.5 kpc). Surprisingly given their close proximity there is little visual evidence of tidal distortions in either galaxy, and the edge-on member, NGC4302 optically shows very little warping at all. However, observations at different wavelengths (H I) reveal a very different picture as there is a bridge of material connecting the two galaxies which is not visible at visual wavelengths. Here material is moving at velocities between 690 and 730 miles per second. NGC4302 is a perfectly aligned edge-on galaxy with an inclination of exactly 90 degrees, and is located about 52 million light years away. A prominent dust lane bisects the galaxy along most of its length. It has a diameter of 87,000 light years, and a central region that does not bulge, qualifying it as a "Superthin galaxy". NGC4298 is tilted by 70 degrees and is very similar in structure to NGC4302, although we view it from a different orientation. The nucleus of the spiral NGC4298 is small but not stellar, and the disk has little spiral structure, showing faint indications of a pinwheel. It is a dusty, spiral galaxy with a nearly face-on orientation and is only about 45,000 light years in diameter.

VISUAL: Both galaxies are easily seen, yet both are somewhat faint. NGC4302 appears as an evenly lit streak with no central brightening and no dust lane, but the galaxy is distinctly seen and "thick" all along its length. NGC4298 is slightly oval shaped and at first appears to be evenly lit across the disk. However, with study, a large brighter center and an almost stellar nucleus can be seen popping in and out. It appears to be slightly tilted with respect to NGC4302. 20-inch f/5 telescope**.**



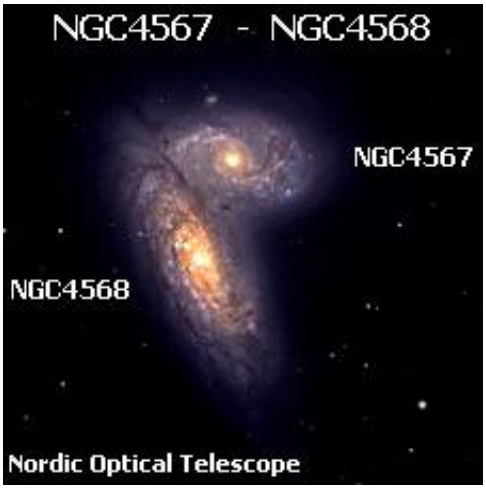
NGC4449, also known as Caldwell 21, is a Magellanic-type dwarf galaxy (irregular galaxy) and a member of the nearby M94 Galaxy Group (Canes Venatici I group of galaxies). Located in the constellation Canes Venatici, it is relatively close at only 12.5 million light years distant and is rich in star forming H II regions. NGC4449 is considered a starburst galaxy with a star formation rate of approximately 0.5 to 1.5 $M\odot$ per year or approximately 0.41 $M\odot\ yr^{-1}\ kpc^{-1}$. It is forming stars twice as rapidly as the Large Magellanic Cloud despite the two galaxies having similar sizes. Starbursts usually occur in the central regions of galaxies, but NGC4449 has stellar formations throughout the galaxy. High resolution HST imaging has revealed populations of both young and old stellar clusters, which are indicative of a prolonged active star formation history, and NGC4449 has been actively forming stars for the last half-billion years. NGC4449 began enhanced star formation activity about 500 million years ago, with the rate being much lower before then. A total of 61 candidate compact star clusters have been identified. Within NGC4449, the central region is the brightest, which indicates the star formation is enhanced in the center compared to other regions in the galaxy, although as mentioned, stars are forming all over NGC4449. A very large nuclear star cluster is present which is dominated by very young stars of only 6 to 10 million years of age, yet they have a metallicity only one-fourth that of the Sun.

VISUAL: NGC4449 is very bright, with a high surface brightness, is easily seen and slightly elongated, with a central brightening that is seen all along the major axis of the galaxy. It is a real visual treat due to its proximity and it shows off a lot of internal structure. The photo at the left is close to the visual image. The two central knots are bright and easily seen and consist of the nucleus and a massive star cluster. The H II regions to the north appear as detached easily seen extended objects. Other H II emission regions appear as small almost stellar knots, and they are located around the periphery. Some of the H II regions and the central core regions responds to nebula filters. There is a lot of detail available here to those who devote sufficient time to appreciate what this galaxy has to offer. 20-inch f/5 telescope



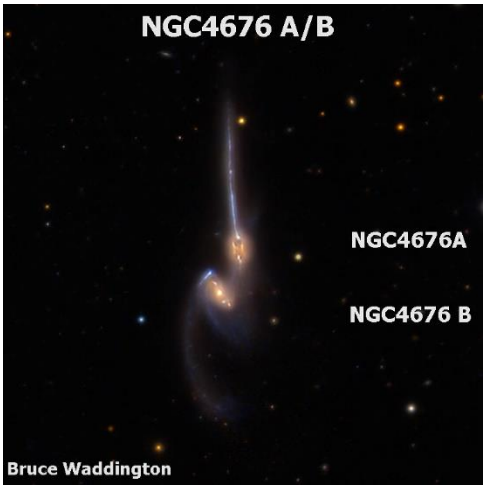
3C 273 is the brightest quasar in the sky at a Vmag. of 14.83, and it was the first quasar to be identified. 3C 273 lies at the heart of a giant elliptical galaxy with an apparent size of 30 arc-seconds at a distance of 2.4 billion light years. It is a radio loud quasar and is a well-known superluminal source, with more than 10 radio components having been detected moving away from the nucleus with different superluminal speeds and position angles. Superluminal motion is an apparent faster than light movement seen 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 at only 2.4 billion light years distance and is one of the most luminous quasars known. The luminosity of the quasar is variable at nearly every wavelength, from radio waves to gamma rays, and on timescales of a few days to decades. If the quasar were only as distant as the star Pollux (～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.

VISUAL: The quasar has a dim star-like appearance and is the eastern most stellar object in a trio of stellar objects, with 3C 273 the brightest of the three. The jet has been seen by the author in the 82-inch telescope at the McDonald Observatory in West Texas. 20-inch f/5 telescope / 82-inch Otto Struve telescope



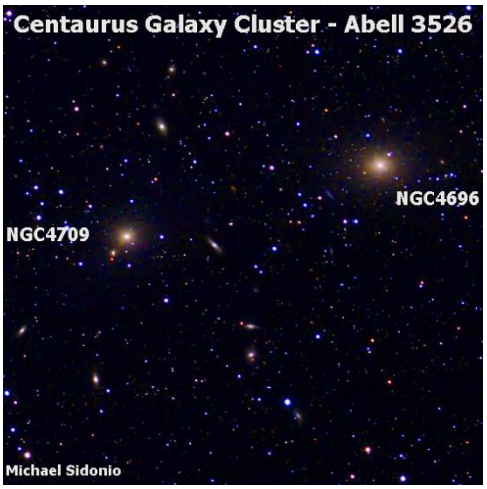
NGC4567, The "Siamese Twins" are in the early stage of merging into a larger object, maybe into an elliptical type galaxy. Their distance is controversial, as some listings have distances of 52 - 60 million light years, while Simbad and the NASA Extragalactic Database or NED have a distance around 100 - 105 million light years. If the more distant figure is correct, then they are not Virgo Galaxy cluster members. Whatever their distance they are one of the nearest interacting galaxies to the Milky Way. The two galaxies are separated by approximately 20,000 light years (6 kpc) and have comparable radial velocities showing they are gravitationally bound. These galaxies were once thought to be a chance alignment and not related, but recent neutral and molecular hydrogen studies, especially in the infrared, show the highest star formation activity is in the areas where the two galaxies overlap, a strong indication they are at the same relative distance and are somewhat interacting. NGC4567 has two prominent spiral arms and appears nearly face-on, while NGC4568 shows an intermediate orientation and is slightly brighter. There is an absence of large scale optical tidal features in either galaxy indicating the actual merger has not yet taken place. The stellar component of NGC4568 is only mildly disturbed while NGC4567 exhibits a faint external ring structure.

VISUAL: Both galaxies are elongated and bright with a high surface brightness. At first both objects appear to be evenly lit throughout, but with study, each object shows a very slight brightening towards the central regions and a very faint stellar nucleus is seen in each galaxy. 20-inch f/5 telescope



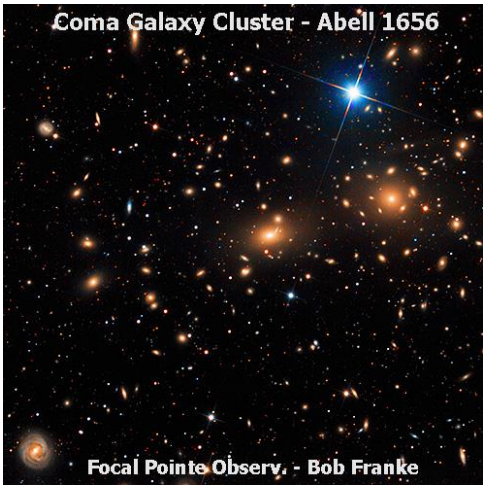
NGC4676A and NGC4676B are commonly referred to as the "Mice" and are about 300 million light years away. This is a classic example of a tidal interaction between two massive galaxies of 100 billion solar masses in a prograde merger. The Mice present one of the earliest stage, gas-rich major merger events, visible in the nearby universe. This interacting system is similar to the famous "Antennae" galaxies (NGC4038/NGC4039), but the Mice are not as evolved as the Antennae. However, they are predicted to evolve into a similar system within the next 100 million years. The first pericentric passage of the pair occurred about 170 million years ago and shock triggered some star formation. The impact of first passage on the stars and gas was significant, with strong bars likely induced in both galaxies. A second smaller burst of star formation occurred more recently around 10 million years ago and was confined within the central regions of the galaxies. Both NGC4676 A and B have the shape and colors of early type spiral galaxies, although the disk regions of both are strongly distorted. The tails are produced by tidal action and this occurs when the relative differences between gravitational pulls on the near and far sides of the galaxy are different. The fairly equal lengths of the two tails is a strong indication the galaxies involved have roughly equal masses. The tidal tail of NGC4676A is seen in an edge-on orientation which explains its ease of visibility, while the orientation of NGC4676B is more face-on resulting in a more difficult visual observation.

VISUAL: Two slightly oval shaped patches are easily seen and both disks are evenly lit with no central brightening. The halos of the two galaxies do not touch and there is black space between them. The beginning of the tail for NGC4676A can be seen without too much difficulty, but the curved tail of NGC4676B was not seen in a 20-inch telescope, but was faintly visible in the 36-inch. 20-inch f/5 telescope



The Centaurus Galaxy Cluster, Abell 3526 is the second closest galaxy cluster to the Milky Way after the Virgo galaxy cluster, and lies at a distance of 115 to 250 million light years. The Centaurus Cluster contains several hundred galaxies of varied and different types and sizes and is loosely structured. It is a strong source of both radio and X-ray emissions. The brightest member galaxy NGC4696 is a giant elliptical type galaxy, which is considered the "cD galaxy". Within NGC4696, dusty molecular filaments have widths of about 200 light years. Visually NGC4696 is very similar to M87, the cD galaxy of the Virgo galaxy cluster. The Centaurus Cluster consists of two distinct subgroups of galaxies. The one associated with the main Centaurus cluster, is centered on NGC4696 and is referred to as "Cen 30". A smaller subgroup, "Cen 45", containing the second brightest galaxy in Centaurus, NGC4709, is located 15 arc-minutes or 620,000 light years to the east and contains fewer galaxies by a factor of 2.5. Despite a large line-of-sight velocity difference (1,500 km s^{-1}) between the two, both Cen 30 and Cen 45 are interacting and are part of the same galaxy cluster. Lately the Centaurus Cluster has seen a lot of professional attention in analyzing dark matter in galaxy clusters.

VISUAL: The galaxy NGC4696 is large and bright with a dense bright core region, with very diffuse edges and is slightly elongated. NGC4709 is slightly fainter and round in shape with a slightly brighter central region. Other fainter members seen include NGC4706, ESO322-102, ESO322-100, NGC4650 and NGC4650A, NGC4622 A/B, & PGC42911. Most appear as small evenly lit halos. 20-inch f/5 telescope

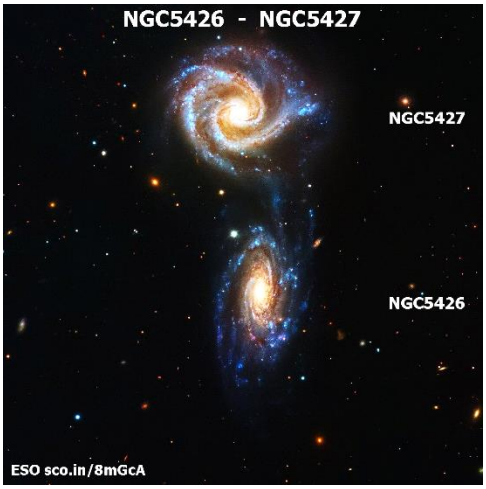


Abell 1656, The "Coma Galaxy Cluster" is a huge grouping of galaxies with over 1,000 cluster members, 800 of which are within a 100 x 100 arc-minute area from the center. The Coma Galaxy Cluster is a classic, highly concentrated galaxy cluster with a very large mass of 1.8 x 10^{15} M⊙. The Coma Cluster and the Leo Cluster (Abell 1367) are the two main galaxy clusters which comprise the much larger Coma Supercluster of Galaxies. Abell 1656 is located approximately 321 million light years from the Earth and the entire cluster is more than 20 million light years in diameter and overall is spherical in shape. Its location near the north celestial pole means there is little extinction from dust and gas which is found in the plane of the Milky Way galaxy. Abell 1656 has a preponderance of elliptical galaxies, both dwarfs and giant ellipticals, which are commonly seen in rich galaxy clusters of this density. The central region of Abell 1656 is dominated by two supergiant elliptical galaxies, NGC4874 and NGC4889, plus a light contaminating eighth magnitude star, HD112887, which is only 265 light years away, less than one-millionth of the distance to the galaxy cluster. The ten brightest spiral galaxies in the cluster have V-magnitudes in the 11 to 14 range, so are easily seen in most amateur telescopes. The few spiral galaxies are found predominantly near the outskirts of the cluster.

VISUAL: The two main galaxies are easily seen, bright and round in shape and both have brighter non-stellar central regions, with halos gradually brightening towards the center. NGC4889 is visually brighter than NGC4874, which means it has an unusually high surface brightness as it is nearly 70 million light years farther away from Earth. The entire area has many galaxies popping in and out of view, which appear as definite non stellar objects. These galaxies are small, round and faint, and pretty much look the same. 20-inch f/5 telescope

The Hickson 68 galaxy group is located 105 - 113 million light years away and is considered to be an intermediate mass galaxy group. There are 137 other nearby galaxies within 1.23 degrees of NGC5353/4, and 53 of these have an average distance from Earth of 113 million light years. Since they are located at the same relative distance as Hickson 68 there could actually be approximately 58 members that are associated with the Hickson 68 group. Galaxies are obviously strongly clustered around NGC5353/NGC5354, and Hickson 68 is only a substructure within the larger, bound galaxy group. All of these galaxies are located in a filament of material that ultimately connects the Coma Galaxy Cluster (Abell 1656) to the Virgo Galaxy Cluster, and they are all infalling toward the main body of the Virgo cluster. Hickson 68 contains three large galaxies, NGC5350, NGC5353 and NGC5354, all of which are radio loud sources with numerous radio emitting structures. The core of the group is dominated by the S0 galaxies, NGC5353 = H68A and NGC5354 = H68B, while the periphery of the group is mostly composed of spiral galaxies, an arrangement typically seen in galaxy clusters. The two elliptical galaxies, NGC5353 & NGC5354, are overlapping from our perspective and are strongly interacting as they are separated by only 29,000 light years (9 kpc).

VISUAL: The three brightest galaxies in Hickson 68 are visible in 6-inch telescopes. The 6th magnitude star nearby interferes and should be moved out of the field of view for best results. This is a very pleasing visual galaxy group in moderate to large apertures with all 5 galaxies easily seen. The two elliptical galaxies are very bright and stand out. 20-inch f/5 telescope

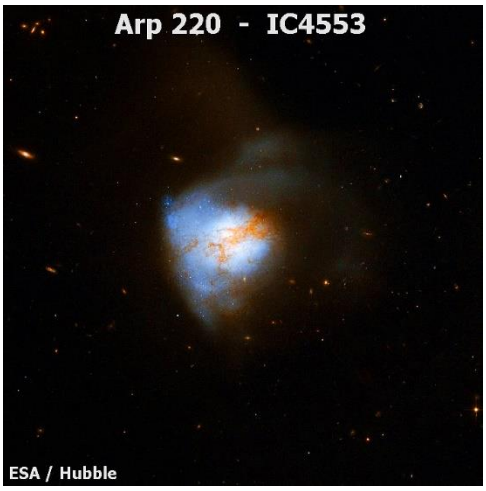


NGC5426 - NGC5427: The two galaxies are interacting with one another, but it is uncertain how strong the interaction really is, or if they will ever actually merge into one galaxy. The current dance will continue for millions of years resulting in increased star formation activity levels in both galaxies. Each galaxy gives the impression the interaction is in the very early stages, as their inner regions show a nice circular undisturbed motion and both exhibit little distortion, indicating the interaction is not very strong. However there are some indications of disturbances, such as the connecting bridge and a straight section of a spiral arm in NGC5427 which appears deformed. The giant H II regions in each galaxy are a sign of recent star formation triggered by the interaction. Another sign of a disturbance is that 38% of their total light comes from the two adjacent halves of the galaxies, while their far sides are noticeably dimmer. This has been observed in other interacting systems. Based on the separation and the systemic velocities it seems the interaction has been going on for approximately 100 million years. Both objects are located about 130 million light years distant, although estimates have ranged as high as 160 million light years. NGC5427 is currently moving from behind NGC5426, towards the foreground and to the southwest.

VISUAL: Both galaxies are easily seen, but both have a low surface brightness which is typical of face-on spiral systems, rendering them visually dim. NGC5427, the larger of the two galaxies is round in shape, with very dim diffuse edges. It has an easily seen large, brighter central region, and the H II knot is also easily seen out along the western edge of the visual galaxy halo. The visually smaller galaxy, NGC5426 is much fainter in appearance than NGC5427, and also has a large brighter central region. 20-inch f/5 telescope

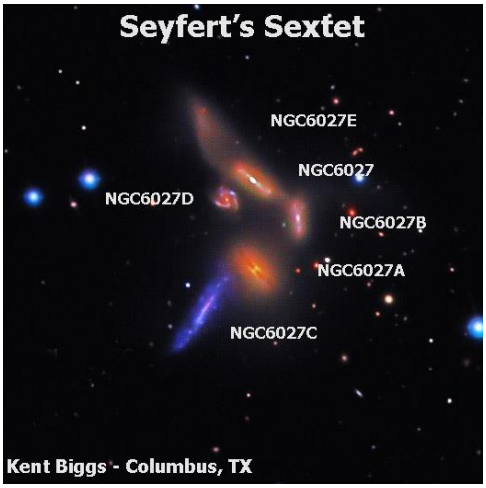
Abell 37, IC972 is a relatively little-known Planetary Nebula, and one reason could be its location. It is located in Virgo, which is commonly thought of as galaxy-country and is not known for planetary nebula observations such as Abell 37. This makes it a somewhat unique object as there are only three other planetary nebulae in this large constellation. Its distance from Earth has been estimated to be from 6,000 to 9,000 light years, placing it well in the foreground of the Virgo galaxies. Abell 37 is a "Highly Evolved" planetary nebula, meaning it is old, and is slowing down in energy production and output, with its central star firmly located in the white dwarf cooling tracks as imaged on the HR Diagram. Abell 37 has a visual magnitude of 14.9, with a faint central star of 17.7 magnitude. The effective temperature of the central star is 89,000 K, so it may be winding down but it still has plenty of energy. A prominent shock front is seen along the eastern and southern side of the periphery. Spherical planetary nebulae, such as Abell 37, are thought to be the end product of stellar evolution of slow rotating, low metallicity single stars. Spherically symmetric asymptotic giant branch (AGB) winds are proposed for single stars with initial masses below approximately 1.3 M⊙.

VISUAL: At 150X Abell 37 could not be seen without a nebula filter, but with an OIII filter in place it easily pops into view. At 212X it can be seen without a filter as an evenly lit grey sphere with no central brightening and the central star was not seen. Through a nebula filter A37 is easily seen and is one of the brightest of the Abell Planetary Nebulae. 20-inch f/5 telescope



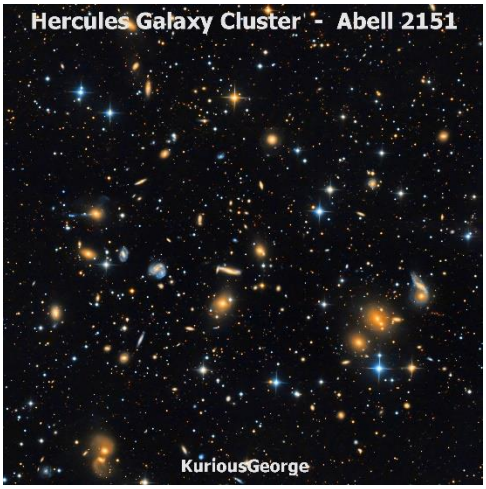
Arp 220, IC4553 is a relatively low surface brightness galaxy with a sharply defined dust lane down the middle, with two very compact nuclei, which are designated Arp 220 East and Arp 220 West. The galaxy has the distinguishing feature of being the prototypical Ultraluminous Infrared Galaxy or ULIRG, and it therefore has been the subject of much intense study. An infrared galaxy emits more energy in the infrared than at all other wavelengths combined with the infrared luminosity created mostly by star formation. Arp 220 has a very high nuclear star formation rate of approximately 340 M⊙ per year, one of the most powerful star-forming environments in the local universe. Its distance, calculated from its angular size, is 251 million light years, while the luminosity based distance is 254.3 million light years. Most of the ULIRGs are young systems with ages less than 1 billion years. The luminosity comes from very massive stars of near 100 solar masses which evolve very rapidly ejecting their mass as elements heavier than hydrogen, with the ejected gas condensing into dust in circum-stellar shells. This galaxy contains more energy than 100 million Milky Way's would contain, and is host to some of the most luminous masers yet discovered. Arp 220 is the result of a collision between two galaxies about 700 million years ago and now is in a late merging stage.

VISUAL: Arp 220 appears as a large round evenly lit halo of light with a moderate surface brightness. No stellar nucleus or nuclei are seen and the brighter central region seen in the photograph is not seen visually, nor is the dust lane. Arp 220 is easily and readily seen and visually appears the same at lower or higher powers, as a moderately diffuse and somewhat faint galaxy. 20-inch f/5 telescope



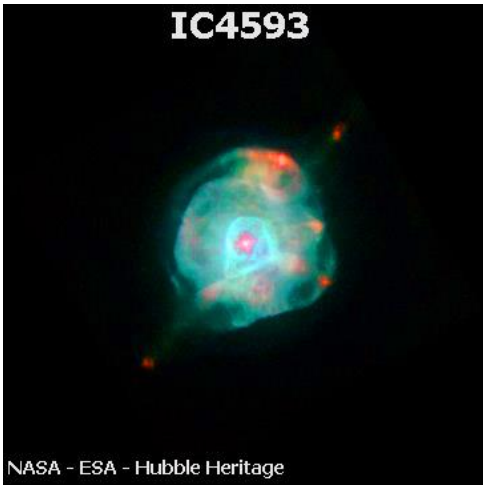
Seyfert's Sextet or Hickson 79 is the most compact group in the Hickson Catalog, and is so small that all of its galaxies would fit entirely within the Milky Way galaxy. It also is one of the most compact and isolated galaxy groups in the local Universe with an average mean galactic separation of only 30,000 light years. The cluster's total diameter is only 110,000 light years (34 kpc), and it is located on average about 202 million light years away. The group is located on the outskirts of the Hercules Galaxy cluster and is now known to consists of only four galaxies with accordant redshifts, one bright tidal tail (NGC6027E), a faint tidal tail and a galaxy, NGC6027D or HCG 79E, with a redshift much larger than the cluster average. Interestingly this galaxy, NGC6027D shows the most internal detail. Hickson listed the group only as a quintet, counting NGC6027 and the remnant as one object. The cluster is still considered to be growing by occasional infall of late type galaxies, but this is a slow process as the cluster is isolated in space, with apparently no nearby companions. It is very possible that the current members are merely remnants of larger galaxies and are embedded in their own debris halo or cocoon. The total neutral hydrogen mass of the cluster is only 4.3 trillion solar masses which is typical of just a single normal spiral galaxy.

VISUAL: Seyfert's Sextet is a very small galaxy cluster and the first thing one notices is the fairly sharp "V" shape of the galaxies, and NGC6027, the brightest galaxy. The group requires magnification in order to best differentiate into separate galaxies. This is a wonderful object to see and anyone who is a visual observer should experience this beautiful cluster with their own eyes. 20-inch f/5 telescope



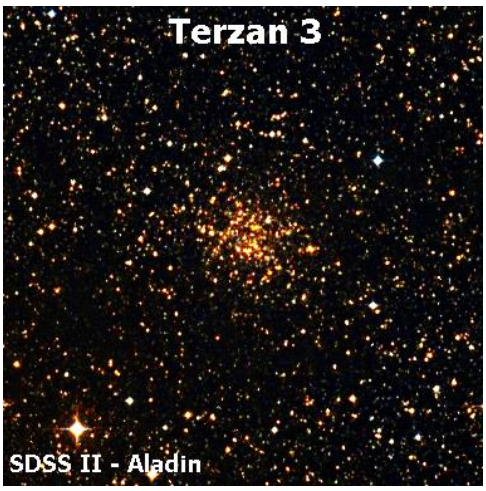
Abell 2151, the "Hercules Galaxy Cluster" is located 479 – 580 million light years away and is irregular in overall shape spanning a diameter of six degrees on the sky. A2151 is noted for its large number (>50%) of late spiral type galaxies, many of which are interacting. This is unusual in rich, dense galaxy clusters where mergers into ellipticals are the more normal situation. A total of 360 potential cluster members have been identified, but there is a lot of foreground and background contamination of galaxies leading to cluster membership difficulties in this region of the sky. Abell 2151 is part of the Hercules Supercluster of galaxies, one of the most massive structures in the local universe, thought to be gravitationally bound. Within A2151 there is a noticeable lack of a central condensation, and an irregular distribution of hot intracluster medium. Abell 2151 is also famous for its high degree of internal subclustering which was first identified by Harlow Shapley in 1934. There are at least three distinct subclusters, with varying ratios of dwarf galaxies to giant galaxies. These structures all lead to the conclusion that Abell 2151 is a young and relatively unevolved galaxy cluster.

VISUAL: Due to the distance to the cluster all of the galaxies are small, diffuse and faint with a Vmagnitude range of 14.6 to 16.0. Here good seeing, transparency and patience are necessary to reveal these galaxies as individual objects. The cluster requires higher magnifications and the first thing one should do is study the photograph in order to help identify each galaxy. Once the orientation of the galaxies is understood then the observation becomes one of "can I see it" or "do I not see it". This truly is a magnificent galaxy cluster which is located half a billion light years away, and demands more than just a cursory look. 20-inch f/5 telescope



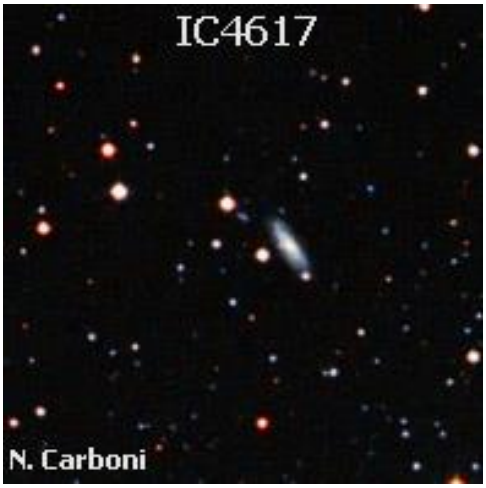
IC4593 is a striking elliptical planetary nebula with clearly defined ansae, and an outer faint halo. A number of condensations are seen extending well beyond the main body which has attracted a lot of professional interest. The central star is variable with a mass loss ratio of 4 x 10^{-8} MΘ yr^{-1} and a wind velocity emanating from it at 870 miles per second (1,400 km s^{-1}). The central star is a spectral type O5 - O7 variable and has a temperature of 40,000K, with a mass of 0.37 ± 0.03 MΘ. The star has heated an inner bubble to around one million degrees. The planetary nebula's distance is not well known which is common, but estimates range from 4,900 to 14,000 light years. It is located at least 1 kpc or 3,260 light years above the galactic plane, with a galactic latitude of 41°. The outer halo of IC4593 extends approximately 30" from the central star and is irregular but overall elliptical in shape. An inner shell is expanding supersonically into a slower expanding outer shell and several distinct internal structures can be identified. The bright core is an asymmetrical, roughly 10 arc-seconds in diameter shell, and this inner region is actually composed of the two shells. The ansae (fliers or jets) are 13 arc-seconds from the central star and are opposing collimated outflows. These objects are thought to be the initial ejection of material in the form of jets moving faster than the rest of the nebula. These phenomena are still not fully understood.

VISUAL: IC4593 is very bright but also very small in size and at low power looks like a star. At 254X the bright star dominates the appearance while the surrounding halo is very small in size and best seen at high power. Fortunately the halo responds very well to a nebular filter which is useful in identifying IC4593 since it is so small it appears mostly as a stellar object. 20-inch f/5 telescope.



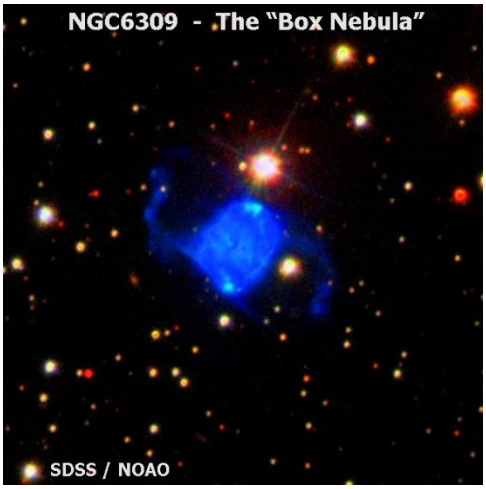
Terzan 3, discovered by Agop Terzan in 1968, is a metal rich, somewhat loosely structured globular cluster, with a high metallicity [Fe/H] = -0.73, and is considerably reddened at E(B-V) = 0.72. The horizontal branch is red, indicating it is metal rich, with a newly Vmagnitude value of 16.9. Terzan 3 contains five variable stars, is slightly elongated and appears tilted which suggests some amount of differential reddening is present. The cluster has been estimated to be 21,200 to 32,000 light years from the Sun, while a distance of 23,000 light years has been recently accepted. From Earth, the cluster appears projected on the outskirts of the galactic bulge and from our perspective, Terzan 3 has a large angular distance from the galactic center of 17.5^{o}. In reality it is located on our side of the galaxy core only 2.7 kpc or 8,800 light years from the galactic center and is part of a group of 32 metal rich globular clusters located within the galactic bulge. Terzan 3, along with six other globular clusters has an orbit which is independent from the Milky Way indicating they may have originally been part of an external dwarf galaxy which was captured by the Milky Way. At least five tidal stream similar merging events are thought to have happened in the distant past.

VISUAL: Terzan 3 is located in a rich star field, so patience and careful star hopping are required. The first thing one notices are two faint stars which appear to be binary stars, but a close inspection shows a faint but obvious glowing halo around these stars. The cluster was best seen at 149X, compared to a higher magnification of 212X which showed only the two stars, but the halo disappeared. 20-inch f/5 telescope.



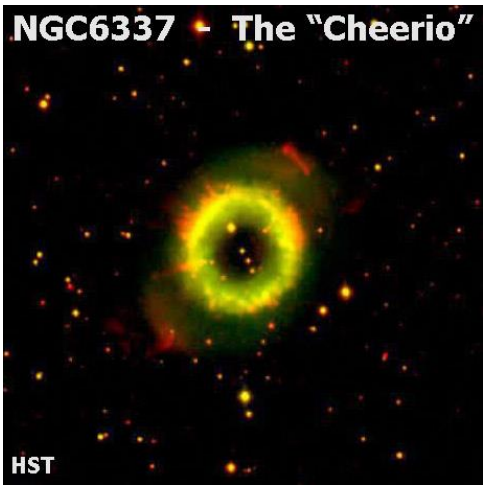
IC4617 is a small galaxy located only 12 arc-minutes north of the large globular cluster Messier 13 and in the same direction as the nearby galaxy NGC6207. Visually IC4617 appears as a slightly tilted spiral with well-defined arms and a prominent dust lane. The core region is considerably brighter than the halo and there is a hint of a bar-like structure. The outer spiral structure on the northeast side contains an elongated structure, and appears to be warped away from the galaxy center. IC4617 is a Seyfert 2 type galaxy, which explains the bright central region, and therefore it is a very active galaxy, with intense emission originating either from profuse stellar formation or from a massive central black hole, or a combination of both. IC4617 has a radial velocity of nearly 11,000 kilometers per second which places it nearly 550 million light years from the Earth and well beyond the 22,000 light years distance to the bright globular cluster Messier 13 at Vmag. 5.78. It is possible that IC4617 is part of the Abell 2197, Abell 2199 superclusters, which are nearby and lie at approximately the same distance.

VISUAL: IC4617 is located just to the west of a bent parallelogram asterism of four 13th and 14th magnitude stars. The key to observing IC4617 is to first locate these four stars just to the north of Messier 13. IC4617 is a very faint object, slightly elongated, with no central brightening and appears only as a slight enhancement in the sky background. A successful observation requires good sky conditions, optics and patience, and if one did not know it was there it could be easily passed by and not noticed. 20-inch f/5 telescope



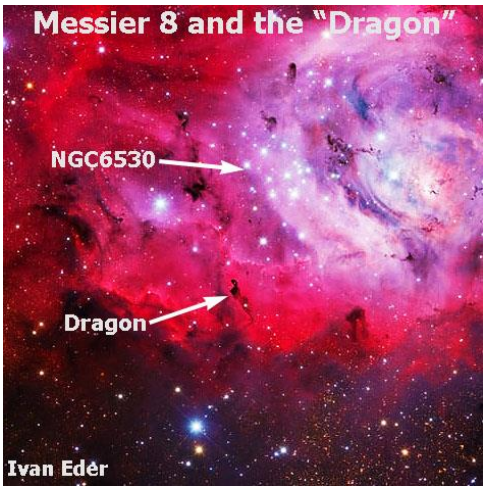
NGC6309 is a bright planetary nebula, discovered by Wilhelm Tempel in 1876 and located at distance estimates from 3,600 to 8,150 light years (1.1 to 2.5 kpc), with 6,500 light years (2 kpc) being generally accepted. The central region is a bright ellipse with a major axis of about 20 arc-seconds (PA 14°) which is formed of many clumps and diffuse gas, and is over half a light year across. It is open in its southwest and southeast regions and faint bubbles are detected in the northeast. The central torus or belt is expanding at 15.5 miles per second (25 km s^{-1}) and is the brightest structure, and what we visually see. It is formed by an irregular assembly of knots which are especially prominent in [N II] light. Spectra indicate NGC6309 is a high excitation object with nebula temperatures around 10,000 K. The northwestern half of the torus is blueshifted while the southeastern half is redshifted. NGC6309 has a complicated history beginning about 150,000 years ago when the AGB progenitor star had a massive ejection event resulting in a large slow expanding shell of material. About 45,000 years ago another episode led to the formation of a round outer halo. Then about 4,000 years ago the star transformed into the planetary nebula we see today with collimated outflows of 62 miles per second producing bipolar lobes.

VISUAL: NGC6309 is rectangular shaped, much like a shoebox, and is bright and easily seen due to a high surface brightness. No central star is seen, but the visual nebula is located just to the south of an 8.6 magnitude star which does not hinder in the observation. At lower magnifications the nebula and star appear to touch. On the southern end of the nebula there is a small, bright somewhat noticeable patch seen in the photo. NGC6309 responds well to nebula filters and magnification and is visually magnificent. 20-inch f/5 telescope



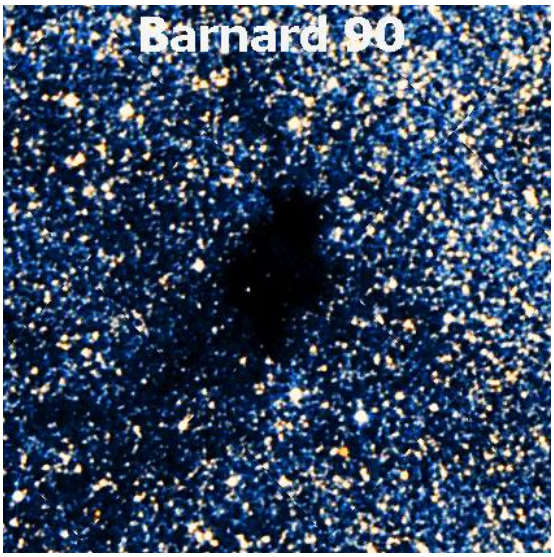
NGC6337, the "Cheerio" is a multi-shell, bi-polar planetary nebula located near the stinger of the Scorpion. Distances to planetaries are difficult to measure accurately, but the distance is estimated to be between 3,580 and 5,550 light years, with 5,200 light years being generally accepted. In appearance NGC6337 is seen as an almost perfectly circular ring. In [O III] light the inner and outer diameters of the ring are 28" and 48" while the actual diameter of the ring is 0.978 light years. What we are seeing visually is the bright, narrow waist or torus in a nearly pole-on orientation of the bipolar object. The nearly perfect circular shape of the toroid indicates a very small tilt with respect to the plane of the sky, of less than 10°. The extended halo which represents the ejected polar lobes are seen as faint puffs of material in a northwest–southeast direction (photo), and is about 1.5 arcminutes in diameter. The torus has a number of bright low ionization knots that are cometary in appearance, showing the outward expansion of the nebula. The illuminating central star has a temperature of 90,000 K, with estimates ranging from 41,700 K to 105,000 K, and a mass of 0.563 M☉. The star is a close binary with a period of only 4.2 hours, and the primary is a pre-white dwarf.

VISUAL: NGC6337 is round, bright, small, and easily seen, with a couple of stars embedded in the halo, one of which is slightly brighter. Three stars are seen inside the ring. The ringlike structure is seen without the aid of a nebula filter, but when viewed through a filter the nebula literally jumps out and looks very much like a donut with a dark central region. The outer halo or lobes is not seen but overall NGC6337 is a beautiful sight. 20-inch f/5 telescope



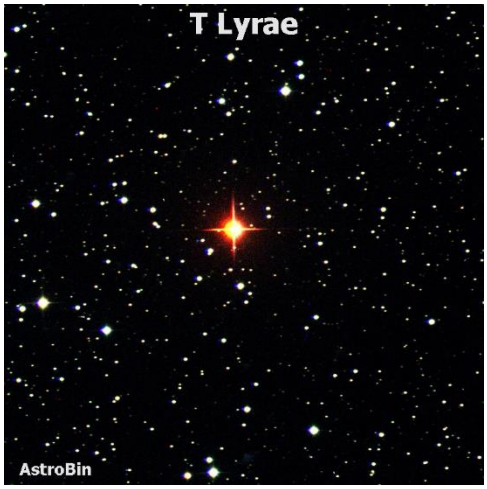
The Dragon and Messier 8: The Lagoon, or Messier 8 (M8), is a prominent Galactic H II region located 4,250 - 5,835 light years away, and is huge, with a diameter of 115 x 50 light years. This is several times the size of the Orion Nebula, which would be dwarfed by M 8 if at the same distance. In the night sky it is three times larger than our full moon and resembles a tailless comet to the naked eye. The Lagoon is currently undergoing star-birth, especially in the eastern half where the open cluster NGC6530 is found and the Bok Globule, the "Dragon" lives. A typical Bok Globule is a frigid condensation of gas and dust bigger than our solar system, but no more massive than our Sun. Under the force of gravity a globule will slowly contract and warm up until it becomes hot and triggers nuclear reactions at the core and will then shine as a star. Bok Globules are the very earliest stage of star formation with masses from 2 to about 50 solar masses. These young protostars are still shrouded in their pre-natal accretion disks, and are about a light year in diameter and are still gravitationally collapsing. To do so there can be no outward force due to heat so their interiors must be cold, and Bok Globules are known to be some of the coldest objects in the universe. These globules are also known as pre-main-sequence objects (PMS) and are also called "young stellar objects" (YSOs).

VISUAL: The "Dragon" structure appears as a long dark streak with a size ratio of about 8 : 2, and is located just to the north of an 11th magnitude star. To see the Dragon a nebula filter must be used and higher powers employed. It could not be seen at a magnification of 149X as the area is too dark, but at 212X it was at first difficult due to the dark background, but like many faint telescope objects once it is noticed it becomes obvious, as a dark elongated object superimposed on a slightly less dark background. 20-inch f/5 telescope



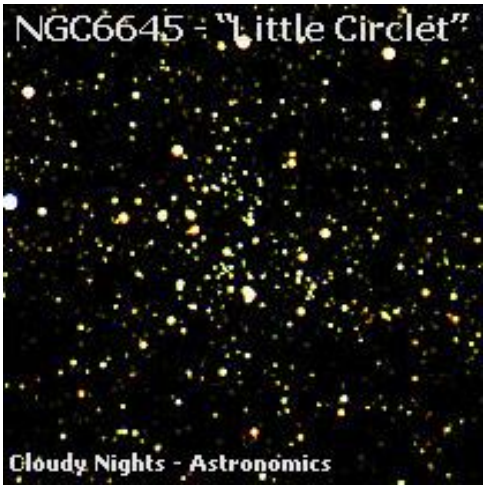
Barnard 90: Edward Emerson Barnard spent most of his astronomical career trying to understand what these mysterious dark features really were. William Herschel described them as "holes in the universe". Barnard described Barnard 90 (B90) as "Irregular, elongated 3' north and south and located among the great star clouds in Sagittarius. It is a well-defined black spot and elliptical shaped and located in an irregular dusky space 13' in diameter. There are many similar dark spots in this region but this one is perhaps the most distinct and is fairly characteristic of the others." Around the turn of the century it was thought the entire universe was being seen in the Milky Way night-sky. Barnard and his fellow astronomers had no idea they were merely looking down the plane of the Milky Way Galaxy, and to them these beautiful opaque regions were simply clouds in space. B90 actually is a large cloud of material which is not illuminated by any nearby heat source so it blocks out everything behind it visually. In a rich starfield this will appear as a dark or black area on the sky. These dark nebulae should not be confused with star forming "Bok Globules" which are much smaller objects, typically containing from 2 to 50 solar masses of material and only about a light year in diameter.

VISUAL: Barnard 90 is a very large oval shaped black patch with no stars seen inside the nebula. It is best seen with higher magnification, 212X, where it stands out from the rich background starfield. At low powers it just blends into the sky background and is barely distinguishable. A wide double star is seen near the southern edge. 20-inch f/5 telescope



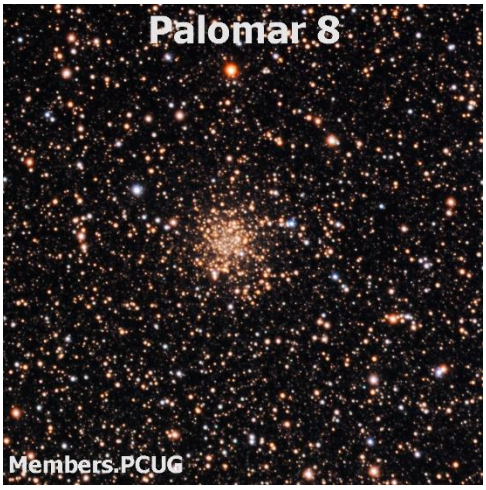
T Lyrae, the "Jewel in the Harp" has one of the highest color indices of any carbon star meaning it is very red. It is a slow pulsating irregular type variable star, because it changes its size over time and visually is one of the reddest stars in the sky. Carbon stars jump out in telescope fields and are fun to hunt down as the orange to red color is visually very striking. T Lyrae has an overall average magnitude of 8.5, but its range is from 7.2 to 10.0 Vmag. its distance is not well known and the Hipparcos satellite data give it a distance of 2,400 light years, but estimates vary from 1,730 to 3,600 light years. Temperature values for T Lyrae also vary from 2,400 to 3,200 K, and the infrared luminosity is around 15,000 times solar. If this luminosity is used and an average temperature of 2,600 K employed, then the diameter of T Lyrae is about 1,200 times that of the Sun. If T Lyrae were at the location of the Sun it would encompass 2.8 Astronomical Units, almost twice the size of the orbit of Mars. If the star is closer to its given upper distance limit, the radius could even be considerably larger. T Lyrae is a special type of variable star with a classification of "type L", which the General Catalog of Variable Stars (GCVS) defines as "slow irregular variables of late spectral type, which show no evidence of periodicity".

VISUAL: T Lyrae is a moderately bright orange colored star which stands out in the field as no stars are nearby, and it looks distinctly different from the other white and bluish-white field stars. It is readily seen at all powers. 20-inch f/5 telescope



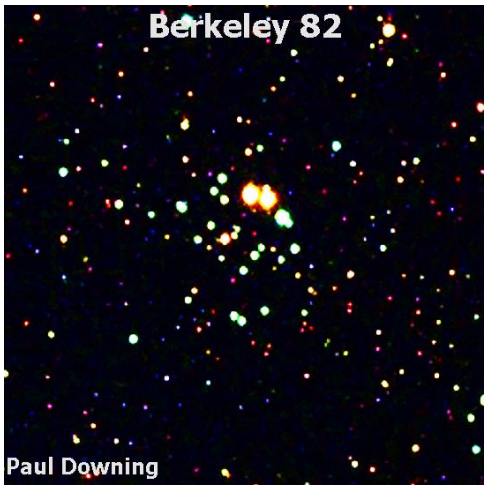
In **NGC6645**, the circlet of stars is distinctly seen and located near the cluster center. A couple of very faint stars are found in the central region, otherwise it is devoid of stellar material. The origin of this circlet of relatively empty space has never been identified, but one or more supernova eruptions could be the reason. Its distance is estimated to be a little over 4,000 light years from the Sun which places it on the outer edge of the Sagittarius Arm. As with many astronomical objects the distance is controversial and some photometric studies indicate a smaller distance of about 2,400 light years. Within 10 arc-minutes of the cluster center, 119 stars were measured with BV photometry and of these a total of 72 members have been positively identified as cluster members. The brighter stars have a mass range from 0.86 to 1.04 solar masses, and a range of temperatures from 6,600 K to 8,100 K. It is not known how many of these are actual cluster members and how many are non-gravitationally bound stellar objects, but an older source lists 90 stars as cluster members located within a background stellar density of 5,320 stars per square degree.

VISUAL: This is a beautiful visual star cluster and is about 2 degrees north of the bright open cluster M25. Even though the cluster is superimposed on the core of the Milky Way it is visually well differentiated from the rich stellar background. However, on deep photographs it is not so easily noticed and blends in with the rich, highly reddened extremely dense stellar background. Visually one gets the impression of a "donut hole" in the middle of the cluster. 20-inch f/5 telescope



Palomar 8 and Palomar 9 are the two brightest of the Palomar globular clusters. Palomar 8 is located about 41,700 light years from the Sun and only 18,000 light years from the center of the galaxy. It has a visual magnitude of 11.2 and an apparent diameter of 13.6 arc-minutes making it a bright easily seen visual object. Its Color Magnitude Diagram (CMD) shows a wide truncated main sequence with a turn off around 19th magnitude. The red giant branch (RGB) is wide and ill defined, possibly due to contamination of field stars in this dense region of the Milky Way. A RGB clump of stars is found at Vmagnitude 17.3 within Palomar 8. The RGB red clump is a bunching up of stars on the red giant branch with temperatures around 5000 K and are also present in some open star clusters. Palomar 8 has been little studied but it is important as it is a disk globular cluster with a high metallicity [Fe/H] = -0.37, or 74% that of the Sun. Globular clusters with high metallicities are always interesting as most of them are also somewhat younger than typical metal poor Milky Way clusters. Their different chemical structures and ages are indications they may have originated in other galaxies and have been captured by the gravitational attraction of the Milky Way.

VISUAL: Palomar 8 is a bright very easily seen globular cluster with six stars being seen at 254X as individual stellar objects on the western side of the cluster. A separate star is also seen on the south side of the halo and all of these individual stars are seen along the periphery of the cluster. Palomar 8 is round in shape and has a high surface brightness, and the entire surface appears granulated giving the impression of stars almost but not quite resolved. It is surprising this is not an "NGC" object as it is certainly bright enough. 20-inch f/5 telescope



Berkeley 82 is rated as a poorly-populated compact group and is considered a true gravitationally bound open star cluster. In 1980, a preliminary photoelectric UBV survey found the three brightest stars in the cluster are (Left to Right – photo at left):

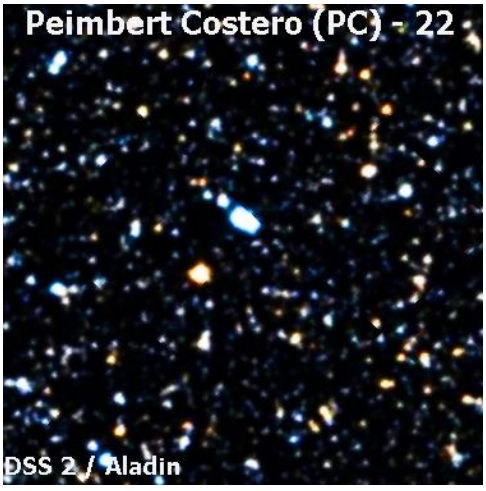
1.) Spectral type G2 II/1b Yellow Giant, Vmag. 10.1
2.) Spectral type K2 II Yellow Giant and Vmag. 11.23
3.) B6 III Giant, Vmag. 10.5

As core-helium-burning stars of 6 solar masses the two brightest members are firmly located on the horizontal branch. If these are true cluster members they lie beyond the red edge of the Cepheid instability strip on the Color Magnitude Diagram. Berkeley 82 is located about 3,200 light years away and is located above the galactic plane in a region of high stellar extinction, with E(B-V) -1.01 ± 0.01. In 1986, an analysis found there are an estimated 65 ± 5 cluster members in the ß = 18 limiting magnitude range, while a later analysis has placed the number of cluster members at around 200. There appear to be a dust lane partially obscuring the southern portions of Berkeley 82 as these stars appears more highly reddened. Berkeley 82 is similar to other open clusters of a similar age and is part of a group of clusters with ages ranging 40 – 100 million years.

VISUAL: Three much brighter stars form an arc and dominate the cluster in brightness and appearance. A total of 13 stars much fainter than these were counted as cluster members down to the limit of visibility. The overall shape of the cluster appears slightly elongated in a north-south trajectory, and quite a few stars are seen popping in and out of view that are too many to count. 20-inch f/5 telescope

NGC6781 is a bipolar or butterfly shaped planetary nebula with a 130" diameter bright shell of low ellipticity, which is double lobed. The ring we see is really the torus, the equatorially pinched in waist of the nebula. NGC6781 has a high inclination of the polar axis relative to the plane of the sky, and we are seeing the object only slightly tilted (23°) from being viewed from a nearly pole-on orientation, like the more famous M57, the Ring Nebula. This tilt enables us to view the extended lobe on the opposite side resulting in the blown-out appearance on the northern side. Its southern side is pointed towards us and the illuminated structure surrounds a central cavity of tenuous highly ionized gas. NGC6781 is a dusty nebula with a dust mass of 0.004 M☉, which is rich in carbon. Its distance has been widely calculated with estimates as low as 978 light years (0.3 kpc) to 4,150 light years (1.27 kpc), while a more recent analysis places it at 3,100 light years distant (Ueta et al., 2014). The very hot central star has a temperature in the range of 110,000 to 140,000 K, and its initial mass was between 1.5 and 3.0 M☉, with a present mass of 0.60 ± 0.03 M☉. The luminosity is 104 – 196 *L*☉, and NGC6781 is in the cooling phase of its evolutionary track. Given an approximate 2.5 M☉ original mass of the central star, the best fit for the age of NGC6781, which is the time since the cessation of the AGB mass loss, is approximately 9,400 years. If the initial mass is a lower 1.5 M☉ , then its age is 20,000 to 40,000 years.

VISUAL: NGC6781 is bright and round in overall shape and a beautiful planetary nebula which is easily seen, with a very high surface brightness. The disk is grey in color and evenly lit throughout, and the edges are diffuse with no central star seen at any magnification. The nebula responds very well to nebula filters. When viewed without the filter the north side of the nebula appears softer and more tenuous than the other edge areas, and when viewed through the filter the nebula here appears to be blown outward. 20-inch f/5 telescope

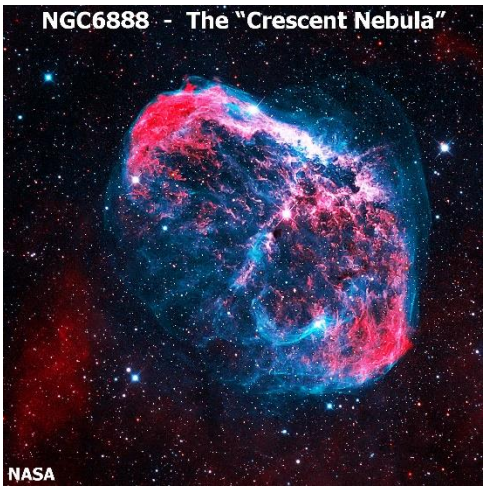


PC 22 was discovered by S.P. Apriamashvili in 1959 and later catalogued by Peimbert and Costero in 1961 who gave it the name PC 22, based upon their last names. This is a multipolar planetary nebula that is probably fueled by a binary star system, although no evidence for binarity has been found. Its distance has been estimated to be 13,000 to 18,000 light years away, but a more recent distance (Frew et al. 2016) derived a mean distance of 17,180 light years (5.27 ± 1.52 kpc). The morphology of the nebula is complex and the elliptical structure, which is normally seen and once thought to form the entire nebula, is actually only the central part of the planetary with multiple shooting outflows. Six large lobes have been identified along with three secondary outflows closer to the central region. PC 22 has been called an evolved "Starfish" planetary nebula. Starfish nebulae describe very young planetaries, such as Henize 2-47 and Minkowski 1-37. All three objects display the same features, namely youth and multiple well defined and fast collimated lobes. At a relatively young age of 10,000 years PC 22 is at the stage where material blown out by the fast post AGB wind is blowing through a slower moving more evolved and larger AGB shell.

VISUAL: PC 22 is easily seen with or without a filter and is elongated, grey in color and evenly lit throughout. It is easily spotted at a low power of 149X, and its high surface brightness means it takes high magnification well. The edges are fairly sharp, and no central star was seen or hinted at. The planetary nebula responds well to nebular filters which only make it appear brighter but renders no additional detail. 20-inch f/5 telescope

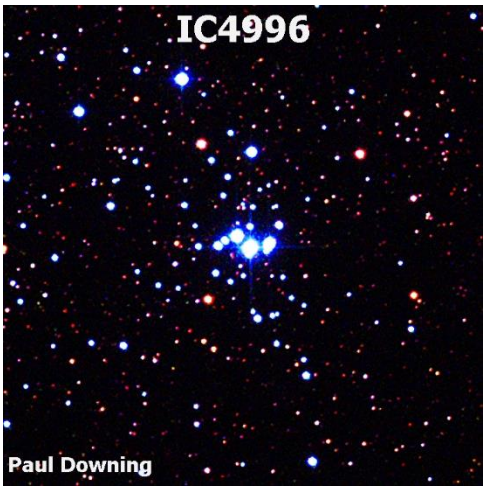
NGC6818, The "Little Gem Nebula", is a planetary nebula roughly 5,550 light years away from Earth. It is bright at a visual magnitude of 9.3, with a slightly oval diameter of 15 by 22 arc-seconds and it is located only 40 arc-minutes to the northwest of Barnard's Galaxy, NGC6822. NGC6818 is a very young planetary nebula 3,500 ± 400 years of age, and optically thin with a double shell of material of about 0.13 M☉ which surrounds a very hot central star of low luminosity. It is located 18° from the galactic plane which is considered to be relatively distant and an indication the progenitor was a low mass star. The Vmagnitude of the central star is 17.06 ± 0.05 and it is located in the middle of the glowing nebular cloud which is just over half a light year in diameter. The stellar mass of the central star is relatively large at about 0.625 M☉, when compared to other planetary nebulae, and it is very hot, at 145,000 K. However, the luminosity is only approximately 3.1 *L*☉, another indicator the initial mass of the star was low. The star is a visual binary star with a faint red companion located 0.093 arcseconds to the south (PA = 190°) of the primary. This corresponds to a separation of ≥ 150 AU and an orbital period of ≥ 1,500 years. The very hot low luminosity star is a good indication the central star is a hydrogen-burning post AGB star, since a helium burning core would be much brighter and would evolve more slowly and from a progenitor of larger mass. The central star is rapidly declining in brightness.

VISUAL: The planetary nebula appears perfectly round in shape and is very bright with an almost incandescent blue color, permitting higher observing powers. The edge of the outer halo is sharply defined against the sky background. The central star has a published magnitude of 17.0, yet at times some faint barely visible wisp near the center of the nebula was noted popping in and out of view. 20-inch f/5 telescope



NGC6888, The Crescent Nebula is an emission nebula located about 5,000 light-years away from Earth. It is classified as a Wolf-Rayet (WR) nebula, although it looks like a supernova remnant, or a planetary nebula. The nebula surrounds a Wolf-Rayet star and is often referred to as a "ring nebulae". Wolf-Rayet stars are the evolved descendants of massive spectral type O or B stars with masses greater than 25 times solar, and they are believed to constitute the last phase in their evolution before the star erupts in a supernova explosion. NGC6888, is a huge cosmic bubble expanding with a velocity of 52.8 miles per second (85 km s^{-1}) and is blown by the fast stellar wind emanating from the central, bright and massive Vmag. 7.4 Wolf-Rayet star, WR 136 (HD 192163) of spectral type WN6 (nitrogen). This hot star is irradiating the cloud with temperatures of 70,000 K to 110,000 K, and is heating the optically thin nebula to a plasma-like feature with temperatures 1.4 to 7.4 million degrees K. The star is only about 1.9 million years old and initially had a mass 25 to 40 times the mass of the Sun. However, it currently contains about 15 solar masses, as the star is blowing off its outer layers in a tremendous Wolf-Rayet wind at a rate of 1,250 to 2,000 miles per second, ejecting the equivalent of the Sun's mass every 10,000 years. This fast wind collides with and energizes the much slower moving 6 miles per second (10 km s^{-1}) wind ejected by the star when it initially became a red giant around 250,000 to 400,000 years ago. It is difficult to explain all of the features seen in this object.

VISUAL: NGC6888 is located 2.5° SW of the star γ Cygni, and in the finder scope look for a flattened kite shape asterism. The central irradiating Wolf-Rayet star is the southern most of these stars. The nebula is oblong in shape and may be seen with or without a nebula filter, but is best seen with a filter in place, and at lower powers, it looks very similar to the photograph. Visually the nebulosity is most apparent along the northern edge. A telescope as small as 8 inches (with filter) can see its nebulosity, but in larger aperture instruments with a nebula filter in place, it becomes a beautiful object, that must be seen. 20-inch f/5 telescope.



IC4996 is located in the Cygnus spiral arm and 130 light years (40 pc) above the plane of the Galaxy, so its reddening is a modest 0.673 magnitude. Its distance has been listed in various places as 5,646 – 7,817 light years. IC4996 contains 65 stars within an angular diameter of 12.2 arc-minutes on the sky, and 16 variable stars are known to exist in the cluster out of 116 stars in the area that have been checked. The low percentage is due to the higher noise level in the region where fainter redder star's variability is impossible to detect. IC4996 contains many large spectral type-B stars which help to age the cluster to a young 7.35 to 10 million years. As further proof of the clusters youth, there are pre-main-sequence (PMS) stars still forming and two cluster members have been identified as PMS pulsators, whereas a third is strongly suspected. They have been identified as Herbig emission line stars of spectral Type Ae/Be and T Tauri stars. Two massive Wolf-Rayet stars are located near the edge of the cluster. Since IC4996 is younger than 10 million years, stellar members with spectral types later than A0 have not yet reached the zero-age main sequence.

VISUAL: This is a very nice and bright open cluster – Visual Eye Candy. The brightest star is near the center at 8.0 V-mag. with a slightly fainter but still bright star next to it. A group of somewhat brighter stars form a crooked chain of 8 stars and this dominates the cluster. The overall shape of IC4996 is elongated and 21 stars were counted down to the limit of visibility as cluster members. 20-inch f/5 telescope

French 1 is also known as **the "Toadstool"** due to its distinctive shape, is an asterism of approximately 13 arc-minutes in size on the sky. It has been speculated this may in fact be a true open cluster, but the individual proper motions are wrong for such an object, and Sue French emphatically states it is an asterism. An asterism is a grouping of stars which appear to be gravitationally bound, but actually are not related as they have different distances, ages and chemical compositions. The Big Dipper is the most recognized asterism. French 1 was discovered by Susan French in 1997, and is more obvious in a telescope field than in photographs. The two brightest stars in the head of the toadstool are HD201095 at Vmag. 8.94 and HD201117 at Vmag. 8.96, while the brightest star, HD201195, is located in the base of the toadstool, with a Vmag. of 8.79. The most easterly star in the cluster is BD+15 4344 with a Vmag. of 9.73 and is located just to the west of the spiral galaxy NGC7025. The galaxy is a Sa type spiral galaxy with a photographic magnitude of 13.7. It is located about 230 million light years away and has an apparent visual diameter of 1.9 x 1.2 arc-minutes. Therefore all of the stars plus the galaxy should be easily seen in telescopes of most apertures.

VISUAL: A total of 21 stars was noted down to the limit of visibility with 9 brighter members. However there are only supposed to be 15 stars in the asterism. French 1 visually stands out well from the stellar background and is best viewed at a low power of around 79X, with a wide field eyepiece. A wide double star makes the base of the "Toadstool". No background halo of unresolved objects is seen, and all of the stars are easily seen. The galaxy, NGC7025, is seen as an elongated object with a slightly brighter core, giving the appearance of a spiral type galaxy. 20-inch f/5 telescope

The above information for each object is just a very-very small sampling of the information available in a soon to be published book entitled "*Advanced Observing – Visual Mysteries of the Universe*". The book is based upon the Advanced Observing Programs of the Texas Star Party, and includes a total of 200 objects along with finder charts. From a total grouping of around a thousand objects, listed over the past eighteen years, these were selected for a number of reasons some of which include telescopic visibility (easy or difficult), something interesting is happening, or the target has rarely been visually seen by anyone. This has proven to be a huge work endeavor and it continues – It is a big Universe and it never stops surprising.
Ad Astra !

Larry Mitchell

Houston Astronomical Society
TSP Advanced Observing Program: Year 2021
Texas Star Party Advanced Observing Chairman