THE UNIVERSITY OF ARIZONA

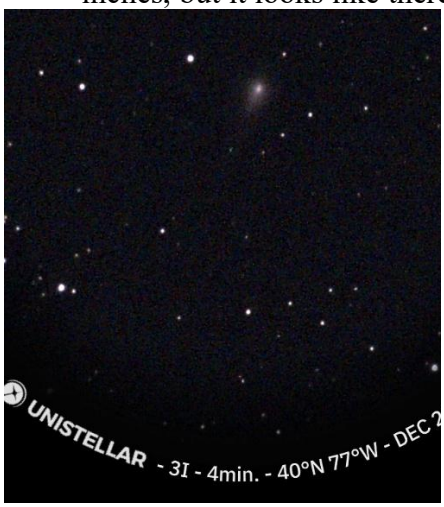
Education & Public Outreach
January 2026, Part 2a

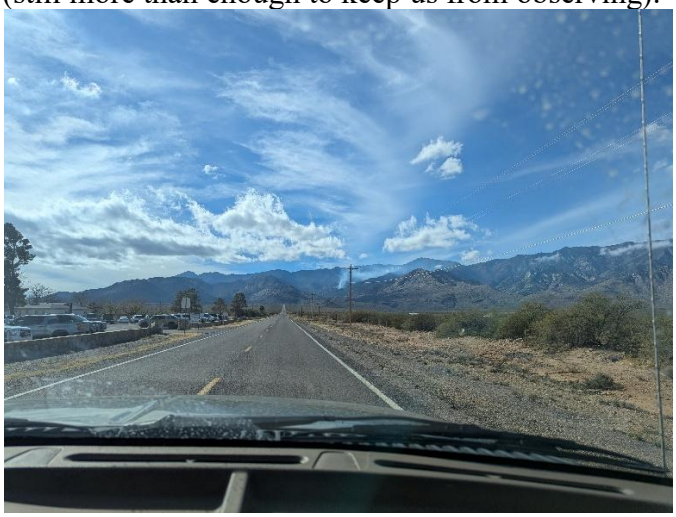
PLANETARY SCIENCE INSTITUTE EST. 1972

VATICAN OBSERVATORY

Some Pictures:

As usual, Laurie Ansorge comes through. Here is her image of interstellar comet 3I/Atlas. Thanks, Laurie! I was up again on Mt. Graham on the VATT in early January. We were scheduled to be there three nights. On the way up, we were very concerned about the weather forecast, but it looked like we might be able to get some observing in the first night. However, I was very concerned by what I saw as we headed up the mountain—smoke (upper right)! Fortunately, there was soon a sign saying that there was a controlled burn and fortunately it was far from the telescopes and so did not have an impact our observing (any ash could ruin the coating on the mirror). The first night, Monday, we had thin clouds for much of the night, but we were able to observe 12 Near-Earth Asteroids, not a bad night. One the lower left is a 2-minute picture I took of Orion about 1:00 in the morning to give you an idea of the cloud cover we had (we could not see a faint as we can on a clear night). The second night, Tuesday, was completely cloudy and we ended up leaving early Wednesday morning, skipping the third night. The bottom middle picture shows a view of the VATT as we were leaving. At the top, the trees have not started growing back from the fire in 2017. On the lower right is what the "access road" looked like the next morning. The VATT is just off to the right (if it were clear, you would be able to see it). It started snowing a few hours after we left. They expected up to 10 inches, but it looks like there was less than that (still more than enough to keep us from observing).





Last week, I presented at ACME (Astronomy for Catholics in Ministry and Education), a workshop organized by Br. Guy Consolmagno, S.J. The workshops are held every two years and are designed "for people working in education in Catholic schools and parishes." I did a meteorite-related activity. Here are some pictures The picture on the right is of the entire group of 24 participants. The middle picture shows the participants examining a meteorite analog, a candy bar that they cut.], write done what they see, and describe it to the entire group. The description cannot use food-related words. Once they have done this, they are all set to study the meteorites and meteor wrongs. The picture on the right shows a group examining the rocks to decide which rocks are from Earth and which are from space meteorites.



Astronomy in the News

3I/ATLAS Update:

Comet 3I/ATLAS Update:

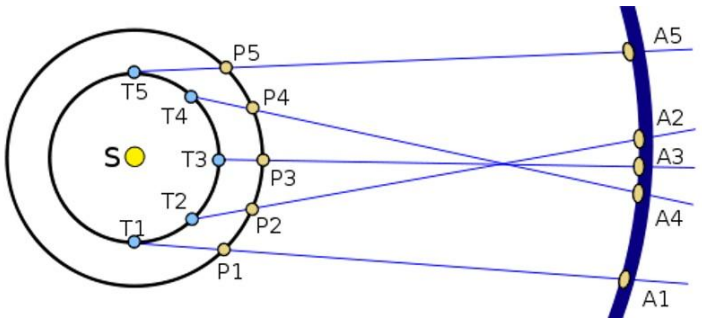
The articles below discuss the work of two different teams of astronomers who searched for technologically-produced (alien) signals from Comet 3I/ATLAS. One was the Green Bank Radio Telescope in West Virginia, and the other was the Allen Telescope Array north of San Francisco. Neither found any evidence of alien signals. 3I/ATLAS is a comet!

https://www.space.com/astronomy/asteroids/interstellar-comet-3i-atlas-isnt-an-alien-spacecraft-astronomers-confirm-in-the-end-there-were-no-surprises

https://www.universetoday.com/articles/inside-the-massive-radio-search-of-our-newest-interstellar-guest

Retrograde Motion:

This is a nice article about retrograde motion, the illusion of the backward motion of the planets farther from the Sun than the Earth. If you are in a car in the "fast lane," as you pass a slower-moving car, it will appear to be moving backwards. The same is true for Mars, Jupiter, Saturn, etc. In January 2027, the Earth will start passing by Mars in their mutual orbits. Mars, in its counterclockwise orbit moves west to east, *relative to the distant background stars,* during most of the year.

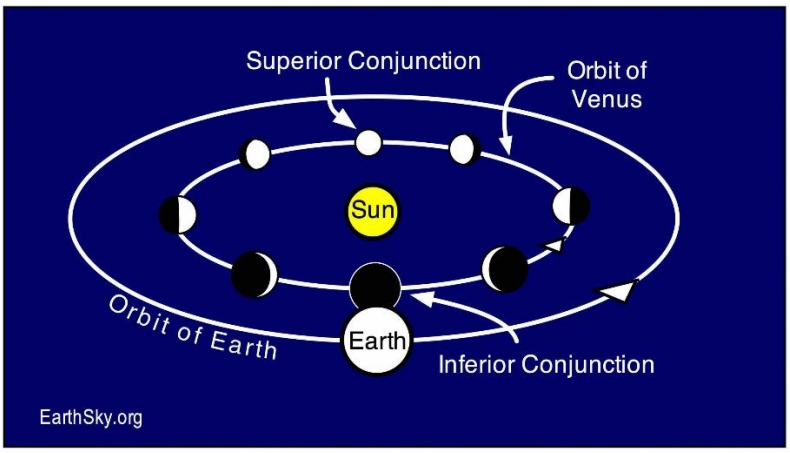


However, due to retrograde motion, Mars will appear to move east to west as the faster Earth passes Mars. Please note that this is different than the true retrograde motions of many of the moons of Jupiter, Saturn, Uranus, and Neptune.

https://earthsky.org/astronomy-essentials/what-is-retrograde-motion/

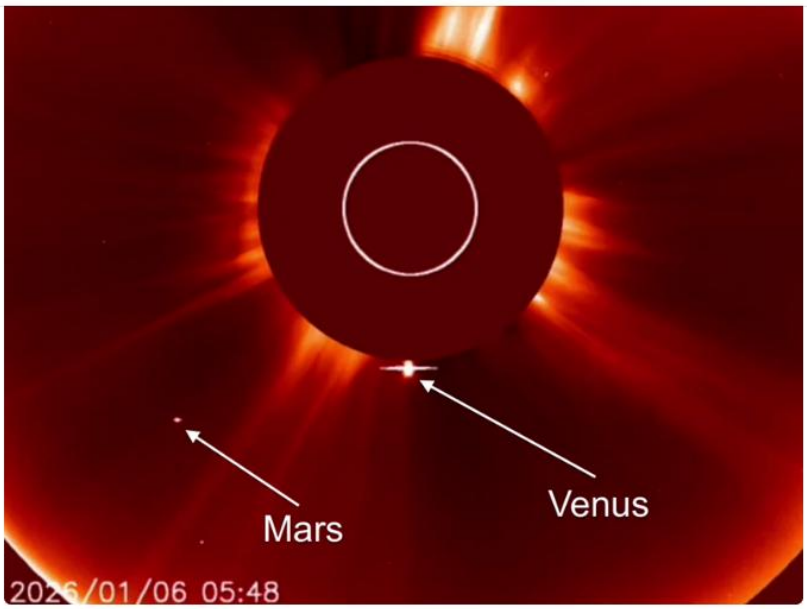
SOHO, Venus and Mars at Conjunction:

As I mentioned in Part 1 of the January Newsletter, both Mars and Venus are in solar conjunction. Both planets are on the far side of the Sun. Mars was in conjunction on January 9 and Venus was in superior conjunction on January 6. The article link below and illustrated on the right explains superior vs. inferior conjunction (far side of the Sun vs. between us and the Sun, respectively).

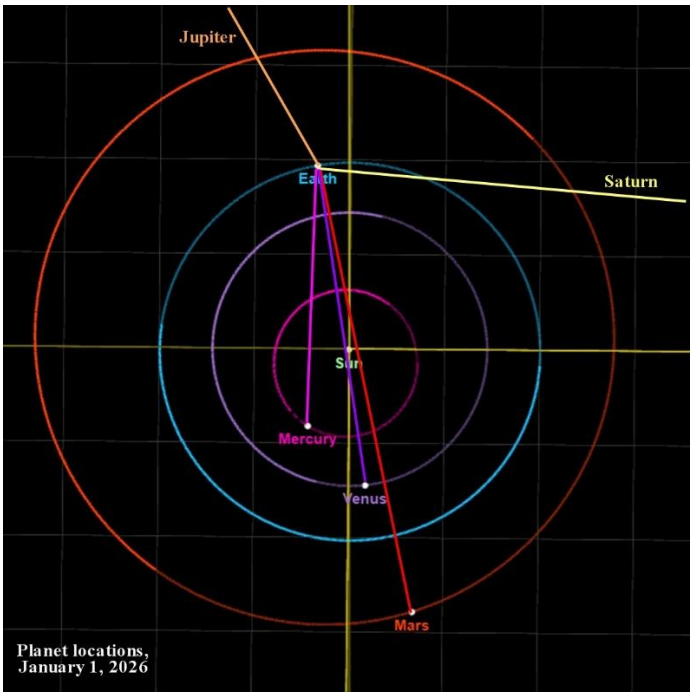


I reported on some of this in the December Newsletter (seeing Venus). The SOHO (**SO**lar and **H**eliospheric **O**bserver) spacecraft orbits between us and the Sun (the opposite Earth-Sun stable orbit from JWST). SOHO blocks the disk of the Sun so it can study the Sun's atmosphere. In early January it imaged both Venus and Mars as they moved behind the Sun. The article has a video of the conjunctions. What is interesting is that Venus and Mars, relative to the Earth looking at the Sun, are moving in opposite directions. Mars is moving left to right (east to west as Mars goes from an evening planet to a morning planet (the Earth moves faster in its orbit, so similar to you, in your car, catching up to a slower moving car). Venus, on the other hand, moves faster in its orbit and is passing both Earth and Mars! I hope that this makes sense. Instead of the stars, the reference object is the Sun. We are now on a four lane (each direction) highway. You are driving in the fast lane and next to you is the another car going at the same speed, the Sun (your reference). You both pass a slower moving Mars that appears to move from left to right relative to you and the other car. However, there is an impatient driver, who decides to overtake all of you and goes into the "slow lane." This is Venus. In your car, you are looking at the Sun moving with you, Mars appears to move from left to right as you pass it, but speedy Venus overtakes you in the far lane and appears to move from right to left. This is essentially what you are seeing with the SOHO movie!

https://earthsky.org/astronomy-essentials/venus-superior-conjunction/



On January 6, 2026 – the day of the Venus superior conjunction – Venus is just outside the occulting disk of the LASCO C2 coronagraph aboard the NASA's sun-observing SOHO spacecraft. Meanwhile, Mars appears from the opposite side of the sun, creating a rare and striking scene of 2 planets approaching near-coincident superior conjunctions. Mars' superior conjunction will fall on January 9. And remember ... Venus orbits one step inward from Earth around the sun. Mars orbits one step outward. Cool! Read more about why Mars appears to be moving in the opposite direction below. Images via NASA/SOHO.



The Orrery image for January 1, 2026, from Part 1 of the Newsletter

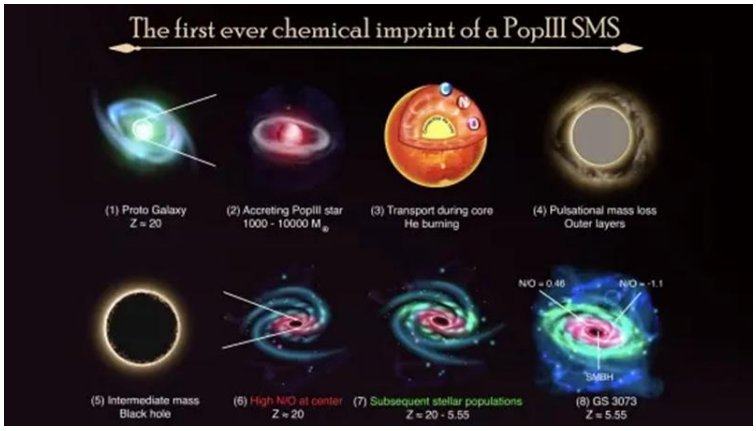
What is Up and Down?

This is an interesting article about how we define up and down—toward the center of the Earth [gravity]? The direction of the Earth's pole? The pole of the plane of the Solar System? Etc.

https://theconversation.com/what-is-below-earth-since-space-is-present-in-every-direction-245348

NASA, ESA, and Other Missions:

JWST, Early Stars:

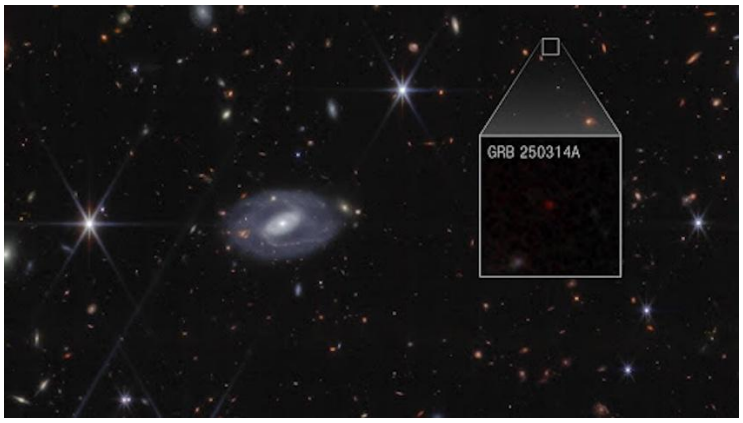


In the November Newsletter, there were several articles about the possible (indirect) discovery of the "first stars," Population III stars. The astronomers have studied the chemical makeup of a galaxy called GS 3073, as it was 1.1 billion years after the Big Bang. They found that the nitrogen-to-oxygen ratio in this galaxy was 0.46. This ratio is consistent with the collapse of supermassive Population III stars (the "first stars") directly into black holes. The supermassive stars would have had masses of between 1,000 and 10,000 solar masses. These black holes would then be the seeds for the creation of supermassive black holes.

https://earthsky.org/space/monster-stars-from-the-cosmic-dawn/

https://www.universetoday.com/articles/astronomers-find-the-first-compelling-evidence-of-monster-stars-in-the-early-universe

JWST, Early Supernova:



"The James Webb Space Telescope has spotted an eruption of energy in the early universe that may be the most distant supernova discovered to date. (Image credit: NASA, ESA, CSA, STScI, A. Levan (IMAPP), Image Processing: A. Pagan (STScI))"

In March 2025, a China/France satellite, Space Variable Objects Monitor detected a 10-second X-ray burst from a distant object. It was named GRB 250314A (named for the date of observation). It was determined that this burst came from a supernova explosion. A few months later, Webb observed the object, confirming its location and determining its age at just 730 million years after the Big Bang. This turns out to have been the earliest observed supernova event ever detected. More observations are planned to verify how much of the light detected by Webb came from the supernova and how much from the surrounding galaxy that was illuminated by the supernova. While this was a very early star, I do not think that it was from a Population III star as the previous article implies that these supermassive stars collapse directly into black holes and do not go supernova.

https://www.livescience.com/space/astronomy/we-were-amazed-scientists-using-james-webb-telescope-may-have-discovered-the-earliest-supernova-in-the-known-universe

HST, Betelgeuse's Stellar Companion:

We have had several articles about the discovery and confirmation of a close-in companion star to the supergiant star Betelgeuse. Astronomers using HST have now observed that the star has a wake of material from the star the is detectable as it goes in front of Betelgeuse. The companion star, named Siwarha (In Arabic, Betelgeuse means *hand of al-Jawzā'*, and Siwarha means *her bracelet* in Arabic.) The astronomers reporting these observations used 8 years' of HST and ground-based telescope to see the wake for the star as it moves through the upper atmosphere of Betelgeuse. Their observations are consistent with the companion star having an orbital distance of 5.78 AU and an orbital period of 2,170 days. This is consistent with the long-term light variability of Betelgeuse.

https://science.nasa.gov/missions/hubble/nasa-hubble-helps-detect-wake-of-betelgeuses-elusive-companion-star/

https://earthsky.org/space/betelgeuses-companion-star-leaves-detectable-wake/

https://www.sciencealert.com/betelgeuse-is-definitely-not-alone-8-year-study-confirms

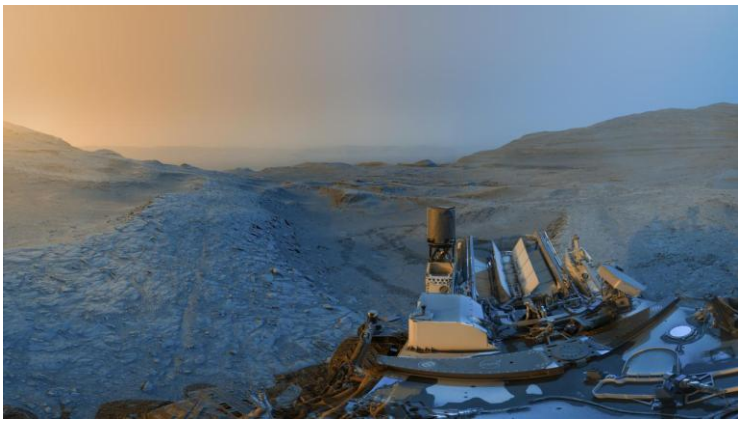
"This artist's concept shows the red supergiant star Betelgeuse and an orbiting companion star. The companion, which is orbiting clockwise from this point of view, generates a dense wake of gas that expands outward. It is so close to Betelgeuse that it is passing through the extended outer atmosphere of the supergiant. The companion star is not to scale; it would be a pinprick compared to Betelgeuse, which is hundreds of times larger. The companion's distance from Betelgeuse is to scale relative to the diameter of Betelgeuse.
Artwork: NASA, ESA, Elizabeth Wheatley (STScI); Science: Andrea Dupree (CfA)"

Curiosity, A Day on Mars:

The navigation cameras on NASA Curiosity Mars Rover have created a black and white panorama of the surface of Mars and then colorize it to represent the colors one would expect to see during the day (the pink sky) to sunset (the blue sky). Mars has a thin carbon dioxide atmosphere. The pink sky represents light scattered by large dust grains in the atmosphere and the blue sky represents around sunset when there one is looking through more atmosphere and there is scattering from the carbon dioxide molecules. I will note that when the first landers on Mars, Viking 1 and 2, the images of the sky were "color corrected" to look blue, before they realized that pink was the true color of the atmosphere.

https://www.space.com/space-exploration/mars-rovers/nasas-curiosity-rover-sends-stunning-new-panorama-from-high-on-mars-mount-sharp

https://images.nasa.gov/details/PIA26680



"NASA's Curiosity rover captured this panoramic view from high on the slopes of Mount Sharp inside Gale Crater, combining images taken on two different Martian days in November 2025 to highlight changing light across ancient, water-shaped terrain. (Image credit: NASA/JPL-Caltech)"

Meteors, Meteorites, Asteroids, and Comets:

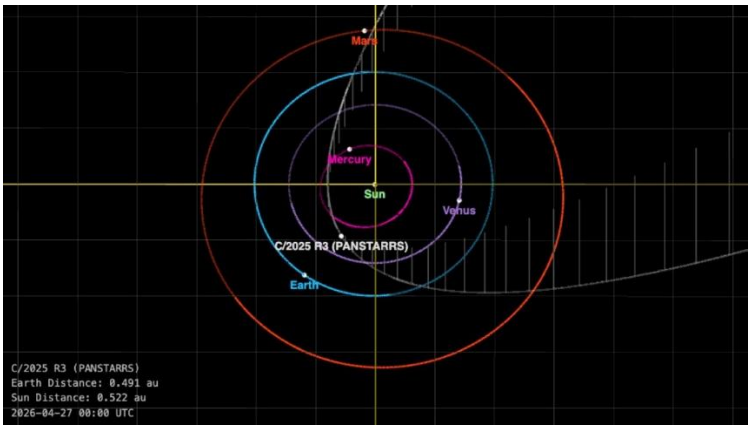
As of January 21, 2026, there are 1,493,114 known minor planets (10,773 added since December 14). Of these, 875,150 are numbered (no change). There are 4,626 known comets (8 more). There are 40,860 (618 more) Near-Earth Objects (NEOs). There are 877 NEOs larger than a kilometer (0.6 miles) in diameter (one more). There are 11,551 NEOs larger than 140 meters (460 ft) in diameter (45 more). [A note: there are two sources for these numbers, and they never agree exactly, even if they are updated the same day. JPL has more total asteroids by over 10 thousand (JPL includes Trans-Neptunian Objects which IAU may not) and the IAU has more NEOs by a few hundred (a possible small difference in definition). I use JPL for total

asteroids and IAU for total NEOs.] 200 NEOs have been discovered since the beginning of the year. A potentially hazardous asteroid is an asteroid whose orbit could bring it with 0.05 AU of Earth and is estimated to be at least 140 meters in diameter. However, many of these have orbits that are fairly-well characterized so there is little to no risk of their hitting Earth in the near future. ESA lists just those that have some potential chance of hitting Earth, usually due to orbital uncertainties. This is why my team observes them on the VATT so that we can reduce these uncertainties. ESA's "At Risk" list as of January 21, 2026, is 1,906 Near-Earth Objects (19 more). We have been credited with removing one asteroid from this list!

Asteroid Close Approaches:
In the last 30 days, 9 asteroids have been **observed** to have come closer to the Earth than the distance to the Moon (LD) with estimated diameters from about 2.9 meters in diameter to about 22 meters in diameter (if high or low reflectivity, respectively). There were 13 additional asteroids observed that came as close as 1.0 to 2.0 times the distance of the Moon, with estimated diameters between 4.3 and 53 meters. In the next 60 days, one asteroid is **predicted** to come closer to us than the Moon and one between 1.0 and 2.0 times the distance to the Moon with estimated diameters of between 4.9 and 13 meters.

Between December 22 (observed) and February 23 (predicted in the next 60 days), seven asteroids with estimated diameters between about 70 meters and 1,000 meters in diameter have passed/will pass between 9.6 and 16.9 lunar distances (LD) of the Earth. Of the four large asteroids that have been **observed** to pass within 20 LD (0.05 AU) of the Earth between December 22 and January 17, one was discovered prior to this year. One was discovered in 2004 and three in 2025. Of the three asteroids that are **predicted** to pass within 20 LD (0.05 AU) of the Earth between February 14 and February 23, 2026, one was discovered in 2001, one was discovered in 2012, and one was discovered in 2025. There are 213 asteroids that were seen or are predicted to come within 20 lunar distances of the Earth (about 0.05 AU) between December 22, 2025, and March 18, 2026 (last 30 days to next 60 days). Of these 166 have been observed (through January 22) and 47 are predicted (starting January 23). Of the 47 predicted close approaching asteroids, three were discovered in December and 15 were discovered in January 2026. This will give you an idea of how many close approaching asteroids are likely to be discovered in the next month! Our last run was partially successful. We observed 12 asteroids one night before clouds and then snow shut us down (lost two nights to weather). Five of these asteroids have close approaches (within 0.2 AU, 77 lunar distances) of Mercury, Venus, and Mars. (Venus/Earth, Venus/Earth/Mars, Mercury/Venus/Earth) with a few close approaches with 0.06 AU (25 LD).

New Comets, Part 1:
Comet C/2025 R3 was discovered by one of the PanSTARRS survey telescopes in September. As of January 16, 2026, it has been observed over 400 times, so its orbit is becoming more precisely known. However, while we know when and how close it will get to the Sun and the Earth, we do not know what its orbital period is, at least thousands of years, if not tens of thousands of years or more. In other words, it is what is known as an Oort cloud comet. It will get closest to the Sun (76 million kilometers, 47 million miles) on April 19 or 20 and will be closest to the Earth (71 million kilometers, 44 million miles) on April 27. It will be a morning object and will best be seen before its closest to the Earth when it will be lost in the glare of the Sun. As is the case with most "new" comets, it may be visible only with binoculars at magnitude 8 or it may get as bright as magnitude 2.5, easily visible to the unaided eye. I will keep you update on how bright it gets. I have seen a few finder charts, but will wait to post one until it looks like it will be worth observing.



"The orbital path of Comet C/2025 R3 (PanSTARRS) through the inner solar system. (Image credit: JPL Small-Body Database Lookup)"

https://www.space.com/astronomy/comets/will-comet-c-2025-r3-panstarrs-be-the-great-comet-of-2026

https://www.livescience.com/space/comets/astronomers-may-have-already-spotted-the-great-comet-of-2026-and-it-could-soon-be-visible-to-the-naked-eye

New Comets, Part 2:

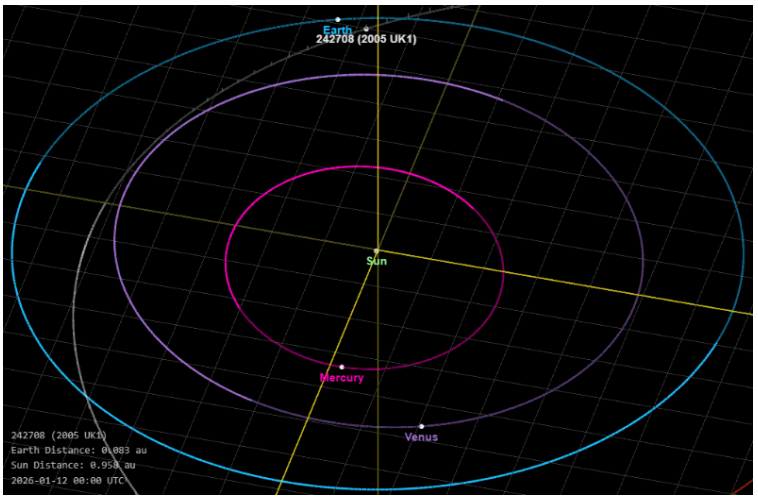
As I am finishing the formatting and editing of this Newsletter, a new, possible visible, comet is announced. Comet C/2026 A1 MAPS is presently about 2 AU from the Sun at a magnitude of 18 (it was discovered on January 13 with precovery image from a few weeks earlier). It is a Kreutz sungrazer group comet. A family of comets that is thought to have derived from a single parent comet, the Great Comet of 1106. C/2025 A1 will reach perihelion in early April at a distance of 0.0055 AU (785,000 km, 488,000 miles) from the Sun. Its orbital period is estimated to be 1,200 years (500-1,900 years). If it survives passage, it may be visible in the evening sky in early April. It is estimated to be about 2.5 km (1.5 miles) in diameter. Note that with 150 observations, the closest approach uncertainty is 10%, but its mean distance (110 AU) and aphelion (220 AU), are uncertain by 40%.

https://earthsky.org/space/new-sungrazing-comet-c-2026-a1-comet-maps/

"This is the new sungrazing comet C/2026 A1 (MAPS). Image via Gerald Rhemann and Michael Jäger. Used with permission."

Asteroid Close Approach:

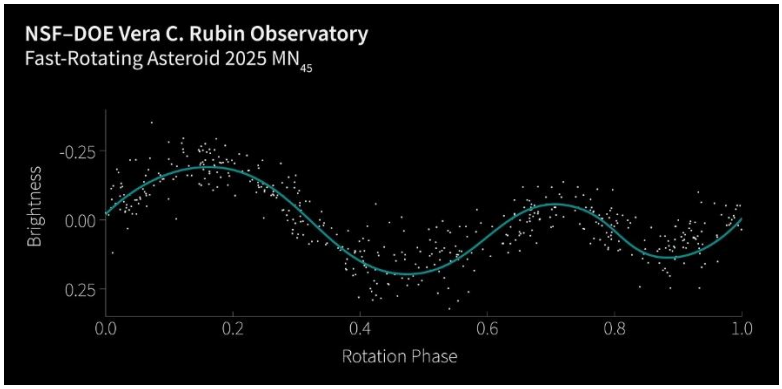
There have been many articles about the close approach of asteroid 242708 2005 UK1. The article I have linked below probably has the best discussion of this asteroid, including its estimated diameter, putting it into context of the meaning of a potentially hazardous asteroid. This asteroid, with an estimated diameter of between 0.6 and 1.4 kilometers (0.4 and 0.85 miles) passed by the Earth at a distance of about 32 times the distance to the Moon. It also has a good explanation of what a Potentially Hazardous Asteroid is (I have defined this several times in the past, but it is good to see others define it, too). Some of the following comes from this article and some from what I have researched (probably more than you wanted to know!). 242708 2005 UK1 was discovered in 2005 by the Catalina Sky Survey. It is defined as an Apollo asteroid; an asteroid whose orbit crosses the orbit of the Earth. It is very close to being in the orbital plane of the planets, with an orbital inclination of only 0.8 degrees (Mars is 1.8 degrees). Its mean distance from the Sun is 2.5 AU and it gets as close as 0.76 AU from the Sun (it has close approaches to Venus) and gets as far from the Sun as 4.2 AU (it also has close approaches to Mars). The closest it got/will get to any of these planets (from 1900 to 2200) is in 2188 when its distance from the Earth will be 23 times the distance to the Moon. Its orbit is known extremely well due to radar observations in 2014, but the results were not good enough to give a better estimate of its diameter. The is one thing that the article got wrong is its magnitude. The number quoted, magnitude 18.1, is its absolute magnitude (a number that is used to compare its brightness with all other asteroids (similar to absolute magnitude M used for stars). In early January, 242708 got as bright as magnitude 15.6. I have used my own image of the asteroid's orbit (from a JPL site) to illustrate where it was on January 12, inside Earth's orbit and probably too close to the Sun in the sky for easy observing. I assume there were astronomers observing this asteroid in late December or early January so that a better diameter for it can be made.



https://earthsky.org/space/potentially-hazardous-asteroid-2004-uk1-safely-pass-earth-jan-12-2026/

Fast-Spinning Main Belt Asteroid:

The Vera C. Rubin Observatory had its first light last April and May. Some of you may have seen its mirror being ground at the Mirror Lab. During the observing period, over a 7-day period, 10 hours of observations, it discovered over 2,100 asteroids (about 200 were previously known asteroids, I think), most of them Main Belt Asteroids. Of these, 76 (75 Main Belts and one Near-Earth Object) were observed frequently enough for astronomers to obtain lightcurves. For background, there is a cutoff at about 2.2 hours. Faster than this rotation rate, an asteroid must be a solid body, as gravity would not be strong enough to prevent a rubble pile asteroid from flying apart. Of these 76 asteroids, 19 have rotation rates less than 2.2 hours. Two have rotation rates between 13 and 16 minutes, and three have rotation rates less than five minutes. The fastest rotator is 2025 MN45, with a rotation rate of 1.88 minutes. I will note that there are about 60 asteroids with faster rotation rates, but they are all NEOs with diameters ranging from a few meters up to about 100 meters.



"This lightcurve shows how the brightness of asteroid 2025 MN45 rises and falls as it rotates. Tracking these changes helps scientists work out how quickly the asteroid spins and what its surface may be like [Most likely we are seeing an asteroid that is elongated and irregular in shape, but, less likely we are see reflectance variations]. (Image credit: NSF–DOE Vera C. Rubin Observatory/NOIRLab/SLAC/AURA/J. PollardAcknowledgement: PI: Sarah Greenstreet [NSF NOIRLab/Rubin Observatory])"

https://www.space.com/astronomy/asteroids/vera-rubin-observatory-discovers-the-fastest-spinning-asteroid-ever-and-its-huge

https://www.sciencealert.com/record-breaking-asteroid-spins-so-fast-it-should-tear-itself-apart

https://www.universetoday.com/articles/rubin-observatory-spots-fastest-spinning-asteroid-ever

Moons and Rings:

As of January 20, 2026 (last update), there are 419 moons (satellites) orbiting six planets (the same). Several moons of Jupiter that were first seen several years ago have been recovered, but they have not officially been confirmed. As of January 19, 2026 (last update), there are 607 asteroids, dwarf planets, Centaurs, and Trans-Neptunian Objects with companions (5 more than the last update on December 14). There are 588 binary systems (5 more), 17 triple systems (same), 1 quadruple (130 Elektra), and 1 sextuple system (Pluto), for a total of 630 companions (5 more). To break this down, 109 Near-Earth Objects (same) have companion moons (5 have 2 moons, same), 36 Mars-Crossing Asteroids (same) have companion moons (1 with 2 moons), 310 Main Belt Asteroids (4 more) have companion moons (1 with 3 moons, 8 with two moons, and 1 with 1 moon and rings; 1 also has dual asteroid/comet designation), 8 Trojan Asteroids have companion moons (same), and 144 Outer Solar System Objects (dwarf planets, Centaurs, and Trans-Neptunian Objects) (1 more) have companion moons (2 with 2 moons, 1 with 5 moons). There are 4 TNOs and Centaurs with moons that have or are suspected to have rings (same) and 1 with rings but no moons. For those of you doing the Solar System Classification activity, this is a good example of how there is overlap among planets, dwarf planets, and asteroids as to how we classify them based on characteristics (moons and rings in this case. There are more satellites/moons of asteroids than there are of planets, 630 vs. 419. There are also more asteroids with rings than planetary ring systems.

Unusual Structure on Jupiter's Moon Europa Explained:

In the past, I have talked about Comparative Planetology—comparing what we see on another world with what we see on Earth. The processes may be the same or at least similar, but at least it is a starting point. Jupiter's moon Europa is an icy moon. It is the smallest of the four Galilean moons (a little smaller than our Moon), but is the second densest, after Io. It is thought to be a differentiated moon, having been heated by tidal interaction with Jupiter and the other large moon. Europa is thought to have an iron core, a rock mantle, and a thin icy crust. Below the ice crust, it is thought to have a salty ocean layer (water and icy crust being about 100 km, 60 miles, thick). Models predict the surface ice layer to be between 30 km thick to as thin as a few kilometers thick. It has virtually no craters on its surface (just over 40 known craters between 1 and 40 km in diameter), implying that the surface is "young," less than a few million years old as liquid water from the interior resurfaces it. The crater Manannán is a 22-kilometer crater near Europa's equator. The recent research reported here proposes that when the crater was formed, the impact created a small crack that allowed briny water to seep up through the crack, similar to what is seen on lakes on Earth. "The study team also finally named Europa's arachnid-like asterisk Damhán Alla, meaning 'spider' or 'wall demon' in Irish. (Manannán is a Celtic god from Irish mythology, which partly inspired the new name.)" Of major importance is the fact that the ice is probably not more than a few kilometers thick in order for the impact to have cracked through the ice crust into the water below.

"NASA's Galileo spacecraft captured this view of the 'spider' on Europa – one of Jupiter's moons – in Manannán crater in May 1998. Image via NASA/JPL/ University of Arizona/ Planetary Science Institute."

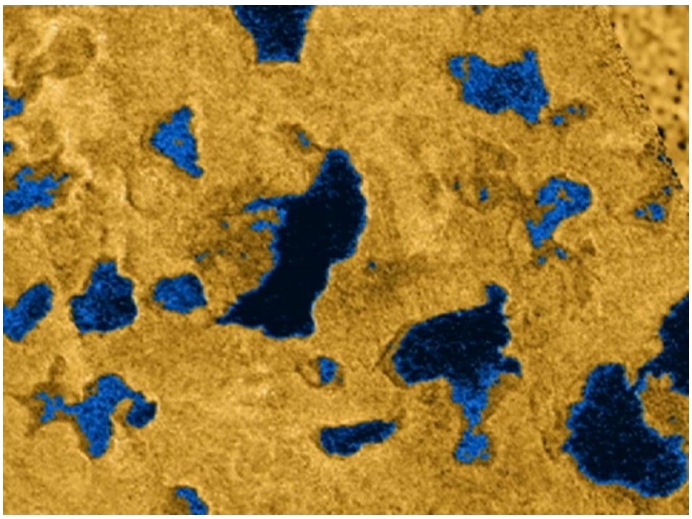
"Lake stars form on Smith Lake, part of the University of Alaska Fairbanks campus. Photo by Tohru Saito."

https://www.livescience.com/space/jupiter/spiders-on-jupiter-scientists-uncover-secret-origins-of-arachnid-like-demon-lurking-on-gas-giants-moon

https://earthsky.org/space/spider-on-europa-brines-geology-astrobiology/

Titan's Interior Revisited:

Twenty years ago, for a period of 13 years NASA's (in collaboration with the European Space Agency and the Italian Space Agency), the Cassini spacecraft orbited Saturn and made frequent flybys of the rings and its largest satellites. The spacecraft flew past the moon Titan ten times. Titan has a thick atmosphere and, as discovered by the orbiter and the lander Huygens a surface covered with water ice and lakes composed primarily of liquid methane and ethane. Titan's orbit is elliptical, so there is tidal heating and distortion of the whole body similar to solid tides on the Earth and Moon. This flexing affects Titan's gravity field and thus the motion of the spacecraft as it flies by. At the time of the mission, modeling of this flexing was found to be consistent with an interior liquid water and ammonia ocean. However, in the research reported here, the authors reanalyzed the data (reducing noise in the data). They determined that the tidal energy in the interior of Titan was greater than would be expected of a liquid ocean



"Mosaic image of Titan's polar methane lakes, from Cassini radar data. (NASA/JPL-Caltech/ASI)"

and was more consistent with a slushy interior beneath an icy crustal layer. They also concluded that there would still be pockets of warm meltwater that would rise toward the surface.

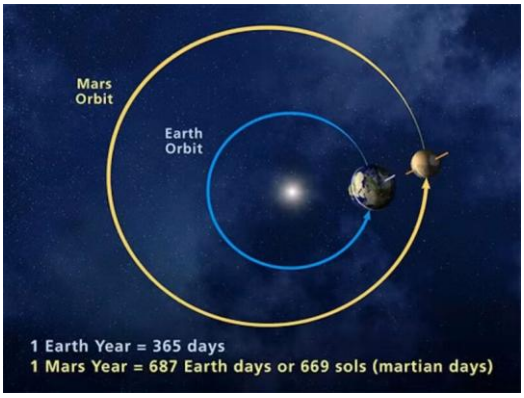
https://www.sciencealert.com/titan-may-not-be-an-ocean-world-after-all-the-truth-is-stranger

https://earthsky.org/space/ocean-on-titan-slush-ice-cassini/

https://www.jpl.nasa.gov/news/nasa-study-suggests-saturns-moon-titan-may-not-have-global-ocean/

Planets and Dwarf Planets:

Mars' Influence on Earth's Climate:

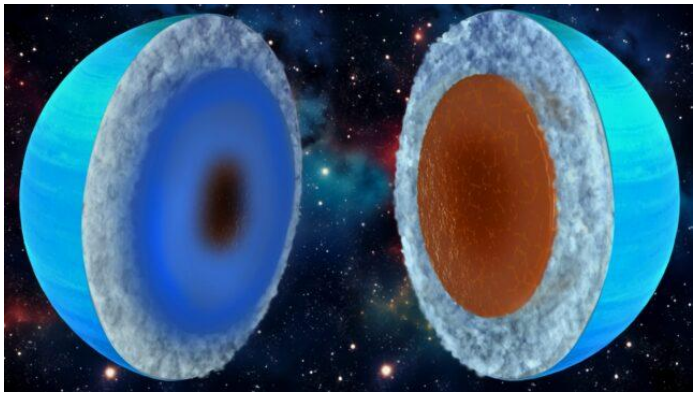


The tilt of the Earth's axis and Earth's orbital ellipticity (not quite a circle) is influenced by small but important the gravitational forces of the other planets, including the Moon and Mars. The authors have modeled the gravitational influence of Mars and show that it has moderated, over hundreds of thousands of years, the tilt of Earth's axis in Earth's orbit, thus affecting Earth's long-term climate. Editor's note: I am always skeptical about connecting coming up with matching cycles of the planets to specific climate cycles. There have been many claims and many that have been disproved in the past, such as the Earth's orbit around the galaxy. From what I have read, the modeling done by the authors looks good, but I am not totally convinced.

https://earthsky.org/space/earths-ice-ages-mars-gravity-milankovitch-cycle/

https://astrobiology.com/2026/01/mars-has-a-large-impact-on-earths-climate.html

Interiors of Uranus and Neptune:



"Uranus could be an ice giant (left) or a rock giant (right) depending on the model assumptions. (Keck Institute for Space Studies/Chuck Carter)"

As is emphasized in the link below and by the authors of the research, only one spacecraft visited the two outer planets (if you do not think of Pluto as a planet), so our knowledge is limited to the Voyager 2 flybys more than 35 years ago and continuing observations by telescopes on Earth and in space (HST and JWST). Prior to the modeling done here, it was assumed that both Uranus and Neptune were composed primarily of water, methane, and other molecules that form ices at low temperatures (and under pressure). Jupiter and Saturn are primarily hydrogen and helium. This is why some planetary astronomers call them ice giants rather than gas giants (historically they are gas giants). The authors have developed new models to show that it is possible (but we do not have sufficient information) that the interiors are rocky and not icy. Either model fits the existing data, depending on your modeling assumptions. Now, scientists can look at existing data and plan experiments in the future that should be able to distinguish between the two models.

https://www.sciencealert.com/uranus-and-neptune-may-not-be-ice-giants-after-all-study-suggests

Exoplanet Update:

As of January 21, 2026, there are 7,939 confirmed extra-solar planets (24 more since December 16, my last update) orbiting 5,398 stars (20 more), with 1,108 star systems (3 more) having more than one exoplanet orbiting them. In addition, there are 2,583 candidate exoplanets (78 more) orbiting 2,266 stars (72 more), with 150 stars (6 more) having more than one exoplanet orbiting them. Most of these candidate exoplanets are likely to be real but need to be confirmed by more detailed ground-based observations or other techniques. I have always used the complete list from the Catalogue of Exoplanets. This includes "exoplanets" with masses greater than 13 times the mass of Jupiter which are more likely to be brown dwarfs. If I limit my list to exoplanets having a mass less than 13 times the mass of Jupiter, the total number is obviously less. Here are the revised statistics: 6,220 confirmed exoplanets (23 more) orbiting 4,641 stars

(20 more), with 1,043 star systems (3 more) having more than one exoplanet orbiting it. In addition, there are 2,126 candidates (unconfirmed) orbiting 1,966 stars, with 132 having more than one exoplanet. There are 824 binary star systems (81 of these are triple or quadruple star systems) with about 1,085 exoplanets orbiting one of the stars and there are 35 star systems with 43 exoplanets orbiting both stars in the binary system. Two star systems have two exoplanets orbiting them. Three star systems have three exoplanets orbiting both stars.

Exoplanet Discoveries of 2025, a Summary:

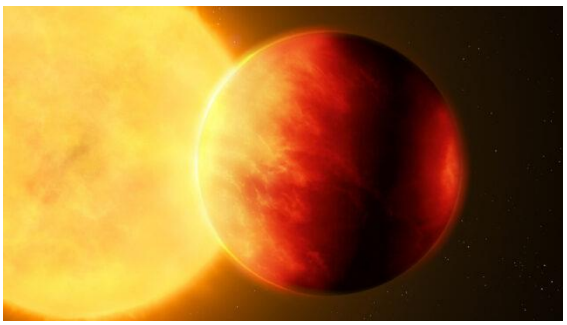
This is an excellent summary of the highlights of exoplanet discoveries this last year. Astronomers have now detected and confirmed more than 6,000 exoplanets around other stars. Most of these exoplanets were discovered by Kepler and TESS. As is noted by the author, the planets in our Solar System are not representative of what astronomers have been discovering. There may be biases that favor super-Earths, mini-Neptunes, and hot Jupiters, etc. but this says something about how the IAU has decided to define a planet. It was not forward-looking. Again, this is a nice summary article.

https://www.space.com/astronomy/exoplanets/the-most-exciting-exoplanet-discoveries-of-2025

"An artist's illustration of the various exoplanets found, with rows of colorful planets of all colors and sizes over a dark background (Image credit: NASA's Goddard Space Flight Center)" [Editorial comment: I do not know enough personally to know how realistic this is. There is no real size range]."

Lava World:

TOI-561 is a yellow-orange star that is a little less massive and cooler than the Sun. It is about 0.5 times as luminous as the Sun. It is orbited by four confirmed and one unconfirmed exoplanet that orbit from 0.01 AU (1/40 the distance of Mercury) out to 1 AU (the distance of Earth from the Sun). The exoplanets are all super-Earths to mini-Neptunes in diameter and mass. The inner exoplanet orbits its primary in about 11 hours. Its mass is about 2 times that of the Earth and its diameter is about 1.4 times that of the Earth, so its density is 0.7 times that of the Earth (its density should be greater than Earth's density if it had a similar composition to the Earth because of size-related greater internal pressure). So, the question for which the authors were looking for an answer to was, is it made of lighter material than the Earth or does it have a thick opaque atmosphere that would make it appear larger as it transits the star? The temperature of the star-lit side was substantially lower than expected, implying that it has a thick atmosphere distributed the heat and that made it look bigger. The authors conclude that the surface is hot enough to have a rocky lava surface that is replenishing the atmosphere (which gets lost to space) and that this has been going on for the life of the planet, about 10 billion years.



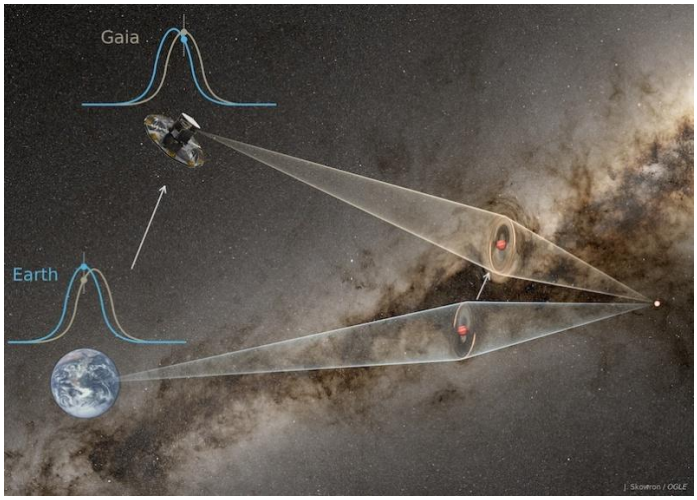
"An artist's impression of an exoplanet close to its star. (Nazarii Neshcherenskyi/Getty Images)"

https://www.sciencealert.com/ancient-wet-lava-ball-exoplanet-defies-expectations

https://earthsky.org/space/atmosphere-on-lava-planet-toi-561-b-exoplanets-webb-space-telescope

Free-Floating Exoplanet/Sub-dwarf Object:

I have, in the past, talked about detecting exoplanets around stars that pass in front of a distant object, warping the light from the distant object, microlensing. For the first time, astronomers have caught a "free-floating (rogue) exoplanet" not associated with a star (the IAU uses the term sub-dwarf object since you do not know the origin of the object—an exoplanet that escape a planetary system, or did it form in deep space. Fortunately, the object was observed from two different locations, a telescope on Earth, and from the Gaia spacecraft. The microlensing gives the mass and because the object was observe from some distance away, the astronomers were able to estimate its distance (like our eyes give us 3D vision. The microlensing event is called KMT-2024-BLG-0792/OGLE-2024-BLG-0516 (two separate programs observing the same object). The object is about 9,800 light-years from us. It has a mass that is about 0.2 times the mass of Jupiter, so slightly less massive than Saturn.



"Artist's concept of the microlensing event as observed by both ground-based observatories and the Gaia space telescope. Image via J. Skowron/ K. Ulaczyk/ Ogle/ AAAS/ Peking University."

https://www.sciencealert.com/astronomers-measure-the-mass-of-a-planet-with-no-star-for-the-first-time

https://earthsky.org/space/saturn-mass-rogue-planet-exoplanets-microlensing/