www.mvastro.org

Membership Meeting
October 9th at the Herrett Center
CSI main campus at 7:00pm

Centennial Observatory
See Inside for Details

Faulkner Planetarium
See Inside for Details

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Magic Valley Astronomical Society is a member of the Astronomical League

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M-51 imaged by Rick Widmer & Ken Thomason Herrett Telescope - Shotwell Camera

Aurora at Pike's Place (Alaska) imaged by Tim Frazier

2023 President's Message

Greetings Friends and Family: Another typical Idaho May, when the weather jumps from winter to summer. And no, I'm not complaining about a series of 80 degree days.

First off, just a note about our next two programs. I'll be presenting our program for May, The Digital Revolution, From the beginning to??? That's on the 13th at 7:00pm in the Herrett Center Library.

Our June program will be presented by Rick Hull. Rick will be discussing Chasing Solar Eclipses. Also to be finalized at our May meeting will be the location of our long awaited planned star party for the weekend of May 19-20. With the 19th as our primary date, and of course, the 20th as our back up date. I hope the warmer weather will allow us to get out and observe our great Idaho skies.

This is my favorite time to grab some of the great objects in Virgo if you're hunting galaxies. According to Astronomy magazine, there are 200 Deep Sky Objects in Virgo brighter than magnitude 13.

Other challenging objects include several edge-on galaxies in Coma Berenices, just north of Virgo, and the Draco Trio.

Also don't forget to remember our summer picnic again scheduled for July the 8th at the CSI Herrett Center back patio.

The best to all of you, Gary Leavitt, MVAS Pres.

***Humankind has not woven the web of life. We are but one thread within it.
Whatever we do to the web, we do to ourselves." ~ Chief Seattle 1854***

Native American Tribes gave names to each of the full moons to keep track of the passing year. The names are associated with the entire month until the next full moon occurs. Since a lunar month averages 29 days, the dates of the moons change from year to year.

May's Full Moon in the language of the Shoshone is buhisea'-mea' (budding, or flower Moon)

Lunar Calendar for May

Be Careful – Be Safe – Get Out There – Explore Your Universe

Events & Holidays for May

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5 Cinco de Mayo  1961 First Manned Spaceflight US	6 Eta Aquariids Peak this weekend (5,6,7)
7	8	9	10	11	12 Centennial Observatory Public Star Party see next page for details.	13 **Membership Meeting** May 13th at the Herrett Center CSI main campus at 7:00pm
14 Mother's Day 	15	16	17	18	19 MVAS Star Party Location announced at the meeting 	20 MVAS Star Party Alternate Date
21	22 Victoria Day 	23 Moon-Venus conjunction at 6:08am 	24	25	26	27
28	29 Memorial Day 	30	31 Centennial Observatory Solar Session see next page for details. 			

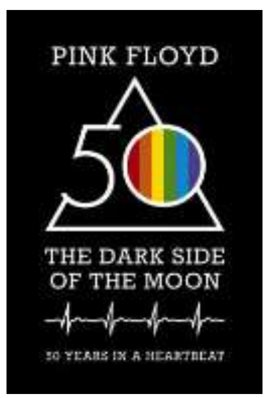
Centennial Observatory and Faulkner Planetarium Events

Observatory Upcoming Events

Event	Place	Date	Time	Admission
Monthly Free Star Party	Centennial Observatory	Saturday, May 13th, 2023	9:45 to 11:45 PM	FREE
Summer Solar Session #1	Centennial Observatory	Wednesday, May 31st, 2023	1:30 to 3:30 PM	FREE

Faulkner Planetarium Shows

Now Showing!



Visit the Herrett Center Video Vault

The Night Sky This Month – May 2023

Brilliant Venus grabs the attention of stargazers all over the world as it rises high and brightens in the May evening sky. The planet lies at the northern edge of the ecliptic, and on May 9 reaches its maximum northerly declination when observers at mid-northern latitudes can see the planet until after midnight. Venus also passes close to the Moon and many bright stars in the western sky throughout the month. Mars also lingers in the west, while Jupiter and Saturn appear low in the east before sunrise. The best meteor shower of the year for southern observers, the Eta Aquariids, is already underway and peaks on May 6 just after the full Moon. But look for these meteors earlier in the week after midnight when the Moon is less of a factor. Here's what to see in the night sky this month.

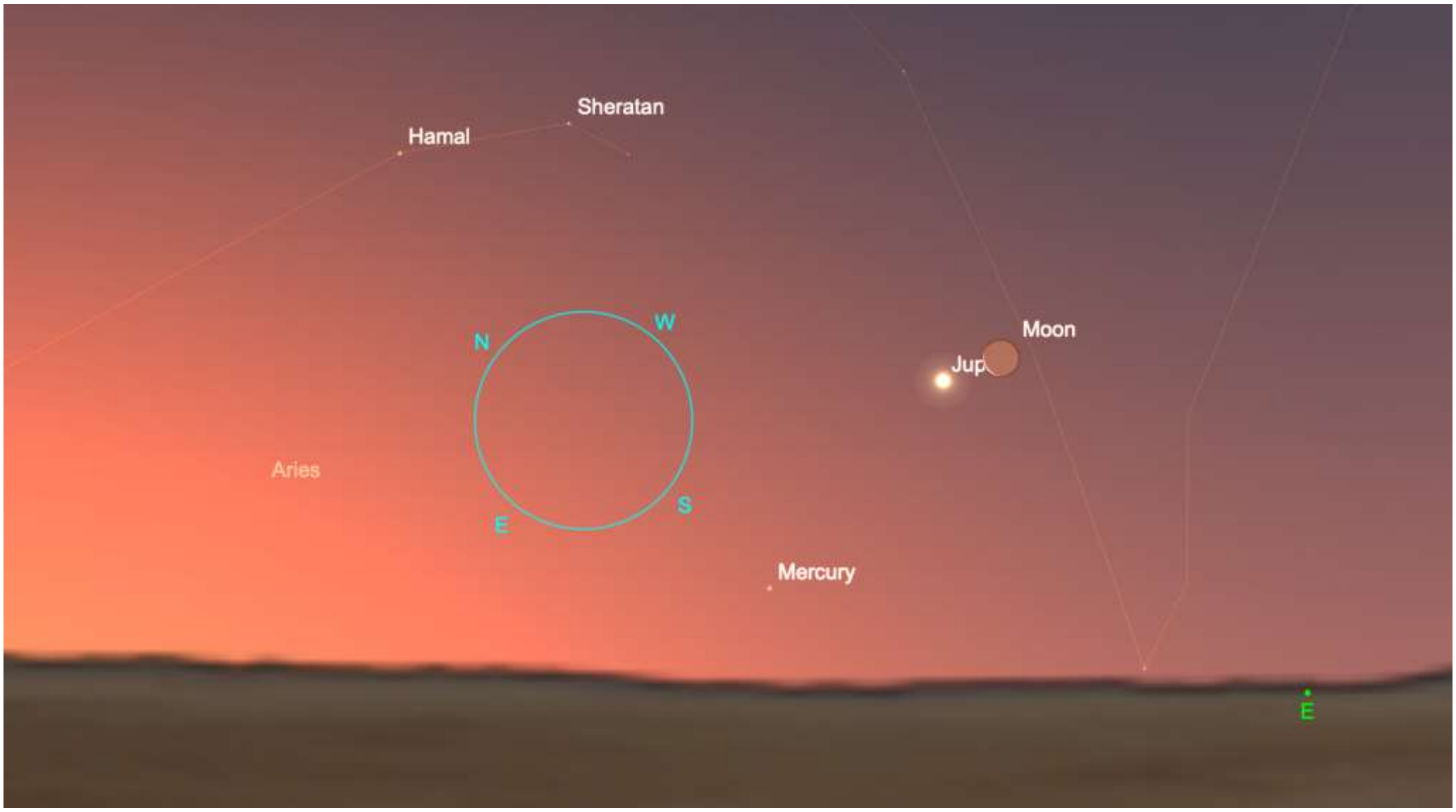
5 May. Full Moon, 17:34 UTC (the 'Flower Moon').

6 May. The usually reliable Eta Aquarid meteor shower peaks. The shower runs from April 21 through May 20 each year, with many meteors still visible for several days on either side of the peak. The Eta Aquarids occur as Earth passes through a stream of icy and dusty debris from Comet 1/P Halley, more commonly called Halley's Comet. We pass through a second stream of the comet in late October during the Orionids meteor shower. Look for the meteors anywhere in the sky, preferably after midnight. They trace their paths back to a point near the star Eta Aquarii which rises in the eastern/southeastern sky before dawn. This is perhaps the best meteor shower of the year for southern hemisphere stargazers, but northern observers may see a few of these meteors too. NOTE: If you're clouded out, you can always watch some of the shower on [the excellent live feed from the Subaru Telescope on Mauna Kea, Hawaii].

7 May. The still-bright gibbous Moon finds itself about two degrees west of Antares in Scorpius in the southeastern sky late in the evening.

9 May. Wander out and see Mars about 5º south of the bright star Pollux in the west-northwestern sky as darkness falls. The planet has faded to magnitude +1.6 and shrunk to just 5" across, but it continues to wander through the northwestern sky after sunset in the coming days and weeks. Look also for much brighter Venus (magnitude -4.2) to the west in one of the 'feet' of Gemini. Today, it lies about 2º north of the star cluster M35 – a great sight in binoculars or small scope!

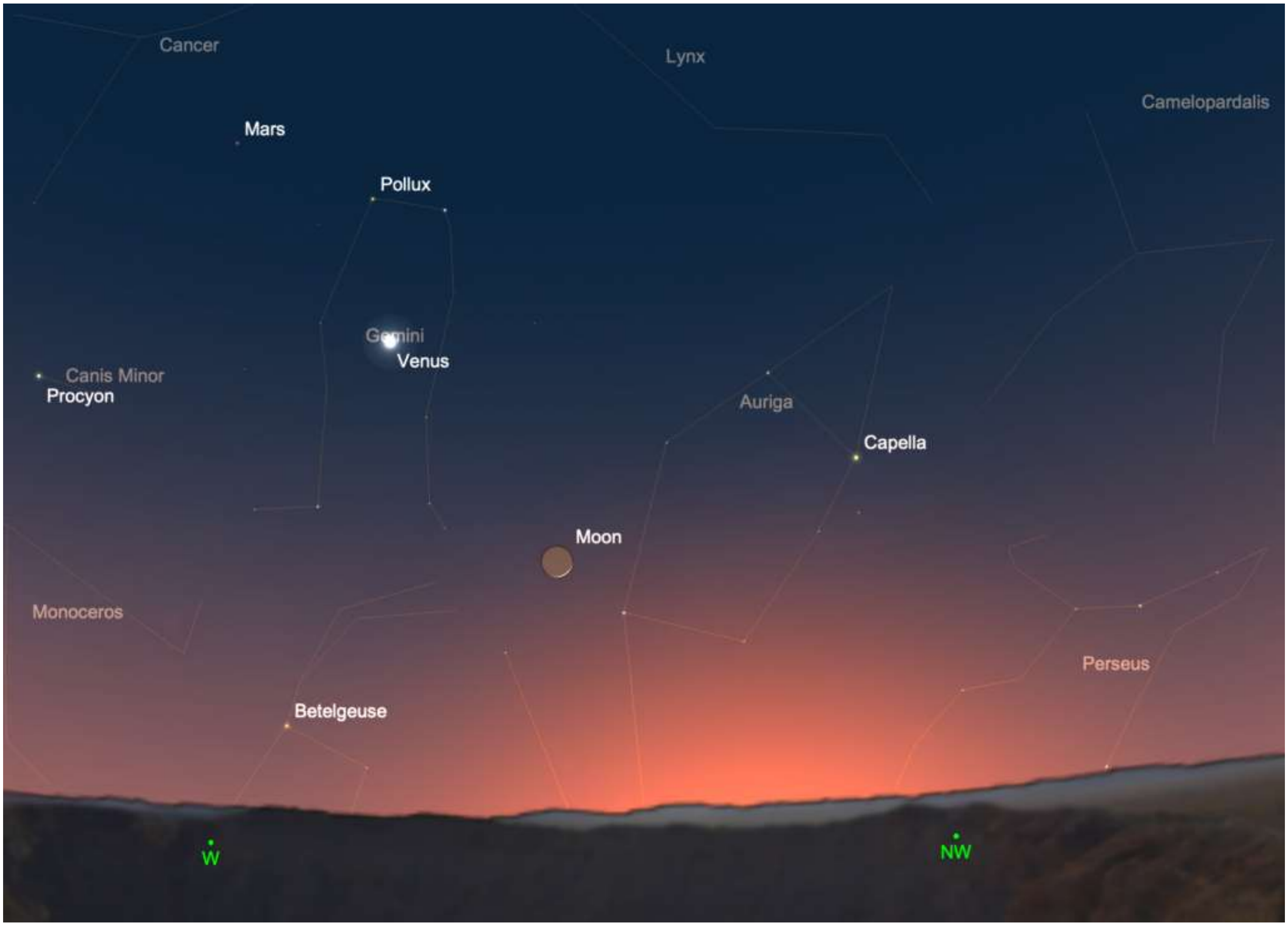
12 May. Last Quarter Moon, 14:28 UTC



Jupiter and a slender crescent Moon rise in the east before sunrise on May 17, 2023.

13 May. The fat crescent Moon and Saturn rise together in the east before dawn as the ringed planet lies about 5º north of the Moon in Aquarius. The planet shines at magnitude +1.0 and spans about 16" (not including rings). It continues to rise earlier each day and works its way into the evening sky later in the year.

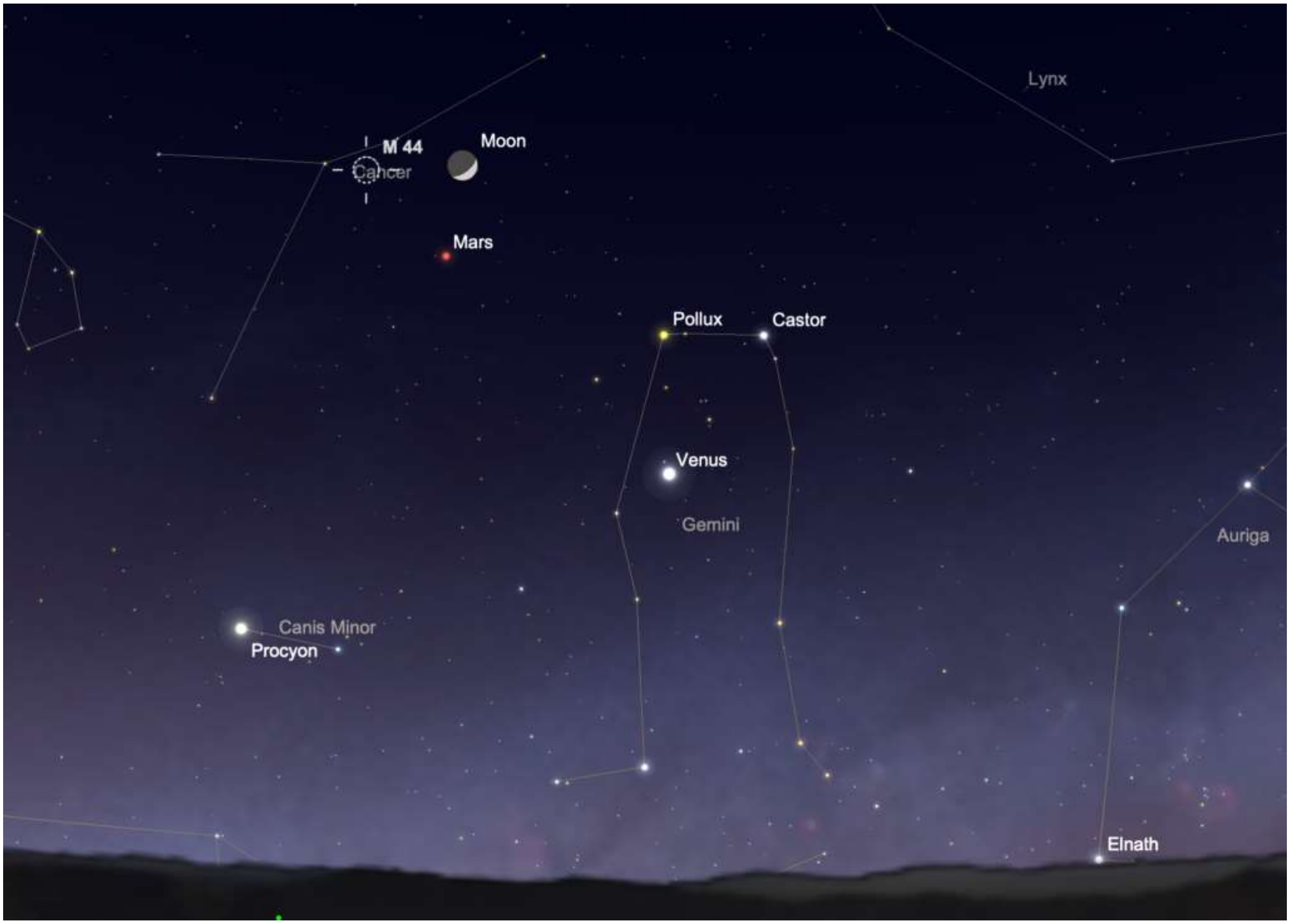
17 May. Jupiter recently emerged into the morning sky and it's wasting no time grabbing attention. Today it lies less than one degree from a slender waning crescent Moon, and observers western North and Central America can see a rare occultation of Jupiter before sunrise (observers in the eastern Americas and Europe can see the occultation by day). For those observing before sunrise, the Moon will lie just a few degrees over the horizon which makes for a challenging observation. Observers looking for the occultation by day see the pair at a higher elevation but will likely need some electronic and optical help to find them. The planet disappears behind the thin lunar 'bright' side and reappears from behind the 'dark' side. [Find precise timings for many locations at this link.]



Venus, Castor, and Pollux form a triangle in the western sky after sunset on May 21, 2023.

19 May. New Moon, 15:53 UTC

21 May. Brilliant Venus forms a triangle with Castor and Pollux in the northwestern sky after sunset. The planet lies to the west of (below) the two stars. A slender crescent Moon lies closer to the horizon, and over the next two days passes within 5º of Venus.



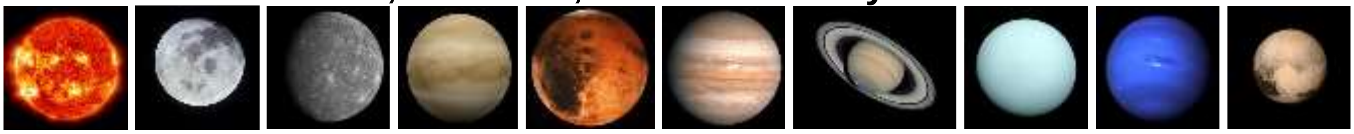
The Moon, Mars, and the Beehive star cluster in western sky during the evening hours of May 24, 2023.

24 May. The crescent Moon, Mars, and the Beehive star cluster M44 form a small triangle about 5º wide in the west after sunset. A pair of binoculars help you take it all in and see the little flock of stars in the famous star cluster.

27 May. First Quarter Moon, 15:22 UTC

31 May. Mars lies on the western edge of the Beehive star cluster (M44) and presents a fantastic sight in binoculars or small telescope. It’s a great photo-op as well.

Our Sun, the Moon, and the Solar System Planets



The Sun is located in Aries on May 1st. It enters Taurus on May 14th.

Brightness, apparent size, illumination, distance from the Earth in astronomical units, and location data for the major planets and Pluto on May 15th: Mercury on May 31st (magnitude +0.4, 7.9", 42% illuminated, 0.85 a.u., Aries), Venus (magnitude -4.2, 19.1", 60% illuminated, 0.87 a.u., Gemini), Mars (magnitude +1.5, 5.0", 92% illuminated, 1.86 a.u., Gemini), Jupiter (magnitude -2.1, 33.7", 100% illuminated, 5.86 a.u., Pisces), Saturn (magnitude +0.8, 16.7", 100% illuminated, 9.97 a.u., Aquarius), Uranus (magnitude +5.9, 3.4", 100% illuminated, 20.66 a.u., Aries), Neptune (magnitude +7.8, 2.2", 100% illuminated, 30.45 a.u., Pisces), and Pluto (magnitude +14.4, 0.1", 100% illuminated, 34.35 a.u., Capricornus).

In the evening, Venus and Mars lie in the west. Mars is located in the west at midnight. Mercury, Jupiter, Uranus, and Neptune can be found in the east and Saturn in the southeast at dawn.

The Moon is 10.7 days old, is illuminated 76.7%, subtends 30.2 arc minutes, and is located in Leo on May 1st at 0:00 UT. It's at its greatest northern declination on May 23rd (+27.8 degrees) and its greatest southern declination on May 9th (-27.8 degrees). Longitudinal libration is at maximum (+4.7 degrees) on May 19th and at minimum (-5.3 degrees) on May 5th. Latitudinal libration is at maximum (+6.7 degrees) on May 11th and at minimum (-6.8 degrees) on May 25th. A deep penumbral lunar eclipse, the 24th of Saros series 141, takes place on May 5th. The eclipse is visible from eastern Europe, most of Africa, the Middle East, Asia, Australia, New Zealand, and Antarctica. Greatest eclipse occurs over the Indian Ocean at 17:22 UT. The Curtiss Cross is visible on May 13th and the Lunar X on May 27th. The Moon is at apogee on May 5th and at perigee on May 17th. New Moon occurs on May 19th. The Hesiodus lunar crater sunrise ray is predicted to begin at 22:00 UT on May 28th. The Moon occults Jupiter on May 17th from certain parts of the world. Browse http://www.lunar-occultations.com/iota/iotandx.htm for information on lunar occultation events.

Visit https://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/ for tips on spotting extreme crescent Moons and https://curtrenz.com/moon.html for Full Moon and other lunar data. Go to https://skyandtelescope.org/wp-content/uploads/MoonMap.pdf and https://celestron-site-support-files.s3.us-east-1.amazonaws.com/support_files/Explore%20the%20Moon%20Map%2024%20x%2033%20RReeves-web.pdf and https://nightsky.jpl.nasa.gov/docs/ObserveMoon.pdf for simple lunar maps.

Click on https://astrostrona.pl/moon-map/ for an excellent online lunar map. Visit http://www.ap-i.net/avl/en/start to download the free Virtual Moon Atlas. Consult http://time.unitarium.com/moon/where.html for current information on the Moon and https://www.fourmilab.ch/earthview/lunarform/lunarform.html for information on various lunar features.

See https://svs.gsfc.nasa.gov/5048 a lunar phase and libration calculator and https://quickmap.lroc.asu.edu/?extent=-90,-25.2362636,90,25.2362636&proj=10&layers=NrBsFYBoAZIRnpEoAsjYIHYFcA2vIBvAXwF1SizSg for the Lunar Reconnaissance Orbiter Camera (LROC) Quickmap. Click on https://www.calendar-12.com/moon_calendar/2023/may for a lunar phase calendar for this month. Times and dates for the lunar crater light rays predicted to occur this month are available at http://www.lunar-occultations.com/rlo/rays/rays.htm

Informative videos discussing astronomical objects worthy of observing each month can be found at https://solarsystem.nasa.gov/skywatching/whats-up/ and https://hubblesite.org/resource-gallery/learning-resources/tonights-sky

Free star maps for this month can be downloaded at http://www.skymaps.com/downloads.html and http://whatsouttonight.com/

An online interactive star chart appears at https://skyandtelescope.org/interactive-sky-chart/

Data on current supernovae can be found at http://www.rochesterastronomy.org/snimages/

Information on observing some of the more prominent Messier galaxies is available at http://www.cloudynights.com/topic/358295-how-to-locate-some-of-the-major-messier-galaxies-and-helpful-advice-for-novice-amateur-astronomers/

Finder charts for the Messier objects and other deep-sky objects are posted at https://freestarcharts.com/messier and https://freestarcharts.com/ngc-ic and https://www.cambridge.org/turnleft/seasonal_skies_april-june

Telrad finder charts for the Messier Catalog and the SAC's 110 Best of the NGC are posted at http://www.custerobservatory.org/docs/messier2.pdf and http://www.star-shine.ch/astro/messiercharts/messierTelrad.htm and https://www.saguaroastro.org/wp-content/sac-docs/Book110BestNGC.pdf

Steve Tonkin's The Binocular Sky Newsletter for May can be seen at https://binocularsky.com/newsletter/BinoSkyNL.pdf

Author Phil Harrington offers an excellent freeware planetarium program for binocular observers known as TUBA (Touring the Universe through Binoculars Atlas) at http://www.philharrington.net/tuba.htm

Stellarium and Cartes du Ciel are useful freeware planetarium programs that are available at http://stellarium.org/ and https://www.ap-i.net/skychart/en/start

Deep-sky object list generators can be found at http://www.virtualcolony.com/sac/ and https://telescopius.com/ and http://tonightssky.com/MainPage.php

Freeware sky atlases can be downloaded at http://www.deepskywatch.com/files/deepsky-atlas/Deep-Sky-Hunter-atlas-full.pdf and https://www.cloudynights.com/articles/cat/articles/observing-skills/free-mag-

For more on the planets and how to locate them, browse http://www.nakedeyeplanets.com/

Summaries on the planets for May can be found at https://skynews.ca/planets-at-a-glance-may-2022/ and https://earthsky.org/astronomy-essentials/visible-planets-tonight-mars-jupiter-venus-saturn-mercury/

The graphic at https://www.timeanddate.com/astronomy/planets/distance displays the apparent and comparative sizes of the planets, along with their magnitudes and distances, for a given date and time.

The rise and set times and locations of the planets can be determined by clicking on https://www.timeanddate.com/astronomy/night/

A wealth of information on solar system celestial bodies is posted at http://www.curtrenz.com/astronomy.html and http://nineplanets.org/

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and https://skyandtelescope.org/observing/sky-at-a-glance/

The first recorded perihelion passage of Comet Halley (1P/Halley) occurred on May 25, 240 BC. Thales of Miletus accurately predicted a solar eclipse on May 28, 585 BC. The German astronomers Gottfried and Maria Magarethe Kirch discovered the bright globular cluster M5 on May 5, 1702. On May 1, 1759, the English amateur astronomers John Bevis and Nicholas Munckley observed Comet Halley on its first predicted return. The French astronomer Charles Messier discovered the globular cluster M3 on May 3, 1764 and the globular cluster M10 on May 29, 1764. The Italian astronomer Annibale de Gasparis discovered asteroid 11 Parthenope on May 11, 1850. Asteroid 14 Irene was discovered on May 19, 1851 by the English astronomer John Russell Hind. The German astronomer Robert Luther discovered asteroid 26 Proserpina on May 6, 1853. The Australian astronomer John Tebbutt discovered the Great Comet of 1861 on May 13. The English astronomer Norman Pogson discovered asteroid 80 Sappho on May 2, 1864. Norman Pogson discovered asteroid 87 Sylvia on May 16, 1866. The 40-inch Clark refractor at the Yerkes Observatory saw first light on May 21, 1897. The Griffith Observatory opened to the public on May 14, 1935. Nereid, Neptune's third-largest satellite, was discovered on May 1, 1949 by the Dutch-American astronomer Gerard Kuiper.

The broad peak of the Eta Aquarid meteor shower is seriously affected by an almost Full Moon this year. Eta Aquarid meteors are debris from the famous periodic comet 1P/Halley. The radiant is located close to the Water Jug asterism in Aquarius near the fourth-magnitude stars Gamma and Zeta Aquarii and rises prior to 3:00 a.m. local time. Southern hemisphere observers are favored. See https://earthsky.org/astronomy-essentials/earthskys-meteor-shower-guide/ and https://www.amsmeteors.org/meteor-showers/meteor-shower-calendar/#eta+Aquariids for additional information on the Eta Aquarids.

Information on passes of the ISS, the Tiangong, the USAF’s X-37B, the HST, BlueWalker 3, Starlink, and other satellites can be found at http://www.heavens-above.com/ / 7-star-charts-r1021 and https://allans-stuff.com/triatlas/

Eighty binary and multiple stars for May: 1 Bootis, Struve 1782, Tau Bootis, Struve 1785, Struve 1812 (Bootes); 2 Canum Venaticorum, Struve 1624, Struve 1632, Struve 1642, Struve 1645, 7 Canum Venaticorum, Alpha Canum Venaticorum (Cor Caroli), h2639, Struve 1723, 17 Canum Venaticorum, Otto Struve 261, Struve 1730, Struve 1555, h1234, 25 Canum Venaticorum, Struve 1769, Struve 1783, h1244 (Canes Venatici); 2 Comae Berenices, Struve 1615, Otto Struve 245, Struve 1633, 12 Comae Berenices, Struve 1639, 24 Comae Berenices, Otto Struve 253, Struve 1678, 30 Comae Berenices, Struve 1684, Struve 1685, 35 Comae Berenices, Burnham 112, h220, Struve 1722, Beta Comae Berenices, Burnham 800, Otto Struve 266, Struve 1748 (Coma Berenices); h4481, h4489, Struve 1604, Delta Corvi, Burnham 28, h1218, Struve 1669 (Corvus); H N 69, h4556 (Hydra); Otto Struve 244, Struve 1600, Struve 1695, Zeta Ursae Majoris (Mizar), Struve 1770, Struve 1795, Struve 1831 (Ursa Major); Struve 1616, Struve 1627, 17 Virginis, Struve 1648, Struve 1658, Struve 1677, Struve 1682, Struve 1689, Struve 1690, 44 Virginis, Struve 1719, Theta Virginis, 54 Virginis, Struve 1738, Struve 1740, Struve 1751, 81 Virginis, Struve 1764, Struve 1775, 84 Virginis, Struve 1788 (Virgo)

Notable carbon star for May: SS Virginis

One hundred and sixty-five deep-sky objects for May: NGC 5248 (Bootes); M3, M51, M63, M94, M106, NGC 4111, NGC 4138, NGC 4143, NGC 4151, NGC 4214, NGC 4217, NGC 4244, NGC 4346, NGC 4369, NGC 4449, NGC 4485, NGC 4490, NGC 4618, NGC 4631, NGC 4656, NGC 4868, NGC 5005, NGC 5033, NGC 5297, NGC 5353, NGC 5354, Up 1 (Canes Venatici); Mel 111, M53, M64, M85, M88, M91, M98, M99, M100, NGC 4064, NGC 4150, NGC 4203, NGC 4212, NGC 4251, NGC 4274, NGC 4278, NGC 4293, NGC 4298, NGC 4302, NGC 4314, NGC 4350, NGC 4414, NGC 4419, NGC 4448, NGC 4450, NGC 4459, NGC 4473, NGC 4474, NGC 4494, NGC 4559, NGC 4565, NGC 4651, NGC 4689, NGC 4710, NGC 4725, NGC 4874, NGC 5053 (Coma Berenices); NGC 4027, NGC 4038-9, NGC 4361 (Corvus); M68, M83, NGC 4105, NGC 4106, NGC 5061, NGC 5101, NGC 5135 (Hydra); M40, NGC 4036, NGC 4041, NGC 4051, NGC 4062, NGC 4085, NGC 4088, NGC 4096, NGC 4100, NGC 4144, NGC 4157, NGC 4605, NGC 5308, NGC 5322 (Ursa Major); M49, M58, M59, M60, M61, M84, M86, M87, M89, M90, M104, NGC 4030, NGC 4073, NGC 4168, NGC 4179, NGC 4206, NGC 4215, NGC 4216, NGC 4224, NGC 4235, NGC 4260, NGC 4261, NGC 4267, NGC 4281, NGC 4339, NGC 4343, NGC 4365, NGC 4371, NGC 4378, NGC 4380, NGC 4387, NGC 4388, NGC 4402, NGC 4429, NGC 4435, NGC 4438, NGC 4517, NGC 4526, NGC 4535, NGC 4536, NGC 4546, NGC 4550, NGC 4551, NGC 4567, NGC 4568, NGC 4570, NGC 4593, NGC 4596, NGC 4636, NGC 4638, NGC 4639, NGC 4643, NGC 4654, NGC 4666, NGC 4697, NGC 4698, NGC 4699, NGC 4753, NGC 4754, NGC 4760, NGC 4762, NGC 4866, NGC 4900, NGC 4958, NGC 5044, NGC 5054, NGC 5068, NGC 5077, NGC 5084, NGC 5087, NGC 5147, NGC 5170, NGC 5247, NGC 5363, NGC 5364 (Virgo)

Top ten deep-sky objects for May: M3, M51, M63, M64, M83, M87, M104, M106, NGC 4449, NGC 4565

Top ten deep-sky binocular objects for May: M3, M51, M63, M64, M84, M86, M87, M104, M106, Mel 111

Challenge deep-sky object for May: 3C 273 (Virgo)

The objects listed above are located between 12:00 and 14:00 hours of right ascension.

They Came from Outer Space: Cosmic Rays and Their Extraterrestrial Origin

Note: This article was written by Dr. Paul Verhage

The world is radioactive; you're constantly bombarded by radiation. About half of it originates from naturally occurring radioactive elements in Earth's crust, like uranium and thorium. There's also a small amount emitted by radon in the air we breathe. But one source of radiation is literally out of this world. And in 1912 the Austrian physicist Viktor Hess proved it.

In 1912, physicists used electroscopes to measure radiation (the Geiger counter had been invented only four years earlier). As you probably recall, an electroscope consists of thin metal foil leaves draped over a metal hook inside a glass jar. When a charged body, like a plastic comb, approaches the electroscope's terminal, a charge is induced on the foil leaves causing them to repel each other. Theoretically, the leaves should repel each other indefinitely. But even in clean dry air the leaves slowly discharge and fall together. Physicists noticed that more intense radiation sources cause the leaves to discharge faster. By measuring the amount of time it takes for the leaves to fall together again, they measured the amount of radiation in the local environment. Hess carried improved versions of the electroscope, called the ionization chamber, on open gondola balloon flights. Some of his flights reached altitudes above 17,000 feet, which for 1912, was quite an impressive feat. Impressive because at 17,000 feet, the air pressure and therefore the amount of oxygen in each breath is about half that at sea level. That's low enough for some people to develop altitude sickness. Adding to the discomfort is the fact that the air temperature is below freezing at this altitude.

For the first 6,000 feet of the ascent, the ionization chambers detected a continuously decreasing amount of ionization in the atmosphere. As expected, radiation from the ground became weaker the higher the balloon ascended. But above 6,000 feet the air became increasingly more ionized. Hess therefore concluded that the upper atmosphere was ionized by a cosmic source of radiation. Hess named this radiation cosmic rays and in 1936, won a Nobel Prize for this research. Today we still refer to it as cosmic rays (radiation); even though it's a bit of a misnomer.

The Stuff of Cosmic Rays

Eighty-six percent of cosmic rays are high energy protons (the nucleus of the hydrogen atom), which is not surprising since hydrogen is the most abundant element in the universe. Of the remaining cosmic rays, 12% are alpha particles (a helium nucleus), 1% are electrons, and 1% are atomic nuclei heavier than helium. Since cosmic rays are mostly subatomic particles and not electromagnetic radiation, it's incorrect to call them rays or radiation. However, because of their history (they were originally believed to be high energy electromagnetic radiation), we still refer to them as rays.

When a cosmic ray enters the atmosphere, it collides with nitrogen and oxygen molecules high in the atmosphere. A collision between a cosmic ray and molecule produces a secondary shower of cosmic rays. The subatomic particles found in the secondary showers include pions and kaons. These unstable subatomic particles eventually decay into subatomic particles like muons, positrons, neutrinos, electrons, and gamma rays. Like many things in life, once is not enough. So secondary cosmic rays collide with nitrogen and oxygen molecules even lower in the atmosphere to produce additional secondary showers. Over time and distance, most of the lower-energy secondary cosmic rays are absorbed into the atmosphere.

One of the most interesting subatomic particles found in cosmic ray showers is the muon. Muons, a heavy form of the electron, have a half-life of 2.2 microseconds. So, traveling at nearly light speed, muons should only cover 2,000 feet before half of them decay. After ten half-lives, or 22 microseconds, less than 1% of the original muons will remain. Therefore, muons should be undetectable on the ground after traveling ten miles from their origin. But at sea level there are plenty of muons in cosmic ray showers. Why is this? As mentioned above, muons travel near the speed of light. The relativistic effect of time dilation slows their internal clock (from our perspective) and allows them to live long enough to reach sea level.

At sea level some secondary showers contain over one million subatomic particles spread over an area 1,000 feet in diameter. The combined energy of these secondary cosmic rays implies that the primary cosmic ray that created them had an energy greater than one million million (one trillion) electron volts. For comparison, photons of visible light have an energy between one and two electron volts. The highest energy cosmic ray detected by the University of Utah had an energy greater than 100 million-million-million (or 100 quintillion) electron volts. That's equal to the energy of a baseball thrown at one hundred miles per hour! If that cosmic ray had been captured in a thimbleful of water, the water would have boiled instantly.

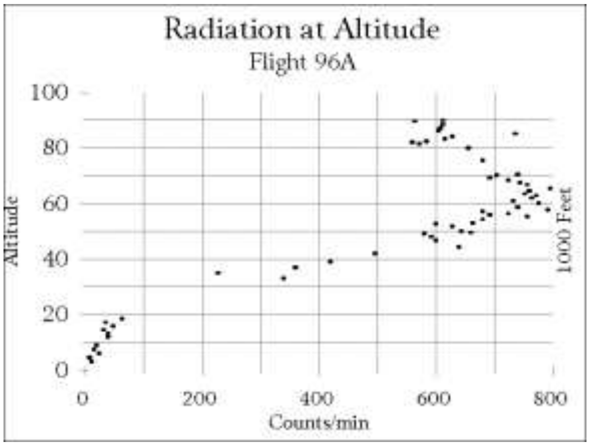
The Origin of Cosmic Rays
There appear to be four sources of cosmic rays. The first source is the sun. Cosmic rays from the sun tend to have the lowest energy and fluctuate in number with solar activity. Events like flares and coronal mass ejections temporarily increase their numbers near Earth. Because of their low energy, they're strongly affected by earth's magnetic field. When conditions are right, they can renter the atmosphere near the poles to create auroras.

The second source creates anomalous cosmic rays. They begin life as neutral atoms and therefore, shouldn't be accelerated to high speeds to become cosmic rays. An October 2002 report by the American Geophysical Union and Southwest Research Institute found that the source of the neutral atoms is dust which comes from collisions between Kuiper Belt Objects in the outer solar system. Sunlight sputters neutral atoms free of the dust and ionizes them. The new ions pick up energy by crossing the heliopause or boundary between our solar system and interstellar space. Physicists believe shock bows like that found at the heliopause can accelerate charged subatomic particles to high energies.

The third source is from supernova explosions. Here ions are accelerated to high energy by passing through the supernova's shock bow (possibly more than once). The galaxy's magnetic field is strong enough to prevent these cosmic rays from escaping the galaxy. So, they wander the galaxy until they smash into something like our atmosphere. Because they're trapped within their galaxy of origin, they're called galactic cosmic rays.

The last source creates the ultra-high energy (UHE) cosmic ray. They have too much energy for the galaxy's magnetic field to trap them. Therefore, they most likely originate in other galaxies and leak into intergalactic space. But this creates a problem. The universe is filled with microwave photons from the Big Bang's cosmic microwave background radiation (CMBR). Collisions between UHE cosmic rays and CMBR photons will reduce the energy of UHE cosmic rays until they're no longer ultra-high. The maximum distance a UHE cosmic ray can travel before losing its UHE status is on the order of 100 to 150 million light years. This limit on their distance of origin is called the Greisen-Zatsepin-Kuzim (GZK) cutoff and its exact distance depends on the energy of the UHE cosmic ray. Therefore, we know UHE cosmic rays must originate in high energy events within our local cluster of galaxies. But what could this event be? No one knows for sure, but perhaps it's a massive black hole in the core of a neighboring galaxy.

My Experience with Cosmic Rays
My first cosmic ray experiment occurred on November 2, 1996. I had launched my near spacecraft, Isaac Asimov, with a Geiger counter. An analysis of its telemetry generated the following chart of cosmic ray flux as a function of altitude.



I expected the flux to increase with altitude as it did, but I wasn't expecting to see their flux drop above 62,000 feet. This led to a visit to the Physics department at Kansas State University with my chart in hand.

Remember that a cosmic ray begins as a single subatomic particle smashing into the atmosphere. A collision between the cosmic ray and a molecule creates a shower of secondary cosmic rays. Those secondary cosmic rays produce additional secondary cosmic rays that eventually lose energy as they approach sea level. As the Isaac Asimov climbed higher, its Geiger counter detected more secondary cosmic rays before they were absorbed by the atmosphere. At an altitude of 62,000 feet, the Geiger counter detected fewer secondary cosmic rays because they hadn't been created yet. Therefore, the Geiger counter was beginning to detect primary cosmic rays. My Geiger counter couldn't measure their individual energies, but if it could, it would have found the average energy of each cosmic ray was increasing.
My Geiger counter could detect single cosmic rays. Therefore above 62,000 feet it was counting individual atoms from another star and possibly from another galaxy millions of light years away. That's an idea that I find to be pretty awesome.

NASA Night Sky Notes

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!

Solar Eclipses Are Coming!

David Prosper

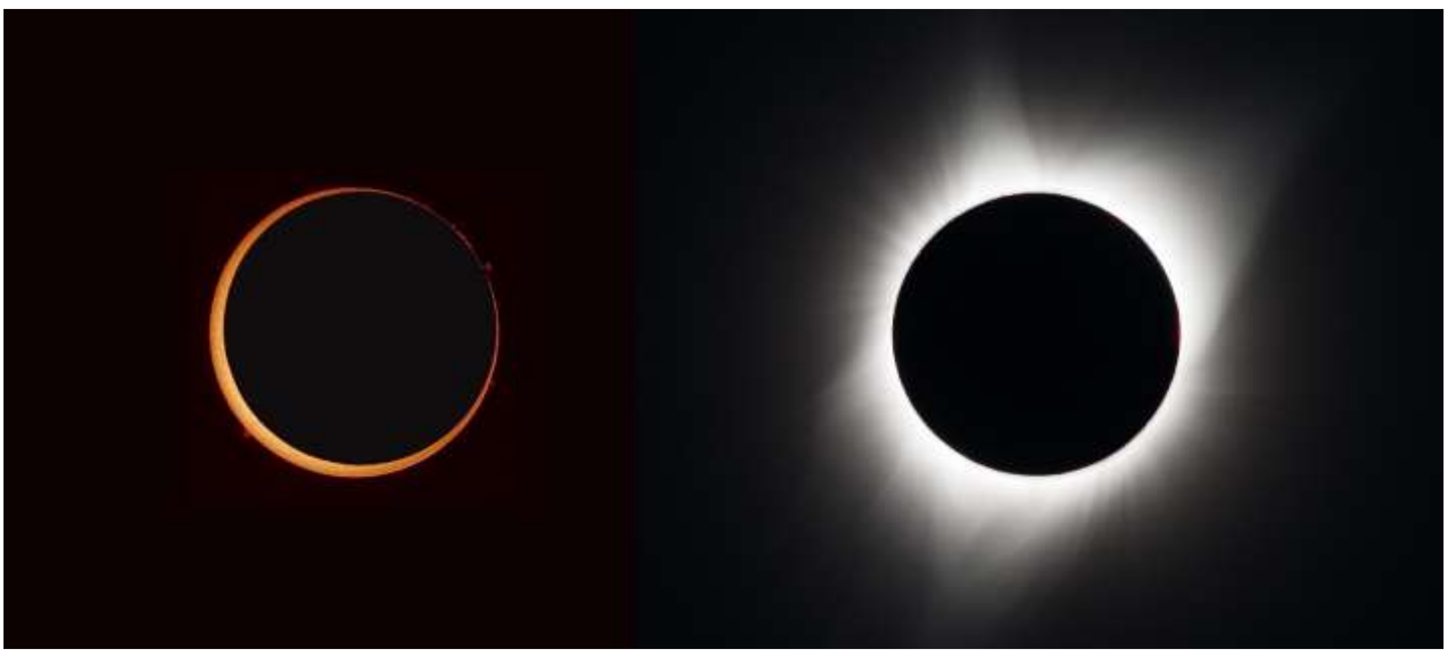
Have you ever witnessed a total solar eclipse? What about an annular solar eclipse? If not, then you are in luck if you live in North America: the next twelve months will see two solar eclipses darken the skies for observers in the continental United States, Mexico, and Canada!

Solar eclipse fans get a chance to witness an **annular eclipse** this fall. On **Saturday, October 14, 2023**, the Moon will move exactly in front of the Sun from the point of view of observers along a narrow strip of land stretching across the United States from Oregon to Texas and continuing on to Central and South America. Since the Moon will be at its furthest point in its orbit from Earth at that time (known as *apogee*), it won't completely block the Sun; instead, a dramatic "ring" effect will be seen as the bright edge of the Sun will be visible around the black silhouette of the Moon. The distinct appearance of this style of eclipse is why it's called an annular eclipse, as *annular* means *ring-like*. If you are standing under a tree or behind a screen you will see thousands of ring-like shadows projected everywhere during maximum eclipse, and the light may take on a wan note, but it won't actually get dark outside; it will be similar to the brightness of a cloudy day. This eclipse must only be observed with properly certified eclipse glasses, or other safe observation methods like pinhole projection or shielded solar telescopes. Even during the peak of the eclipse, the tiny bit of the Sun seen via the "ring" can damage your retinas and even blind you.

Just six months later, a dramatic **total solar eclipse** will darken the skies from Mexico to northeast Canada, casting its shadow across the USA in a strip approximately 124 miles (200 km) wide, on **Monday, April 8, 2024**. While protection must be worn to safely observe most of this eclipse, it's not needed to witness totality itself, the brief amount of time when the Moon blocks the entire surface of the Sun from view. And if you try to view totality through your eclipse viewer, you won't actually be able to see anything! The Moon's shadow will dramatically darken the skies into something resembling early evening, confusing animals and delighting human observers. You will even be able to see bright stars and planets - provided you are able to take your eyes off the majesty of the total eclipse! While the darkness and accompanying chilly breeze will be a thrill, the most spectacular observation of all will be the Sun's magnificent *corona!* Totality is the only time you can observe the corona, which is actually the beautiful outer fringes of the Sun's atmosphere. For observers in the middle of the path, they will get to experience the deepest portion of the eclipse, which will last over four minutes - twice as long as 2017's total solar eclipse over North America.

While some folks may be lucky enough to witness both eclipses in full – especially the residents of San Antonio, Texas, whose city lies at the crossroads of both paths – everyone off the paths of maximum eclipse can still catch sight of beautiful partial eclipses if the skies are clear. The Eclipse Ambassadors program is recruiting volunteers across the USA to prepare communities off the central paths in advance of this amazing cosmic ballet. Find more information and apply to share the excitement at eclipseambassadors.org. NASA has published a fantastic Solar Eclipse Safety Guide which can help you plan your viewing at bit.ly/nasaeclipsesafety. And you can find a large collection of solar eclipse resources, activities, visualizations, photos, and more from NASA at solarsystem.nasa.gov/eclipses

This detailed solar eclipse map shows the paths of where and when the Moon's shadow will cross the USA for the upcoming 2023 annular solar eclipse and 2024 total solar eclipse, made using data compiled from multiple NASA missions. Where will you be? This map is very detailed, so if you would like to download a larger copy of the image, you can do so and find out more about its features at: https://svs.gsfc.nasa.gov/5073 Credits: NASA/Scientific Visualization Studio/Michala Garrison; eclipse calculations by Ernie Wright, NASA Goddard Space Flight Center.



Photos of an annular total solar eclipse (left) and a total solar eclipse (right). Note that the annular eclipse is shown with a dark background, as it is only safe to view with protection – you can see how a small portion of the Sun is still visible as the ring around the Moon. On the right, you can see the Sun's wispy corona, visible only during totality itself, when the Moon completely – or totally - hides the Sun from view. A total solar eclipse is only safe to view without protection during totality itself; it is absolutely necessary to protect your eyes throughout the rest of the eclipse! Credits: Left, Annular Eclipse: Stefan Seip (Oct 3, 2005). Right, Total Eclipse, NASA/Aubrey Gemignani (August 21, 2017)

Phil Harrington's Cosmic Challenge

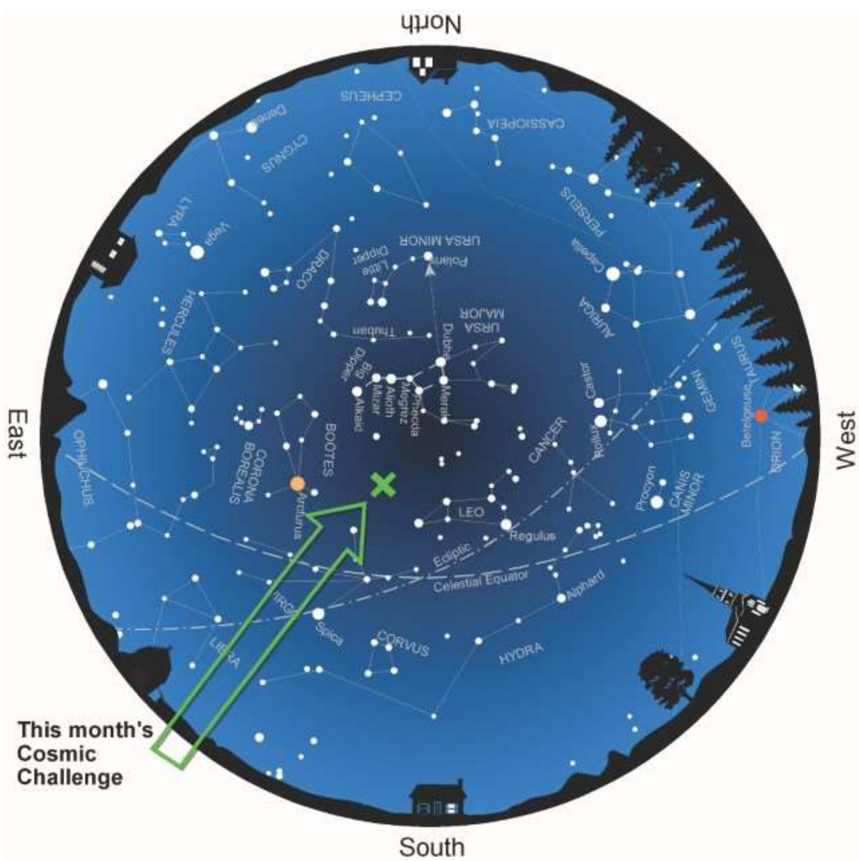
Abell Galaxy Cluster (AGC) 1656

This month's suggested aperture range: 15-inch (38cm) and larger This month’s featured telescope: JMI NGT-18 18" f/4.5 Newtonian	

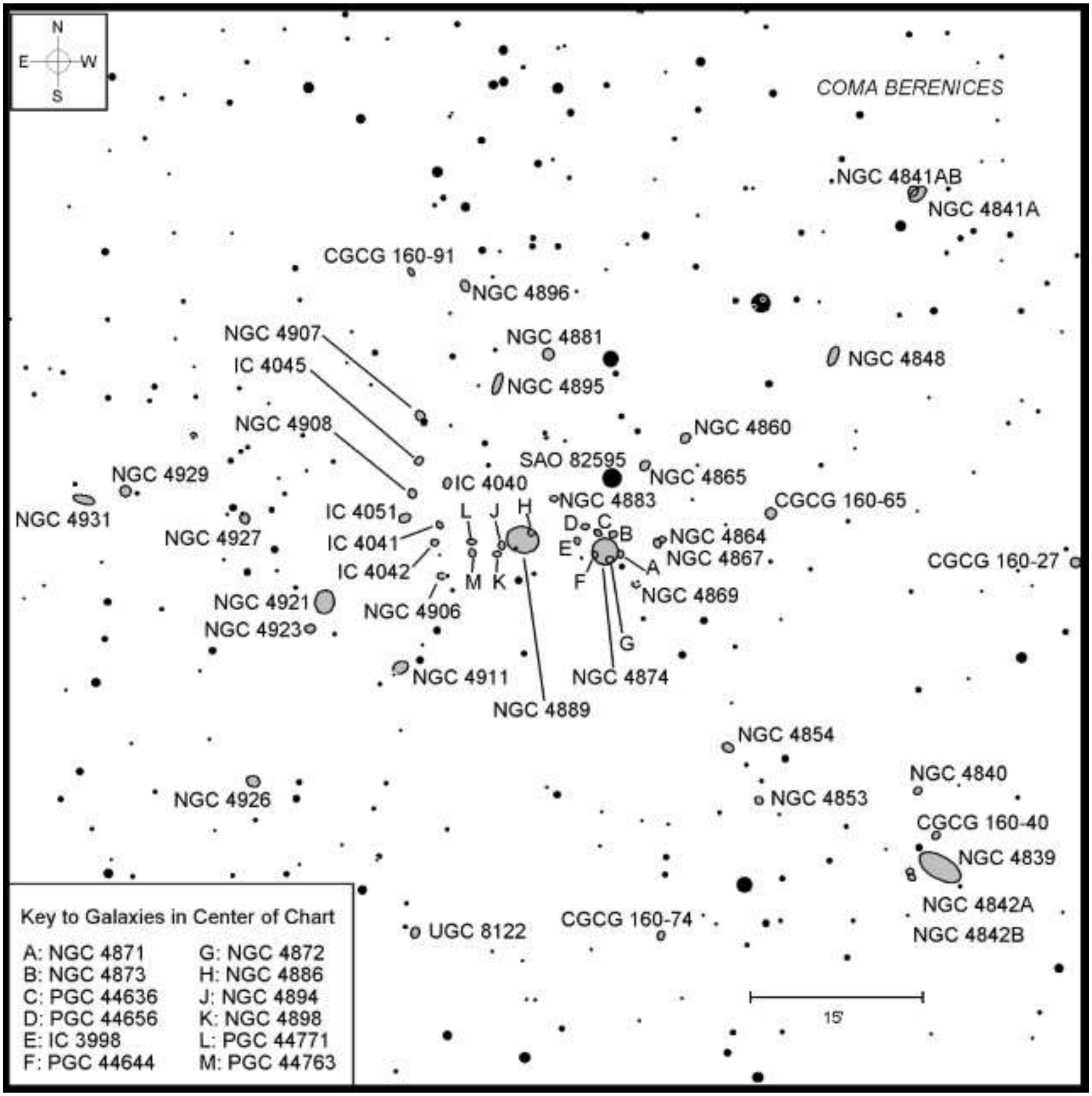
Target	Type	RA	DEC	Const.	Mag.	Span
AGC 1656	Galaxy cluster	12h 59.8m	+27° 58'	Coma Berenices	--	224'

The Coma Galaxy Cluster, **Abell Galaxy Cluster (AGC) 1656**, contains more than 800 galaxies brighter than photographic magnitude 16.5. It’s a real galactic forest that will take great patience to make your way through. There is no rushing this one. Unless you have enough time to devote to the task, best to push on to another target and come back here when you do. In fact, you will never get through this huge collection of galaxies in one sitting. Or even two, three, or four sessions, for that matter. AGC 1656 could well take *years* before every galaxy in view is recorded and identified.

Where, oh where, to begin? Making our way through the cluster may take time, but finding it does not. The geometric center of AGC 1656 lies 2¾° west of Beta (β) Comae, the star at the right angle of the constellation's triangular outline. The cluster covers the 3¾° gap between 31 Comae at its western edge and 41 Comae just inside its eastern border, and is centered very near 7th-magnitude SAO 82595.



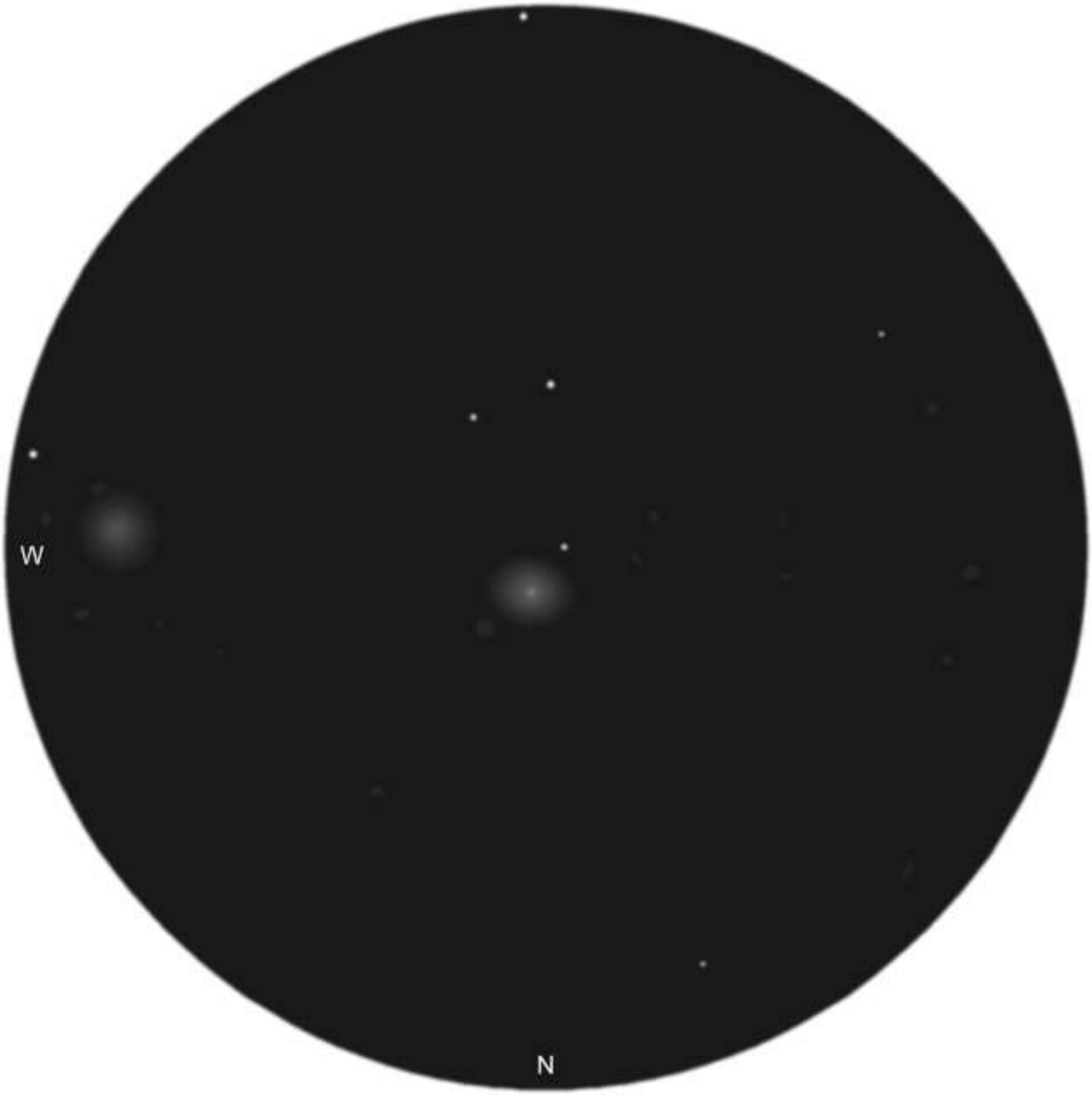
Summer star map showing the location of this month's <u>Cosmic Challenge</u>
***Credit:** Map adapted from **Star Watch** by Phil Harrington*



Above: Finder chart for this month's Cosmic Challenge.
Credit: *Chart adapted from* ***Cosmic Challenge*** *by Phil Harrington.*
Click on the chart to open a printable PDF version in a new window.

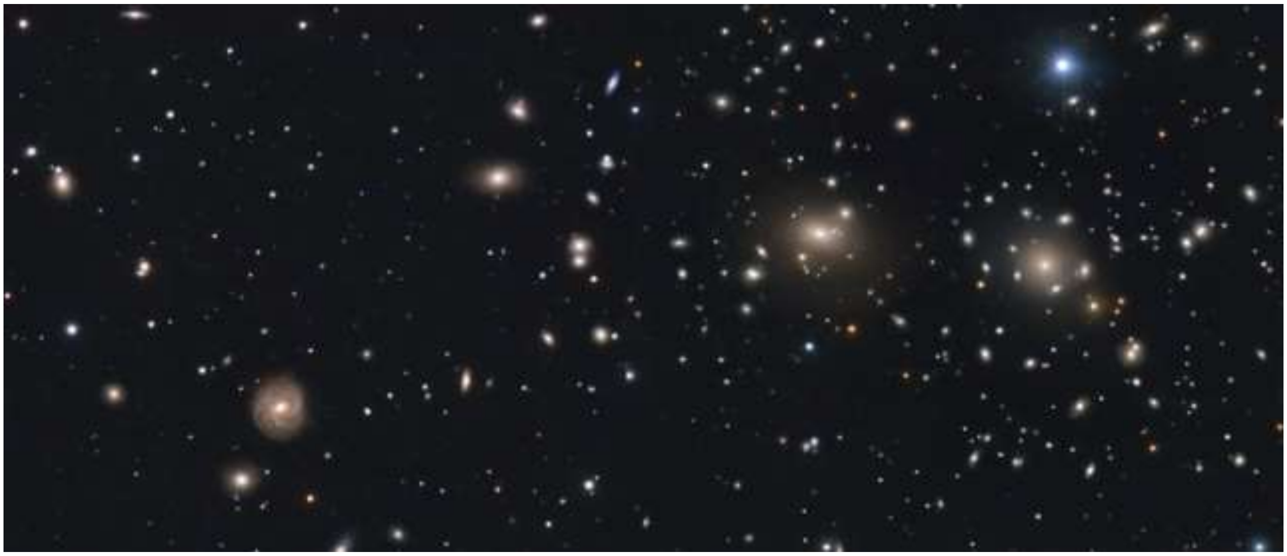
The table at the end of this article lists 74 of the cluster's galaxies that are brighter than 15th magnitude. That's your assignment, to see as many as you can. There simply is not enough room to describe them all here, but here are a few highlights to kick off your project.

We will begin with **NGC 4874** and **NGC 4889** at the heart of the cluster, both depicted in the digitized sketch below. Both are bright enough to be within the range of 8-inch instruments, although glare from SAO 82595 may hamper their visibility. NGC 4889, the more obvious of the two, is a giant elliptical galaxy in the spirit of the monster galaxy M87 in the Virgo cluster. But while M87 is some 60 million light years away, NGC 4889 is projected to be 308 million light years distant. Taking that into account, NGC 4889 is actually the more luminous of the two. As with M87, astronomers have detected strong emissions emanating from the core, the signature of a supermassive black hole. Through the largest backyard telescopes, NGC 4889 displays a fairly bright, oval disk elongated east-to-west and surrounding a brighter core.



Above: NGC 4874 (left) and NGC 4889 in this rendering through the author's 18-inch (46cm) reflector.

Below: A mosaic of two frame of the Coma cluster. NGC 4874 and NGC 4889 are shown to the right, while NGC 4921 is toward the lower left. Image by Derek Santiago (CN member schmeah). Click on the image for a larger version.



Although it is a little smaller and fainter than its neighbor, elliptical galaxy NGC 4874 is no slouch. You'll find it just 7' west of NGC 4889 and 6' due south of SAO 82595. Again, we find a strong radio source buried deep within the core of the galaxy. Visually, NGC 4874 strikes me as more than 0.1 magnitudes fainter than NGC 4889, despite the listing. Look for a round glow that draws to a brighter central core.

The best view of both galaxies comes at 200x or more, since the resulting narrow field helps to move that distracting star out of view. Once the glare is gone, suddenly, a swarm of smaller, fainter companions begin to dot the field. With averted vision, I can count no fewer than 9 island universes. **NGC 4886** is superimposed over the northwestern edge of NGC 4889; **NGC 4883** about 4' to the northwest of its core; **NGC 4894** just 2' east-southeast of the core, and **NGC 4898** a little further to the southeast still. On dark nights, **PGC 44763** and **PGC 44771** pose even greater challenges. Look for the PGC pair 5' east of NGC 4889. Beyond them, lie **IC 4042**, **IC 4041**, and **IC 4040**, along with **NGC 4906**.

That covers the eastern half of that single eyepiece field; NGC 4874 and its brood still lie in the western half. Two galaxies drift nearby. Can you spot **NGC 4872**, which appears superimposed on, or perhaps immersed in, the larger galaxy's southwestern edge? **NGC 4871** is also close at hand, just 1' west of the galaxy's core. Finally, watching these two smaller companions is **NGC 4873**. Look for it just 1.5' to the northwest. All three shine between 13th and 15th magnitude and are smaller than 1 arc-minute across.

You might be able to spot a lone island universe floating a third of the way from NGC 4874 back toward NGC 4889. That's **IC 3998**. This extremely faint, round system forms a close pair with **PGC 44652** just 1' to its south-southeast. Several other members of the PGC listing also hover near NGC 4874, including **PGC 44636** and **PGC 44656** to its north. None of these marginal objects has a surface brightness greater than perhaps half a magnitude above background, so you may need to boost magnification even further to maximize image contrast.

Expanding the view some, look for the interacting pair of **NGC 4864** and **NGC 4867** about 5' west of NGC 4874. At 200x, I can only make out a very dim, distended blur, but increasing to 300x helps resolve the individual cores, which are separated by only 35".

From NGC 4889, scan slowly toward the southwest to find **NGCs 4853** and **4854**, a pair of tiny 13th-magnitude spirals separated from one another by 5' and lying just to the north of an 8.5-magnitude field star. Slide 17' due west of that star to find the elliptical galaxy **NGC 4839** and another horde of fainter companions. NGC 4839 shines at about 12th magnitude and is the brightest galaxy in this quadrant of the cluster. Through my 18-inch (46cm) reflector at 206x with averted vision, it appears as a soft, oval glow tilted southwest-northeast around a brighter core. Photographs expose a small companion superimposed just to the southwest of the core, but I have never been able to resolve it individually. Averted vision may, however, reveal several smaller, fainter galactic smudges in the same field, including the double system **NGC 4842A/4842B** just 2½' to the southeast. **NGC 4840** is also in the picture, 7' north-northeast of NGC 4839.

Selected Members of AGC 1656 Brighter than Magnitude 15 (Highlighted entries are discussed above)

Galaxy	RA	Dec	Magnitude*	Size (')
NGC 4715	12 49.9	+27 49.3	12.7	1.4'x1.2'
NGC 4728	12 50.5	+27 26.2	13.1	0.8'x0.7'
NGC 4738	12 51.1	+28 47.3	12.5	2.3'x0.4'
UGC 8017	12 52.9	+28 22.3	12.1	1.0'x0.4'
CGCG 159-104	12 53.3	+27 05.7	13.0	0.8'x0.6'
UGC 8025	12 54.0	+29 36.1	11.9	2.1'x0.4'
NGC 4789A	12 54.1	+27 08.9	13.3	3.0'x2.1'
NGC 4789	12 54.3	+27 04.1	11.7	1.9'x1.5'
NGC 4793	12 54.7	+28 56.3	10.6	2.9'x1.4'
NGC 4798	12 54.9	+27 24.7	12.2	1.4'x1.0'
NGC 4807	12 55.5	+27 31.3	12.6	1.0'x0.8'
IC 3900	12 55.7	+27 15.0	13.0	0.8'x0.5'
NGC 4816	12 56.2	+27 44.7	12.3	1.2'x1.0'
CGCG 160-27	12 56.5	+27 56.4	13.6	0.8'x0.8'
NGC 4819	12 56.5	+26 59.2	12.1	1.8'x1.4'
NGC 4827	12 56.7	+27 10.7	12.3	1.4'x1.2'
NGC 4839	**12 57.4**	**+27 29.9**	**11.8**	**4.0'x1.9'**
CGCG 160-40	12 57.4	+27 32.7	13.6	0.5'x0.3'
NGC 4841A	12 57.5	+28 28.6	11.8	1.6'x1.0'
NGC 4840	**12 57.5**	**+27 36.6**	**12.8**	**0.7'x0.6'**
NGC 4841B	12 57.5	+28 28.9	11.7	1.0'x0.7'
NGC 4842A	**12 57.6**	**+27 29.5**	**13.1**	**0.5'**
NGC 4842B	**12 57.6**	**+27 29.1**	**14.9**	**0.4'x0.2'**
UGC 8076	12 57.8	+29 39.3	13.8	1.0'x0.6'
UGC 8080	12 58.0	+26 51.6	12.9	1.0'x0.6'
NGC 4848	12 58.1	+28 14.5	12.4	1.9'x0.6'
NGC 4849	12 58.2	+26 23.8	12.2	1.8'x1.3'
CGCG 160-62	12 58.3	+29 07.7	13.5	0.8'x0.6'
CGCG 160-65	12 58.5	+28 00.8	13.1	1.0'
NGC 4853	**12 58.6**	**+27 35.8**	**12.8**	**0.7'x0.6'**
NGC 4854	**12 58.8**	**+27 40.5**	**12.8**	**1.0'x0.6'**
NGC 4859	12 59.0	+26 48.9	12.7	1.6'x0.7'
NGC 4860	12 59.1	+28 07.4	12.7	1.0'x0.7'
NGC 4864	**12 59.2**	**+27 58.6**	**12.2**	**0.7'x0.7'**
CGCG 160-74	12 59.2	+27 24.1	13.7	0.6'x0.4'
NGC 4867	**12 59.3**	**+27 58.2**	**12.9**	**0.6'x0.5'**
NGC 4865	12 59.3	+28 05.1	12.1	0.9'x0.5'
NGC 4869	12 59.4	+27 54.7	12.2	0.7'x0.7'
NGC 4871	**12 59.5**	**+27 57.3**	**12.8**	**0.7'x0.5'**
NGC 4873	**12 59.5**	**+27 59.0**	**12.9**	**0.7'x0.5'**
NGC 4872	**12 59.6**	**+27 56.8**	**13.6**	**0.6'x0.4'**
NGC 4874	**12 59.6**	**+27 57.6**	**11.2**	**2.3'x2.3'**
PGC 44636	**12 59.6**	**+27 59.2**	**14.8**	**0.4'x0.3'**
PGC 44644	12 59.7	+27 57.2	14.5	0.4'x0.2'
PGC 44656	**12 59.7**	**+27 59.7**	**14.3**	**0.4'**

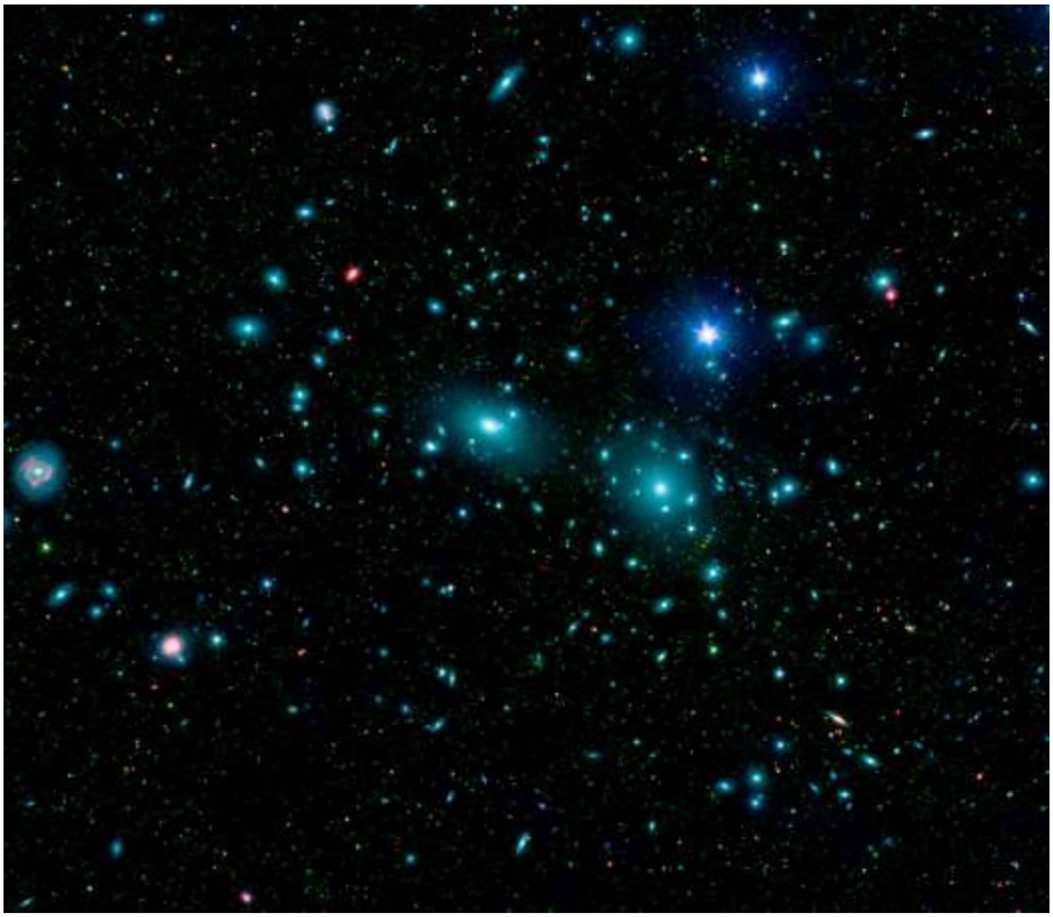
IC 3998	**12 59.8**	**+27 58.4**	**13.8**	**0.6'x0.4**
NGC 4883	**12 59.9**	**+28 02.1**	**13.0**	**0.6'x0.4'**
NGC 4881	13 00.0	+28 14.8	12.7	1.0'x1.0'
NGC 4892	13 00.5	+26 53.8	12.1	1.7'x0.5'
NGC 4886	**13 00.5**	**+27 59.3**	**12.8**	**0.6'x0.6'**
NGC 4889	**13 00.1**	**+27 58.6**	**11.1**	**2.8'x2.2'**
NGC 4894	**13 00.3**	**+27 58.0**	**13.6**	**0.6'x0.3'**
NGC 4895	13 00.3	+28 12.1	12.3	2.0'x0.7'
NGC 4898	**13 00.3**	**+27 57.3**	**13.2**	**0.5'x0.5'**
PGC 44763	**13 00.5**	**+27 57.3**	**13.9**	**0.5'x0.3'**
PGC 44771	**13 00.5**	**+27 58.3**	**14.2**	**0.6'x0.3'**
NGC 4896	13 00.5	+28 20.8	12.9	1.0'x0.6'
IC 4040	**13 00.6**	**+28 03.6**	**13.5**	**1.0'x0.3'**
IC 842	13 00.7	+29 01.2	12.5	1.4'x0.6'
NGC 4906	**13 00.7**	**+27 55.6**	**12.8**	**0.5'**
IC 4041	**13 00.7**	**+27 59.8**	**13.8**	**0.5x0.3'**
IC 4042	**13 00.7**	**+27 58.3**	**12.7**	**0.7'x0.5'**
IC 4045	13 00.8	+28 05.4	12.7	0.7'x0.4'
NGC 4907	13 00.8	+28 09.5	10.7	0.9'x0.7'
UGC 8122	13 00.8	+27 24.3	13.4	1.0'x0.5'
NGC 4908	13 00.9	+28 02.6	12.5	0.8'x0.6'
CGCG 160-91	13 00.9	+28 21.9	13.1	0.7'x0.5'
IC 4051	13 00.9	+28 00.5	12.5	1.0'x0.8'
NGC 4911	13 00.9	+27 47.4	11.8	1.4'x1.0'
NGC 4922	13 01.4	+29 18.5	12.6	1.5'x1.2'
NGC 4921	13 01.4	+27 53.2	11.2	2.0'x1.7'
NGC 4923	13 01.5	+27 50.8	12.9	0.9'x0.6'
IC 843	13 01.6	+29 07.8	12.6	1.3'x0.5'
IC 4088	13 01.7	+29 02.6	12.2	1.8'x0.5'
NGC 4926	13 01.9	+27 37.5	12.2	1.2'x1.0'
NGC 4927	13 01.9	+28 00.3	12.6	0.9'x0.7'
NGC 4929	13 02.7	+28 02.7	13.1	1.0'x1.0'
NGC 4931	13 03.0	+28 01.9	12.4	2.0'x0.6'
NGC 4944	13 03.8	+28 11.1	12.1	1.8'x0.6'
NGC 4952	13 05.0	+29 07.4	12.1	1.8'x1.2'
NGC 4957	13 05.2	+27 34.2	12.3	1.4'x1.2'
NGC 4961	13 05.8	+27 44.0	12.1	1.7'x1.1'
CGCG 160-136	13 06.0	+29 16.7	13.3	0.6'x0.6'
NGC 4966	13 06.3	+29 03.7	11.9	1.2'x0.8'
UGC 8195	13 06.4	+29 39.5	13.9	1.6'x0.2'
MCG +5-31-132	13 06.6	+27 52.4	14.2	0.8'x0.4'
NGC 4971	13 06.9	+28 32.8	13.0	0.8'x0.8'
NGC 4983	13 08.5	+28 19.2	11.0	1.1'x0.7'
UGC 8229	13 08.9	+28 11.1	12.3	1.4'x0.9'
· * Note: As listed in the NASA/IPAC Extragalactic Database				

This brief summary is not even the tip of the galactic iceberg that awaits the largest backyard telescopes here. Hundreds of faint fuzzies can be found within the 4° span of AGC 1656. But to hunt them down, you will need several detailed charts that show the area at a sufficiently large enough scale and plot field stars faint enough to wade your way through this intergalactic maze. Use the chart here to identify as many as you can, but as mentioned previously, to go deep into a galactic ocean like AGC 1656, you need customized charts for your specific telescope and eyepieces.

For more information and observing tips on observing AGC 1656 and other Abell Galaxy Clusters, visit Alvin Huey's website, faintfuzzies.com. There, you will find information about his online book Observing Selected Small Galaxy Groups as well as other volumes in his deep-sky observing guide series.

Have a favorite challenge object of your own? I'd love to hear about it, as well as how you did with this month's test. Contact me through my website or post to this month's discussion forum.

Until next month, remember that half of the fun is the thrill of the chase. Game on!



NASA / JPL-Caltech / L. Jenkins (GSFC)
http://www.spitzer.caltech.edu/images/1803-ssc2007-10a1-Dwarf-Galaxies-in-the-Coma-Cluster

About the Author: Phil Harrington writes the monthly *Binocular Universe* column in Astronomy magazine and is the author of 9 books on astronomy, including Cosmic Challenge: The Ultimate Observing List for Amateurs.

Visit www.philharrington.net to learn more.

Magic Valley Astronomical Society

550 Sparks St.
Twin Falls, ID

The Magic Valley Astronomical Society (MVAS) was founded in 1976. The Society is a non-profit [501(c) 3] educational and scientific organization dedicated to bringing together people with an interest in astronomy.

In partnership with the Centennial Observatory, Herrett Center, College of Southern Idaho - Twin Falls; we hold regularly scheduled monthly meetings and observation sessions, at which we share information on current astronomical events, tools and techniques for observation, astrophotography, astronomical computer software, and other topics concerning general astronomy. Members enthusiastically share their telescopes and knowledge of the night sky with all who are interested. In addition to our monthly public star parties we hold members only star parties at various locations throughout the Magic Valley.

MVAS promotes the education of astronomy and the exploration of the night sky along with safe solar observing through our public outreach programs. We provide two types of outreach; public star parties and events open to anyone interested in astronomy, and outreach programs for individual groups and organizations (e.g. schools, churches, scout troops, company events, etc.), setting up at your location. All of our outreach programs are provided by MVAS volunteers at no cost. However, MVAS will gladly accept donations. Donations enable us to continue and improve our public outreach programs.

Membership is not just about personal benefits. Your membership dues support the work that the Magic Valley Astronomical Society does in the community to promote the enjoyment and science of astronomy.
Speakers, public star parties, classes and support for astronomy in schoolrooms, and outreach programs just to name a few of the programs that your membership dues support.

Annual Membership dues will be:
$20.00 for individuals, families, and $10.00 for students.
Contact Treasurer Jim Tubbs for dues information via e-mail: jtubbs015@msn.com

Donations to our club are always welcome and are even tax deductible. Please contact a board member for details.

Lending Telescopes: The society currently has three telescopes for loan and would gladly accept others please contact President Robert Mayer, for more information on these and other benefits.

Telescopes are an individual thing and not practical for public use. However, everyone should have the experience of a good look at the moon for at least 5 minutes in their life time. It is a dimension and feeling that is unexplainable. Pictures or TV can't give this feeling, awareness, or experience of true dimension. A person will not forget seeing our closest neighbor, the moon.

Norman Herrett in a letter to Dr. J. L. Taylor, president of the College