Snake River Skies

The Newsletter of the Magic Valley Astronomical Society

www.mvastro.org

Membership Meeting

Saturday, November 9th 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

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

MVAS President's Message

November 2019

Colleagues,

Ordinarily, one treat is good enough for a month, but in November, we have two. To start with, our regular meeting on Saturday, Nov. 9, will feature one of the scientists on hand for one of the major scientific developments of our times. Dr. William Kells will talk to us via Skype regarding Gravitational Waves. Kells was part of the research team that made the first observation of the effect of two black holes merging into one via LIGO in Sept. 2015. We're grateful to both him and the Centennial Observatory's Chris J. Anderson for making this possible.

If that wasn't enough, two days later, Nov. 11, the transit of Mercury lines up on Veterans' Day. The planet will already be on the face of the sun when it comes up (7:21 from where I'm writing in Burley), but will last until just after 11 a.m. The Centennial Observatory will open at 7:15 a.m. and stay open until 11:15 a.m. That's Veterans' Day, so the rest of the college campus will be closed. That means volunteers like you will be gladly welcomed. While it's not as rare as transits of Venus, the next one won't happen until 2032, and that won't be visible in Idaho – the next one for Idaho is 2049. Take a chance to get out and see it.

This is also the time of year that local schools start up projects and fairs that need our help. I've already been in contact with Declo Elementary for a STEM fair on Nov. 20, and there could be stops and Heyburn and Rupert Elementary schools down the road. We'd really invite you to take the time to volunteer. Over the past few weeks, I've had the opportunity to listen to the NASA Podcast, Gravity Assist, which focuses on NASA's exploration of the solar system. The host of the podcast, NASA Chief Scientist, Jim Green, interviews a NASA scientist over the course of the show on a particular aspect of the system, whether it be Venus or the Kuiper Belt, but at the end, he asks the scientist to share with the audience what his or her "Gravity Assist" was – what or who inspired that person to take up science. With these public outreach sessions, we, too, have a chance to be a "Gravity Assist" for someone.

Speaking of "Gravity Assists," last month we held our annual elections. The current board was reelected, and I want to thank them for making things happen despite me. In addition to myself returning as president, Gary Leavitt (vice-president), Jay Hartwell (secretary), and Jim Tubbs (treasurer) all return for another year of service. David Olsen has graciously accepted the invitation to continue as newsletter editor, and we want to thank Rick Widmer for his many years as webmaster.

Clear Views,

Rob Mayer

Calendar

November 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4 First Quarter Moon Visible 51% 	5	6	7	8	9 MVAS Meeting at 7:00pm at the Herrett Center Public Star Party Centennial Obs. 9:45p - 12:00a
10	11 Veterans Day Remembrance Day 	12 Full Moon 100% Visible  Frost Moon	13	14	15	16
17	18	19 Last Quarter Moon  Visible: 55% ↓ Age: 21.75 days	20	21	22	23
24	25	26 New Moon Lunation 1199  Visible 1% Age 29.38%	27	28 Thanksgiving Day 	29	30

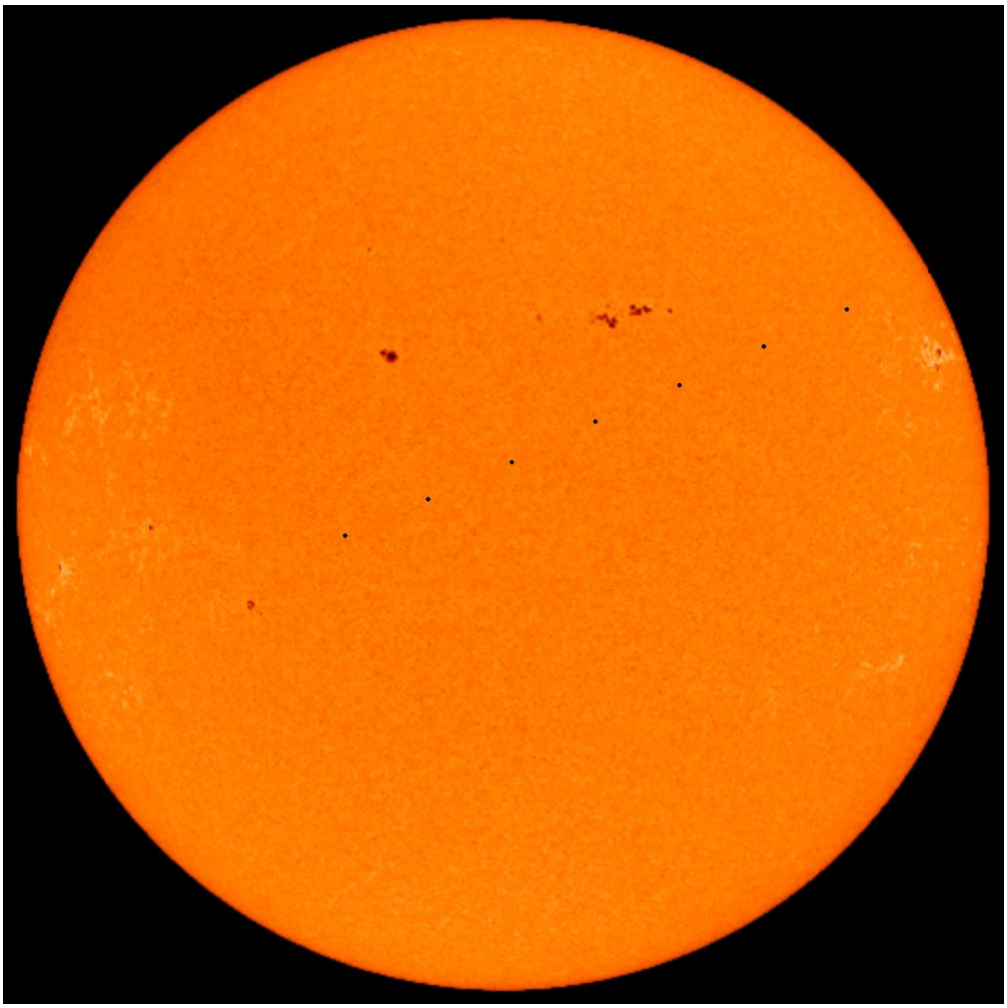
Snake River Skies is the Newsletter of the Magic Valley Astronomical Society and is published electronically once a month.
 Full Moon names follow the traditional Algonquin First Nation history.

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

November Transit of Mercury

The Solar Transit of Mercury
Monday, November 11th, 2019

This is the first time Mercury will pass directly between the sun and Earth since May 9th, 2016, and the last time until November 13th, 2032. (The next Mercury transit *visible in Idaho* won't be until May 7th, 2049). This event cannot be viewed without a properly-filtered telescope or other similarly-equipped optics.



Simulated solar-filtered telescope view of Mercury (black dot) as it moves across the sun's face in half hour intervals, from 7:30 (left of center) to 11:00 AM MDT (upper right). (Sunspots are for illustration purposes only—sunspots on the actual day of the transit, if any, will be different in both size and location.)

Mercury transit timeline

All times listed are in Mountain Standard Time (UT-7 hrs.). Sunrise time is given for Twin Falls, Idaho, USA.

- 5:35 AM — **First contact.** Mercury begins to cross sun's face (pre-sunrise, not visible from Idaho).
- 5:37 AM — **Second contact.** Mercury appears as black dot completely on sun's disc (pre-sunrise, not visible from Idaho).
- 7:15 AM — **Centennial Observatory opens** for free solar telescope viewing, weather permitting. Please dress warmly!
- 7:24 AM — **Sunrise.** Mercury already visible as a tiny black "ink drop" (silhouette) to the lower left of the center of the sun's face (only with visible with solar-filtered telescopes).
- 8:20 AM — **Greatest transit.** Mercury makes its closest apparent approach to the center of the sun's disc.
- 11:02 AM — **Third contact.** Mercury's leading edge appears to contact the edge of the sun's disc.
- 11:04 AM — **Last contact.** Mercury exits the solar disc, ending the transit.
- 11:15 AM — **Observatory closes.**

November Celestial Calendar

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

11/1 The Moon is at descending node (longitude 280.3 degrees) at 22:00
11/2 The Moon is 0.6 degree south of Saturn at 7:00; the Moon is 0.4 degree south of Pluto.
11/3 Daylight Saving Time (DST) ends today; the equation of time is at a maximum of 16.49 minutes at 15:00
11/4 First Quarter Moon occurs at 10:23; the Lunar X (Purbach or Werner Cross), an X-shaped clair-obscur illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, predicted occurrence.
11/7 The Moon is 3.6 degrees south-southeast of Neptune at 8:00; the Moon is at apogee, subtending 29' 30" from a distance of 405,058 kilometers (251,691 miles) at 8:36
11/8 Mars is three degrees north of the first-magnitude star Spica (Alpha Virginis) at 15:00
11/9 Venus is 3.9 degrees north of the first-magnitude star Antares (Alpha Scorpii) at 20:00
11/11 The Moon is 4.0 degrees south of Uranus at 4:00; Mercury is in inferior conjunction at 15:00
11/12 Asteroid 4 Vesta (magnitude +6.5) is at opposition at 9:00; Full Moon, known as the Beaver or Frost Moon, occurs at 13:34; the peak of the Northern Taurid meteor shower (15 per hour) is predicted to occur at 23:00
11/13 The Moon is 7.3 degrees south-southeast of the bright open cluster M45 (the Pleiades) in Taurus at 10:00
11/14 The Moon is 2.9 degrees north of the first-magnitude star Aldebaran (Alpha Tauri) at 3:00
11/15 The Moon is 1.5 degrees south of the bright open cluster M35 in Gemini at 20:00
11/16 The Moon is at the ascending node (longitude 99.1 degrees) at 9:00
11/17 The Moon is 5.4 degrees south of the first-magnitude star Pollux (Beta Geminorum) at 12:00
11/18 The peak of the Leonid meteor shower (15 to 20 per hour) is predicted to occur at 6:00; the Moon is 0.9 degree north of the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 11:00
11/19 Last Quarter Moon occurs at 21:11
11/20 The Moon is 3.6 degrees north-northeast of the first-magnitude star Regulus (Alpha Leonis) at 2:00; Mercury is stationary at 15:00; the Curtiss Cross, an X-shaped clair-obscur illumination effect located between the craters Parry and Gambart, is predicted to be visible at 18:59
11/22 The Sun is at longitude 240 degrees at 15:00
11/23 The Moon is at perigee, subtending 32' 35" from a distance of 366,716 kilometers (227,867 miles), at 7:41; the Sun enters Scorpius (ecliptic longitude 241.1 degrees) at 18:00; the Moon is 7.1 degrees north-northeast of Spica at 21:00
11/24 The Moon is 4.0 degrees north-northeast of Mars at 13:00; Venus (magnitude -3.9) is 1.4 degrees south of Jupiter (magnitude -1.8) at 13:00
11/25 Mercury (magnitude -0.3) is 9.5 degrees east of Mars (magnitude +1.7) at 1:00; the Moon is 1.8 degrees north-northeast of Mercury at 5:00
11/26 Mercury is at its greatest heliocentric latitude north today; New Moon (lunation 1199) occurs at 15:06
11/27 The Moon is 7.1 degrees north-northeast of Antares at 3:00; Neptune is stationary at 20:00
11/28 The Moon is 0.7 degree north of Jupiter, with an occultation occurring in western Asia, the Middle East, most of Europe, northern Africa, at 11:00; Mercury is at greatest western elongation (20 degrees) at 11:00; Venus is at its southernmost declination (-24.8 degrees) at 17:00; Venus is at aphelion (0.7282 astronomical units from the Sun) at 18:00; the Moon is 1.9 degrees north of Venus at 19:00
11/29 The Moon is at the ascending node (longitude 278.6 degrees) at 4:00; the Moon is 0.9 degree south of Saturn, with an occultation occurring in South Georgia, Antarctica, and New Zealand, at 21:00
11/30 The Moon, Saturn, and Pluto lie within a circle with a diameter of 3.6 degrees at 3:00; the Moon is 0.5 degree south of Pluto, with an occultation occurring in southeastern Polynesia, portions of Antarctica, Kerguelen Island, and southern Australasia, at 4:00; the Sun enters Ophiuchus (ecliptic longitude 248.0 degrees) at 14:00

Edmund Halley, William Herschel, Harlow Shapley, and Edwin Hubble were born this month.

Copernicus observes a lunar eclipse on November 5, 1500. Wolfgang Schuler independently discovers Tycho's Supernova on November 6, 1572. Cornelius Gemma independently discovers Tycho's Supernova on November 9, 1572. Tycho Brahe observes Tycho's Supernova on November 11, 1572. SN 1604 (Kepler's Supernova) becomes visible to the unaided eye on October 9, 1604. Nicolas-Claude Fabri de Peiresc makes the first telescopic observations of M42 (the Orion Nebula) on November 26, 1610. Jan de Munck discovers Comet C/1743 X1 (the Great Comet of 1744) on November 29, 1743. Captain James Cook observes a transit of Mercury from New Zealand on November 9, 1769. William Herschel discovers the ring galaxy NGC 922 on November 17, 1784. E.E. Barnard discovers the emission nebula NGC 281 (the Pacman Nebula) on November 16, 1881. The first photograph of a meteor was taken on November 26, 1885. The minor planet/comet 2060 Chiron or 95P/Chiron was discovered by Charles Kowal on November 1, 1977.

The Sun, the Moon, & the Planets

The Moon is 3.7 days old, is 16.7% illuminated, subtends 31.2 arc minutes, and resides in Sagittarius on November 1st at 0:00 UT. The Moon reaches its greatest northern declination on November 17th (+23.0 degrees) and its greatest southern declination on November 2nd (-23.1 degrees) and November 29th (-23.1 degrees). Longitudinal libration is at a maximum of +7.1 degrees on November 1st and +5.9 degrees on November 29th and a minimum of -4.9 degrees on November 16th. Latitudinal libration is at a maximum of +6.7 degrees on November 9th and a minimum of -6.7 degrees on November 23rd. New Moon occurs on November 26th. The Moon is at apogee (a distance of 63.51 Earth-radii) on November 7th and at perigee (a distance 57.50 Earth-radii) on November 23rd. The Moon occults Saturn and Pluto on November 2nd, Saturn again on November 29th, and Pluto again on November 30th from certain parts of the world. Consult http://www.lunar-occultations.com/iota/iotandx.htm for information on lunar occultations taking place this month. Visit http://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/ for tips on spotting extreme crescent Moons and http://www.curtrenz.com/moon06.html for Full Moon data. 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

The Sun is located in Libra on November 1 at 0:00 UT. It moves into Scorpius on November 23rd and Ophiuchus on November 30th.

Brightness, apparent size, illumination, distance from the Earth in astronomical units, and location data for the planets and Pluto on November 1: Mercury (magnitude +0.5, 8.6”, 29% illuminated, 0.79 a.u., Libra), Venus (magnitude -3.8, 10.1", 94% illuminated, 1.57 a.u., Libra), Mars (magnitude +1.8, 3.7", 99% illuminated, 2.54 a.u., Virgo), Jupiter (magnitude -1.9, 33.4", 100% illuminated, 5.90 a.u., Ophiuchus), Saturn (magnitude +0.6, 16.0", 100% illuminated, 10.77 a.u., Sagittarius), Uranus (magnitude +5.7, 3.7", 100% illuminated, 18.89 a.u. on November 16th, Aries), Neptune (magnitude +7.9, 2.3", 100% illuminated, 29.54 a.u. on November 16th, Aquarius), and Pluto (magnitude +14.3, 0.1", 100% illuminated, 34.45 a.u. on November 16th, Sagittarius).

Mercury is in inferior conjunction on November 11th, is stationary on November 20th, is its greatest heliocentric latitude north on November 26th, and is at its greatest western elongation on November 28th. It transits the Sun on November 11th. Articles on this rather rare event, which occurs in either May or November up to 13 times a century, appear on pages 139 to 143 of the Observer’s Handbook 2019, pages 48 and 49 of the November 2019 issue of Sky & Telescope, pages 50 and 51 of the November 2019 issue of Astronomy, and pages 22 and 23 of the November/December 2019 issue of SkyNews. Contact I takes place at 12:35:27 UT, contact II at 12:37:08 UT, greatest transit at 15:19:48 UT, contact III at 18:02:33 UT, and contact IV at 18:04:14 UT. Mercury subtends just ten arc seconds as it crosses the Sun’s disk over the course of nearly 5 hours and 29 minutes. The entire transit is visible from extreme western Africa, the Atlantic Ocean, Central and South America, and eastern North America. The transit will not be visible from Australia, Indonesia, Japan, and central and eastern Asia. The next transit of Mercury occurs on November 13, 2032 but will not be visible from the United States. Browse https://www.timeanddate.com/eclipse/transit/2019-november-11 and http://www.eclipsewise.com/oh/tm2019.html for additional information on the event. After the transit, Mercury begins its finest morning apparition of the year. It rises approximately seven minutes earlier and brightens by approximately one-half magnitude with each passing day and should be visible by November 18th. The speediest planet increases in illumination from crescent to waxing gibbous phase in only two weeks. Mercury and Mars are in quasiconjunction on November 25th. The Moon passes two degrees north of Mercury on the same date. Mercury rises about 75 minutes before the Sun by month’s end.

Venus and Jupiter are separated by just over 23 degrees on November 1st, nine degrees by November 15th, four degrees by November 20th, and two degrees by November 22nd. On November 23rd and November 24th, the two brightest planets are just approximately 1.5 degrees apart. A thin waxing crescent Moon lies two degrees north of Venus on November 28th. Venus is at its southernmost declination for 2019 about one hour before it reaches aphelion on November 28th. Venus sets about 105 minutes after sunset on November 30th.

Mars is located three degrees north of Spica on November 8th and four degrees south of the Moon on November 24th. The Red Planet travels eastward through Virgo and by November 30th lies within 0.2 degree of Lambda Virginis (magnitude +4.5) in the southeastern portion of the constellation. Mars rises about 150 minutes before the Sun by the end of the month. During November, it remains less than four arc seconds in apparent size.

Jupiter departs Ophiuchus and enters Sagittarius around the middle of the month. It sets approximately 80 minutes after the Sun on November 30th. Venus, Jupiter, and a slender crescent Moon form a picturesque triangle at evening twilight on November 28th.

Saturn lies just to the south of the Teaspoon asterism in Sagittarius. As November ends, the Ringed Planet is just 15 degrees in altitude in the southwest one hour after sunset. The Moon passes less than one degree south of Saturn on November 2nd and November 29th. At mid-month, the planet is 16 arc seconds in apparent size and its rings span 36 arc seconds and are inclined by 25 degrees. Iapetus lies to the east of Saturn and is at its dimmest during the first half of the month. Enceladus attains greatest eastern elongation on the evening of November1st. For information on the positions of Saturn's major satellites, browse http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/

Uranus lies in southwestern Aries roughly halfway between second-magnitude star Hamal (Alpha Arietis) and the fourth-magnitude star Alrescha (Alpha Piscium). The ice giant culminates around 9:30 p.m. local time.
Visit http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/09uranus_2019_1.pdf

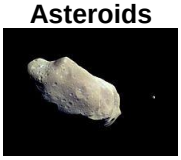
Neptune is positioned 1.3 degrees west-southwest of the fourth-magnitude star Phi Aquarii in eastern Aquarius on the first day of November. As the month ends, Neptune is 1.5 degrees from the star. Be aware that a seventh-magnitude star is located -.0.9 degree west of Phi Aquarii. The waxing gibbous Moon passes four degrees south of Neptune on November 10th. Neptune reaches its second stationary point on November 27th and then resumes prograde motion. Browse http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/10neptune_2019_1.pdf

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. Another article appears on pages 16 to 19 of the December 2019 issue of Sky & Telescope. Finder charts for Uranus and Neptune are also available online at https://s22380.pcdn.co/wp-content/uploads/WEB_UrNep_2019-2020_updated.pdf

Pluto lies too close to the horizon to be observed this month.

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

Asteroids



As it travels south-westward through Taurus and Cetus, asteroid 4 Vesta shines brighter than magnitude +6.9 for the entire month. During the first week of November, the second largest asteroid can be found in western Taurus, less than one degree from the fourth-magnitude stars Omicron and Xi Tauri. Vesta passes 0.3 degree due south of Omicron Tauri on November 5th. On November 12th, Vesta (magnitude +6.5) is at opposition. It glides 0.9 degree south of the fifth-magnitude star Lambda Ceti on November 30th. Asteroids brighter than magnitude +11.0 reaching opposition this month include 196 Philomela (magnitude +10.9) on November 2nd, 675 Ludmilla (magnitude +10.5) on November 10th, 10 Hygiea (magnitude +10.3) on November 26th, and 88 Thisbe (magnitude +10.9) on November 28th. For information on this year's bright asteroids and upcoming asteroid occultation events respectively, consult https://curtrenz.com/asteroids.html and http://asteroidoccultation.com/

Carbon Star

Notable carbon star WZ Cas (Cassiopeiae) Right Ascension $00^h\ 01^m\ 15.85670^s$ | Declination +60° 21′ 19.0235″

Comets

Comet C/2017 T2 (PanSTARRS) may brighten to ninth or tenth as it heads north-westward through Auriga. It passes about one degree to the east of the open cluster M38 on November 2nd. Comet PanSTARRS can be found approximately three degrees to the west of the first-magnitude star Capella on the nights of November 26th and November 27th. On those dates, the comet's dust tail is edge-on and may be visible to the southeast of its coma. For additional information on comets visible this month, browse http://cometchasing.skyhound.com/ and http://www.aerith.net/comet/future-n.html

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

Meteors

The peaks of the Southern and Northern Taurid meteor showers take place on November 6th and November 12th respectively but will be severely compromised by bright moonlight. These streams form part of the complex associated with Comet 2P/Encke. The Leonid meteor shower occurs on the night of November 17th/18th. Unfortunately, the waning gibbous Moon will be located about 20 degrees to the west of the radiant and will compromise this year's Leonids. Leonid meteors are debris from the periodic comet 55P/Tempel-Tuttle. Due to their high speed (71 kilometers or 44 miles per second), the fastest of any meteor shower, the Leonids produce more fireballs than most showers. The minor Alpha Monocerotid and November Orionid meteor showers occur on November 21st and November 28th respectively. See https://www.skyandtelescope.com/observing/best-meteor-showers-in-2019/ for information on 2019's better meteor showers.

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

Two stars with exoplanetary systems, Upsilon Andromedae (magnitude +4.1) and 51 Andromedae (magnitude +5.5), can be seen this month without optical aid.

The famous eclipsing variable star Algol (Beta Persei) is at a minimum, decreasing in brightness from magnitude +2.1 to magnitude +3.4, on November 3rd, 6th, 9th, 12th, 15th, 17th, 20th, 23rd, 26th, and 29th. Consult http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/ and page 50 of the November 2019 issue of Sky & Telescope for the times of the eclipses. Algol is at minimum brightness for observers in North America for about two hours centered at 2:57 a.m. EST on November 9th, at 11:46 p.m. EST on November 11th, and at 8:35 p.m. EST on November 14th. The chance of seeing Algol at least one magnitude fainter than normal on a random night is about 1 in 30. For more on Algol, see http://stars.astro.illinois.edu/sow/Algol.html and http://www.solstation.com/stars2/algol3.htm

Seventy binary and multiple stars for November: Otto Struve 514, Alpha Andromedae (Alpheratz), Struve 3, h1947, Struve 19, Struve 24, 26 Andromedae, Struve 40, Pi Andromedae, Delta Andromedae, Struve 47, Eta Andromedae, Struve 79, Beta Andromedae (Mirach), Struve 108, Struve 179, South 404 (Andromeda); 1 Arietis, Struve 178, Gamma Arietis, Lambda Arietis (Mesarthim) (Aries); Struve 3053, Struve 3057, Struve 16, Struve 30, Otto Struve 16, Alpha Cassiopeiae (Schedar), Struve 59, Eta Cassiopeiae, Burnham 1, Struve 70, Otto Struve 23, h1088, Struve 163, Struve 170, Struve

182 (Cassiopeia); 34 Piscium, Struve 8, 35 Piscium, Struve 15, 38 Piscium, 42 Piscium, 49 Piscium, 51 Piscium, 55 Piscium, 65 Piscium, Psi Piscium, Otto Struve 22, Struve 98, Otto Struve 26, Phi Piscium, Zeta Piscium, h636, Otto Struve 30, Struve 122, Struve 132, Otto Struve 31, 100 Piscium, Struve 145, 107 Piscium, h644 (Pisces); h5440, Kappa-1 Sculptoris, h1949, h3442, h3379, Tau Sculptoris, Epsilon Sculptoris (Sculptor); Struve 143, Struve 183 (Triangulum)

Seventy deep-sky objects for November: M31, M32, M110, NGC 252, NGC 404, NGC 752 (Andromeda); NGC 680, NGC 691, NGC 697, NGC 772 (Aries); Cr 463, IC 1747, K14, M103, NGC 129, NGC 133, NGC 146, NGC 185, NGC 225, NGC 281, NGC 278, NGC 381, NGC 436, NGC 457, NGC 559, NGC 637, NGC 654, NGC 659, NGC 663, Tr 1 (Cassiopeia); NGC 40, NGC 188 (Cepheus); NGC 151, NGC 175, NGC 178, NGC 210, NGC 227, NGC 245, NGC 246, NGC 247, NGC 274, NGC 337, NGC 578, NGC 584, NGC 596, NGC 615, NGC 636, NGC 681, NGC 720, NGC 779 (Cetus); NGC 7814 (Pegasus); M76, St 4 (Perseus); M74, NGC 128, NGC 194, NGC 488, NGC 524 (Pisces); NGC 24, NGC 55, NGC 134, NGC 150, NGC 253, NGC 254, NGC 288, NGC 289, NGC 439, NGC 613 (Sculptor); M33, NGC 672 (Triangulum)

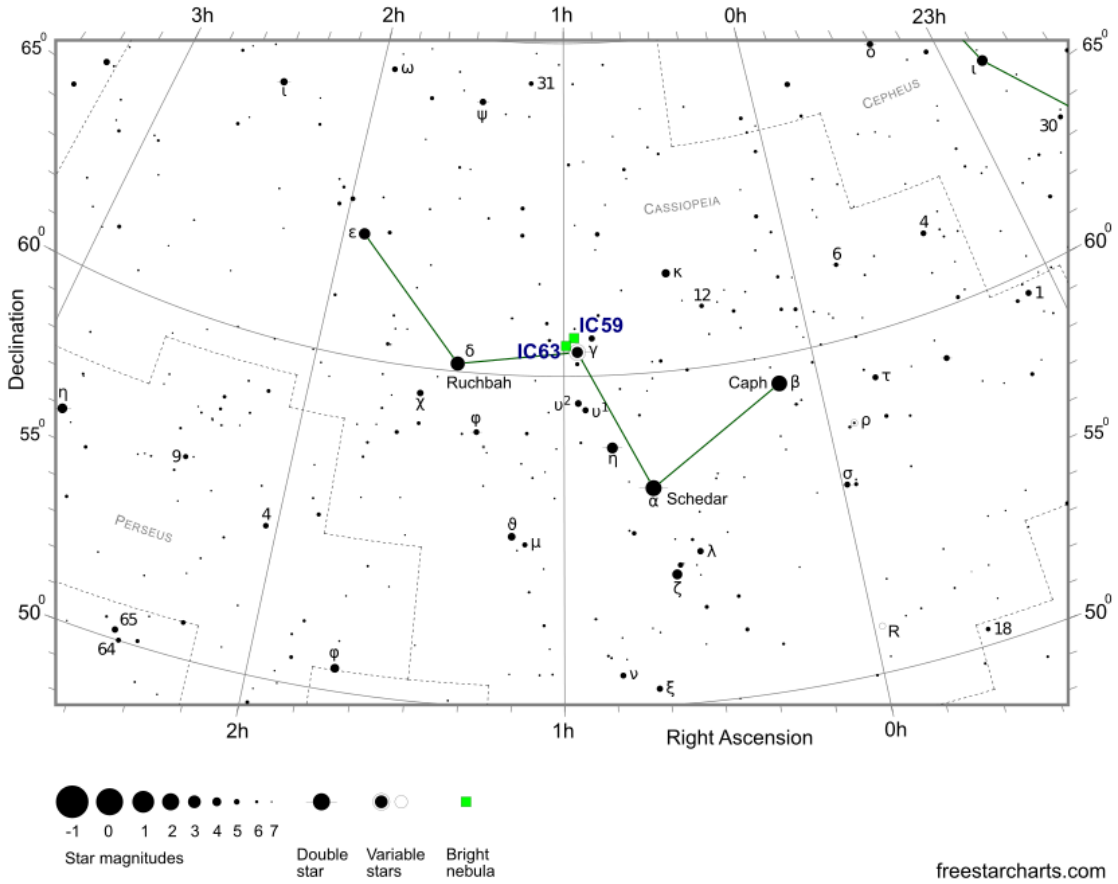
Top ten binocular deep-sky objects for November: M31, M33, M103, NGC 225, NGC 288, NGC 253, NGC 457, NGC 654, NGC 663, NGC 752

Top ten deep-sky objects for November: M31, M32, M33, M76, M103, M110, NGC 40, NGC 253, NGC 457, NGC 752

Challenge deep-sky object for November: IC 59 and IC 63 in Cassiopeia. See chart below.

The objects listed above are located between 0:00 and 2:00 hours of right ascension.

IC 59 and IC 63 - Reflection and Emission Nebulae



Free star charts for the month can be downloaded at http://www.skymaps.com/downloads.html and https://www.telescope.com/content.jsp?pageName=Monthly-Star-Chart and http://whatsouttonight.com/

Data on current supernovae can be found at http://www.rochesterastronomy.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 https://www.cambridge.org/turnleft/seasonal_skies_october-december

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

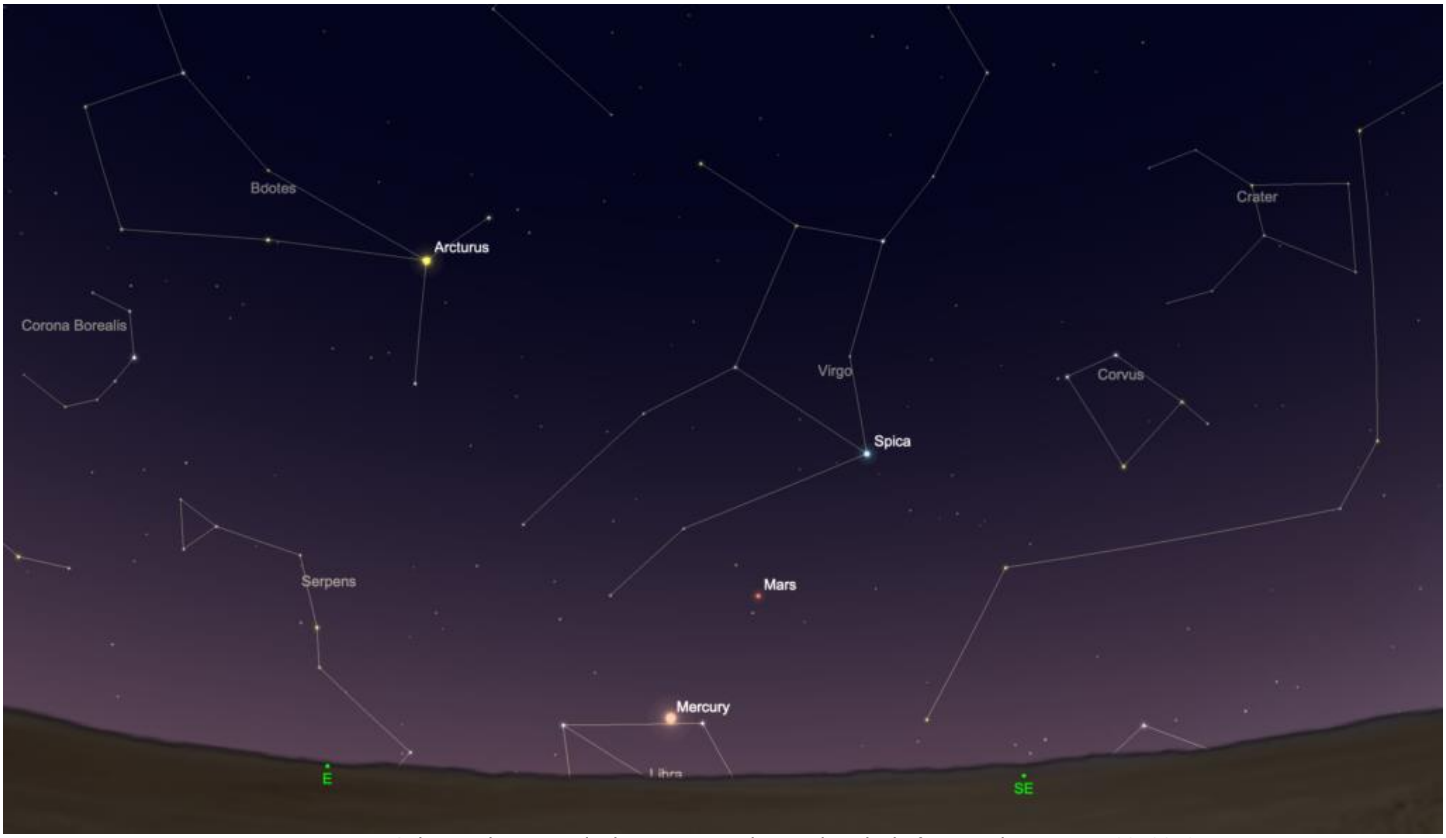
Information pertaining to observing some of the more prominent Messier galaxies can be found at http://www.cloudynights.com/topic/358295-how-to-locate-some-of-the-major-messier-galaxies-and-helpful-advice-for-novice-amateur-astronomers/

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://telescopius.com/

Freeware sky atlases can be downloaded at http://www.deepskywatch.com/files/deepsky-atlas/Deep-Sky-Hunter-atlas-full.pdf and http://astro.mxd120.com/free-star-atlases

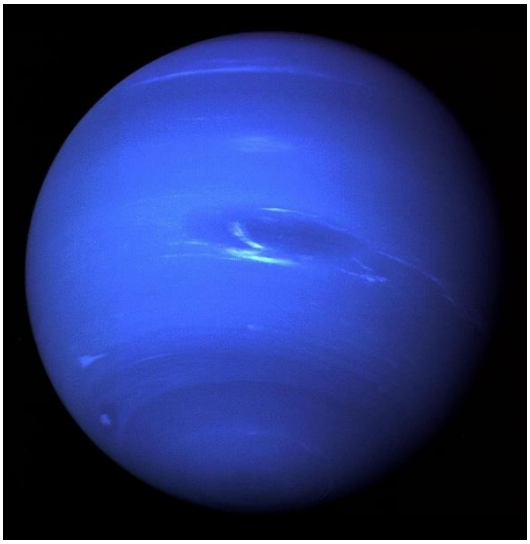


Mercury, Mars, Spica, and Arcturus in the eastern early morning sky before sunrise on Nov. 28, 2019.

The *Voyager* Odyssey
Chapter 8: The Neptune flyby & the moon Triton
by Loretta J Cannon

"There it was just sitting out there on the edge of our solar system, waiting for somebody to come out and appreciate its beauty, just waiting for the day that humans would get out there and go, 'Wow'."
- Candy Hansen, Imaging Science Team
quoted in documentary *The Farthest Voyager in Space* (2017)

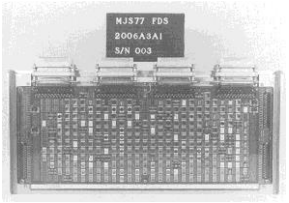
Voyager 2 encountered Neptune 30 years ago this August and, as the first and only spacecraft to reach the planet, it gave us not only surprising answers but also more questions regarding this bright blue giant. It had taken *Voyager* twelve years to reach the edge of the solar system. Data transit from *Voyager* took four hours one-way, at the speed of light, to cover the 2.7 billion miles to reach Earth. More fascinating is that, when launched, there was no system in place to receive a faint signal from the outer solar system. The sheer size of space is mind-boggling. When discovered in 1826, the existence of Neptune almost *doubled* the size of the then-known solar system. Another issue was the spacecraft's speed. On approach to Neptune, *Voyager 2* was moving at 42,000 mph, which gave mission planners very little time to acquire data before the spacecraft zipped away. Have you ever tried to take a picture of a stationary object while driving past at only 40 mph? The entire Neptune-Triton flyby was only five hours long.


Neptune as seen by *Voyager 2* credit: NASA/JPL

Planet	Distance from Sun in millions of miles: *N*,000,000 where *N* =
Mercury	35
Venus	67
Earth	93
Mars	142
Jupiter	485
Saturn	893
Uranus	1784
Neptune	2815

Scale of Solar System

After the problems encountered during the Saturn flyby, when the spacecraft's scan platform 'froze' during an attempt to execute a series of very fast maneuvers whilst on the other side of the planet, new methodology had to be devised to accomplish data acquisition for the next, faster flybys of Uranus and Neptune. During the four and a half years before reaching Uranus, experiments were conducted and changes were made to the onboard computers.



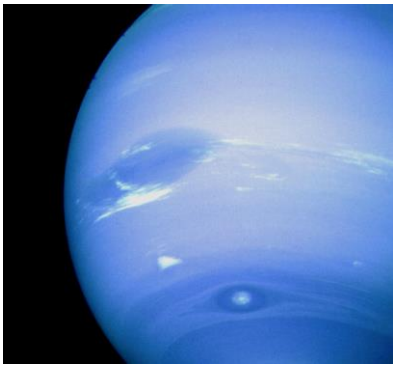
Flight Data System hardware
credit: NASA/JPL (photo 360-751AC)

There are three dual-redundant computers on board each *Voyager* spacecraft, two of which are reprogrammable inflight, a project design begun during the *Mariner* missions that proved very useful, allowing corrections to a second spacecraft after lessons learned during an initial flyby. The reprogrammable *Voyager* computers are the Central Computer & Sequencer (CCS) and the Flight Data System; the third system handles attitude control and articulation of the scan platform. For the Jupiter and Saturn flybys, the scan platform moved while the spacecraft flew along. For the two outer planets, the entire spacecraft moved its orientation relative to the planet using its hydrazine attitude-control jets (remember, there are 16 of them around the main 'bus'), allowing a pirouette. Another change for faster data acquisition was ingenious. Images were sent immediately to the backup computer for processing and data encoding (compression) which freed the main computer to direct the camera(s) to take the next image(s); the backup computer was used as an additional working computer.


Very Large Array credit: https://science.naro.edu

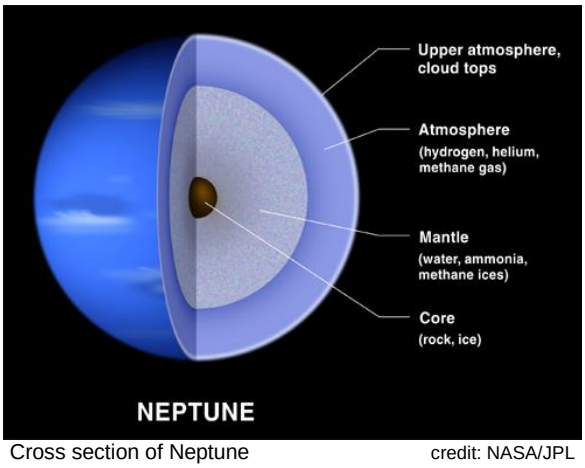
In order to detect the faint signal from 2.7 billion miles away, the JPL Deep Space Network (DNS) was upgraded. Formally started in 1963, the DSN has been as critical as the spacecraft we send exploring. The original antenna dishes in the Mojave Desert were 210 and 85 feet (original number of antennas unknown at this time). Today there are eight antennas there ranging from 230 feet to 112 feet; two other sites have been added, at Madrid (Spain) and Canberra (Australia). This link provides some interesting reading (https://www.gdscc.nasa.gov). For the Neptune data

acquisition, NASA received help from non-DSN antennas – the Very Large Antenna array in New Mexico, Australia's Parkes Observatory, and Japan's Usuda Deep Space Center. All this effort was worth the over 10,000 images we received.



Neptune's Great Dark Spot credit: NASA/JPL

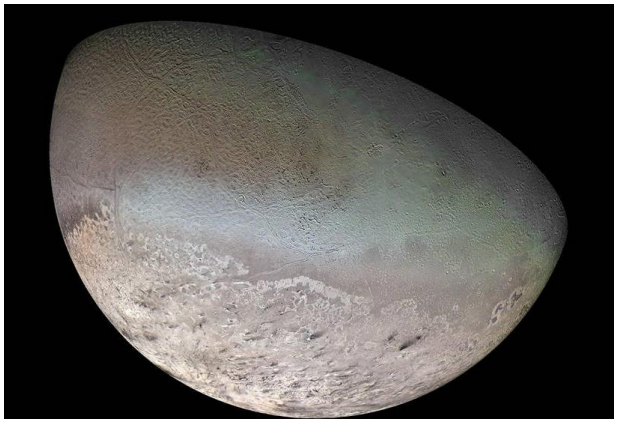
Neptune's appearance was stunning. On approach, the soon-to-be-named Great Dark Spot in the southern hemisphere could clearly be seen. Follow this link to an approach movie posted on the Planetary Society's website: https://www.planetary.org/multimedia/space-images/neptune/approaching-neptune-video.html (WARNING: there is a strobe effect in this video). The clouds on Neptune, unlike Jupiter, are not swirly but are blown in fairly straight lines around the planet by the fastest winds (1,500 mph) in the solar system across a surface unimpeded by features like mountains or valleys. The Great Dark Spot itself turned out to be ephemeral. In the years since *Voyager*, ground and space telescopes revealed that it has disappeared from the southern hemisphere while two new dark spot storms have appeared in the northern hemisphere. White spots (clouds) pop up and disappear over time. Methane, and perhaps carbon monoxide and hydrogen cyanide, in the atmosphere are believed to be responsible for Neptune's intense blue hue.



Cross section of Neptune credit: NASA/JPL

We left with more questions than answers regarding not only Neptune's magnetic field but also its internal composition and heat. Though 27 times stronger than Earth's, the magnetic field is not oriented along the planet's rotational axis; rather, like Uranus, it is offset. Imagine if Earth's magnetic north reoriented itself from the North Pole to Seattle, WA. Neptune is believed to have a core of ice, Fe, and Ni, similar in size to Earth's (tho small for a big planet). Covering this core is a thick mantle or ocean composed of superheated (1827-4725^{O}C) liquid water, ammonia, and methane under high pressure, which though fluid is still considered 'icy'. The gaseous atmosphere is composed of mostly hydrogen and helium with methane. And here is where it gets interesting. Above the cold (-17.6^{O}C) stratosphere, the thermosphere is 'heated' to near 475^{O}C. This is 2 ½ times the amount of solar heat received. We don't know why.

Prior to *Voyager*, we'd identified only two moons, Nereid and Triton, and Triton proved to be full of surprises. To reach Triton, the spacecraft swooped over Neptune's north pole, within a mere 3,000 miles of the very active atmosphere, and down towards the moon. About 22% smaller than our moon, this body is the coldest world (-235^{O}C) in the solar system. The surface, composed of mainly nitrogen ice, has been compared to a cantaloupe. It has an atmosphere of mostly nitrogen, interestingly like Titan (orbiting Saturn) and our Earth. A faintly pink methane ice comprises the huge south polar cap. Larry Soderblom, *Voyager* imaging and planetary expert, tells the story of how they were attempting to create a mosaic of Triton when two photos just wouldn't line up. So, they put them into a stereo viewer and "up popped these geysers!" It is believed that sunlight passing through the frozen nitrogen heats up dark particles (carbonaceous?) beneath, perhaps vaporizing nitrogen, then gas builds up, and whoosh – plumes erupt up to 8,000 meters high, depositing dark streaks on the surface. Lastly, if having a nitrogen-rich atmosphere and geysers on the coldest world weren't enough, Triton orbits in the *opposite* direction to Neptune's spin. This last oddity has led some to theorize that Triton formed elsewhere and was later captured by Neptune's gravity into an initial highly elliptical orbit, which squeezed and stretched the moon, heating the interior and leading to volcanic eruptions. As Triton's orbit became more circular, the moon cooled, leaving the current pitted and cracked surface.



Triton's polar ice cap credit: NASA/JPL-CalTech

For December, we'll learn about the famous Golden Record. In January, it's the 34th anniversary of the Uranus flyby. Then in February, we'll close out the Voyager journey.

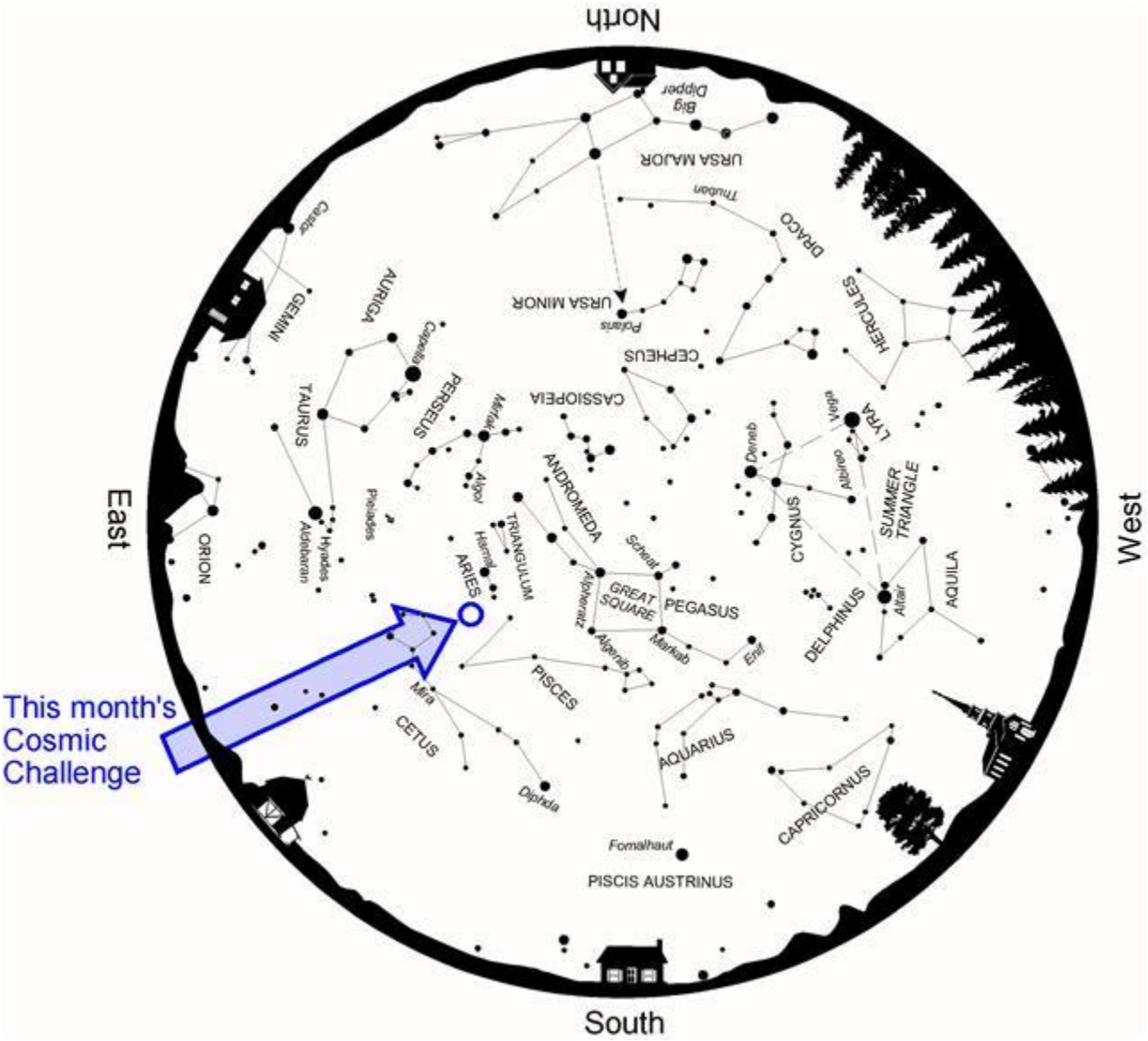
Phil Harrington's Cosmic Challenge

Cosmic Challenge: Satellites of Uranus

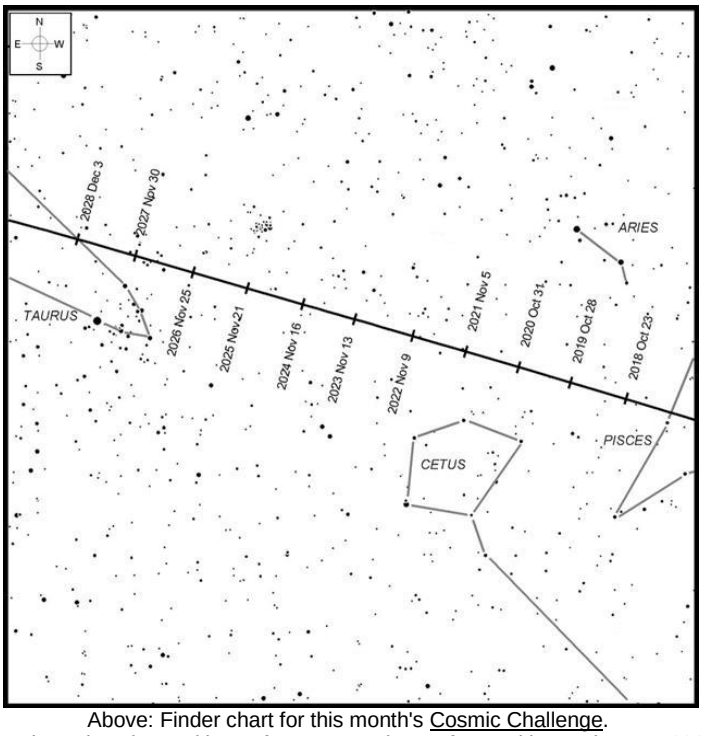
	10-inch (25 cm) to 14-inch (36 cm) telescopes.

If you were like me, then one of the first things you saw through a telescope was Jupiter and its four Galilean moons. I was absolutely amazed with the idea that I could come back after only a few hours and see that the moons had moved with respect to the planet and each other. Imagine Galileo's astonishment when he saw this wondrous sight for the first time.

The Galilean satellites can be seen in a pair of steadily held binoculars. Moving farther out to Saturn, its largest moon, Titan, can be spotted with little effort through the smallest backyard scopes. How about the moons orbiting the planet Uranus? Have you ever seen any of them? Not possible, you say?



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



Above: Finder chart for this month's Cosmic Challenge.
The chart plots the positions of Uranus on dates of opposition to the year 2028.
Click on the chart to open a printable PDF version.

Of the 27 known satellites in the Uranian family, four stand out, just as the four Galilean satellites do among the Jovian clan. William Herschel discovered the first two Uranian moons on January 11, 1787, six years after he had discovered the planet itself. The next two remained undetected until the British astronomer William Lassell (1799-1880) spotted them on October 24, 1851. It is these four that we hope to catch through our own telescopes.

The four major moons of Uranus -- Titania, Oberon, Ariel, and Umbriel -- take their names from the writings of William Shakespeare and Alexander Pope. Oberon was the King of the Fairies in A Midsummer Night's Dream, while Titania was his queen. Ariel was the leading sylph in Alexander Pope's poem The Rape of the Lock and, coincidentally, also the spirit who serves Prospero in Shakespeare's The Tempest. Finally, Umbriel was named for the "dusky melancholy sprite" in The Rape of the Lock.

All four are made of rock mixed with a frozen cocktail of ammonia, methane, and water ice. Like the major moons of Jupiter, Saturn, and Neptune, Titania, Oberon, Ariel, and Umbriel all orbit Uranus almost exactly in the plane of the planet's equator. Due to the odd, sideways tilt of Uranus's rotational axis, however, this can cause the moons to appear at odd angles with respect to the planet itself. As the planet orbits the Sun, the paths followed by the moons appear to change shape and orientation over time. Currently, they appear oriented northwest-southeast, tracing out narrow clockwise paths around the planet.

Uranus’s two largest moons, Titania and Oberon, each measure about 900 miles (1,500 km) in diameter. Photos taken during the 1986 Voyager 2 flyby show that Titania's battered surface is crisscrossed by valleys and faults that stretch for hundreds of miles. Although many impact craters are seen, there are fewer than on Oberon. Together, the fewer craters and many fault lines tell us that Titania’s surface is younger than Oberon’s. Since both moons are the same physical age, this means that Titania must have once experienced a higher level of geologic activity than its neighbor.

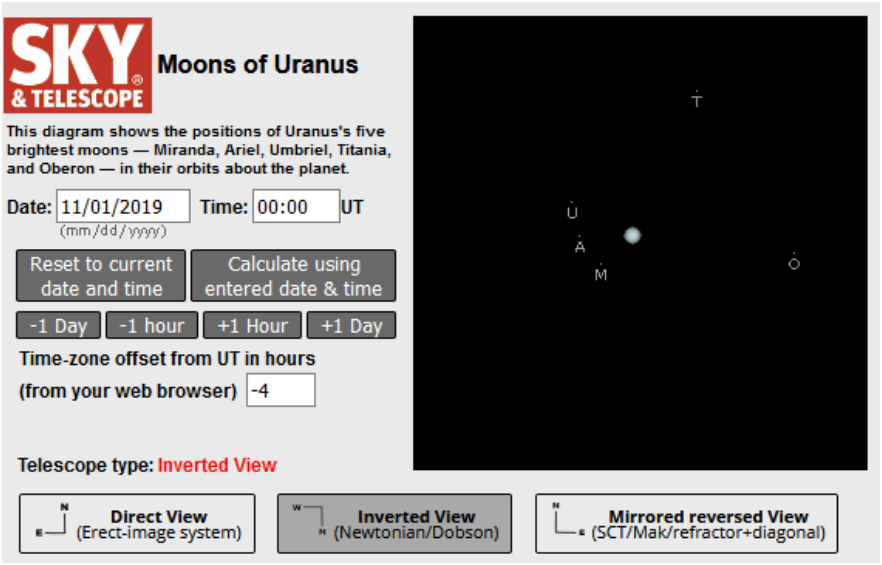
Neither Titania nor Oberon ever exceeds 14th magnitude. Of the two, Oberon is easier to spot since it orbits farther from Uranus and, therefore, can appear farther away from the planet's glare. Even at greatest elongation, however, it is always less than an arc-minute away from the planet. Ariel, measuring 720 miles (1,158 km) across, resembles Titania in Voyager photos, with an interweaving network of valleys and faults threaded across its frigid surface. These faults, as well as those on Titania, may be the result of the rapid cooling of the moon's hot core shortly after formation.

Finally, Umbriel (727 miles or 1170 km in diameter) bears a strong resemblance to Oberon. Its dark surface is scarred by many impact craters, but lacks the faults and valleys that characterize Titania and Ariel. Umbriel and Ariel get about as bright as Titania and Oberon, but because they orbit even closer to the planet, present an even greater challenge to observers. Ariel, the closest, is never more than 15" from Uranus.

Above: The five largest moons of Uranus, as imaged by Voyager 2 in 1986. NASA images.

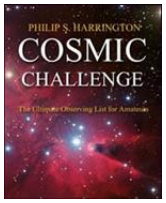
If spotting those four is "easy," then try your luck with a fifth moon, Miranda. Miranda's surface terrain is a real mishmash. Some regions are likely very old, based on crater counts, while other areas are comparatively new, again based on the number of craters. There are many theories out there trying to explain its disheveled appearance. Some suggest it was shattered into pieces due to one or more collisions in its early history, but was able to reassemble itself in a haphazard, inside-out manner. Others explain the Miranda jigsaw-like surface was caused by upwelling of partially melted ices. Miranda is, after all, about 50% ice. So far, only Voyager 2 has flown past the Uranian system, so clearly more close-up investigation is needed.Can *you* actually see Miranda for yourself? Hold on tight, it averages 16th magnitude! While that's below the cutoff for our featured aperture range this month, it just might be visible through some super-sized amateur telescope.

For the best chance at seeing any of these challenging targets, Uranus should near opposition, when its distance away from Earth is least. That just happened on October 28, which makes this month ideal for the hunt. But you'll need to wait patiently until each satellite is at its greatest elongation point from the planet. To help you find out when that will occur, several popular software programs, including the old school program Guide by Project Pluto, plot the location of each Uranian moon for any date and time. Sky & Telescope magazine's web site also has an excellent Javascript utility that will show each moon's position at any time. The tool uses your system's time and date by default, but it can be set manually for any occasion between 2008 and this year. Here is the line-up from November 1, 2019, at 00:00 Universal Time (UT). [If need be, use this web site to convert between Universal Time, also known as Greenwich Mean Time (or GMT) and your local time.]



To learn the ins and outs of the S&T tool, read this article by Roger Sinnott and Adrian Ashford.

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.

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 Messenger Crosses the Sun: Mercury Transit 2019

By David Prosper

Did you know that there are two other objects in our skies that have phases like the Moon? They're the inner planets, found between Earth and the Sun: Mercury and Venus. You can see their phases if you observe them through a telescope. Like our Moon, you can't see the planets in their "new" phase, unless they are lined up perfectly between us Earthlings and the Sun. In the case of the Moon, this alignment results in a **solar eclipse**; in the case of Mercury and Venus, this results in a **transit**, where the small disc of the planet travels across the face of the Sun. Skywatchers are in for a treat this month, as Mercury transits the Sun the morning of **November 11**!

You may have seen the transit of Venus in 2012; you may have even watched it through eclipse glasses! However, this time you'll need a solar telescope to see anything, since eclipse glasses will only reveal the Sun's blank face. Why is that? Mercury is the smallest planet in our solar system, and closer to the Sun (and further away from Earth) during its transit than Venus was in its 2012 transit. This makes Mercury's disc too small to see without the extra power of a telescope. Make absolutely certain that you view the transit via a telescope equipped with a safe solar filter or projection setup. Do NOT combine binoculars with your eclipse glasses; this will instantly burn a hole through the glasses – and your eyes! While most people don't have solar telescopes handy, many astronomy clubs do! Look for clubs hosting Mercury transit observing events near you at bit.ly/findnsn (USA) or at bit.ly/awbtransit (worldwide).

What a fun opportunity to see another planet during the day! This transit is expected to last over five hours. Folks on the East Coast will be able to watch the entre transit, weather permitting, from approximately 7:35 am EST until around approximately 1:04 pm EST. Folks located in the middle of North America to the west coast will see the transit already in progress at sunrise. The transit takes hours, so if your weather is cloudy, don't despair; there will be plenty of time for skies to clear! You can find timing details and charts via eclipse guru Fred Espenak's website: bit.ly/mercurytransit2019 Mercury's orbit is small and swift, and so its position in our skies quickly changes; that's why it was named after the fleet-footed messenger god of Roman mythology. In fact, if you have a clear view of the eastern horizon, you'll be able to catch Mercury again this month! Look for it before dawn during the last week of November, just above the eastern horizon and below red Mars. Wake up early the morning of November 24th to see Mars, the Moon, and Mercury form a loose triangle right before sunrise.

Discover more about Mercury and the rest of our solar system at nasa.gov

More information on the transit is found here and get your certificate.

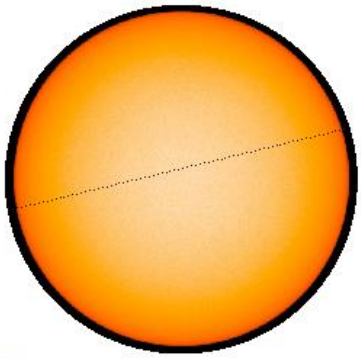
https://www.astroleague.org/PlanetaryTransit_Venus2012 This is the correct link if you want your ALCOR award.

https://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=653. Printable certificates are here.

I Saw the Mercury Transit!

November 11, 2019

(Name)



The next transit of Mercury will occur on November 13, 2032.
Keep looking up with events and activities at the Night Sky Network: nightskynetwork.org

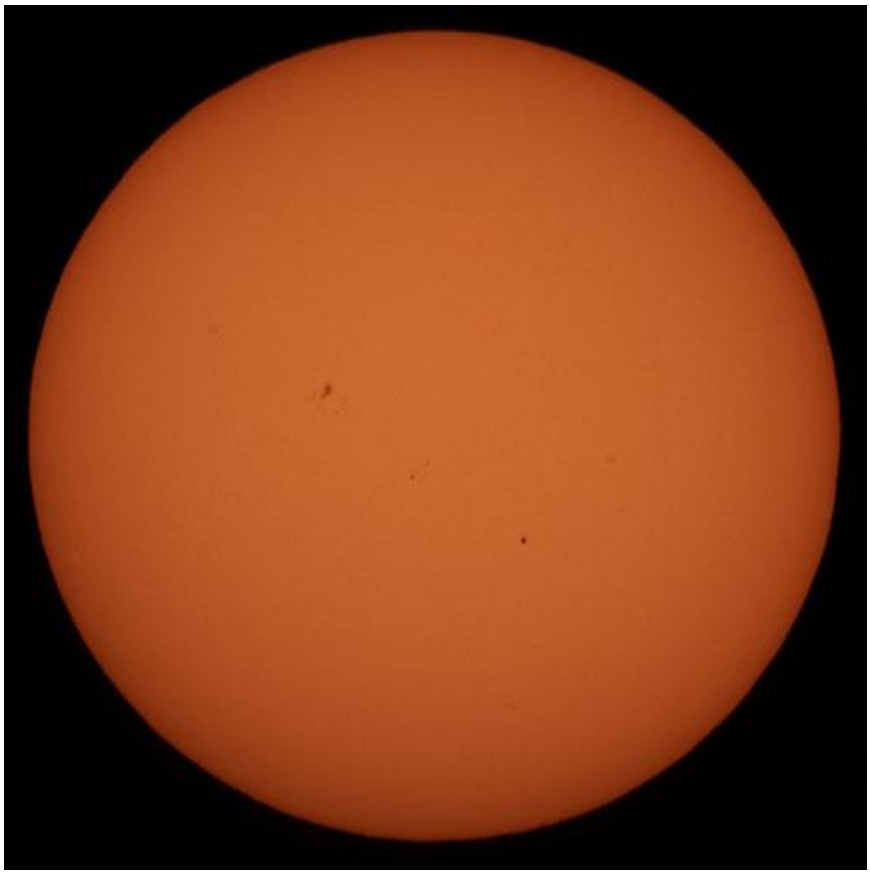


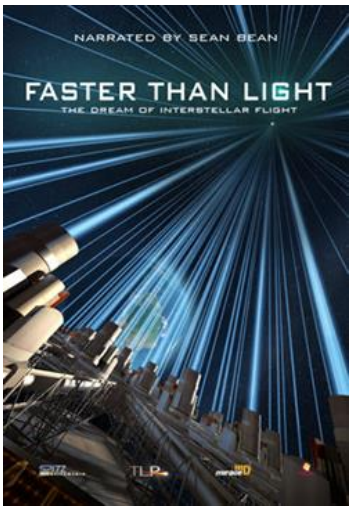
Photo of the 2016 Mercury transit taken by David Huntz of the *Oklahoma City Astronomy Club.*
Mercury is the tiny dot seen lower right of center; the larger mark seen above the left of center is a sunspot. Mercury's disc is tiny!

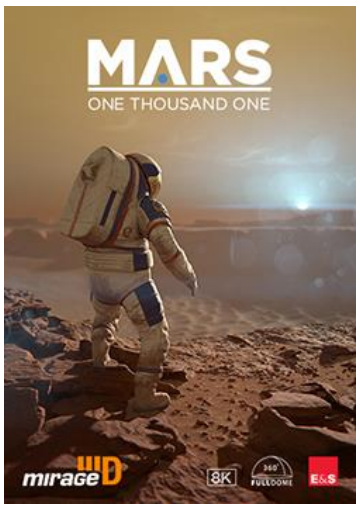
Observatory and Planetarium

Event	Place	Date	Time	Admission
Monthly Free Star Party	Centennial Observatory	Saturday, November 9th, 2019	6:00 PM to midnight	FREE
Transit of Mercury	Centennial Observatory	Monday, November 11th, 2019	7:15 to 11:15 AM	FREE
Telescope Tuesday	Centennial Observatory	Tuesday, November 12th, 2019	6:00 to 9:00 PM	$1.50 or free with Faulkner Planetarium admission
Telescope Tuesday	Centennial Observatory	Tuesday, November 26th, 2019	6:00 to 9:00 PM	$1.50 or free with Faulkner Planetarium admission

CSI Centennial Observatory / Faulkner Planetarium Herrett Center

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.

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.