Snake River Skies

The Newsletter of the Magic Valley Astronomical Society

www.mvastro.org

Membership Meeting

Saturday, December 14th 2019
7:00pm at the
Herrett Center for Arts & Science
College of Southern Idaho.

Public Star Party follows at the Centennial Observatory

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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

MVAS President's Message

December 2019

Colleagues,

The snow is beginning to fall, and Thanksgiving has passed. I would be remiss if I did not take the time to thank you for all of your efforts this year. I realize we're here because we share a common interest, a common hobby, or rather fanaticism, if you will, but it's easy to make this just a solitary interest. However, because we all work together, we learn more, and we have some great moments of sharing. Just as important, we help others around us understand just why this field is important. Again, I want to thank you for continuing to plug along. Already, we've had some pictures arrive in November, so I look forward to seeing what we come up with next year.

December also means our annual Christmas Party. That will be Saturday, Dec. 14, at 7 p.m., in the library of the Herrett Center. As we've done in the past, bring a potluck appetizer, snack, or dessert, as well as an inexpensive astronomy-themed gift for an exchange. Afterward, we'll test our astronomical memory and knowledge with the annual game.

I look forward to seeing you there. Until then, be careful, and don't be afraid to sneak out and get some images.

Clear views,

Rob Mayer

Calendar

December 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4 First Quarter Moon Visible 52% ↑ Age: 7.57 Days 	5	6	7
8	9	10 Telescope Tuesday 6:00p – 9:00p Centennial Observatory	11	12 Full Moon 100% Visible  Cold Moon	13	14 MVAS Meeting at 7:00pm at the Herrett Center Public Star Party Centennial Obs. 6:00p - 12:00a
15	16	17	18	19 Last Quarter Moon  Visible: 55% ↓ Age: 22.46 Days	20	21 Winter Solstice 
22	23	24	25 Christmas 	26 New Moon Lunation 1200  Visible 1% ↑ Age: .28 Days	27	28
29	30	31 New Year's Eve 				

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

HOLIDAY PARTY

2019

WHEN: Saturday December 14th, 2019 7:00pm

WHERE: Herrett Center for the Arts & Science

Join the Magic Valley Astronomical Society for the annual members' Holiday Party Saturday December 14th, 2019 at Herrett Center for the Arts & Science. We will celebrate with an always delicious appetizer potluck and fun astronomy gift exchange! Also join the fun for the annual Astronomy Quiz presented by Chris Anderson, Production Specialist & Observatory Coordinator; Faulkner Planetarium

December Celestial Calendar

All times, unless otherwise noted, are UT (subtract seven hours and, when appropriate, one calendar day for MDT)

12/4 The earliest end of evening twilight at 40 degrees north takes place today; the Lunar X (Purbach or Werner Cross), an X-shaped illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, is predicted to occur at 06:44; First Quarter Moon occurs at 6:58
12/5 The Moon is at apogee, subtending 29' 33" from a distance of 404,446 kilometers (251,311 miles), at 4:08
12/7 The earliest sunset at latitude 40 degrees north occurs today
12/8 The Moon is 5 degrees north of Uranus at 11:00
12/10 The Moon is 7.3 degrees south of the bright open cluster M45 (the Pleiades) in Taurus at 19:00
12/11 Venus is 1.8 degrees south of Saturn at 4:00; the Moon is 2.9 degrees north of the first-magnitude star Aldebaran (Alpha Taurii) at 11:00
12/12 Full Moon (known as the Before Yule, Cold, Long Nights, and Oak Moon) occurs at 5:12; Venus, Saturn, and Pluto lie within a circle with a diameter of 2.7 degrees at 19:00
12/13 The Moon is 1.5 degrees south of the bright open cluster M35 in Gemini at 4:00; the Moon is at the ascending node (longitude 98.4 degrees) at 14:00; Venus (magnitude -3.9) is 1.1 degrees south of Pluto (magnitude +14.3) at 16:00
12/14 The Moon is 5.3 degrees south of the first-magnitude star Pollux (Beta Geminorum) at 18:00; the peak of the Geminid meteor shower (100 to 120 per hour) occurs at 19:00
12/15 The Moon is 1.0 degree north of the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 16:00
12/16 Mercury is 5.0 degrees north-northeast of the first-magnitude star Antares (Alpha Scorpii) at 7:00
12/17 The Moon is 3.7 degrees north of the first-magnitude star Regulus (Alpha Leonis) at 7:00
12/18 The Moon is at perigee, subtending 33' 16" from a distance of 370,265 kilometers (230,072 miles), at 20:25; the Sun enters the constellation of Sagittarius (ecliptic longitude 266.6 degrees) at 20:00
12/19 Mercury is at the descending node today; Last Quarter Moon occurs at 4:57; Venus is at its southernmost latitude from the plane of the ecliptic (-3.4 degrees) at 23:00
12/20 The Curtiss Cross, an X-shaped clair-obscure illumination effect located between the craters Parry and Gambart, is predicted to be visible at 9:23
12/21 The Moon is 7.2 degrees north-northeast of the first-magnitude star Spica (Alpha Virginis) at 4:00
12/22 The Sun's longitude is 270 degrees and winter solstice in the northern hemisphere occurs at 4:19
12/23 The Moon is 4.0 degrees south of Mars at 2:00; the peak of the Ursid meteor shower (5 to 10 per hour) occurs at 3:00
12/24 The Moon is 7.1 degrees north-northeast of Antares at 11:00
12/25 The Moon is 1.9 degrees north-northeast of Mercury at 12:00; the equation of time equals 0 (i.e., mean solar time equals apparent solar time) at 16:00
12/26 New Moon (lunation 1200) occurs at 5:13; the Moon is 0.3 degree northeast of Jupiter at 8:00; the Moon is at the descending node (longitude 278.4 degrees) at 13:00; the Moon is at its southernmost declination (-23.2 degrees) for the year at 20:00
12/27 The Moon is 1.2 degrees south of Saturn at 12:00; the Moon is 0.6 degree south of Pluto. Jupiter is in conjunction with the Sun at 19:00
12/29 The Moon is 1.0 degree south of Venus.
12/30 Mercury is at aphelion today; the middle of the eclipse season (i.e., the Sun is at the same longitude as the Moon's descending node, 278.3degrees) occurs at 8:00

Tycho Brahe, Johannes Kepler, Isaac Newton, E. E. Barnard, and Arthur Eddington were born in December.

Giovanni Cassini discovered the Saturnian satellite Rhea on December 23, 1672. Nicolas Louis de Lacaille discovered NGC 2070 (the Tarantula Nebula) on December 5, 1751. The bright spiral galaxies M81 and M82 in Ursa Major were discovered by Johann Bode on December 31, 1774. William Herschel discovered the galaxy pair NGC 3166 and NGC 3169 in Sextans on December 19, 1783. Caroline Herschel discovered Comet 35P/Herschel-Rigoliet on December 21, 1788. Caroline Herschel discovered Comet C/1791 X1 (Herschel) on December 15, 1791. The Jovian satellite Himalia was discovered by Charles Perrine on December 3, 1905. Audouin Dolfus discovered the Saturnian satellite Janus on December 15, 1966. The Saturnian satellite Epimetheus was discovered by Richard Walker on December 18, 1966.

The Sun, the Moon, & the Planets

The Moon is 4.2 days old, is illuminated 19.1%, subtends 30.4 arc minutes, and is located in Virgo on December 1st at 0:00 UT. Due to the position of the ecliptic, the Moon reaches its highest point in the sky for the year in December. It attains its greatest northern declination (+23.2 degrees) for the month on December 14th and greatest southern declination (-23.2 degrees) on December 27th. Longitudinal libration is at a maximum of +5.0 degrees on December 26th. It's at a minimum of -4.7 degrees on December 12th. Latitudinal libration is at a maximum of +6.8 degrees on December 7th and a minimum of -6.8 degrees on December 20th. New Moon occurs on December 26th. The Moon is at apogee (a distance of 63.41 Earth-radii) on December 5th and at perigee (a distance of 58.05 Earth-radii) on December 18th. The Moon occults Pluto on December 27th and Venus on December 29th from certain parts of the world. Consult http://www.lunar-occ...ota/iotandx.htm for more on these events. Visit http://saberdoesthes...does-the-stars/ for tips on spotting extreme crescent Moons and http://www.curtrenz.com/moon.html for Full Moon data. Browse http://www.cambridge...ft/the_moon.htm and http://www.shallowsky.com/moon/ for information on various lunar features. Click on https://www.calendar...r/2019/december 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-occ...o/rays/rays.htm

The Sun is located in Ophiuchus, a non-traditional constellation of the zodiac, on December 1st. Sol enters Sagittarius on December 18th. Winter solstice for the northern hemisphere occurs when the Sun is farthest south for the year on December 21st. It is the shortest "day" of the year (9 hours and 20 minutes) at latitude 40 degrees north. An annular solar eclipse visible from western Australia, Asia, the Middle East, eastern Europe, extreme eastern Africa, the Indian Ocean, and the Pacific Ocean occurs on December 26th. It's the 46th eclipse of 71 in Saros 132. Greatest eclipse takes place in eastern Sumatra (Indonesia) at 05:17:48 UT1 and has an annular duration of 3 minutes 39 seconds. For more on this event, consult http://www.eclipsewi...ml#SE2019Dec26A or page 49 of the December 2019 issue of Sky & Telescope.

Brightness, apparent size, illumination, distance from the Earth in astronomical units (a.u.), and location data for the planets and Pluto on December 1st: Mercury (magnitude -0.6, 6.3", 69% illuminated, 1.07 a.u., Libra), Venus (magnitude -3.9, 11.6", 89% illuminated, 1.44 a.u., Sagittarius), Mars (magnitude +1.7, 3.9", 98% illuminated, 2.39 a.u., Virgo), Jupiter (magnitude -1.8, 32.1", 100% illuminated, 6.15 a.u., Sagittarius), Saturn (magnitude +0.6, 15.4", 100% illuminated, 10.78 a.u., Sagittarius), Uranus (magnitude +5.7, 3.7", 100% illuminated, 19.18 a.u. on December 16th, Aries), Neptune (magnitude +7.9, 2.3", 100% illuminated, 30.05 a.u. on December 16th, Aquarius), and Pluto (magnitude +14.3, 0.1", 100% illuminated, 34.80 a.u. on December 16th, Sagittarius).

During the evening, Venus, Jupiter, and Saturn can be found in the southwest, Uranus in the southeast, and Neptune in the south. Uranus is in the west at midnight. In the morning, Mercury and Mars are located in the southeast.

Venus, Saturn, and Pluto are all located in Sagittarius within a circle with a diameter of 2.7 degrees on December 12th.

A bright gibbous **Mercury** is visible in the southeastern morning sky in early December. By December 16th, the speediest planet will be too close to the Sun to be seen. It is at the descending node on December 19th. The Moon passes less than two degrees north-northeast of Mercury on December 25th. The closest planet to the Sun is at aphelion on December 30th. Mercury shrinks in apparent size from 6.3 to 4.9 arc seconds but increases in illumination from 69 to 99% during December.

Brilliant **Venus** climbs higher into the morning sky and Saturn sinks lower as the month unfolds. The bright globular cluster M22 lies less than one degree to the north of Venus on December 2nd. M75, another globular cluster, lies with one degree of Venus on the night of December 18th and December 19th. Venus and Saturn are five degrees apart on December 6th. The second-magnitude star Nunki (Sigma Sagittarii) is less than two degrees from Venus on that date. Venus passes less than two degrees from Saturn on December 11th. That distance increases to more than ten degrees by December 20th. Venus is at its heliocentric latitude south on December 20th. The Moon passes one degree south of the brightest planet on December 28th. Venus increases in apparent size to 13.0 arc seconds but decreases in illumination to 82% by December 31st.

A tiny **Mars** exits Virgo and enters Libra early in the month. It climbs higher in the morning sky and reaches an elongation of 40 degrees by the end of December. The Red Planet rises by more than three hours before the Sun as the year ends. Mars is four degrees south of the waning crescent Moon on the night of December 23rd.

Jupiter is lost in the glare of sunset by midmonth. The largest planet is in conjunction with the Sun on December 27th.

Saturn lies very low in the southwest during December. Saturn's disk spans 15 arc seconds and its rings 35 arc seconds on December 1st. Its rings are tilted by 24 degrees. A slender crescent Moon passes 1.2 degrees south of the Ringed Planet on December 27th.

Uranus lies in southern Aries near the border with Pisces, a region lacking in any bright stars. Uranus is five degrees north of the Moon on December 8th. The gas giant planet attains an altitude of about 60 degrees in the south around 9:30 p.m. local time early in the month and doesn't set until a few hours after midnight. Visit http://www.bluewater...anus_2019_1.pdf and http://www.nakedeyep....com/uranus.htm for finder charts.

Neptune is located 1.5 degree west-southwest of the fourth-magnitude star Phi Aquarii on the first day of the month. As December ends, Neptune lies 1.1 degrees from the star. The waxing gibbous Moon passes four degrees south of Neptune on 10th. Neptune sets before midnight this month. Browse http://www.bluewater...tune_2019_1.pdf and http://www.nakedeyep...com/neptune.htm for finder charts.

Articles on Uranus and Neptune with finder charts appear on pages 48 and 49 of the September 2019 issue of Sky & Telescope and on pages 52 to 55 of the October issue of Astronomy. Finder charts for Uranus and Neptune are also available online at https://s22380.pcdn....020_updated.pdf

Click on http://www.skyandtel...watching-tools/ for JavaScript utilities that will illustrate the positions of the five brightest satellites of Uranus and the position of Triton, Neptune's brightest satellite.

Pluto will not be readily visible again until next year. ☹

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

Asteroids

Asteroid 15 Eunomia shines at tenth magnitude as it travels northeastward through Aquarius this month. It passes 0.8 degree south of the third-magnitude star Alpha Aquarii on December 17th. During the final week of December, Eunomia glides through the Water Jar asterism, which consists of Gamma, Pi, Zeta, and Eta Aquarii. Asteroid 55 Pandora (magnitude +11.1) occults the 6.5-magnitude star 18 Aurigae for up to 7 seconds from Africa, southern United States, and Mexico on the evening of December 6th. Click on http://www.asteroido...07_55_62270.htm for additional information. Asteroids brighter than magnitude +11.0 reaching opposition this month include 97 Klotho (magnitude +10.1) on December 2nd, 28 Bellona (magnitude +10.5) on December 10th, 132 Aethra (magnitude +10.5) on December 14th, and 69 Hesperia (magnitude +10.5) on December 30th. For information on this year's bright asteroids and upcoming asteroid occultation events, consult http://www.curtrenz.com/asteroids.html and http://asteroidoccultation.com/ respectively.

Carbon Star

Notable carbon star for December: U Camelopardalis Right Ascension $03^h\ 41^m\ 48.17393^s$ | Declination +62° 38′ 54.3906″

Comets

Comet C/2017 T2 (PanSTARRS) may brighten to ninth magnitude as it heads northwestward along the border of Perseus and Camelopardalis. The comet passes just north of the open cluster NGC 1528 in Perseus on December 15th and through the faint emission nebula Sharpless 2-205. Visit http://cometchasing.skyhound.com/ and http://www.aerith.ne...t/future-n.html for information on comets that are visible this month. A list of the closest approaches of comets to Earth is posted at http://www.cometogra.../nearcomet.html

A list of the closest approaches of comets to the Earth is posted at http://www.cometography.com/nearcomet.html

Meteors

The peak of Geminid meteor shower occurs on the morning of December 14th but is adversely affected by moonlight from a bright waning gibbous Moon. The Geminids, which are associated with the Palladian asteroid, or possible cometary nucleus, 3200 Phaethon, have become the most reliable meteor shower of the year. Geminid meteors appear to originate from a radiant that's just northwest of Castor (Alpha Geminorum). That radiant lies almost at the zenith at 2:00 a.m. local time. Geminid meteors travel at a relatively slow speed of 35 kilometers per second (22 miles per second). An article on this year's Geminids can be found on pages 48 and 49 of the December 2019 issue of Sky & Telescope. The Ursids, a normally minor meteor shower with a maximum zenithal hourly rate of 10 per hour, peak on the morning of December 23rd and are not affected by a thin crescent Moon. A surge of up to 30 meteors per hour may occur this year. The radiant is located close to Kochab (Beta Ursa Minoris), some 15 degrees from the n celestial pole. See https://earthsky.org...d-meteor-shower and https://www.imo.net/...urces/calendar/ for additional information on the Geminids and https://earthsky.org/?p=2976 and https://www.imo.net/...urces/calendar/ for more on the Ursids.

Orbiting Earth

Information on Iridium flares and passes of the ISS, the X-37B, the HST, and other satellites can be found at http://www.heavens-above.com/

Solar System Info

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

Various events taking place within our solar system are discussed at http://www.bluewaterastronomy.info/styled-4/index.html

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

The Deep Sky

Various events taking place within our solar system are discussed at https://cosmicpursui...sky-this-month/ and http://www.bluewater...ed-4/index.html

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and http://www.skyandtel...ky-at-a-glance/

The famous eclipsing variable star Algol (Beta Persei) is at a minimum, decreasing in magnitude from +2.1 to +3.4, on December 2nd, 5th, 8th, 10th, 13th, 16th, 19th, 22nd, 25th, 28th, and 30th (UT dates). Algol is at minimum brightness for approximately two hours and is well-placed for observers in N America on the nights of December 4th (centered at 10:18 p.m. EST) and December 25th (centered at 12:02 a.m. EST). Consult page 50 of the December 2019 issue of Sky & Telescope for the times of the eclipses. For more on Algol, see http://stars.astro.i.../sow/Algol.html and http://www.solstatio...ars2/algol3.htm

Free star charts for the month can be downloaded at http://www.skymaps.com/downloads.html and https://www.telescop...thly-Star-Chart and http://whatsouttonight.com/

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

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 http://www.cambridge...y-september.htm

Telrad finder charts for the Messier Catalog and the SAC's 110 Best of the NGC are posted at http://www.astro-tom...charts/map1.pdf and http://sao64.free.fr...ataloguesac.pdf respectively.

Information pertaining to observing some of the more prominent Messier galaxies can be found at http://www.cloudynig...ur-astronomers/

Author Phil Harrington offers an excellent freeware planetarium program for binocular observers known as TUBA (Touring the Universe through Binoculars Atlas), which also includes information on purchasing binoculars, 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 http://tonightssky.com/MainPage.php and https://dso-browser.com/

Freeware sky atlases can be downloaded at http://www.deepskywa...-atlas-full.pdf and http://astro.mxd120....ee-star-atlases

One hundred and five binary and multiple stars for December: Gamma Andromedae, 59 Andromedae, Struve 245 (Andromeda); Struve 362, Struve 374, Struve 384, Struve 390, Struve 396, Struve 400, Struve 19, Otto Struve 67 (Camelopardalis); Struve 191, Struve Iota Cassiopeiae, Struve 263, Otto Struve 50, Struve 283, Struve 284 (Cassiopeia); 61 Ceti, Struve 218, Omicron Ceti, Struve 274, Nu Ceti, h3511, 84 Ceti, h3524, Lambda Ceti, Struve 330 (Cetus); h3527, h3533, Theta Eridani, Rho Eridani, Struve 341, h3548, h3565, Tau-4 Eridani, Struve 408, Struve 411, h3589, h3601, 30 Eridani, 32 Eridani (Eridanus); h3478, h3504, Omega Fornacis, Eta-2 Fornacis, Alpha Fornacis, See 25, Xi-3 Fornacis, h3596 (Fornax); Struve 268, Struve 270, h1123, Otto Struve 44, h2155, Nu Persei, Struve 297, Struve 301, Struve 304, Eta Persei, Struve 314, Otto Struve 48, Tau Persei, Struve 331, Struve 336, Es588, Struve 352, Struve 360, Struve 369, Struve 382, Struve 388, Struve 392, Struve 410, Struve 413, Struve 425, Otto Struve 59, Struve 426, 40 Persei, Struve 434, Struve 448, Es277, Zeta Persei, Struve 469, Epsilon Persei, Es878 (Perseus); Struve 399, Struve 406, Struve 401, Struve 422, Struve 430, Struve 427, Struve 435, 30 Tauri (Taurus); Epsilon Trianguli, Struve 219, Iota Trianguli, Struve 232, Struve 239, Struve 246, 10 Trianguli, Struve 269, h653, 15 Trianguli, Struve 285, Struve 286, Struve 310 (Triangulum)

One hundred deep-sky objects for December: NGC 891 (Andromeda); IC 342, K6, St23, Tom 5 (Camelopardalis); Be65, IC 1848, K4, Mel15, NGC 896, NGC 1027, St2, Tr3 (Cassiopeia); M77, NGC 788, NGC 835, NGC 864, NGC 908, NGC 936, NGC 955, NGC 958, NGC 1015, NGC 1016, NGC 1022, NGC 1042, NGC 1052, NGC 1055, NGC 1087, NGC 1094 (Cetus); IC 2006, NGC 1084, NGC 1140, NGC 1187, NGC 1199, NGC 1209, NGC 1232, NGC 1291, NGC 1300, NGC 1309, NGC 1332, NGC 1337, NGC 1353, NGC 1357, NGC 1395, NGC 1400, NGC 1407, NGC 1421, NGC 1426, NGC 1440, NGC 1452, NGC 1453, NGC 1461 (Eridanus); NGC 1079, NGC 1097, NGC 1201, NGC 1292, NGC 1316 (Fornax I Galaxy Cluster), NGC 1317, NGC 1326, NGC 1344, NGC 1350, NGC 1360, NGC 1365, NGC 1371, NGC 1374, NGC 1379, NGC 1380, NGC 1381, NGC 1387, NGC 1398, NGC 1404, NGC 1406, NGC 1425 (Fornax); Bas10, Cz8, IC 351, IC 2003, K5, Mel 20, M34, NGC 869, NGC 884, NGC 957, NGC 1023, NGC 1058, NGC 1161, NGC 1245, NGC 1275 (Perseus I Galaxy Cluster), NGC 1333, NGC 1342, NGC 1444, Tr2 (Perseus); M45 (Taurus); NGC 777, NGC 784, NGC 890, NGC 925, NGC 949, NGC 959, NGC 978A/B (Triangulum)

Top ten binocular deep-sky objects for December: M34, M45, Mel15, Mel20, NGC 869, NGC 884, NGC 1027, NGC 1232, St2, St23

Top ten deep-sky objects for December: M34, M45, M77, NGC 869, NGC 884, NGC 891, NGC 1023, NGC 1232, NGC 1332, NGC 1360

Challenge deep-sky object for December: vdB14 (Camelopardalis)

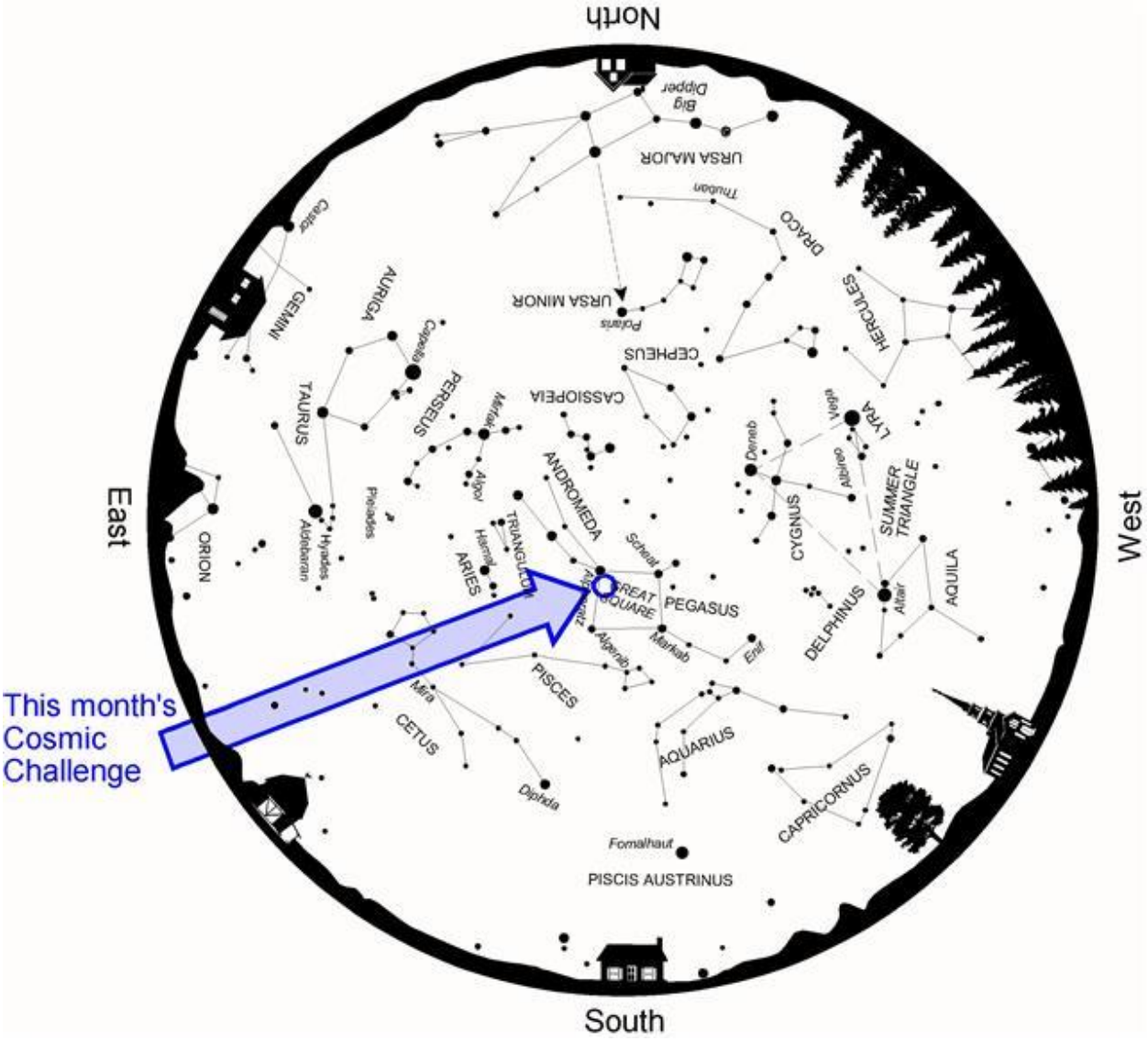
Phil Harrington's Cosmic Challenge

Cosmic Challenge: NGC 1 and NGC 2

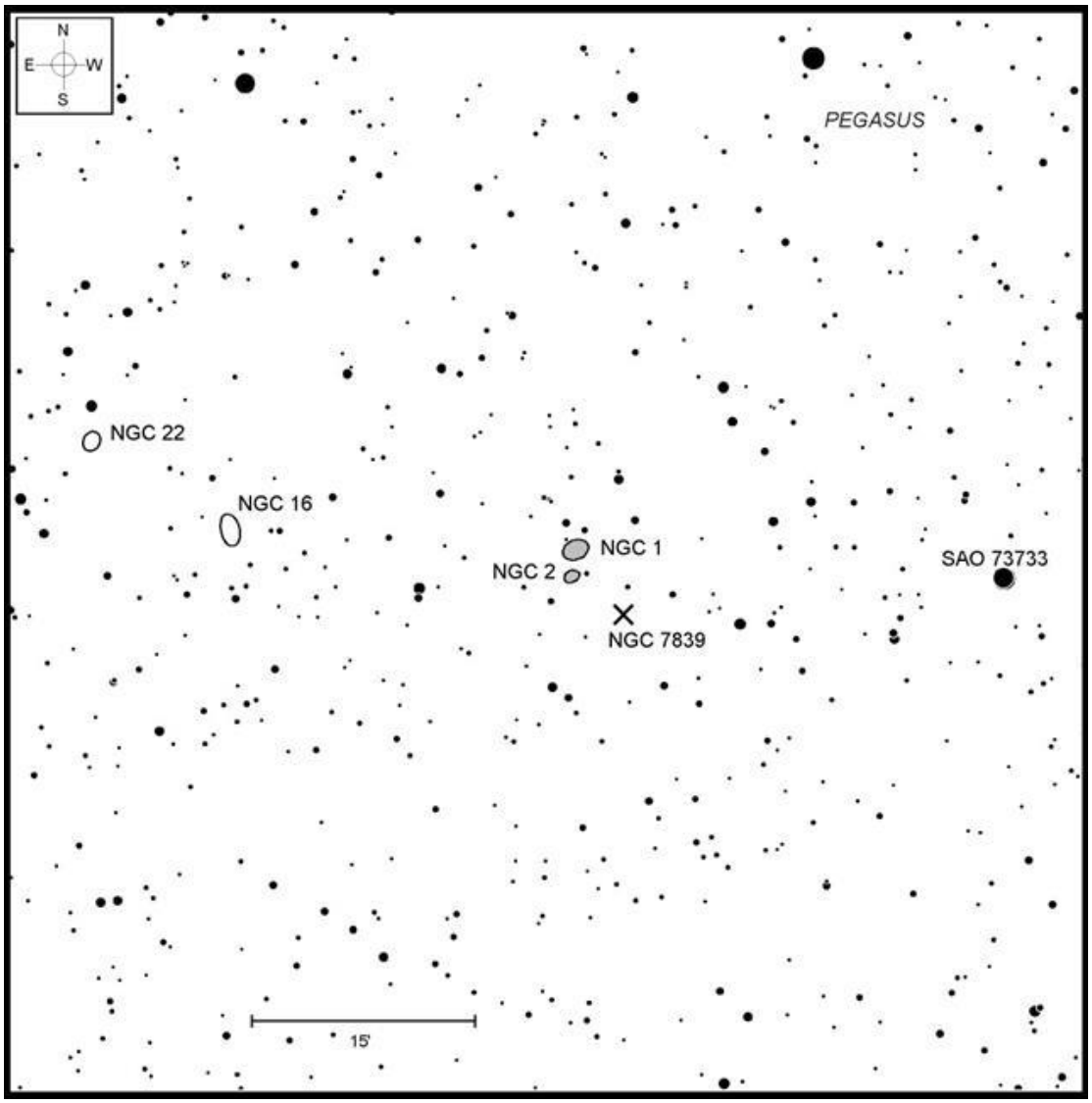
	10-inch (25 cm) to 14-inch (36 cm) telescopes.

Target	Type	RA	DEC	Const.	Magnitude	Size
NGC 1	Galaxy	00h 07.3m	+27° 42.5'	Pegasus	12.8	1.8'x1.1'
NGC 2	Galaxy	00h 07.3m	+27° 40.7'	Pegasus	14.1	1.2'x0.7'

As 2019 draws to an end, let's talk about a first. I am always interested in seeing the first of anything, whether it's the first day of a new year, the opening day of baseball season, the first robin of spring, the first snowflake of winter, or the first object in a particular deep-sky catalog. In the case of the latter, NGC 1, along with NGC 2, create our final challenge of the year.



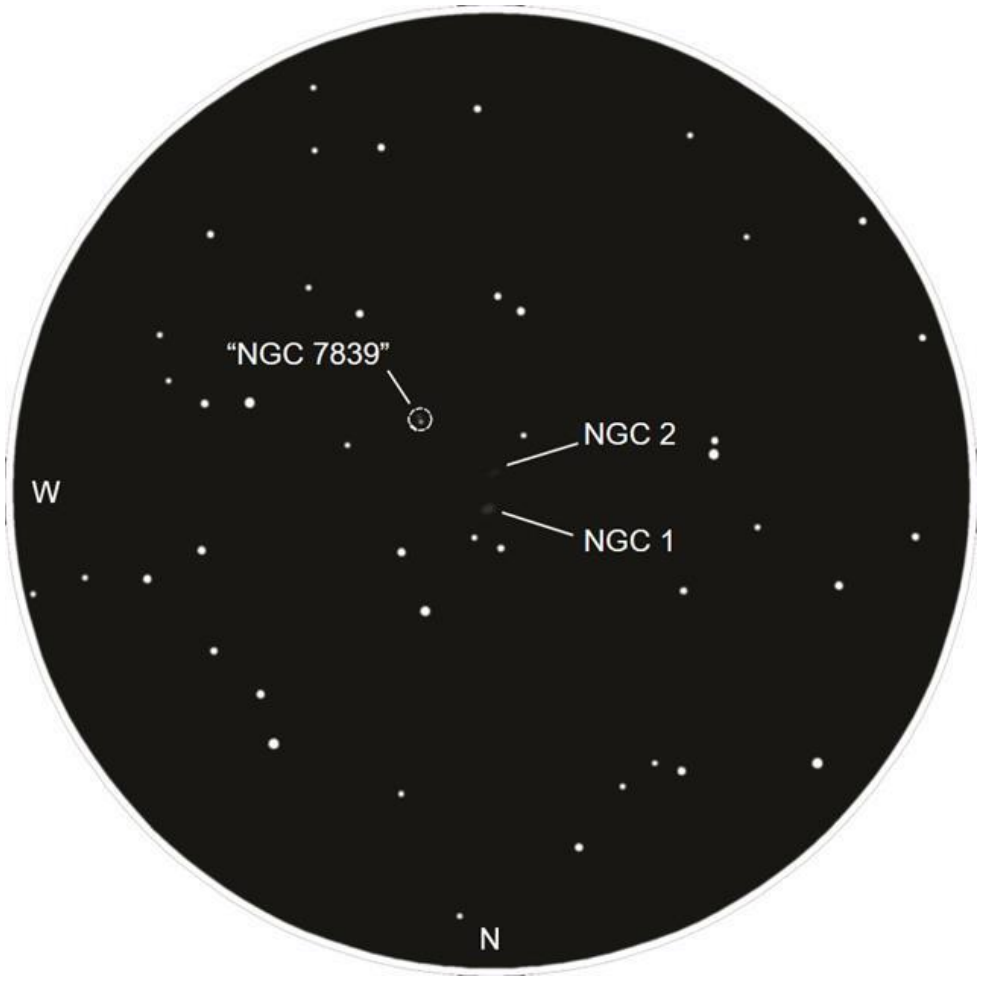
Above: Early evening star map. Credit: Map adapted from Star Watch by Phil Harrington



Finder chart for this month's Cosmic Challenge. Click on the chart to open a printable PDF version.

When he assembled and published the *New General Catalogue of Nebulae and Clusters of Stars*, or NGC, in 1888, John L.E. Dreyer (1852-1926) decided to organize the more than 7,800 entries in order of increasing right ascension beginning at 00 hours. In epoch 1860 coordinates, upon which the original NGC was based, this tiny pair of galaxies came in first, with NGC 1's position listed as 00h 00m 04s. But in the ensuing years, Earth's precession -- that slow, circular, 26,000-year wobbling of our rotational axis -- has shifting the celestial coordinate system underneath the stars. Today, in epoch 2000 coordinates, no fewer than 30 NGC objects have "lower" Right Ascension values than NGC 1.

We are not going to let that little fact spoil our fun, are we? Never! NGC 1 and NGC 2 still present formidable challenges for our telescopes. Together, these spiral galaxies are located 1.4° south of Alpheratz, the star at the northeastern corner of the Great Square (although technically, Alpheratz belongs to neighboring Andromeda; hence its dual identity of Alpha [α] Andromedae). Follow a crooked line of four 6.5-magnitude stars that extends from Alpheratz to the southwest for about 1½°. The fourth star in that line, the yellow giant SAO 73733, is ½° due west of our galactic pair.



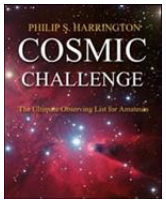
NGC 1 and NGC 2 as seen through the author's 10-inch (25cm) reflector. The position of NGC 7839 is also circled, although as noted in the text, that is actually a misidentified pair of faint stars.

NGC 1 is the brighter of the galaxies, and may actually be visible in telescopes as small as 6 inches in aperture under dark skies. My 10-inch at 58x uncovers a dim, oval disk just 2' south of an 11th-magnitude star. By increasing magnification to 106x and using averted vision, I can just spot a stellar core in the center. The core becomes easier to see by increasing magnification three- or four-fold, but only under steady seeing.

I also find that 106x is just right for spotting the small, dim disk of NGC 2 through the 10-inch. Like NGC 1, NGC 2 is slightly elongated and oriented approximately northwest-southeast. NGC 2 is three times fainter than its neighbor, so only shows a faint, uniform glow. Get set to use averted vision just to spot it, regardless of magnification.
Despite their close proximity to each other, NGC 1 and NGC 2 do not constitute a true physical pair. Astronomers can tell that NGC 2 is farther away than NGC 1 by studying the redshifts in their spectra, as well as by comparing the level of structural detail visible in photographs. Today's best estimates place NGC 1 at approximately 215 million light years away, while NGC 2's calculated distance is about 345 million light years.

Incidentally, some charts also plot another target, NGC 7839, in the immediate area. Although this object can appear "nebulous" through telescopes, it turns out that NGC 7839 is nothing more than a pair of very faint Milky Way stars some 4' southwest of NGC 2.

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



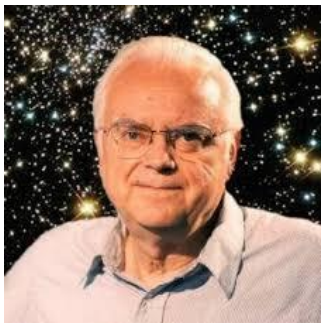
About the Author: Phil Harrington writes the monthly *Binocular Universe* column in Astronomy magazine and is the author of 9 books on astronomy. Visit his web site at www.philharrington.net to learn more.

The *Voyager* Odyssey

Chapter 9: The Golden Record

by Loretta J Cannon

"This may, in the long run, be the only evidence that we ever existed."
- Frank Drake, Golden Record Technical Director
quoted in documentary *The Farthest Voyager in Space* (2017)



Frank Drake @FDrakeA (twitter)

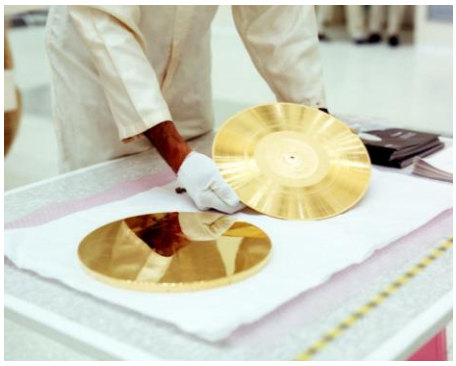
Are we alone in the universe? We don't have conclusive evidence . . . yet. However, from a statistical viewpoint, the probability points to the affirmative. In 1961 Dr. Frank Drake – then a radio astronomer at the National Radio Astronomy Observatory (NRAO) in Green Bank, WV – developed a conceptual equation to examine the parameters for estimating the number of technologically advanced civilizations in the Milky Way galaxy with which communication is possible: $N = R_* \ f_p \ N_e \ f_l \ f_i \ f_c \ L$ where R_* is the rate of star formation per year in the galaxy, f_p is the fraction of those stars with planets, N_e is the number of planets environmentally suitable for life, f_l is the fraction of suitable planets on which life develops, f_i is the fraction of life-bearing planets with intelligent life, f_c is the fraction of those planets with technologically advanced civilizations producing detectable interstellar signals, L is the length of time that such civilizations survive. In the previous year, Drake had conducted the first study to detect interstellar radio signals. For four months, Project Ozma 'listened' to two stars similar in age to our sun, Tau Ceti and Epsilon Eridani, both about eleven light years away. And while no confirmed signal was detected, the legitimacy of the search for extra-terrestrial life was established. In 1984, Drake was involved in the founding of the non-profit SETI Institute; click here for an interview with him [https://rosetta.jpl.nasa.gov/news/interview-frank-drake-founder-seti]. While Drake is well-known within the fields of astronomy, physics, etc., there is another scientist who took astrophysics and the search for extra-terrestrial life mainstream.

Carl Sagan credit: NASA

Dr. Carl Sagan is well known not only for the acclaimed television series *Cosmos*, and as the author of fifteen books – including *The Dragons of Eden*, which garnered him a 1978 Pulitzer – but also mostly as the person who presented the universe in everyday terms to everyday people. At the time the *Voyager* mission was getting underway in 1972, Sagan was a visiting professor at JPL and had been involved with two *Mariner* and both *Viking* missions. For *Pioneers* 10 & 11, Drake, Sagan and Linda Salzman-Sagan designed the 6 x 9" gold anodized plaque that was affixed to both spacecraft, our first message to the stars.

The *Voyager* mission had been underway for about four years when, in December 1976, the mission project manager, John Casani, asked Sagan to oversee the creation of a new message to the stars. Remember, the launch date for *Voyager* 2 was slated for the following August, which gave him less than six months to design, get approval for, and create a message. Sagan assembled an impressive group of consultants for initial input on message design: Frank Drake (NRAO), Philip Morrison (MIT), A.G.W. Cameron (Harvard), Leslie Orgel (Salk Inst), B.M. Oliver (Hewlett-Packard), Steven Toulmin (Univ Chicago), and science-fiction writers Isaac Asimov, Arthur C. Clark and Robert Heinlein. Oliver put voice to a sentiment common among the consultants:

> "There is only an infinitesimal chance that the plaque will ever be seen by a single extraterrestrial, but it will certainly be seen by billions of terrestrials. Its real function, therefore, is to appeal to and expand the human spirit, and to make [the idea of] contact with extraterrestrial intelligence a welcome expectation of mankind."
>
> Sagan,C, FD Drake, A Druyan, T Ferris, J Lomberg, L Salzman-Sagan (1978) *Murmurs of Earth*, New York: Random House



Golden Record and cover credit: NASA/JPL

In January 1977, Drake made the excellent suggestion that, for the same weight and volume, they could attach a long-playing (LP) phonograph record, rather than another plaque, to the spacecraft.

An LP record allowed much more information than could be engraved on a plaque, and the durability and longevity of a record (wherein information is etched into the grooves, especially one made of gold) is worlds better than a magnetic tape recording. For those of you who don't know, a long-playing record is 33½ rpm, as opposed to a 45 or a 78. These numbers refer to the revolutions per minute of the record on the turntable when it is played (also the speed at which it was recorded). Interestingly, LP records, i.e. vinyl, are making a comeback. Information would be recorded on both sides of the record, and by recording at half-speed, that gave them 2 hours of playing time. Initially, only sounds were considered, but Drake suggested that they could include *both* sound and images. This should work since a television picture is composed of signals at different frequencies . . . if they could find a way to translate picture frequencies to something that could be recorded on an LP record. Sagan then presented the message format – an LP record – to NASA, which then took weeks for all required approvals.

Side 1 of Golden Record credit: NASA/JPL-CalTech

By the time Sagan's group received a green light, they had perhaps six weeks or so to acquire and record everything. Teams were led by: Sagan and Tim Ferris on music selections, Linda Saltzman Sagan on greetings in as many languages as possible, Ann Druyan on sounds of the earth. Jon Lomberg's team coordinated the images that, as noted above, would need to be recorded 'audio-ly'. Unfortunately, they discovered that in 1977 the technology to do this hadn't quite been invented. Then radio astronomer-electronics designer Valentin Boriakoff pulled a rabbit out of a hat; he found Colorado Video Inc, a small company in Boulder, CO that had just designed a machine with a special computer to send visual images over phone lines. CVI was delighted to be involved in the *Voyager* project and successfully recorded all chosen images. Not only did they work for free, but they solved the issue of how to record in color and then were able to record each image in only eight seconds. This link takes you to a NASA page depicting some of the included images: https://voyager.jpl.nasa.gov/golden-record/whats-on-the-record/images/. It is worth noting that Colorado Video is still in business, though their website doesn't include any information on their contribution to the *Voyager* mission on their 'About Us' page; either they're modest or maybe they've forgotten.

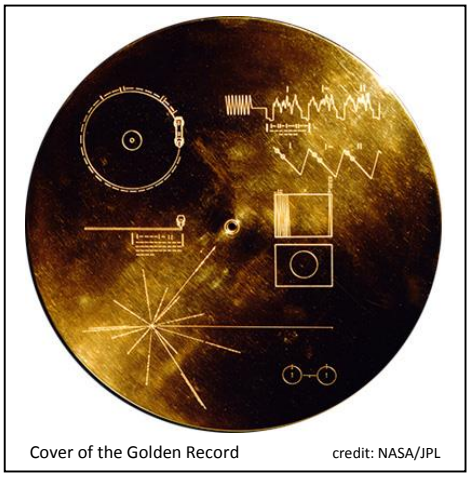

An RCA tv ~1946 credit: Wiki-Fletcher6

As content was being sought, there arose a debate regarding whether we should be sending an intentional message (which would include directions to Earth) to alien civilizations. Some were afraid that aliens would conquer us (think *Twilight Zone*, the episode where the fictional book 'To Serve Man' turned out to be a cookbook!). The counter argument included: the *Voyager* record would not be the first message to be sent to interstellar space. Television signals have been beaming towards space since the first broadcast in 1928 (an American program called 'The Queens Messenger'). And there were plaques on both *Pioneer*s 10 & 11 which already gave clear directions to Earth. The reasoning, then, was that since we're choosing to send a message, let's take some care with the content, let's show them who we are and how we live, let's speak to them in our native voices, and let's share our soul.

A total of 116 images were obtained. They recorded 55 greetings and 50 different 'sounds' of Earth. And 27 musical selections were collected. Among the images are: a DNA strand, a mother & baby, a string quartet, Jane Goodall with chimps, Sydney opera house, a baby being born. Fifty-five individuals agreed to come to two different recording sessions at Cornell University in June 1977 to record a greeting, each in a different language. They are hopeful, friendly, and inviting. The Nepali speaker's greeting is this author's favorite, "Wishing you a peaceful future from the earthlings!" While collecting sounds, Druyan met biology professor Roger Payne who recorded whale song. He knew exactly which song would be best - a humpback whale song recorded on April 13, 1970 off the coast of Burmuda. Who knows, maybe this is the one 'greeting' that some alien civilization will understand (think *Star Trev IV*). An amazing effort was made to sample music from all over our home world, from Mozart's *Magic Flute* to an Aboriginal song, from Peruvian panpipes to Azerbaijani bagpipes, from Zaire to India, and Bulgaria to China. The entire content of the record is fully described, and all images depicted, in the book *Murmurs of Earth*, published in 1978, a year before the fly-by of Jupiter. This is the definitive resource for the golden record as it was written by the folks who created it: Carl Sagan, Frank Drake, Ann Druyan, Timothy Ferris, Jon Lomberg, and Linda Salzman-Sagan. But for 40 years the general public could not hear this 'interstellar

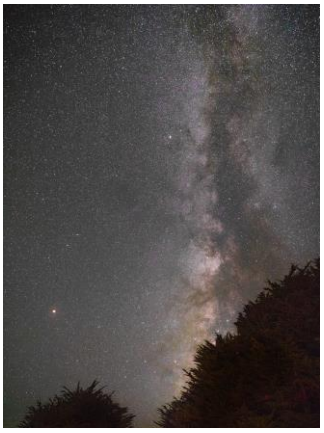
mixtape'. Then in 2017, a Kickstarter campaign produced a boxed set of sounds and the story of the golden record; link to NPR story https://www.npr.org/2017/09/30/554489944/the-voyager-golden-record-finally-finds-an-earthly-audience.

The finished record was packaged, along with a stylus for playing, under a special cover. The designers included directions to Earth (as on the *Pioneer* plaques) and instructions for playing the record. If you look closely, you will note there are no words on this cover, no English words. The instructions are written in binary. The top left image depicts a view looking down on the record being played with binary code around the record indicated the playing speed. The next image down on the left is an elevation view of the record with the stylus with more binary 'words'. The bottom left image defines Earth's location using pulsar stars. The top four images on the right define how to read and scan the pictures on the record with directions in binary. The bottom image on the right is a hydrogen atom.


Cover of the Golden Record credit: NASA/JPL

So, let's return to our original question. This amazing message, safely ensconced under an informative cover, is traveling to the stars at about 36,000 miles per hour, but will anyone hear it? For our answer, we'll consider Drake's Equation in relation to our intrepid *Voyagers*. But don't worry, we're not doing math. The first variable, R_*, can be thought about by considering what is known about the sheer number of galaxies in the known universe. The story goes that within a soda straw size of dark sky are many thousands of galaxies with billions of stars in each of them. Extrapolate this to the whole sky – plenty of stars being made. The next two variables, f_p and N_e, can be considered by looking at data from the Kepler space telescope, which scanned specific patches of sky for almost nine years looking for planets orbiting distant suns. This link [https://solarsystem.nasa.gov/resources/311/kepler-orrery-iii/] is a visual, and moving, representation of some of the planets found by Kepler. The variables f_l and f_i and f_c are more esoteric and this author (unfortunately) can't think of a good way to consider them (sorry). The last variable, L, is truly the truly sticky wicket.

Time is a huge constraint. The scientist contributors to the documentary *The Farthest Voyager in Space* discussed this concept in relation to our own intellectually advanced civilization. To paraphrase theoretical physicist Lawrence Krauss: In a galaxy that's 12 billion years old, our solar system is young at only 4½ billion years old. And during that entire 4½ billion years (4,500,000,000), the only evidence of intelligent life has been in the last 60 to 80 years. That's a miniscule 0.0000016% of the lifetime of our solar system when intelligent life has been evident. When George Lucas wrote his epic story, he may not have been writing fiction. "A long time ago, in a galaxy far, far away . . .." All of that could have happened and we'll never know – when they were alive, we may have just been bacteria.


Milky Way credit: BAS homepage

Space is the other constraint. Our minds cannot fully grasp the immensity of our own solar system, let alone our galaxy, or the universe. On a moonless night, in some 'dark sky' area of our world, the velvet of the night sky appears carpeted with stars, especially if the milky way is visible. But there's a whole lot of empty out there. Remember the table included with last month's article on Neptune? The distance from Uranus to Neptune is almost TWICE the distance from the Sun to Uranus. It took our little spacecraft 35 years (23 of those traveling close to 36,000 mph) to reach the edge of the solar system. And, according Dr. Krauss, the Milky Way galaxy and the Andromeda galaxy are on a collision course, expected to 'impact' in about two million years. Yet, when these galaxies collide, almost no stars will hit any other star.

Is there other life in the universe? Yes, without a doubt. Will anyone listen to our message in a bottle? Maybe. But at least there's something of who we are out there. Dr. Drake is right. This message may truly end up being the only evidence that any of us ever existed. There is a comfort in that. Happy Holidays.

In January, it's the 34th anniversary of the Uranus flyby. Then in February, we'll close out the Voyager journey.

About the Author: Loretta J Cannon is a 3rd generation Idahoan. She earned both of her Bachelor degrees from Boise State University and her Masters from Arizona State University. After almost20 years working for local banks, non-profits and the Federal government, she is somewhat retiredand devotes her time to science writing & editing and real estate. She can be reached at LorettaJCannon@gmail.com.

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.org to find local clubs, events, and more!

The Orion Nebula: Window into a Stellar Nursery

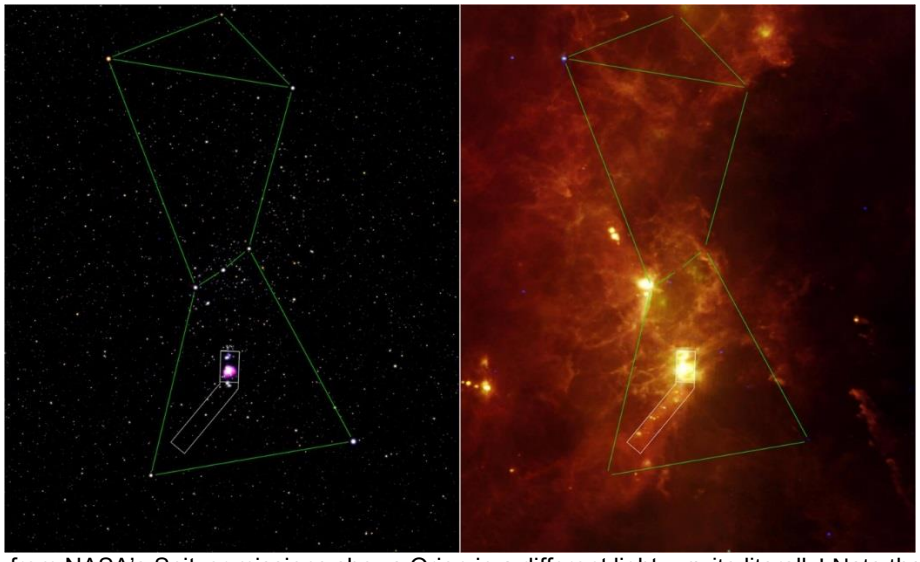
By David Prosper

Winter begins in December for observers in the Northern Hemisphere, bringing cold nights and the return of one of the most famous constellations to our early evening skies: Orion the Hunter!

Orion is a striking pattern of stars and is one of the few constellations whose pattern is repeated almost unchanged in the star stories of cultures around the world. Below the three bright stars of Orion's Belt lies his sword, where you can find the famous Orion Nebula, also known as M42. The nebula is visible to our unaided eyes in even moderately light-polluted skies as a fuzzy "star" in the middle of Orion's Sword. M42 is about 20 light years across, which helps with its visibility since it's roughly 1,344 light years away! Baby stars, including the famous "Trapezium" cluster, are found inside the nebula's whirling gas clouds. These gas clouds also hide "protostars" from view: objects in the process of becoming stars, but that have not yet achieved fusion at their core.

The Orion Nebula is a small window into a vastly larger area of star formation centered around the constellation of Orion itself. NASA's Great Observatories, space telescopes like Hubble, Spitzer, Compton, and Chandra, studied this area in wavelengths we can't see with our earthbound eyes, revealing the entire constellation alight with star birth, not just the comparatively tiny area of the nebula. Why then can we only see the nebula? M42 contains hot young stars whose stellar winds blew away their cocoons of gas after their "birth," the moment when they begin to fuse hydrogen into helium. Those gas clouds, which block visible light, were cleared away just enough to give us a peek inside at these young stars. The rest of the complex remains hidden to human eyes, but not to advanced space-based telescopes.
We put telescopes in orbit to get above the interference of our atmosphere, which absorbs many wavelengths of light. Infrared space telescopes, such as Spitzer and the upcoming James Webb Space Telescope, detect longer wavelengths of light that allow them to see through the dust clouds in Orion, revealing hidden stars and cloud structures. It's similar to the infrared goggles firefighters wear to see through smoke from burning buildings and wildfires.

Learn more about how astronomers combine observations made at different wavelengths with the Night Sky Network activity, 'The Universe in a Different Light," downloadable from bit.ly/different-light-nsn. You can find more stunning science and images from NASA's Great Observatories at nasa.gov.



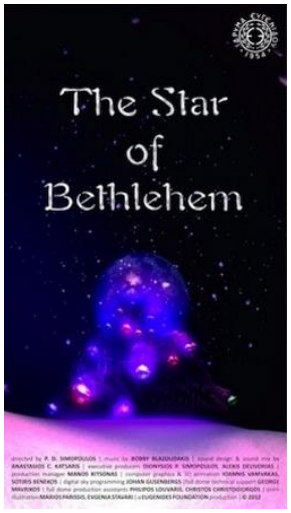
Caption: This image from NASA's Spitzer missions shows Orion in a different light – quite literally! Note the small outline of the Orion Nebula region in the visible light image on the left, versus the massive amount of activity shown in the infrared image of the same region on the right. Image Credit: NASA/JPL-Caltech/IRAS /H. McCallon. From bit.ly/SpitzerOrion

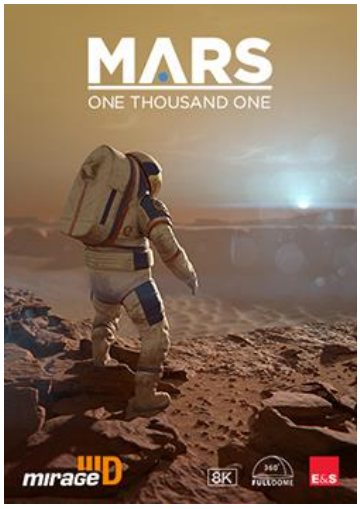
Observatory and Planetarium

CSI Centennial Observatory / Faulkner Planetarium Herrett Center

Event	Place	Date	Time	Admission
Telescope Tuesday	Centennial Observatory	Tuesday, December 10th, 2019	6:00 to 9:00 PM	$1.50 or free with Faulkner Planetarium admission
Monthly Free Star Party	Centennial Observatory	Saturday, December 14th, 2019	6:00 PM to midnight	FREE

College of Southern Idaho Campus Twin Falls, ID
Faulkner Planetarium / Show Times





Now Showing

3 of the shows showing at the Faulkner Planetarium. Visit the link above for show times.

Danish Christmas tree (*Juletræet;* not a show in the planetarium).

About the Magic Valley Astronomical Society

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.

Membership Benefits:
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 of Southern Idaho, Twin Falls, ID, USA.