

OKLAHOMA SPACE ALLIANCE

OUTREACH – March 2025

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet at the
at Cyber Hall and Gaming Lounge next to Norman Computer
at 2:00 p.m. on March 8, details inside



Sunrise on the Moon as seen by *Blue Ghost*, March 3, 2025

OKLAHOMA SPACE ALLIANCE OUTREACH March 2025

March Meeting

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, March 8, at the location next to Norman Computers on West Main in Norman. Prospective members are welcome.

The meeting room is in the Cyber Hall and Gaming Lounge next to Norman Computers. Please enter through the Cyber Hall door. The Cyber Hall is at 914 W Main St, opposite Norman High School. The phone number is (405) 292-9501. To get to the meeting space from points north, take Highway 77 exit off I-35, and continue south until you reach Main Street. Norman Computers is about a block and a half west of this on the south (left) side of a small mall.

Saturday, March 8, 2:00 p.m. (tentative)

1. Introductions and review of Space events this past month
2. What's Happening in Space, News, Pictures, and Videos approximately one hour. See <http://osa.nss.org> before the meeting for items to be discussed.
3. Break
4. Oklahoma Space Alliance Chapter Business Discussion
 - a. Review OSA treasurer's report.
 - b. Minutes of January and February Meetings
 - c. Posters
 - d. Membership Business
5. Video (to be announced)
6. Chat

Minutes of February 8 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance met February 8, 2024, at the McMurrays' house in Norman, Oklahoma. Attending in person were Clifford and Claire McMurray, Adam Hemphill, Dave Sheely, and Syd Henderson. Robin Scott attended by Zoom. OSA President Clifford McMurray presided over the meeting He and Clifford did an *Update* discussing links to material covered in the meeting and this is online at <https://osa.nss.org/Update2502.pdf> so I'll cover the details that aren't covered there.

Bezos's landing ship that they use for New Glenn booster landings is named Jacklyn after his mother. The lost payload was the

The payload of the first New Glenn launch was a test version of Blue Ring Pathfinder. From the article <https://www.space.com/space-exploration/launches-spacecraft/jeff-bezos-blue-origin-launches-massive-new-glenn-rocket-into-orbit-on-1st-flight-video>: 'Blue Ring is being developed as part of the Defense Innovation Unit's (DIU) Orbital Logistics Program. ... Blue Origin is developing Blue Ring to fulfill DIU's need for a "heavy utility multi-orbit logistics vehicle," or m-OLV.' The next flight of New Glenn will be sometime this spring.

SpaceX lost contact with the Starship second stage after seven minutes and forty seconds. All debris (which resulted from an on-board self-destruct mechanism to prevent it from falling out of control) fell within the designated area but there was some property damage. But it did produce a spectacular artificial meteor shower.

The next flight of Starship will feature an attempt to catch the second stage since they are making a bunch of changes. [This may have to wait since the last second stage self-destructed. In any case, the launch will be late at night on March 3, so it may not make *Outreach* but will make *Update*.]

Bill Nelson has resigned as NASA Administrator with the incoming administration (similar to Jim Bridenstine four years ago). We went through some news of Jared Isaacman's appointment. He has some conflict of interest because he was issued SpaceX stock.

The first Argonaut mission has been scheduled for 2031. This is the ESA's cargo lander that will support lunar colonies and perhaps someday Mars expeditions.

Artemis 2 is now scheduled to launch in May of 2026. [This has caused a cascade of reschedulings for the later Artemis missions from September launches to May launches.]

We inspected an article on the *Tianzhou* cargo spacecraft which supplies the Tiangong space station, and the commercial spacecraft that will supplement or replace it.

Yutu-2 (“Jade Rabbit 2”) was still transmitting last September, which made it the longest-lived lunar rover. However, it stopped transmitting last month. Still, January 3 was the sixth anniversary of its landing, and five years and nine months is pretty spectacular.

The Pentagon needs to put together a plan for the Iron Dome space defense system within sixty days, Sunita Williams is now fourth overall for total EVA time, and first for women.

We watched a livestream of Earth via Sen from SpaceTV, but weren’t able to figure out what part of Earth it was showing. You can watch it too at <https://www.youtube.com/watch?v=fO9e9jnhYK8>.

The new Varda spacecraft was just one of 121 payloads carried on a SpaceX rideshare mission.

India’s successful test docking was at eleven millimeters per second, which is extremely soft (and also indicates to me how precise they were.)

One of Blue Origin’s test experiments is to show how fire would propagate in Zero-G.

Vast is going through qualification work. Currently they don’t have a contract with NASA. In fact, they are getting no outside funding at all. They will be launching modules in 2029 and 2030.

We had a look at the proposed Vast-2 space station. This features eight modules, two each on an arm of a cross, plus a core module. It can be complete by 2032. If they can get the first module up before the ISS is decommissioned, they will be doing well.

We looked at a video about the *Blue Ghost* and *Resilience* moon landers. The latter is part of *Hakuto-R Mission 2*.

With the flyby return of Elon Musk’s Tesla Cruiser, we looked at other manmade objects that returned and were mistaken for natural objects. One of these was the *Rosetta* spacecraft which was doing an Earth flyby in 2007 on its way to a comet. Between 2020 and 2022, mistaken for asteroids were *Lucy*, *BepiColombo*, both doing flybys, the *SpectR* X-ray observatory at the Earth-Sun L2 point, and, most famously, an upper stage from what appears to be the launch of the *Surveyor 2* lunar probe which failed in 1966. We also got a link to <https://www.wherisroadster.com>.

We watched a video of SpaceDeX mission and docking.

The first module of India’s space station will go up in 2028.

--Minutes By OSA Secretary Syd Henderson

Minutes of January 11 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance met January 11, 2025, at the Cyber Hall and Gaming Lounge at Norman Computers in Norman, Oklahoma. Attending in person were Clifford McMurray, Adam Hemphill, Julie Keosourinha, John Northcutt, Dave Sheely, and Syd Henderson. OSA President Clifford McMurray presided over the meeting. Clifford did an *Update* discussing links to material covered in the meeting and this is online at <https://osa.nss.org/Update2501.pdf> so I’ll cover the details that aren’t covered there.

There were 13 RocketLab launches in 2024 and 17 Russian. By comparison, SpaceX predicted 136 launches and made 134. By comparison, China made 67 launches out of 68, so SpaceX made twice as many launches as China, which nonetheless set a national record for more launches. Many of these were launching satellites for China’s new communications network. The current configuration of SLS cannot make a moon landing and it is likely that the configuration that can is dead. SLS is both overbuilt and underbuilt for what it needs to do.

China may have spent more on Space in 2024 than the US.

We looked at a *Space News* article on NASA Administrator nominee Jared Isaacman and the upcoming confirmation hearings. He owns stock in SpaceX (in connection with the *Polaris Dawn* mission) and if he retains it he could have a potential conflict of interest, so expect the subject to come up.

NASA has two concepts for returning the samples *Perseverance* is collecting on Mars, one using a sky crane, and the second a heavy launcher. Adam is skeptical (as am I) of RocketLab’s 2031 date for their bid for the Sample Return mission, partly because the first Neutron launch was moved from late 2024 to May 2025.

A typo in *Update*: The American record for longest spacewalk is eight (not nine) hours and 56 minutes, so China’s Cai Xuzhe and Song Lingdong’s 9 hours and 6 minutes is indeed a new record. (The American record was an ISS mission in 2001.)

We watched a video on Mars Chopper, a proposed drone that would have six helicopter-type rotors, one at each vertex of a hexagon.

Thailand is the first nation to sign both the Artemis Accords and the ILRS (China's version).

Killer satellites tend to move slowly to their target, so ULA's proposal to intercept them is viable. However, it would also add a deplorable amount of debris (as might the killer satellite if that is its mission).

The retired military weather satellite that broke up on December 18 is one of a series that has a bad record of breaking up in orbit. Since it broke up at an altitude of 840 km, the debris will be up for a very long time.

--Minutes By OSA Secretary Syd Henderson

Space News

I was hoping to have a report here on the launch of *Starship 8*, but it was aborted at T-40 seconds on March 3. Clearly it doesn't observe *Outreach* deadlines but will hopefully launch in time for this month's meeting. They are not going for an upper stage catch this time, which seems wise after January's second stage failure, but they will try for a first stage catch. The second stage, meanwhile, will carry four dummy Starlink satellites and splash into the Indian Ocean after sixty-six minutes. The second stage that exploded last time was carrying ten dummy Starlinks.

It appears we were slightly off on why Mars is red. It is still due to iron oxide, but the color better matches hydrated iron oxide, presumably formed when Mars was still wet.

Firefly Aerospace's *Blue Ghost* lunar lander made a soft landing on the Moon at 2:34 a.m. CST on March 2. This is only the second soft landing on the Moon by a private spacecraft, the first being IM-1's *Odysseus* in February 2024. Unlike *Odysseus*, *Blue Ghost* made a perfect landing and landed on flat terrain so there was no danger of it falling over. On March 3, Firefly released our cover photo showing its first sunrise on the Moon.

Blue Ghost will operate on the Moon for one lunar daytime, which is equivalent in length to fourteen Earth days. This means it will be able to observe the total eclipse of the Moon from the lunar surface, which I guess makes it a total eclipse of the Sun from its perspective. Since it's storing solar power, it will continue a few Earth day lengths into lunar night.

The mission, by the way, is dubbed "Ghost Riders in the Sky."

Intuitive Machine's second lunar launch took place aboard a SpaceX Falcon 9 rocket at 7:16 CST on February 27. This includes Intuitive Machine's IM-2 Nova C lander, named *Athena*. On February 22, 2024, IM-1 achieved the first soft landing by a commercial spacecraft, *Odysseus*, but was damaged on landing and fell over on its side, which limited how much science it could do. The landing site is Mons Mouton near the lunar South Pole, which is where *VIPER* was supposed to land (and may yet, since there are efforts to revive the mission, though I'm skeptical with the current move for government spending cuts by DOGE).

Mons Mouton, by the way, is not small. In fact, it has a prominence of 20,000 feet over the surrounding area, equivalent to that of Denali (aka Mount McKinley).

This mission also contains the Micro Nova Hopper, Grace, which will investigate Marston crater, the depths of which are permanently shadowed and may contain water ice.

Assuming this mission is successful, it will be the third soft landing on the Moon by a private spacecraft, after Sunday's landing by *Blue Ghost*. Currently the landing is scheduled for March 6, which is after this newsletter was published, but before our meeting.

Note that there is one more spacecraft heading for the Moon, space's *Hakuto-R Mission 2*, which was launched in January along with *Blue Ghost*, but is a highly elliptical orbit so it can be captured by the Moon. Its lander *Resilience* and rover *Tenacious* are planned to land on the Moon in May or June. If successful, it will be the fourth soft landing on the Moon by a private company/ (*Hakuto-R Mission 1* crash-landed on the Moon in April 25, 2023. *SLIM*, which made a soft landing on January 19, 2024, was a mission by Japan's JAXA space agency, hence not a private spacecraft.)

We had a flurry of stories recently about the near-Earth asteroid 2024 YR4, which was estimated to have up to 3% chance of hitting the Earth. Since it is somewhere between 120 and 300 feet across, it could potentially cause damage to a major city. However, as usual, refinements in calculating its orbit now eliminate the possibility of a collision with Earth,

but there is an up to 2% chance of it hitting the Moon in 2032. Hopefully not where we or China are setting up a Moon base, though the odds against that are, of course, astronomical. “If the asteroid did hit the moon, Boslough” [of the University of New Mexico] says, based on the uncertainty in its size, it could leave a crater anywhere from about 400 meters across to as much as 1.8 km. across -- larger than Arizona's Meteor Crater.” (“Asteroid Won't Hit Earth, But Might Hit Moon — a Potential Science Bonanza,” by David L. Chandler, <https://skyandtelescope.org/astronomy-news/>, 28 February 2025.) It's likely that further refinements to 2024 YR4's will eliminate the possibility of a lunar collision, but we can hope.

ARCA (Astroparticle Research with Cosmics in the Abyss), part of the upcoming Kilometre Cubic Neutrino Telescope, has already made a major discovery, namely a neutrino thirty times as energetic as the previous record-holder. This neutrino has an energy of 220 peta electronvolts, or 220 million billion electronvolts. Another way of putting this is that it has the energy of 234 million protons turned into energy—and remember, this is a neutrino, with a rest mass less than an eighth of an electronvolt. So, something has increased its energy 10^{18} times. What this could be is unclear. Since they are uncharged, electric force won't affect them, though there is some speculation that neutrinos may have magnetic moments though those have never been detected. It seems likely, though, that it was emitted by some other highly energetic particle that is mystery to us.

You may wonder how we detected the notoriously elusive neutrino. It struck something in the upper atmosphere (high-energy neutrinos are more likely to hit something), producing a muon with nearly the same energy, that then lit up sensors producing a shower of photons and other particles. But any particle getting deep enough into the atmosphere to produce that muon must be chargeless, and a neutron would have encountered something higher up. Thus, a neutrino.

Sky Viewing

The highlight this month is a **total eclipse of the Moon**, visible in the early morning of March 14. This one is just about perfect for the Americas; in fact, the only place in mainland North and South America that don't see totality in its entirety is the eastern tip of the bulge of Brazil. Even Hawaii gets to see it. It occurs pretty much simultaneously all over North America, with partiality beginning at 12:09 a.m. CDT, totality from 1:16 a.m. through 2:32 a.m., and partiality ending at 3:48 a.m. The Pacific coast has it even better: mid-totality for them is almost exactly at midnight.

There will be a second total lunar eclipse in September that is a perfect opposite of this one: it is visible throughout almost all of the Old World, but the only place in the Americas where it is visible is, yes, the eastern tip of the bulge of Brazil. We will get our next one on March 3, 2026, and it is no coincidence that these are occurring at six-month intervals (minus eleven days per year, which is the difference between the solar and lunar years).

We also have our first major meteor shower since early January: the **Lyrid meteor shower** peaks in the early morning hours of April 22. Though the Lyrids can reach 90 meteors per hour, 20 per hour is more usual. The Moon will be a crescent rising around 3:30 a.m., so it will not be a factor. By the way, the Lyrid radiant is actually in an inconspicuous place at the border of the constellation Hercules, but Vega is nearby and is the fifth-brightest star in the night sky (and goes almost straight overhead in Norman). Although the peak will be just after midnight, you may be seeing Lyrids as early as 9 – 10 p.m.

Although we've had a brief period in early February when all eight major planets were simultaneously visible in the evening (including one beneath your feet and two by binoculars), this is over, with four planets, Saturn, Neptune, Mercury and Venus, in conjunction with the Sun in March. The next time all the planets (except Earth and I'm holding out for Pluto) will simultaneously be in the evening sky will be 2040, but I'm sure Venus, Saturn, Mars and Jupiter will be before then. And in a few months they will all be in the sky in the morning.

Mercury is relatively easy to find at magnitude -0.3 in the western sky about forty minutes after sunset on March 8 when it is at greatest elongation however, it is dimming rapidly as it approaches inferior conjunction on March 22. On March 13, Mercury and Venus will be side by side in the sky. Mercury will be five magnitudes dimmer, though still first magnitude. Mercury becomes a morning star in April, reaching greatest elongation on April 22, rising an hour before the Sun.

Venus is still brilliant in the western sky just after sunset but setting earlier each night and will be lost in twilight by March 16. It is in inferior conjunction with the Sun on March 22. It is a little fortunate that this is an inferior conjunction because Venus will brighten rapidly after the end of March as its crescent gets fatter and will be brilliant in the morning sky by mid-April.

In contrast, **Mars** is almost overhead in the mid-evening sky, and at magnitude 0.0 is very easy to find, especially since you can follow the ecliptic through Venus and Jupiter. Mars is now moving away from us, so it will dim to magnitude 0.4 by the end of March and around magnitude 0.6 by late April. In early April, it will be in Gemini south of Castor and Pollux but will move into dim Cancer later in the month.

Jupiter, on the other hand, is almost overhead at sunset, and, at magnitude -2.3 is highly conspicuous. By the end of March, it will be setting around 1:00 a.m., and by the end of April, it will set around 11:00 p.m. and be magnitude -2.0. It will be in Taurus all this time, gradually moving toward the tips of the horns of the Bull on its way to Gemini, which it will not reach before conjunction with the Sun.

Saturn will be in conjunction with the Sun on March 11 and is currently not visible. It should begin to get visible in the morning sky in early April and will be rising a couple hours before the Sun by the end of April. Saturn's rings are now almost on edge, and will be on edge on March 23, discreetly hidden in twilight. This makes Saturn a much less prominent object, but it's a great time if you want to see Saturn's moons, especially Titan.

Uranus is near the border of Taurus and Aries on the western side of Taurus. At magnitude 5.7, it is theoretically visible to the naked eye under totally dark skies, but you'll need binoculars at least to identify it. It will disappear from even telescopic view in mid-April as it approaches conjunction with the Sun on May 17. Its blue tinge helps. Uranus is now in Taurus, where it will remain until 2032. It's south and a little west of the Pleiades. To search for Uranus, try <https://lovethehightsky.com/see-uranus-through-a-telescope>

Neptune is in conjunction with the Sun on March 19 so is lost even to telescopes. In late April, it may just be possible to find it in the eastern sky just before sunrise, but at magnitude 7.9, it definitely requires a strong pair of binoculars or a telescope. It's a difficult object to search for, but <https://lovethehightsky.com/see-neptune-through-a-telescope/> should be a help. Like Uranus it has a definite blue tinge that will help distinguish it from background stars. Neptune has the advantage that if you find it at all, it will be in about the same place for the next year or two.

Viewing Opportunities for Satellites (March 8 – April 8, 2025)

You can get sighting information at www.heavens-above.com, which gives you a constellation map showing the trajectory of the satellite. You can also get data at <https://spotthestation.nasa.gov/sightings/>.

With the addition of the solar panels, the International Space Station can be as bright as magnitude -4.0 making it brighter than all the stars other than the Sun and all the planets other than Venus. The Hubble Space Telescope can get up to magnitude 1.5, which is brighter than the stars in the Big Dipper, but magnitude 2.0 is more likely. *Tiangong* is the Chinese Space Station. It currently gets up to magnitude -2.2 after the addition of the Wentian module last July.

The "mag." beside the date indicates the brightest magnitude the satellite gets during the pass. Most of the ISS passes get between -2.9 and -3.9, which is brighter than Jupiter ever gets, but not quite as bright as Venus.

Missions to and from the International Space Station and *Tiangong* can change their orbits. The next launch to the ISS is the SpaceX Crew 10 mission and there will be a return flight of Crew 9 soon after, which will return Bruce Willmore and Suni Williams after their extremely extended stay. A Progress resupply module will arrive on April 8. The next launch to *Tiangong* is the crew change on April 25. There will be no launches to Hubble in the foreseeable future. Also note that the ISS (and presumably *Tiangong*) sometimes have to alter orbits to avoid space debris. Hubble is high enough that this is less of a concern.

The information below is from Heavens Above.

HST 3/7 mag. 2.0			ISS 3/11 mag. -3.4		
Time	Position	Elevation	Time	Position	Elevation
7:17 a.m.	234°	10°	9:09 p.m.	239°	10°
7:20	174	28	9:12:47	320	59
7:23	120	14	9:13:07	349	55

Vanishes into Earth's shadow.

HST 3/8 mag. 2.0			ISS 3/12 mag. -3.8		
Time	Position	Elevation	Time	Position	Elevation
6:52 a.m.	235°	10°	8:21 p.m.	220°	10°
6:55	175	28	8:24	136	70*
6:58	115	10	8:27	52	11

*Passes through Orion's Belt and then close to Mars.

Tiangong 3/20 mag. -2.0			
	Time	Position	Elevation
Appears from Earth's shadow.			
	6:11:18 a.m.	207°	49°
	6:11:54	152	64
	6:15	70	10

Tiangong 3/31 mag. -2.1			
	Time	Position	Elevation
Appears from Earth's shadow.			
	6:07:54 a.m.	255°	25°
	6:09:35	24	79
	6:13	111	10

Tiangong 3/29 mag. -1.4			
	Time	Position	Elevation
	6:34 a.m.	302	10°
	6:37	19	50
	6:40	97	10

ISS 4/1 mag. -3.5			
	Time	Position	Elevation
	8:13 p.m.	308°	10°
	8:17	224	71
	8:20	138	10

ISS 3/29 mag. -3.8			
	Time	Position	Elevation
	9:04 p.m.	312°	10°
	9:07:52	41	68
	9:08:39	106	47

Tiangong 4/8 mag. -2.0			
	Time	Position	Elevation
	8:41 p.m.	227°	10°*
	8:43:43	151	50
	8:46:13	77	14

Vanishes into Earth's shadow.

Key: Position is measured in degrees clockwise from north. That is, 0° is due north, 90° is due east, 180° is due south, and 270° is due west. Your fist held at arm's length spans about ten degrees. "Elevation" is elevation above the horizon in degrees. So, to view Tiangong at 8:43:43 p.m. on April 8, measure three fist-widths east of due south, then five fist-widths above the horizon.

Programming Notice: NASA+ on the Web

NASA-TV has become NASA+ <https://plus.nasa.gov/>

NASA+ live event schedules are available at <https://www.nasa.gov/live/> or <https://plus.nasa.gov/scheduled-events/>.

Calendar of Events

Sometime in 2025 (most likely September): End of *JUNO* mission to Jupiter.

Sometime in 2025: Israel launches its *Beresheet 2* landers (two of them) and orbiter to the Moon. For more information, see en.wikipedia.org/wiki/Beresheet_2.

Sometime in 2025: Launch of the *LSAS lunar lander*, a joint project of the European Union and Israel. (LSAS is the LUNAR Surface Access Service program.)

Sometime in 2025: Launch of *Skynet 6A* by Airbus and the UK Ministry of Defense, which will catapult us into the Terminator universe.

Sometime in 2025: Uncrewed Starship lunar landing demonstration. For more information, en.wikipedia.org/wiki/Starship_HLS

Sometime in 2025 [moved from 2024]: Maiden flight of Rocket Labs Neutron launcher, from Wallops Island, Virginia.

Sometime in 2025: Maiden flight of the Aurora rocket and first orbital launch from Spaceport Nova Scotia.

First half of 2025: In flight fuel transfer from Starship to a target.

March: *Fram2*, a four-passenger civilian flight by Crew Dragon. This will be the first crewed flight ever launched into polar orbit. For more information, visit <https://en.wikipedia.org/wiki/Fram2>.

March: *New Glenn* will carry a prototype Blue Moon lunar lander to the Moon. This is known as *Pathfinder Mission 1*. [Note: the launch date for this is flexible and could be as late as November.]

March 7: Mercury is at its greatest eastern elongation, 18.2 degrees east of the Sun (so can be seen after sunset).

March 8: Oklahoma Space Alliance meeting, 2:00 p.m., Norman Computers. Meeting information will be posted at <http://osa.nss.org>.

March 11: Saturn is in conjunction with the Sun.

March 12 [Moved from March 25]: SpaceX launches SpaceX *Crew-10* to the ISS. This is the mission that will allow the *Boeing Crew Flight Test* crew to finally come home (aboard Crew-9, which has been serving as a lifeboat).

March 14: Oklahoma City Astronomy Club meets at Science Museum Oklahoma. 7:00 p.m., followed by a talk at about 7:45 p.m. See www.okcastroclub.com for details. I imagine they'll be celebrating the next event.

March 14: Total eclipse of the Moon, visible throughout the Americas.

March 15 [Moved from January]: First flight of *Eris*, from Bowen Spaceport at Abbot Point in Queensland, Australia. If successful, this will give Australia the ability to launch its own satellites.

March 19: Neptune is in conjunction with the Sun.

March 22: Venus is in inferior conjunction with the Sun.

March 24: Mercury is in inferior conjunction with the Sun.

Second quarter of 2025 [moved from February]: First (uncrewed) *Gaganyaan* flight test. For more information, see https://en.wikipedia.org/wiki/Gaganyaan_1.

Second quarter of 2025 [moved from September 2024]: *ESCAPADE Blue* and *Gold* Mars Orbiters launch by New Glenn. For more information, see en.wikipedia.org/wiki/EscaPADE.

April: First flight test of ESA's uncrewed Space Plane *Vega-C*. For more information, see https://en.wikipedia.org/wiki/Vega_C.

April 8: Soyuz launch of Expedition 72/73 to the ISS from Baikonur Cosmodrome.

April 11: Oklahoma City Astronomy Club meets at Science Museum Oklahoma. 7:00 p.m., followed by a talk at about 7:45 p.m. See www.okcastroclub.com for details.

April 12: Oklahoma Space Alliance meeting, 2:00 p.m., Norman Computers. Meeting information will be posted at <http://osa.nss.org>.

April 20: *Lucy* flies by asteroid 52246 Donaldjohanson.

April 22: Mercury is at its greatest western elongation, 27.4 degrees west of the Sun (so can be seen before sunrise).

April 21-22: Peak of Lyrid meteor shower.

April 25: *Shenzhou 20* launch to the Tiangong Space Station. This will carry three taikonauts to replace the crew already there.

May: Launch of *Axiom-4* (*Ax-4*) mission to the ISS, via Falcon 9. This carries one professional astronaut and three private astronauts, including the winner of the *Space Hero* reality show. For more information, see https://en.wikipedia.org/wiki/Axiom_Space.

May: First *Dream Chaser* cargo mission via Vulcan Centaur. This is the mission that was supposed to go up in July 2024.

May: Launch of *Tianwen-2* (formerly *Zheng He*), China's asteroid sample return mission and comet orbiter, which will visit Earth's co-orbital asteroid Kamo'oalewa and comet 311P/PANSTARRS,. For more information, see <https://en.wikipedia.org/wiki/Tianwen-2>.

May: Maiden flight of the *Tianlong 3* launch vehicle.

May 3-4: Peak of Eta Aquariid meteor shower. This is one of the two showers originating from Halley's Comet.

May 9: Oklahoma City Astronomy Club meets at Science Museum Oklahoma. 7:00 p.m., followed by a talk at about 7:45 p.m. See www.okcastroclub.com for details.

May 10: Oklahoma Space Alliance meeting, 2:00 p.m., Norman Computers. Meeting information will be posted at <http://osa.nss.org>.

May 17: Uranus is in conjunction with the Sun,

May 29: Mercury is in superior conjunction with the Sun.

May 31: Venus is at its greatest western elongation, 45.9 degrees west of the Sun (so can be seen before sunrise).

June [Moved from April]: Third and last Cygnus launch to the ISS.

June 14: Oklahoma Space Alliance meeting, 2:00 p.m., Norman Computers. Meeting information will be posted at <http://osa.nss.org>.

June 19 - 22: International Space Development Conference 2025 in Orlando, Florida. For more information, visit <https://isdc.nss.org>.

June 24: Jupiter is in conjunction with the Sun.

Second half of 2025: First launch of Stoke Space's *Nova* Rocket.

Second half of 2025: Several launches of Orbex (Orbital Express Launch Ltd.)'s *Prime* rocket. This is a small launcher; what is notable is that this will launch from SaxaVord Spaceport in the Shetland Islands, making it possible the first orbital launcher from the UK, and by a private company at that.

July [Moved from March]: Launch of South Korea's *Hanbit-Nano* from Alcântara Space Center in Brazil. This is the first private launch from Alcântara.

Mid-July [moved from March]: Launch of Russia's *Bion -M No. 2*, to observe the effects of the Van Allen radiation belts on mice over a period of 30 days.

July 3: Mercury is at its greatest eastern elongation, 25.9 degrees east of the Sun (so can be seen after sunset).

July 27: Peak of Southern Delta Aquariid meteor shower.

July 31: Mercury is in inferior conjunction with the Sun.

August [moved from First Quarter]: Maiden flight of *Pallas-1* launch vehicle by Galactic Energy in China. For information, see en.wikipedia.org/wiki/Pallas-1.

August: First operational crewed mission of *Starliner 1* to the ISS. This now seems doubtful, with SpaceX's Crew-11 taking this spot. For more information, visit https://en.wikipedia.org/wiki/Boeing_Starliner-1.

August 12 – 13: Peak of Perseid meteor shower.

August 19: Mercury is at its greatest western elongation, 18.6 degrees west of the Sun (hence can be seen before sunrise).

September: Launch of *IMAP* heliophysics probe to the L1 Lagrangian point (the one between us and the Sun). For more information, visit https://en.wikipedia.org/wiki/Interstellar_Mapping_and_Acceleration_Probe and https://en.wikipedia.org/wiki/Space_Weather_Follow_On-Lagrange_1

September [moved from June]: Maiden flight of LandSpace's *Zhuque-3* orbital launch vehicle.

September: First HTV-X resupply mission to ISS (by Japan).

September 7: Total lunar eclipse, visible throughout the Old World. The only part of the Americas that can see any of this is eastern Brazil.

September 13: Mercury is in superior conjunction with the Sun.

September 20: Saturn is at opposition.

September 23: Neptune is at opposition.

Fourth quarter of 2025: *Axiom-5*, a four-person fourteen-day mission to the ISS.

Fourth quarter of 2025: Launch of CLPS mission to the Lunar South Pole, including PROSPECT. CLPS=Commercial Lunar Payload Services.

October: A SpaceX *Nova-C* mission to the Moon takes Intuitive Machines' IM-3 lander, NASA's Lunar Vertex rover, and several NASA Cadre rovers. For information, en.wikipedia.org/wiki/IM-3

October 8 – 9: Peak of Draconid meteor shower.

October 22 – 23: Peak of Orionid meteor shower. This is the other meteor shower originating from Halley's Comet.

October 29: Mercury is at its greatest eastern elongation, 23.9 degrees east of the Sun (so can be seen after sunset).

November [moved from September]: Astrobiotic's *Griffin Mission 1*, including lunar lander and CubeRover. They leave Earth on a Falcon Heavy. This was originally going to carry *VIPER*, which has been cancelled.

November 5: Peak of South Taurid meteor shower.

November 12: Peak of North Taurid meteor shower.

November 16 – 17: Peak of Leonid meteor shower.

November 20: Mercury is in inferior conjunction with the Sun.

November 21: Uranus is at opposition.

December 7: Mercury is at its greatest western elongation, 20.7 degrees west of the Sun (hence can be seen before sunrise).

December 13 – 14: Peak of Geminid meteor shower.

December 21 – 22: Peak of Ursid meteor shower.

Sometime in 2026: Launch of ispace's *Mission 3*. First flight of ispace's APEX 1.0 lunar lander.

Sometime in 2026 [Moved from January 2025]: Launch of the *Venus Life Finder Probe and Photon* relay satellite to Venus by RocketLab's Electron Booster. For more information, visit https://en.wikipedia.org/wiki/Venus_Life_Finder.

Sometime in 2026: Launch of Japan's *Martian Moons Exploration* (MMX) which includes a Phobos lander and sample return. For information, see [en.wikipedia.org/wiki/Martian_Moons_eXploration_\(MMX\)](https://en.wikipedia.org/wiki/Martian_Moons_eXploration_(MMX)).

Sometime in 2026 [Moved from 2025]: Second (uncrewed) *Gaganyaan* flight test. This one will carry the Vyommitra humanoid robot.

Sometime in 2026 [Moved from 2025]: Third (uncrewed) *Gaganyaan* flight test. This one will carry the Vyommitra humanoid robot. For more information on the *Gaganyaan* program, see <https://en.wikipedia.org/wiki/Gaganyaan>.

Sometime in 2026 [maybe]: India launches its first crewed orbital flight *Gaganyaan 4*. For more information on the *Gaganyaan* program, see <https://en.wikipedia.org/wiki/Gaganyaan>.

Sometime in 2026: India launches *Mars Lander Mission* (MLM 2 or *Mangalyaan 2*). This seems to be same as MOM2. For more information, https://en.wikipedia.org/wiki/Mars_Lander_Mission

Sometime in 2026: Maiden flight of *Terran R* mission to Mars from Impulse Space. For more information, en.wikipedia.org/wiki/Terran_R.

Sometime in 2026: Launch of MIT's *Venus Habitability Mission*.

Sometime in 2026: second *Blue Ghost* mission, carrying *Lunar Pathfinder* to the far side of the Moon. (Lunar Pathfinder is not to be confused with UK Pathfinder which failed launch in 2024, Intuitive Machines GEO Pathfinder, which is a variant of SHERPA, or Pathfinder Mission 1, which is part of the Blue Moon program.)

Sometime in 2026: *Gaganyaan-5*, India's second crewed spaceflight.

Sometime in 2026: *Gaganyaan-6*, India's first resupply mission to the ISS.

Sometime in 2026: Maiden flight of *Volans*, the first orbital launch vehicle developed in Singapore.

Sometime in 2026: Launch of *Canadensys* lunar rover, the first for Canada.

First quarter of 2026: Launch of *Daytona 1*, carrying the first pair of satellites for Tropical Weather Analytics' Hurricane Hunter Satellite Constellation. Daytona is a series of launchers for the Phantom Space Corporation, en.wikipedia.org/wiki/Phantom_Space_Corporation#Daytona

April 2026 [Moved from September 2024]: *Artemis 2*, the first crewed test flight of SLS and Orion. This will be a free-return mission: that is, it will loop around the Moon without landing. For more information, visit https://en.wikipedia.org/wiki/Artemis_2.

Mid-2026: *Starship* launch of the *Starship HLS* lunar lander and FLEX, Astrolab's demo lunar lander. *Starship HLS* is the craft SpaceX will use to transfer astronauts to the Moon.

May 2026 [moved from August 2025]: launch of Vast's *Haven-1* space station. For more information, en.wikipedia.org/wiki/Haven-1.

May 2026: The *Psyche* probe flies by Mars.

June 2026 [Moved from 2025]: first crewed mission to Vast's *Haven-1* space station. For information, en.wikipedia.org/wiki/Haven-1.

July 2026: *ClearSpace-1* will capture *PROBA-1* and deorbit it.

July 2026: *Hayabusa 2* flies by 98943 Torifune.

Fourth quarter of 2026: China launches the lunar mission *Chang'e 7*, which includes an orbiter, a lander and a hopping probe. For more information, see https://en.wikipedia.org/wiki/Chang%27e_7.

Fourth quarter of 2026: China launches its *Xuntian* space telescope, which will orbit close to orbit close to *Tiangong* for easy servicing. For more information, visit <https://en.wikipedia.org/wiki/Xuntian>

November 2026]: *BepiColombo* arrives at Mercury orbit.

December 28, 2026: *Hera* arrives at the binary asteroid Didymos (the one we hit with an impactor).

Sometime in 2027: Launch of the first two modules of the *Lunar Orbiter Platform Gateway* by SpaceX's Falcon Heavy. These were originally going to be launched on separate spacecraft but are now bunked together.

Sometime in 2027: First flight of *Long March 10*, which will be China's vehicle for crewed Moon missions.

Sometime in 2027: Launch of *NEM-1*, the core module of the *Russian Orbital Service Station*, or *ROSS*. For more information, see https://en.wikipedia.org/wiki/Russian_Orbital_Service_Station.

Sometime in 2027: USSF's *DRACO* demonstration of a nuclear thermal rocket in low-Earth orbit. For more information, see en.wikipedia.org/wiki/Demonstration_Rocket_for_Agile_Cislunar_Operations.

Sometime in 2027: Launch of the *Payload Power Thermal Module*, the first module of Axiom's space station. It will dock with ISS and await the arrival of *Hab-1*, which it will dock with as part of a free-flying space station.

May 2027 [Moved from October 2026]: Launch of the *Nancy Grace Roman Space Telescope* [formerly known as WFIRST] to the Earth-Sun L2 point. For more information, see https://en.wikipedia.org/wiki/Nancy_Grace_Roman_Space_Telescope.

Mid 2027 [Moved from September 2026]: Launch of *Artemis 3*, which will be the first crewed lunar landing since 1972. For information, see en.wikipedia.org/wiki/Artemis_3.

August 12; 2027: *Lucy* flies by asteroid 3548 Eurybates in its first encounter with a Trojan asteroid. It will fly by at least 3 more Trojans in 2027 and 2028.

September 2027: Launch of *Luna 26*, the Luna-Resurs-Orbiter. This mission is in tandem with next year's Luna 27 lander. For more information, see https://en.wikipedia.org/wiki/Luna_26.

September 2027 Launch of the *NEO Surveyor* which will be able to detect more than 90% of near-earth objects greater than 460 feet in diameter. For more information, see https://en.wikipedia.org/wiki/NEO_Surveyor.

September 15, 2027: *Lucy* flies by Trojan asteroid 15094 Polymele.

Sometime in 2028: JAXA launches *DESTINY+*, an asteroid flyby mission to Phaethon, the parent of the Geminid meteor shower. It will arrive there in 2029. For information, see en.wikipedia.org/wiki/DESTINY%2B.

Sometime in 2028: Launch and landing of Japan/India *LUPEX* (Lunar Polar Exploration) lander. India knows this as Chandrayaan-5. For more information, see https://en.wikipedia.org/wiki/Lunar_Polar_Exploration_Mission.

Sometime in 2028: Launch of *Luna 27*, the Luna-Resurs Lander which will land in the South Pole-Aitkin Basin on the far side of the Moon. This mission is in tandem with 2027's Luna 26 orbiter. For more information, see https://en.wikipedia.org/wiki/Luna_27#Science_payload.

Sometime in 2028: Launch of *Chang'e 8*, which will include a lander, rover and a 3D printing experiment using lunar resources. This will be the last Chang'e mission before China sends a human crew to the Moon.

Sometime in 2028: first uncrewed test launch of *Orel*, Russia's new crewed spacecraft, with first crewed launch later in the year. For information, [https://en.wikipedia.org/wiki/Orel_\(spacecraft\)](https://en.wikipedia.org/wiki/Orel_(spacecraft)).

Sometime in 2028: Launch of the first module of India's *Bharatiya Antariksha* space station. For more information, see https://en.wikipedia.org/wiki/Bharatiya_Antariksha_Station.

First quarter of 2028: Launch of the *Emirates Asteroid Mission* to the asteroid belt, where it will make at least seven flybys of asteroids, the largest of which are Chimaera and Justitia. [See May 2035.]

March 29, 2028: Launch of India's *Shukrayaan-1* Venus orbiter. This is also cammed VOM (Venus Orbiter For more information, see <https://en.wikipedia.org/wiki/Shukrayaan-1>.

April 2028: Launch of ESA's *Ramses* spacecraft, which will fly by near Earth asteroid Apophis.

April 18, 2028: *Lucy* encounters asteroid 11351 Leucus.

July 2028: Launch of *Dragonfly*, the Titan helicopter mission. For information, see [en.wikipedia.org/wiki/Dragonfly_\(spacecraft\)](https://en.wikipedia.org/wiki/Dragonfly_(spacecraft)).

September 2028: Launch of *Artemis 4*, a Lunar Gateway expedition which will also land four astronauts on the Moon. For more information, https://en.wikipedia.org/wiki/Artemis_IV.

October 2028: ESA launches the *ExoMars Mars Rover*, which has been christened *Rosalind Franklin*. For more information, visit <https://en.wikipedia.org/wiki/ExoMars>.

November 11, 2028: *Lucy* flies by Trojan asteroid 21900 Orus.

Sometime in 2029: Launch of *Solar Polar Orbit Observatory* by China.

Sometime in 2029: Launch of the *ARIEL Space Telescope* and the *ESA/JAXA Comet Interceptor* mission via Ariane 62 to the Sun-Earth L₂ point, where the Interceptor will wait for a long-period comet to come by.

Sometime in 2029: Blue Origin will launch Blue Moon MKS Crewed Lunar Demo via New Glenn.

Sometime in 2029: Launch of MIT's Venus Atmosphere Sample Return Mission.

April 21, 2029: *OSIRIS-APEX* rendezvous with the asteroid Apophis. Note: *OSIRIS-APEX* is the same spacecraft as *OSIRIS-REx*; it is renamed "Apophis Explorer" for this part of its mission.

August 2029: The *Psyche* asteroid probe arrives at asteroid 16 Psyche. For more information, visit [https://en.wikipedia.org/wiki/Psyche_\(spacecraft\)](https://en.wikipedia.org/wiki/Psyche_(spacecraft)).

September 2029: Launch of *Tianwen 4* which will carry a Jupiter orbiter and a mission to Uranus. The Uranus spacecraft will eventually leave the solar system, something that only the US has achieved.

Sometime in 2030: *DESTINY+* flies by asteroid 3200 Phaethon, the parent body of the Geminid meteor shower.

Sometime in 2030: Russia launches *Boomerang*, aka *Fobos-Grunt 2*, which will return samples from Mars's moon Phobos. (*Fobos-Grunt 1*) failed in low-Earth orbit in 2011.)

Sometime in 2030: Launch of China's *Tianwen-3* Mars sample return mission and orbiter.

Sometime in 2030: China will land a crewed mission on the Moon.

Sometime in 2030: Launch of the ESA's *NEOMIR* (Near-Earth Object Mission in the Infrared).

Sometime in 2030: Launch of Russia's *Luna 28* sample return mission.

Sometime in 2030: Maiden flight of *Siraya*, Taiwan's first orbital launch vehicle.

Sometime in 2030 [moved from 2027]: Projected launch of the ESA's *Earth Return Orbiter* Mars. This vehicle will bring the *Perseverance* Mars samples to Earth.

Sometime in 2030: Launch of *UVEX*, NASA's Ultraviolet Explorer wide-field ultraviolet telescope.

Sometime in 2030: Launch of ISS Deorbit Vehicle by Space X. This will bring the ISS era to a close.

March 2030 {moved from September 2029}: Launch of *Artemis 5* to the Moon. This mission carries the ESPRIT Refueling Module to the Lunar Gateway, and a crew and the crewed Lunar Terrain Rover.

April 11, 2030: *Europa Clipper* arrives at Jupiter.

Sometime in 2031 or 2032: Launch of *DAVINCI*, a NASA Discovery Program mission to Venus.

Sometime in 2031: Projected launch of Sample Retrieval Lander and Mars Ascent Vehicle to return *Perseverance*'s Mars samples. This mission is still undergoing revisions.

Sometime in 2031: Russia launches the VENERA-D Venus orbiter and lander. For more information, visit <https://en.wikipedia.org/wiki/Venera-D>.

Sometime in 2031: Launch of the first of ESA's Argonaut lunar landers.

March 2031: Launch of *Artemis 6* to the Moon.

Spring 2031: *Europa Clipper*'s first flyby of Europa.

June 2031: Launch of *VERITAS* orbiter and Venus Atmosphere Sample Return Mission to Venus. For more information, see [https://en.wikipedia.org/wiki/VERITAS_\(spacecraft\)](https://en.wikipedia.org/wiki/VERITAS_(spacecraft)).

July 2031: *Hayabusa 2* arrives at asteroid 1998 KY26.

July 2031: *JUICE* flies by Ganymede then is inserted into Jupiter orbit.

December 2031: Launch of ESA's *EnVision* Venus orbiter.

Sometime in 2032: Launch of the *Yenisei* lunar flyby mission. This will be the first Russian manned mission to the Moon (though it's not a landing).

Sometime in 2032: Launch of Lunar Cruiser, the pressurized crewed rover built by JAXA, Toyota and NASA.

Sometime in 2032: Launch of first South Korean lunar lander.

Sometime in 2032: Launch of Japan's LiteBIRD, which will analyze the effect of gravitational waves on the Cosmic Microwave Background.

March 2032: Launch of *Artemis 7* to the Moon. This will include the crewed Lunar Cruiser rover built in Japan.

July 2032: *JUICE* flies by Europa.

Sometime in 2033: Launch of *Artemis 8* to the Moon, which includes the first component of the Artemis Base Camp.

Sometime in 2033: First flight of the *Long March 9* super-heavy launch vehicle. This looks like it will be able to carry 53,000 kg to the Moon and 44,000 kg to Mars and will probably carry Chinese astronauts to the Moon.

March 2, 2033: *Lucy* flies by the double Trojan asteroid 617 Patroclus-Menotius. I believe these are the largest asteroids it will encounter.

December 2034: *Juice* achieves Ganymede orbit.

Sometime in 2035: Launch of *LISA* gravitational wave observatory.

May 2035: The *Emirates Asteroid Mission* touches down on Justitia.

Sometime in 2036: *Dragonfly* arrives at Titan.

August 12, 2045: The next total solar eclipse is visible in Oklahoma City. This one is also visible in Salt Lake City, Denver, Little Rock (again), Tampa Bay and New Orleans.

Oklahoma Space Alliance Officers, 2025

Clifford McMurray, President and *Update* Editor

405-329-4326 (H) 405-863-6173 (C)

Dave Sheely, Vice-President, 405-821-9077 (C)

Syd Henderson, Secretary & *Outreach* Editor,

405-321-4027 (H) 405-365-8983 (C)

Tim Scott, Treasurer, 405-740-7549 (H)

OSA E-mail Addresses and Web Site:

ahemphil at gmail.com (Adam Hemphill)
 cliffmcmurray at hotmail.com (Claire & Clifford McMurray)
 sheely at sbcglobal.net or david.sheely.1 at us.af.mil (David Sheely)
 sydh at ou.edu (Syd Henderson)
 sswift42 at aol.com (Steve Swift)
 ctscott at mac.com (Tim Scott)
 t_koszoru01 at cox.net (Heidi and Tom Koszoru)
 john.d.northcutt1 at tds.net (John Northcutt)
 lensman13 at aol.com (Steve Galpin)

E-mail for OSA should be sent to sydh at ou.edu. Members who wish their e-mail addresses printed in Outreach, and people wishing space-related materials e-mailed to them should contact Syd. Oklahoma Space Alliance website is <http://osa.nss.org> . Webmaster is Syd Henderson.

Other Information

Oklahoma Space Industrial Development Authority (OSIDA), 401 Sooner Drive/PO Box 689, Burns Flat, OK 73624, 580-562-3500. Website is <http://airspaceportok.com/#home>,
 Science Museum Oklahoma (former Omniplex) website is www.sciencemuseumok.org. Main number is 602-6664.
 Tulsa Air and Space Museum, 7130 E. Apache, Tulsa, OK 74115.
 Web Site is www.tulsaairandspacemuseum.com. Phone (918) 834-9900.
 The Mars Society address is The Mars Society, 11111 West 8th Avenue, Unit A, Lakewood, CO 80215. Phone: (303) 980-0890 Their web address is www.marsociety.org.
 The National Space Society's Headquarters Executive Director e-mail nsshq@nss.org. The Chapters Coordinator is Bennett Rutledge 720-641-7987, rutledges@chapters.nss.org. The address is: National Space Society, 1300 I Street NW, Suite 400E, Washington, DC 20005. Phone (321)452-2448. The web page is space.nss.org.
 The Planetary Society phone 626-793-5100. The address is 60 South Los Robles Avenue, Pasadena, California, 91101, and the website is www.planetary.org. E-mail is tps@planetary.org.
 NASA Spacelink BBS 205-895-0028. Or try www.nasa.gov .
 Congressional Switchboard 202/224-3121.
 Write to any U. S. Senator or Representative at [name]/ Washington DC, 20510 (Senate) or 20515 [House]

OKLAHOMA SPACE ALLIANCE
A Chapter of the National Space Society
MEMBERSHIP ORDER FORM

Please enroll me as a member of Oklahoma Space Alliance. Enclosed is:

_____ \$10.00 for Membership. (This allows full voting privileges but covers only your own newsletter expense.)
_____ \$15.00 for family membership
_____ TOTAL amount enclosed.

National Space Society has a special \$20 introductory rate for new National Space Society regular membership rates are \$62, Student memberships are \$40, Senior \$51. You can save five dollars off if you auto-renew. Part of the cost is for the magazine *Ad Astra*. If you choose to receive the magazine digitally, memberships are \$52 for regular, \$30 for students and \$41 for seniors (with the same \$5 off for auto-renew. Mail to: National Space Society, PO Box 98106, Washington, DC 20090, or join at www.nss.org/membership. (Brochures are at the bottom with the special rate.) Be sure to ask them to credit your membership to Oklahoma Space Alliance.

To join the Mars Society, visit www.marssociety.org. One-year memberships are \$50.00; student and senior memberships are \$25, and Family memberships are \$100.00. Three-year memberships are double one-year memberships. Their address is Mars Society, 11111 W. 8th Ave, Unit A, Lakewood, CO 80215.

Do you want to be on the Political Action Network?

_____ Yes _____ No. [See brochure for information.]

Name _____

Address _____

City _____ State ____ ZIP _____

Phone (optional or if on phone tree) _____

E-mail address (optional) _____

OSA Memberships are for 1 year, and include a subscription to our monthly newsletters, *Outreach* and *Update*. Send check & form to **Oklahoma Space Alliance, 102 W. Linn, #1, Norman, OK 73071.**