RASC Toronto Centre – www.rascto.ca
The Sky This Month – Dec 12, 2018 to, Jan 30, 2019 (times in EST)
by Chris Vaughan

NEWS

Space Exploration – Public and Private

Ref. http://spaceflightnow.com/launch-schedule/

Launches

Dec. 18 at approx. 9:24-9:50 am EST - A SpaceX Falcon 9 rocket from Cape Canaveral Air Force Station, Florida, payload USAF's first third-generation navigation satellite for GPS.
Dec. 18 at TBD - Arianespace Soyuz rocket from Sinnamary, French Guiana, payload first Composante Spatiale Optique military reconnaissance satellite into polar orbit.
December at TBD - Geosynchronous Satellite Launch Vehicle Mk. 2 rocket from Satish Dhawan Space Center, Sriharikota, India, payload GSAT 7A communications satellite for the Indian Air Force.
Dec. 25 at TBD - Proton rocket and Breeze M upper stage from Baikonur Cosmodrome, Kazakhstan, payload Blagovest No. 13L communications satellite.
Dec. 25 at TBD - Soyuz rocket from Vostochny Cosmodrome, Russia, payload Kanopus-V 5 and 6 Earth observation satellites for disaster response, mapping and forest fire detection.
Dec. 27 at TBD - Soyuz rocket from Baikonur Cosmodrome, Kazakhstan, payload EgyptSat-A Earth observation satellite.
Dec. 30 at 11:38 am EST - SpaceX Falcon 9 rocket from Vandenberg Air Force Base, California, payload 10 satellites for the Iridium next mobile communications fleet.
TBD at 3:00-4:30 am EST - An air-launched Northrop Grumman Pegasus XL rocket from Cape Canaveral Air Force Station, Florida, payload NASA's Ionospheric Connection Explorer (ICON) satellite to study the ionosphere.
January at TBD - Long March 5 rocket from Wenchang, China, payload Shijian 20 communications satellite.
January 7 (?) at TBD - Falcon 9 rocket from Kennedy Space Center, Florida, payload Crew Dragon spacecraft on an uncrewed test flight to the ISS.
Early 2019 at TBD - Falcon Heavy rocket from Kennedy Space Center, Florida, payload Arabsat 6A communications satellite for Arabsat of Saudi Arabia.
January at TBD - Falcon 9 rocket from Cape Canaveral Air Force Station, Florida, payload PSN 6 communications satellite and Israeli SpaceIL's Lunar Lander.
Jan. 23 at 6:40-7:35 pm EST - ULA Delta 4 rocket from Cape Canaveral Air Force Station, Florida, payload 10th Wideband Global SATCOM spacecraft.
Jan. 30 at TBD - Geosynchronous Satellite Launch Vehicle Mk. 3 (GSLV Mk.3) rocket from Satish Dhawan Space Center, Sriharikota, India, payload Chandrayaan 2 mission, India's second mission to the moon. Chandrayaan 2 will consist of an orbiter, the Vikram lander and rover.

New Horizons at Ultima Thule!

At 05:33 UT (12:33 am EST) on January 1, 2019, the distant New Horizons spacecraft will speed past a previously unexplored Kuiper Belt object designated 2014 MU69, or Ultima Thule. The distance to the dual-lobed (or perhaps binary) object will be 44.3 AU from Earth, for a one-way radio signal travel time of 6h8m4s. The closest approach will be only 3,500 km from the object, three times closer than New Horizons flew to Pluto. On January 1, 2019, the object's sky position will be 0.25 degrees northwest of the naked-eye star 41 Sgr, but too close to the sun to observe.

By the time we wake up on New Years Day, we'll have another world to wonder at! http://pluto.jhuapl.edu/

OSIRIS-ReX at Bennu
Recently analyzed data from NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) mission has revealed water locked inside the clays that make up the asteroid Bennu.

OSIRIS-REx currently is performing a preliminary survey of the asteroid, flying the spacecraft in passes over Bennu's north pole, equator, and south pole at ranges as close as 7 km to better determine the asteroid's mass. The mission's scientists and engineers must know the mass of the asteroid in order to design the spacecraft's insertion into orbit because mass affects the asteroid's gravitational pull on the spacecraft. Knowing Bennu's mass will also help the science team understand the asteroid's structure and composition.

This survey also provides the first opportunity for the OSIRIS-REx Laser Altimeter (OLA), an instrument contributed by the Canadian Space Agency, to make observations, now that the spacecraft is in proximity to Bennu.

The spacecraft's first orbital insertion is scheduled for Dec. 31, and OSIRIS-REx will remain in orbit until mid-February 2019, when it will initiate another series of flybys for the next survey phase, to orbit the asteroid at a range of 1.4 km to 2.0 km from the center of Bennu — setting new records for the smallest body ever orbited by a spacecraft and the closest orbit of a planetary body by any spacecraft.

Sample collection is scheduled for July 4, 2020, to be returned to Earth (in Utah) on September 24, 2023.

https://www.asteroidmission.org/?latest-news=nasas-newly-arrived-osiris-rex-spacecraft-already-discovers-water-asteroid

InSight on Mars
Audio from Mars!!!!!! https://www.youtube.com/watch?v=yT50Q_Zbf3s

This Month in History (a sampling)

Ref. http://www2.jpl.nasa.gov/calendar/, http://www.planetary.org/multimedia/space-images/charts/whats-up-in-the-solar-system-frohn.html,
http://www.lunar-occultations.com/rlo/calendar.pdf

Astro-Birthdays and Milestones
Dec 14, 1546 – Tycho Brahe, pioneering naked-eye astronomer
Dec 16, 1917 – Sir Arthur C Clarke, prolific Sci-Fi author, TV host, and conceptualizer of geosynchronous satellites. "Any sufficiently advanced technology is indistinguishable from magic."
Dec 16, 1857 – E.E. Barnard, American astronomer, astrophotographer, pioneer in stellar proper motion
Dec 20, 1996 – Death of Carl Sagan, aged 62, planetary scientist, teacher, author, pioneer in astronomy and space outreach, co-founder of The Planetary Society
Dec 25, 1642 – Sir Isaac Newton, author, Renaissance man, pioneer in calculus, gravitation, optics and light spectra, builder of the Newtonian telescope
Dec 27, 1571 – Johannes Kepler, contemporary of Brahe, applied physics to astronomy, Laws of Planetary Motion
Dec 28, 1882 – Arthur Stanley Eddington, distinguished British astronomer and astrophysicist, developed stellar mass-luminosity relationship
Jan 8, 1942 – Stephen Hawking born

Jan 8, 1642 – Death of Galileo Galilei, and in 1908, Birth of Doctor Who (William Hartnell)
Jan 10, 1946 – Robert Wilson, co-discoverer of cosmic microwave background born
Jan 15, 2014 – passing of John Dobson, aged 98, pioneer of astronomy outreach and developer of Dobsonian, born Sep 14, 1915 in Beijing
Jan 16, 1944 - Jill Tarter, American SETI pioneer and radio astronomer

Astronomy and Space Exploration
Dec 12, 1995 – SOHO Observatory launched
Dec 15, 1970 – Venera 7 becomes first spacecraft to land on another planet and return data
Dec 13, 1920 – The first diameter of a star, Betelgeuse, is measured by Francis Pease with an interferometer at Mt. Wilson
Dec 23, 1672 – Giovanni Cassini discovers Saturn's moon Rhea
Dec 29, 1888 – Isaac Roberts photograph of M31 reveals that it is NOT a mere nebula
Jan 1, 1801 – Giuseppe Piazzi discovers Ceres
Jan 4-15, 1610 – Galileo uses his spyglass to observe craters and mountains on the Moon, moving spots on the Sun, moons revolving around Jupiter, the phases of Venus, and the almost innumerable stars of the Milky Way!
Jan 9, 1839 – Scottish astronomer Thomas Henderson publishes first stellar parallax measurement
Jan 16, 1969 – Discovery of first Optical Pulsar, in the Crab Nebula, by John Cocke & Michael Disney using a 36" telescope at Kitt Peak
Jan 17, 1929 - Edwin Hubble Publishes Paper that the Universe is Expanding
Jan 19, 2006 - New Horizons Mission launch for 9 year trip to Pluto (flyby in July, 2015) and Kuiper Belt
Jan 25, 2004 – Opportunity Rover landing on Mars
Jan 27, 1967 – Apollo 1 crew, Grissom, Chaffee, and White perished in a capsule fire during training
Jan 28, 1986 – Shuttle Challenger explodes shortly after liftoff

Star Parties, etc.

Ref: http://www.amsky.com/calendar/events/#may, https://www.skynews.ca/star-party-calendar/

"**RASC Dark Skies Observing**", Long Sault Conservation Area – window runs Jan 7-10
"**RASC City Skies Observing**", Bayview Village Park, Toronto – window runs Jan 14-17
"**RASC Solar Observing**", Ontario Science Centre Teluscape –10 to noon on Jan 5 (or Jan 12)

OBSERVING

Globe at Night 2019

A citizen science program to map light pollution around the world. During the observing window, you are encouraged to make a visual measurement to determine the limiting magnitude of stars you can observe at your location. The website provides charts for assisting observations, instructions for submitting results, and an interactive map showing current and historical results. Details are at http://www.globeatnight.org/
Campaigns: **Orion** Dec 29, 2018 to Jan 7, 2019 and **Orion** Jan 27 to Feb 5, 2019.

Sunrise/Sunset

December 12, sunrise at 7:41 am, sunset at 4:40 pm (8h59m of daylight)
January 30, sunrise at 7:36 am, sunset at 5:25 pm (9h49m of daylight)

Friday, December 21 at 5:23 pm – Northern Winter Solstice
Wednesday, January 2 at midnight – Earth at perihelion (147,099,761 km)

Astronomical Twilight

The skies are not truly dark until the Sun drops well below the horizon. Below are the times of true darkness, also known as Astronomical Twilight. Astrophotography is best done in full darkness. Details are at
https://www.timeanddate.com/sun/canada/toronto?month=10
http://www.timeanddate.com/astronomy/canada/toronto

Dec 12, astronomical twilight ends at 6:24 pm EST and starts at 5:58 am EST (11h34m of imaging time)
Jan 30, astronomical twilight ends at 7:04 pm EST and starts at 5:56 am EST (10h52m of imaging time)

Moon - Orbit

Apogee – Wed, Dec 12 at 7 am EST
Perigee – Mon, Dec 24 at 5 am EST
Apogee – Tue, Jan 8 at 11 pm EST
Perigee – Mon, Jan 21 at 3 pm EST

Moon - Phases

Saturday, December 15 at 6:49 am - First Quarter Moon (sets around midnight)
Saturday, December 22 at 12:49 pm - Full Oak/Cold/Long Nights Moon
Saturday, December 29 at 4:34 am - Last Quarter Moon (rises around midnight)
Saturday, January 5 at 8:28 pm - New Moon and Partial Solar Eclipse
Monday, January 14 at 1:45 am - First Quarter Moon (sets around midnight)
Monday, January 21 at 12:16 am - Full Wolf/Old Moon and Total Lunar Eclipse, supermoon
Sunday, January 27 at 4:10 pm - Last Quarter Moon (rises around midnight)

Libration

E limb most exposed on Dec 31 (+6.5°) and Jan 28 (+7.5°)
W limb most exposed on Dec 19 (–6.7°) and Jan 16 (–7.6°)
N limb most exposed on Dec 18 (+6.8°) and Jan 15 (+6.8°)
S limb most exposed on Jan 27 (–6.8°)

Moon – Conjunctions, Eclipses, etc.

January 5 - Partial Solar Eclipse

This Moon's shadow for this partial solar eclipse will first make contact with the Earth in Sichuan Province, China. It will sweep north into eastern Siberia and then south through the Aleutian Islands before ending the eclipse in the North Pacific Ocean. First contact occurs at 0:27 UT on January 6. Greatest eclipse occurs near Srednekolymsk at 01:41:28 UT, at which time 71% of the Sun's diameter will be covered. Last contact occurs at 03:12 UT. Proper solar filters will be required to view the entire eclipse. For those watching online, the eclipse will run from 7:27 pm EST to 10:12 pm EST on January 5, with greatest eclipse at 8:41:28 EST.

January 20-21 - Total Lunar Eclipse

For this "Supermoon" total lunar eclipse, occurring only 0.6 days before perigee, the Moon's diameter will appear larger than average. The moon will pass deeply through the northern umbra, extending totality to 1h02m in duration, and darkening the Moon's southern half much more than its northern half. At greatest eclipse, the Moon will be in Cancer, 7 degrees west of Messier 44 (The Beehive Cluster). The entire event will be visible from North and South America, the eastern Pacific Ocean, and westernmost Europe.

In Toronto, the Eclipse timings are as follows:
Penumbra First contact: 9:36:30 pm EST on January 20
Umbra First contact: 10:33:54 pm EST (Partial begins)

Umbra Second contact: 11:41:17 pm EST (Totality begins)
Maximum Eclipse: 12:13:27 am EST on January 21
Umbra Third contact: 12:43:16 am EST (Totality ends)
Umbra Fourth contact: 1:50:39 am EST (Partial ends)
Penumbra Last contact: 2:48:00 am EST on January 21

Lunar Appulses and Conjunctions

On **January 31** the old moon will sit 2 degrees west (to the upper right) of Venus. Observers in eastern Micronesia, Polynesia (except Hawaii), Galapagos Is., southern Central America, and northwest South America will see the moon occult Venus. In North America, the moon will aid in finding Venus during the morning daylight hours.

Starting in mid-evening on Thursday, December 20, the waxing gibbous moon's orbital motion will carry it directly through the Hyades star cluster, the stars that form the triangular face of Taurus, the bull. The moon will enter the cluster at about 8 pm EST. By 4 am EST, the moon will exit the cluster after passing within a degree above the bright foreground star Aldebaran.

In late evening on Monday, December 24, the orbital motion of the waning gibbous moon will carry it just below the center of the large open star cluster known as the Beehive (and Messier 44) in Cancer. Both objects will fit within the field of view of a telescope at low magnification, although the bright moonlight will obscure the cluster's dimmer stars.

Planetary Appulses and Conjunctions

On **December 21**, in the eastern pre-dawn sky, Mercury will move to sit only one degree north (to the upper left) of slightly brighter Jupiter, allowing both planets to appear within the same field of view of a telescope at low magnification. On **January 22**, Venus' more rapid eastward motion will overtake Jupiter, appearing 2.3 degrees north of (above) the giant planet. The duo will fit into the field of view of binoculars and widefield telescopes. On **December 21**, the planets Mercury and Jupiter will rise together from the east-southeastern horizon. Brighter Jupiter will sit only one degree south (to the lower right) of Mercury, allowing both planets to appear within the same field of view of a telescope at low magnification. Jupiter will pass 15 arc-minutes north of the bright globular cluster NGC6235 on **January 16**, setting up a nice photo opportunity. On **January 22**, Venus' more rapid eastward motion will overtake Jupiter, placing it 2.3 degrees north of (above) the giant planet. The duo will fit into the field of view of binoculars and widefield telescopes.

Planets and Dwarf Planets

Due to the planet's position above the morning ecliptic, during December **Mercury** will continue an excellent pre-dawn apparition. It will reach greatest western elongation and maximum brightness on December 15, when it will be best seen between 6:15 and 7:15 am local time. It will remain visible for the rest of December. On December 21, Mercury will move to sit only one degree north (to the upper left) of slightly brighter Jupiter, allowing both planets to appear within the same field of view of a telescope at low magnification. Come January, Mercury will be well on its way downward and toward the sun, limiting its visibility to a short period after 7 am local time during the first half of the month. On January 4, the very old crescent moon will land less than 3 degrees above Mercury. For the rest of the month, Mercury will move towards superior conjunction with the sun on January 30. At the same time, Mercury will wax towards a completely full phase and shrink in apparent disk diameter from 5.2" to 4.8".

From mid-December and through January, **Venus** will shine brightly in the eastern pre-dawn sky, remaining visible until just before sunrise due to its brilliance. The planet will enter Libra on December 13, move into Scorpius on January 10, and then transition into southern Ophiuchus after mid-month. On January 6, the

planet will reach its greatest angle west of the sun, when it will shine at a maximum brilliance for the year (magnitude -4.6) and will exhibit a 50% illuminated, 25 arc-second diameter disk. For the rest of January, Venus will slowly wax in phase (to 62%), and shrink in apparent diameter to 19.3 arc-seconds. The old moon will land 4.5 degrees to the west (upper right) of Venus. On January 22, Venus' more rapid eastward motion will overtake Jupiter, appearing 2.3 degrees north of (above) the giant planet. The duo will fit into the field of view of binoculars and widefield telescopes. To end the month, the old moon will return on January 31 to sit 2 degrees west (to the upper right) of Venus. Observers in eastern Micronesia, Polynesia (except Hawaii), Galapagos Is., southern Central America, and northwest South America will see the moon occult Venus. In North America, the moon will aid in finding Venus during the morning daylight hours.

The year 2019 will be a poor one for observing **Mars**. From mid-December through January, the red planet will remain well-positioned for viewing in the southwestern evening sky as a medium-bright, reddish, naked-eye object because the evening ecliptic has lifted it higher, and also because it is travelling rapidly eastward, leaving Aquarius for Pisces on December 21, while the stars shift west every evening. Due to this motion, Mars will set at about 11:30 pm local time for the next six weeks. Mars will decrease in brightness and apparent disk diameter from mid-December to the end of January, starting at magnitude +0.17 and a maximum apparent disk diameter of 8.49 arc-seconds. But Earth's increasing distance from the planet will dim Mars to magnitude +0.88 and shrink it to 6.14 arc-seconds on January 31. The waxing crescent moon will pass 5 degrees to the south (to the lower left) of Mars on January 12.

Jupiter, recently past opposition, will spend late December and all of January low in the southeastern pre-dawn sky among the stars of southern Ophiuchus. The magnitude -1.77 planet will rise 70 minutes before the sun (at 6:36 am local time) on December 12 and 3.5 hours ahead (at 4:12 am) at the end of January. On December 21, the planets Mercury and Jupiter will rise together from the east-southeastern horizon. Brighter Jupiter will sit only one degree south (to the lower right) of Mercury, allowing both planets to appear within the same field of view of a telescope at low magnification. The old crescent moon will land 3 degrees northeast (to the left) of Jupiter on January 3. The planet will pass 15 arc-minutes north of the bright globular cluster NGC6235 on January 16, setting up a nice photo opportunity. On January 22, Venus' more rapid eastward motion will overtake Jupiter, placing it 2.3 degrees north of (above) the giant planet. The duo will fit into the field of view of binoculars and widefield telescopes. The old moon will return to hop past Jupiter on January 30 and 31.

Saturn will be visible with difficulty within the western evening twilight during mid-December. It will reach conjunction with the sun on January 2, and it won't become a reasonable observing target, in the eastern pre-dawn sky, until well after mid-month, when it will start to rise before 7 am local time. Saturn will spend all of 2019 in Sagittarius.

Blue-green **Uranus** (magnitude 5.76) will spend latter December and January among the stars of eastern Pisces, slowly moving westward until its retrograde loop ends on January 6. Uranus will be very well positioned for evening observing all month long, holding a position more than halfway up the southern and southwestern sky as soon as it's full dark. Although Uranus may be seen with the naked eye in a very dark sky, binoculars or a small telescope will make seeing it relatively easy. The magnitude +4.25 star Omicron Piscium will aid you in finding Uranus for the first part of the year. On December 12, Uranus will sit 1.3 degrees northeast (to the upper left) of that star. The separation will increase only slightly by the end of January.

For December and January, deep blue **Neptune** will be visible in the western sky during early evening. The distant planet will spend the month moving eastward through the stars of Aquarius. The planet will be framed within the triangle formed by the naked eye stars Lambda (λ) (aka Hydor), Psi1,2,3 (ψ), and Phi (ϕ)Aquarii. On

December 12, it will sit 2 degrees east of Lambda and will steadily drift eastward to appoint midway between Lambda and Phi on January 31.

Dwarf planet **Ceres** (magnitude ~8.85)will spend the next six weeks travelling eastward through Libra in the southeastern pre-dawn sky. By the end of January, the magnitude 8.8 object will be rising at 2:30 am local time. Asteroid **(2) Pallas** (magnitude 9.05 to 8.65) will be a post-midnight target well positioned for observing in the southeastern sky among the stars of Virgo. Magnitude 7.78 asteroid **(3) Juno** will be well-positioned in the evening sky on the border between Eridanus and Taurus. Asteroid **(4) Vesta** (magnitude 8.0) will be visible low in the western evening sky, travelling east through Capricornus, until about mid-January.

Comets

Ref http://www.aerith.net/comet/weekly/current.html, http://cometchasing.skyhound.com/, https://in-the-sky.org/data/comets.php , https://www.ast.cam.ac.uk/~jds/ , http://www.cobs.si/

Comet C/2018 V1 (Machholz-Fujikawa-Iwamoto) is near its peak brightness now of about magnitude 5.5 and will fade rapidly from now on. On December 12, it is poorly positioned, low in the southwestern early evening sky in Scutum and sets at about 7 pm local time. For the next month, it will move southeast (right to left), crossing through northern Sagittarius.

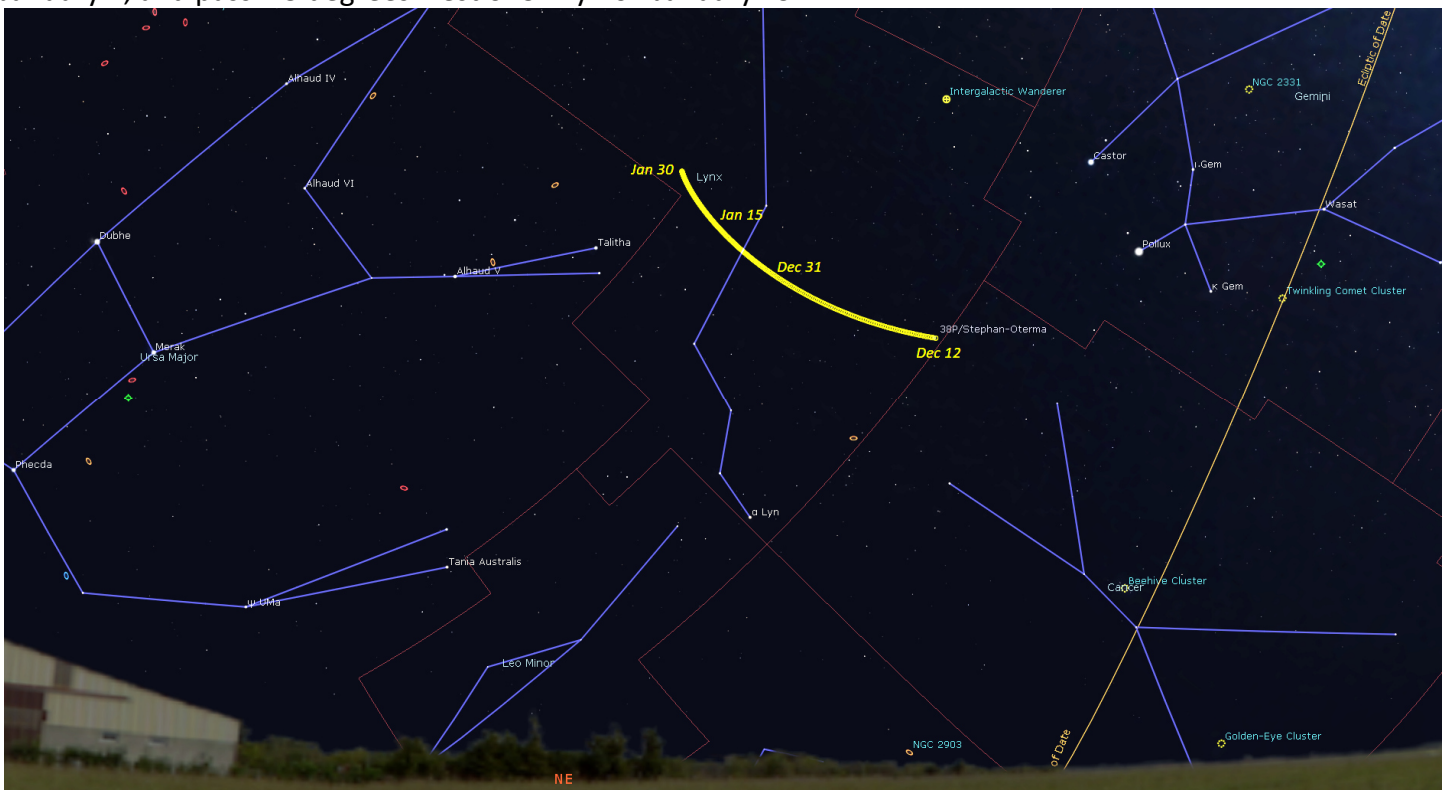
Comet 46P/Wirtanen is a periodically returning comet (5.4 years) discovered on January 17, 1948 by Carl Wirtanen. Comet 46P/Wirtanen is predicted to brighten until December 16, when its orbit will carry it closest to both Earth and the sun. It's now bright enough to see without binoculars if you are under a dark sky away from artificial lights. It's quite easy in binoculars, if you know where to look. The moon will become quite bright in the comet's vicinity as we head toward the comet's peak brightness - and also beyond until about December 24.

Look for a faint, green, fuzzy blob surrounding a bright point of light. Reports are that the halo around the comet is as wide as a full moon – that's half a finger's width held at arm's length. If Comet 46P/Wirtanen grows a tail, the tail will extend east (to the left), away from the sun. You can begin to look for the comet as soon as the sky is dark. The comet will then climb to its highest point, halfway up the southern sky, in mid-evening.

The orbit of this comet is carrying it north, up through the plane of the solar system from below. It will become circumpolar on December 23. From December 12 to 18, Comet 46P/Wirtanen will cross Taurus. From December 19 to 28, it will cross Auriga, and then pass thorough northern Lynx until January 11, when it will cross into Ursa Major for the rest of January.

On Saturday, December 15, the comet will land 4.5° below the very easy-to-identify Pleiades star cluster. On Sunday, the night when comet 46P/Wirtanen should be at peak brightness, the comet will shift to the lower left of the Pleiades. Additional events include: 1.25° southeast of the Northern Trifid Nebula (NGC 1579) on December 19, 25 arc-minutes southwest of Saclateni (Zeta Aur) on December 21, slide 1° east of Capella on December 23, pass 1.5° southeast of 15 Lyn on December 31, pass 23 arc-minutes north of 24 Lyn on January 4, land 4 arc-minutes south of the Pancake Galaxy (NGC 2685) on January 16, and pass 6 arc-minutes north of 17 UMa on January 24.

38P/Stephan-Oterma (2018) is a periodic comet (37.96 Years) that is presently peaking in predicted brightness at magnitude 9.0 and will slowly fade through January. The comet is well placed for evening observing for the next six weeks. Unfortunately, this comet will not pass any bright markers in December or January. On December 12, it will sit in northern Cancer, 10 degrees east of Castor. From there it will travel north into Lynx, passing the 6.20 magnitude star 32 Lyn on December 19, then pass 2 degrees east of Alciaukat (31 Lyn) on January 7, and pass 1.5 degrees west of 34 Lyn on January 19.



Meteor Shower(s)

Ref. http://www.amsmeteors.org/meteor-showers/meteor-shower-calendar/, https://www.imo.net/files/meteor-shower/cal2018.pdf

Geminids (Dec 4 to 16)

The Geminids meteor shower, one of the most spectacular of the year, will peak before dawn on Thursday, December 14, when up to 120 meteors per hour are possible to see under dark sky conditions. Geminids meteors are often bright, intensely colored, and slower moving than average because they are produced by particles dropped by an asteroid designated 3200 Phaethon. The best time to watch for Geminids will be from full darkness on Wednesday until dawn on Thursday morning. At about 2 am local time, the sky overhead will be plowing into the densest part of the debris field. The early-setting crescent moon on the peak night will provide a dark sky for meteor-watchers. Radiant is ~1° Northwest of Castor, in the constellation of Gemini (RA 7h 28m, Decl. +33°)

Ursids (Dec 17 to 23)

The annual Ursids meteor shower, produced by debris dropped by periodic comet 8P/Tuttle, will peak during the early hours of Saturday, December 22, when seeing up to 20 meteors per hour is possible, under dark skies. The best time to watch will be from midnight to dawn that morning. Unfortunately, a full moon on the peak night will spoil the show for Ursids meteor watchers in 2018. Ursids will appear to radiate from a position in the sky above the Little Dipper (Ursa Minor) near Polaris, but the meteors can appear anywhere. Radiant is ~1° Northwest of Kochab, in the constellation of Ursa Minor (RA 14h 36m, Decl. +75°)

Quadrantids (January 1 to 10)

Named for a now defunct constellation near the north celestial pole called the Quadrant, the annual Quadrantid meteor shower runs from Dec 30th to Jan 12th. This is one of the most reliable showers of the year, producing up to 100 meteors per hour at the peak. Many are bright fireballs owing to the shower's source, an asteroid designated 2003EH. The shower will peak on Thursday evening, January 3, while the Earth is traversing the thickest part of the debris field, but the best time for viewing comes before dawn on Friday morning, when the shower's radiant is high in the northeastern sky. The moon will be out of the night sky on the peak, greatly increasing the number of meteors you will see. Radiant is ~9° Northeast of Nekkar (Beta Bootis), between constellations of Draco, Her, Boo, and UMa (RA 15h 20m, Decl. +49°)

Asteroids

Ref. http://neo.jpl.nasa.gov/ca/, http://www.minorplanetcenter.net/ https://www.youtube.com/watch?v=ONUSP23cmAE#action=share

According to the Minor Planet Centre…

Near-Earth Objects Discovered This Year:	1,867 (~162/month)
Minor Planets Discovered This Year:	8,474 (~737/month)
Comets Discovered This Year:	41 (~3.6/month)
Observations This Year:	17.4 million

Satellites

Current GTA International Space Station (ISS) evening pass series lasts until December 16 (Most are visible between 5:15 and 6:30 pm). A morning pass series runs from December 22 to January 13 (Most are visible between 5:30 and 7 am). Another evening series commences on Jan 20. Some higher/brighter ones include*:

Date	Time	Direction	Alt.	Mag.
Mon, 24-Dec	7:05 am to 7:11 am	moves SW to ENE	68°	-3.4

Wed, 26-Dec	6:57 am to 7:03 am	moves WSW to NE	58°	-3.7
Thu, 27-Dec	6:07 am to 6:11 am	moves SW to ENE	83°	-3.9
Tue, 8-Jan	6:53 am to 6:58 am	moves WNW to SE	85°	-3.9

*far future predicted times may shift slightly

Iridium Flares most frequent evening flares occur between 6 pm and 7:30 pm, with morning flares common from 5:30 to 7:30 am. Local occurrences info at www.heavens-above.com and enter your location, from phone/tablet apps, Chris Vaughan's Skylights (subscribe to email here or visit www.astrogeoguy.tumblr.com)

Occultations – Lunar and Asteroidal

Ref: http://www.asteroidoccultation.com/ and http://www.poyntsource.com/New/Global.htm (additional links on the following URLs open track maps), http://www.lunar-occultations.com/bobgraze/index.html

Lunar Occultations

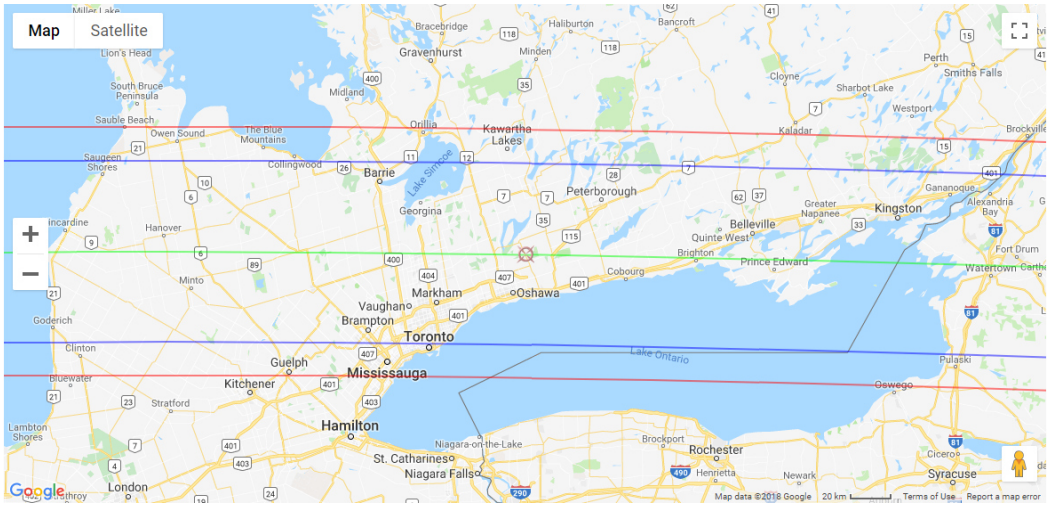
In the southwestern sky on Thursday evening, December 14, the dark leading limb of the moon will move over the naked-eye (magnitude 4.95) star **Psi3 Aquarii** at approximately 6:21 pm EST. The star will reappear from behind the moon's illuminated east limb, near the moon's southern pole, at 7:28 pm EST.

As the southeastern sky is darkening on Tuesday evening, December 18, the dark leading limb of the moon will move over the naked-eye (magnitude 4.30) star **Xi Ceti** (Al Kaff al Hidhmah II) at approximately 5:35 pm EST. The star will reappear from behind the moon's illuminated east limb at 6:47 pm EST.

In the southeastern sky on Friday evening, January 18, the southerly, dark, leading limb of the gibbous moon will move over the naked-eye (magnitude 4.35) double star **54 Orionis** at approximately 7:57 pm EST. The star will reappear from behind the moon's illuminated east limb, near the moon's southern pole, at 8:44 pm EST.

Asteroidal Occultations

Rank 99 - 18 Dec 2018 at 12:49 am EST asteroid (124) Alkeste (mag 12.2) occults star TYC 1268-01046-1 (mag11.7), dips 1.03 mags for 6.9 seconds, alt 65° in the Hyades (Taurus), visible across Kincardine – Aurora - Belleville corridor.
http://www.asteroidoccultation.com/2018_12/1218_124_57478.htm



Variable Stars

The "Demon Star" Algol (Beta Persei) in Perseus is among the most accessible variable stars for beginners. Its naked-eye brightness dims noticeably for about 10 hours once every 2 days, 20 hours, and 49 minutes because

a dim companion star orbiting nearly edge-on to Earth crosses in front of the much brighter main star. On Friday, December 28 at 6:06 pm EST, Algol will reach its minimum brightness of magnitude 3.4. At that time, it will sit more than halfway up the northeastern horizon. By 11 pm EST, the star will be near the zenith and will have brightened to its usual magnitude of 2.1. Another conveniently timed minimum occurs on Thursday, January 17 at 7:49 pm EST.

Mira, Latin for "wonderful" and also known as Omicron Ceti, lends its name to a class of variable stars known as pulsating variables. It is the brightest of this class of objects. Mira, which is located in the neck of Cetus, is well positioned for observing on winter evenings. The star is a very low temperature, M7-class red giant situated at a distance of 200-300 light-years from the sun. Its mean magnitude is approximately 6.6, but its pulsations lift it from magnitude 9.5 to magnitude 3.0, or brighter on occasion. The light curve typically brightens over 110 days and then drops over 220 days. It is currently near its peak brightness.

Double Stars

The "Winter Albireo", also designated 145 Canis Majoris and HR2764, is an underrated, lovely coloured double star located 3.5° northeast of Wezen in Canis Major. The blue and orange stars are magnitude +5.95 and +4.80, and classed as F0 and K4III, respectively. The current separation is 26.4 arc-seconds at an angle of 52°. By the end of December, this double will rise in the east after mid-evening and remain visible all night long.

Sigma Orionis, also designated as 48 Orionis, is a +4.0 magnitude naked-eye star located 49 arc-minutes southwest of Alnitak, Orion's eastern belt star. It's also just 32 arc-minutes west of the Horsehead Nebula. In a telescope, Sigma Orionis splits into a spectacular multiple star system that resembles a narrow dart 8 arc-minutes in length. This area of the sky is well placed for observing from mid-evening onwards.

Iota Cancri is a wide binary consisting of blue (magnitude +6.58) and yellow (magnitude +4.02) stars separated by 30.5 arc-seconds. Cancer rises in the east after mid-evening.

Constellations on the Meridian (Annually in early January)

7 pm: Sculptor, Fornax, Cetus, E. Pisces, Aries, Triangulum, Andromeda, W. Perseus, and Cassiopeia
9 pm: Fornax, Eridanus, NE. Cetus, Taurus, E. Aries, Perseus, and Camelopardalis
11 pm: Columba, Lepus, Orion, W. Gemini, E. Taurus, Auriga, and Camelopardalis
1 am: Puppis, Canis Major, Monoceros, Canis Minor, E. Gemini, W. Cancer, and Lynx

Winter Star party Skylights (Annually in December/January)

Holiday Packages - Winter Milky Way, Orion's Belt, Hyades in Taurus, Square of Pegasus (👁/🔭)
Christmas Lights – NGC457 Owl/ET (Cas), NGC884, 869 Double Cluster (Per), M45 The Pleiades (Tau), etc. (🔭/🔭)
Festive Candles – M42 Orion Nebula and M78 (Ori), Heart & Soul Nebulae (Cas), etc. (🔭/🔭)
Ornaments – M31 (And), M81, 82 Bode's (Uma), Blinking Planetary (Cyg), M56 (Tri), Blue Snowball (And) (🔭/🔭)
Make it a Double – Castor (Gem), Almaak (And), Polaris (UMi), etc. (🔭/🔭)
Centerpieces - Betelgeuse and Rigel (Ori), Capella (Aur), Aldebaran (Tau) (👁/🔭)

See you at DDO, Long Sault C A, Bayview Village Park, or the CAO!

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