

# OKLAHOMA SPACE ALLIANCE

## OUTREACH – July 2024

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet at the  
at the room next to Norman Computer  
at 2:00 p.m. on July 13, details inside



Figure 1 Location of recurrent nova T Coronae Borealis (the X on the map) which is expected to go nova very soon. (See "Space News" inside.) Source: Wikipedia Commons

## OKLAHOMA SPACE ALLIANCE OUTREACH July 2024

### July Meeting

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, July 13, at the location next to Norman Computers on West Main. Prospective members are welcome.

The meeting room is in the Cyber Hall and Gaming Lounge at Norman Computers. Norman Computers is at 916 W Main St, opposite Norman High School. The phone number is (405) 292-9501. To get to the meeting space from points north, take the 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 July 13, 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 May and June meetings
  - c. Posters
  - d. Membership Business
  - e. ISDC 2024
5. Video (to be announced)
6. Chat

### Minutes of June 8 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance met June 8, 2024, at the Cyber Hall and Gaming Lounge at Norman Computers in Norman, Oklahoma. Attending were Adam Hemphill, Kevin?, Tim Scott, Dave Sheely, and Syd Henderson. Claire and Kip McMurray were at his 50<sup>th</sup> class reunion. OSA President Adam Hemphill presided over the meeting Adam presented an update containing links to material covered in the meeting and this is online at <https://osa.nss.org/Update2406.pdf> so I'll cover the details that aren't covered there.

Virgin Orbit's LauncherOne shut down prematurely on its sixth launch (which is why they're no longer flying). The problem is that they can't do a full vacuum test on Earth.

Levitating trains have an advantage on the Moon since they have no moving parts for moon dust to get into. The levitating train project is called FLOAT, FLOAT is magnetic robots levitating over a three-layer track. Cars can be put on these. FLOAT is part of a ten-year LunA initiative by DARPA.

16 Virtus Solis solar power satellites would cover the whole world.

All our commercial crew spacecraft rely on Airborne Systems for parachutes. SpaceX just bought a second supplier for parachutes.

Isar Aerospace is a German company although they intend to launch from a new spaceport in Norway. They will manufacture 80% of Spectrum launchers themselves.

High-Energy rockets are designed to launch directly into high orbits as opposed to launching to LEO and transferring to a high orbit.

Supernova's solar-thermal propulsion rocket will begin launches in late 2025 so they must already be working on hardware.

We watched the launch and re-entry of Starship's fourth, successful mission. This was the first time we actually had coverage all the way from orbit to landing, thanks to Starlink.

No changes in bank account.

--Minutes By OSA Secretary Syd Henderson

### Minutes of May 11 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance met May 11, 2024, at the Cyber Hall and Gaming Lounge at Norman Computers in Norman, Oklahoma. Attending were Adam Hemphill, Claire and Clifford McMurray, Kevin?, John Northcutt, Tim Scott, Dave Sheely, and Syd Henderson. OSA President Adam Hemphill presided over the meeting He presented an *Update* put together by Clifford McMurray discussing links to material covered in the meeting and this is online at <https://osa.nss.org/Update2405.pdf> so I'll cover the details that aren't covered there.

*Chang'e 6* is carrying a (secret) rover that carries an infrared imaging spectrometer. *Chang'e 6* will probably spend at least three weeks before landing so it can take advantage of the lunar day.

Adam thinks the new requirement for reentry licenses is less necessary because other commercial space companies learned to lesson from Varda's problem getting its payload back to Earth. [FAA hadn't made a provision for reentry licenses so for a while Varda looked to be stranded or have to land in another country.—SFH]

If we send a 1,000 kg (1 metric ton) lander to Mars, we can bring back 25 kg of samples collected by the Perseverance rover.

NASA has a survey on space priorities and the time limit is three days after this meeting..

Adam: SpaceX would be more likely to get into Commercial Mars than Sample Return. They are already talking about Starlink on Mars.

Starlink is now running a profit of about \$600 million out of \$6 billion.

Adam: So far all proposals for space debris removal consume the removal satellite along with the target debris.

Adam thinks that they will have to deploy removal satellites that will stay in space to perform more missions. [That's the only way I see it being cost-effective.—SFH]

Switzerland, Sweden and Slovenia sign the Artemis Accords. [Slovakia signed on May 30. Now if they can just get San Marino to join.]

NASA selected three companies to build lunar rovers.

Kip will not be able to do the next *Update*.

Claire and Kip McMurray and Dave Sheely will be going to the International Space Development Conference in Los Angeles. Syd will attend the Chapters Assembly meeting remotely. [I hope to publish the minutes in the July *Outreach*.]

--Minutes by OSA Secretary Syd Henderson

### NSSCA Minutes May25th 2024

[via Prathmesh Barapatre. Comments in brackets are from Syd Henderson and not part of the minutes.

#### Roll Call

Prathmesh Barapatre, NSSCA Chair / NSS Mumbai

Frank Garza, NSS Phoenix Chapter

Jan Roston - Sacramento

Bennett Rutledge, NSS Denver Chapter

Jim Plaxco, Chicago Society for Space Studies

Perri Doure - Colorado

Avinash Shirode - NSS Nashik Chapter

Mario Anzalotti - NSS PHOENIX

David Stuart - NSS Seattle

10.Dennis Pearson - PASA

11. Pat Crepeau - Space Conveyor Specialty Chapter

12.Linda Plush - Space Nursing Society

13.Gabriela Lindberg from OASIS chapter 14.Priyal Bordia - NSS Mumbai Chapter

15.Hiya Pokharna - NSS Mumbai Chapter

16.George cooper Cuyahoga Valley Space Society

17.Sydney Henderson [Oklahoma Space Alliance-Syd]

[Dave Sheely was also at the meeting but for some reason is not in the roll call, perhaps because I was chapter representative—Syd].

Approval for Minute shared for April 08th 2024:

Minutes for the April 08th 2024 meeting were approved with no changes to be made.

Old Business:

Chapter Committee Resources:

1. Upcoming NSSCA Meetings to be decided at ISDC 2024:

Next Meetings:

June 10th, 2024 – 5pm PDT

July, August, and September meetings are as follows:

July: Monday, July 8, 2024 - 5 pm PDT

August: Monday, August 12, 2024 – 5 pm PDT

September - Saturday, September 7, 2024 – 8am PDT

Chapter Resources Pages –

To receive the Zoom link to the Chapters Assembly meetings, contact Prathmesh Barapatre at: [prathmesh.barapatre@outlook.com](mailto:prathmesh.barapatre@outlook.com)

**Parade of Planets** - June 3rd, 2024, in the USA – On the Eastern Horizon just before sunrise in the US – 6 planets will align in the sky. Jupiter will be closest to the horizon, then Mercury, Uranus, Mars, Neptune and Saturn. The ideal date to view the alignment may vary depending on your location. May 27 Through June 3rd worldwide.

**Next Total Eclipses in the next 10 years** – globally

<https://www.timeanddate.com/eclipse/list-total-solar.html>

**Space Education Summit** – May 31st 7am PDT to 5PM PDT. Free and all online. It features an opening panel with astronauts, four concurrent sessions in multiple strands, and a closing capstone session. The different tracts are: Education – Consciousness and Psychology – Young Professionals and Culture & Design, and Ethics & Law. You can get your tickets here: <https://spaceeducation.squarespace.com>.

C. Chapter Assembly Executive Secretary -

Ms. Perri Doutre was elected as NSSCA Executive Secretary.

Chapter Award Winners 2024 –

324 activities – 19 STEM activities - 39 Types of activities – 106 talks – 3,400 people reached – 8 countries, 5 continents, 980 virtual events 104 meetings. These are the documented events though we know there were many others not reported.

Florida Space Development Council – Best New Chapter for Resurrecting the Old Chapter

Oregon L5 – Honorable Mention: Second life and space online chat (MOO)

HAL5 - Honorable Mention: In-Person Speaker Events – Huntsville Alabama

Space Nursing Society – Honorable Mention: World Outreach in the Medical Field

NSS Iowa Chapter – Honorable Mention: Speakers in Zoom and Meetings

San Antonio – Honorable Mention: Educational Activities

NW Jersey – Honorable Mention: Space and Science Podcast

Guayaquil – Special Merit: Dave Dunlop International Chapter

New Delhi Space Society – Special Merit: Social Media for region

10.

Sacramento L5 Space Society – Special Merit: NASA Projects Applications and Student Balloon Project

11. Middle Tennessee - Special Merit: Astronomy and Space Viewings and talks

12.Colombia NSS - Special Merit: Best Small Chapter

13.Chicago Society for Space Studies: Excellence Award

14.NSS (USA) Mumbai: Excellence Award

15.David Stuart – Claire McMurray Chapter Advocate of the Year

16.National Space Society of North Texas – Robert Compton Chapter of the Year

## Space News

T Coronae Borealis is a recurrent nova that was discovered by John Birmingham in 1866 (though it had been observed several times before that, in 1787 and perhaps 1217, without astronomers realizing what it was). It recurred in 1946, and the current light curve looks just like it did before the two latest outbursts. Thus, it is expected that it will explode again in the very near future—perhaps as soon as August, although it could also be any time in the next year or two. It gets up to magnitude 2, which would make it a bit brighter than Alphecca, the brightest star in the constellation Corona Borealis. The location will be where I drew the x in the lower left of the crown. This month's cover is a map of Corona Borealis and Boötes with Arcturus for reference (Arcturus is the 4<sup>th</sup> brightest star in the night sky and the brightest in the northern sky.) Corona Borealis is pretty distinctive but you'd need to have a moderately dark sky to see anything but Alphecca (and, soon, the nova).

Astronaut William “Bill” Anders died June 7 at age 90. He was a member of the Christmas flight, *Apollo 8*, and as such not only became one of the first three people to orbit the Moon but shared the honor of being one of the “Time Men of the Year” with his crewmates. He also took the most iconic photograph of the era when he snapped the Earth rising over the edge of the Moon. This photograph, *Earthrise*, has been endlessly reproduced. I remember it on the cover of *The Last Whole Earth Catalog*, and it played a vital role in jumpstarting the environmental movement. (A few seconds before, Frank Borman took a black-and-white photograph showing the Earth emerging from behind the Moon, but it's Anders' color photograph that became famous.)

*Apollo 8* was Ander's only mission to space: *Gemini 13*, on which he would have flown, was cancelled, and he a backup crew for *Apollo 11*.

Boeing's *Starliner* spacecraft launched on June 5, initially without incident, but a helium leak was soon detected, then several. These were minor and didn't threaten the mission, but it was discovered that five of the twenty-eight maneuvering jets malfunctioned as it neared its planned docking. Four of the five have been restored but the fifth is still out. Boeing is testing a version of Starliner on the ground to see if they can reproduce the problems. In the meantime, Butch Wilmore and Suni Williams, who were supposed to return on June 14, have had their mission extended to at least the end of July. Mission managers do say that the craft could be brought back now but they want to play safe. Beyond that, Starliner will begin nearing the end of its batteries' life, though NASA has indicated that they can extend the mission to 90 days if need be, which would be in early September. No word on whether SpaceX can carry new batteries on of its several supply missions in that time.

Space Pioneer's *Tianlong 3* spacecraft was supposed to be undergoing a static fire test June 30 when it accidentally launched, presumably because the anchoring failed. After a minute of glorious freedom, it crashed near Gongyi in a spectacular fireball which apparently didn't injure anyone. If so, mission control was very, very lucky. Space Pioneer's previous spacecraft, *Tianlong 2*, reached orbit fifteen months ago, and was the first 'private' Chinese spacecraft to reach orbit. *Tianlong 3* is much more powerful, being able to carry eight times as much payload into orbit for a total of seventeen tonnes.

Tianlong, by the way, means “Heavenly Dragon,” and is the name of a mythical dragon. Tiangong means Heavenly Palace or Sky Palace, and I'm forever mistyping Tianlong.

## Sky Viewing

The next two months feature one minor shower, the **Alpha Capricornids**, one medium-sized shower the Southern **Delta Aquariids**, and one major shower, the **Perseid Meteor Shower**. The first two both peak in late July, with the Southern Delta Aquariids peaking on July 30 with 12 – 20 per hour, and the Alpha Capricornids on July 31 with only about five. These showers actually have shallow peaks, and both have radiants in the southern part of the sky (Aquarius and Capricornus are adjacent constellations in the Zodiac), so you can really look for them at the same time. The Moon will be in its last crescent phase and will rise about 2:30 a.m. but probably won't be bright enough to interfere with the meteor showers.

The Perseids, on the other hand, get up to a hundred meteors per hour. I've seen them from a dark park in the center of Norman, but there's more light pollution now so I'd advise getting a few miles away from the city. The peak is on the night of August 11 – 12, and the radiant is in the north near Cassiopeia. The Moon will be in its first quarter, so it will be

setting around midnight and won't interfere with the meteors at their peak. The Perseids tend to have larger fragments than many meteor showers, so they tend to be brighter. It's also possible to see meteors a few mornings before and after the peak, so try on the mornings of August 10 through 14..

There are four first magnitude stars that can be occulted by **the Moon**: Regulus (most often since it is almost on the ecliptic), Aldebaran, Spica and Antares. The Moon will occult Spica around 10:00 p.m. on July 13 and **Spica** will be hidden by the Moon for about three hours. This occultation will be visible in its entirety throughout Oklahoma and Texas as well as most of Mexico.

**Mercury** is currently about magnitude -0.2 in the west just after sunset. If you have a clear horizon, start looking about a half-hour after sunset. It reaches greatest elongation on July 22 but is also growing dimmer. Unlike Venus, Mercury is brightest when it is on the far side of its orbit when we see most of its disk, and it is approaching inferior conjunction on August 18. This means that it will be magnitude 1.0 or worse through all of August, and also fading into twilight.

**Venus** has now passed its June 4 superior conjunction with the Sun and is very low in the western sky just after sunset. Even by the end of August it will be only five degrees above the horizon a half-hour after sunset. However, this will improve for the rest of the year and early into the next year. Since it's on the far end of its orbit, it is about magnitude -3.9, which is almost a magnitude less bright than it be in December.

The reason that Mercury and Venus differ so much in when they are brightest is that Mercury is only on average twice as far when it is most distant than when it is closest, so the increase in the area we see more than compensates for the increased distance. Venus, on the other hand, is six times farther when it is most distant than when it is closest, so not only is closer, but actually looks biggest and brightest when it's a fat crescent.

**Mars** is currently about magnitude 1.0 and is easy to see in the eastern sky before sunrise, about twenty degrees higher than the much brighter Jupiter. The constellation is Aries, and Mars will be the brightest "star" in the constellation. Aries has one pretty bright star (Hamal, magnitude 2.01, about as bright as Polaris) one moderately bright star (Sheratan, magnitude 2.66) and a couple of stars around magnitude 3.5, so it's not all that dim. Mars moves into Taurus in mid-July, where it joins Aldebaran, and they will be almost exactly the same brightness and color, though Aldebaran is located in the V-shaped cluster, the Hyades, that makes up the horns of the Bull (it's not actually a member) and Mars will be closer to the Pleiades.

**Jupiter** is also in Taurus and will be spending some time visiting the Hyades. It is still fairly low in the east before sunrise, but at magnitude -2.0 is easily visible, and will shortly be dominating the hours before dawn as it dominated the evening hours a few months ago, it and Venus have essentially switched roles. Jupiter will be rising a couple of hours earlier each month, and since we are past the summer solstice, will soon be visible through the a.m. hours before sunrise.

**Saturn** is currently rising about midnight and is magnitude 1.1. It is located in Aquarius below the circlet of Pisces, where it will be for several months, as it goes into retrograde motion before its September 7 opposition. By then, it will be magnitude 0.7. If you look about two fist-widths south of Saturn, you will see the first-magnitude star Fomalhaut, which is only a half magnitude less bright than Saturn. Both of them are easily the brightest objects in their part of the sky.

**Uranus** is in Taurus, closer to Mars than to Jupiter. This also means that it is pretty low in the sky at sunrise. Uranus passes about a half-degree north of Mars on July 15 and will be about twenty degrees higher each month. It will be in Taurus until 2032. Since it is magnitude 5.8, it is theoretically visible to the naked eye in really dark skies, but you would probably need binoculars or a small telescope. To search for Uranus, try <https://lovethenightsky.com/see-uranus-through-a-telescope/>

**Neptune** at magnitude 7.9 definitely requires a strong pair of binoculars or a telescope. It's also in an inconspicuous part of Pisces below the Cirlet asterism about ten degrees (one fist-width) to the left of Saturn. It's a difficult object to search for, but <https://lovethenightsky.com/see-neptune-through-a-telescope/> should be a help. 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 (July 13 – August 13, 2024)

You can get sighting information at [www.heavens-above.com](http://www.heavens-above.com), which gives you a constellation map showing the trajectory of the satellite. The Sky & Telescope web site carries ISS observation times for the next few nights at [sky-andtelescope.com/observing/almanac](http://sky-andtelescope.com/observing/almanac). 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 and will do so several times below.

The “mag.” beside the date indicates the brightest magnitude the satellite gets during the pass. All 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 big question at the moment is when the *Starliner* that went up to the ISS on June 5 will return home. (See “Space News.”) Current projection is July 31 but remember Butch Wilmore and Suni Williams were supposed to come back on June 14. The Cygnus cargo module currently attached to the ISS will be released on July 12. The next launch to the ISS will be a Cygnus cargo craft on August 3. A Progress cargo module will be launched on August 15, and a Crew Dragon in mid-August. There are no launches to *Tiangong* until September 30. 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.

Tiangong 7/12 mag. -2.2			
	Time	Position	Elevation
	4:58:00 a.m.	253°	39°
	4:59:01	334	82
	5:02:	64	10

Tiangong 7/25 mag. -2.4			
	Time	Position	Elevation
	10:19 p.m.	244°	10°
	10:22:12	169	89
	10:22:20	74	82
	Vanishes into Earth’s Shadow		

HST 7/16 mag. 1.7			
	Time	Position	Elevation
	9:47 p.m.	245°	10°
	9:50:27	183	30
	9:52:20	138	20*
	*Passes very close to Antares		
	Vanishes into Earth’s shadow		

ISS 7/26 mag. -3.2			
	Time	Position	Elevation
	9:14 p.m.	324°	10°
	9:16:55	38	45
	9:17:26	68	41
	Vanishes into Earth’s shadow		

HST 7/17 mag. 1.8			
	Time	Position	Elevation
	9:28 p.m.	246°	10°
	9:31:01	185	29
	9:33:53	128	13*
	*Passes barely above Antares and the Moon		

Tiangong 7/26 mag. -1.8			
	Time	Position	Elevation
	9:16 p.m.	222°	10°
	9:19	169	89
	9:22	77	10

HST 7/18 mag. 1.9			
	Time	Position	Elevation
	21:08 p.m.	246°	10°
	21:12	186	28
	21:15	125	10*
	*Passes just below Antares and above the Moon		

Tiangong 7/27 mag. -1.6			
	Time	Position	Elevation
	9:49 p.m.	258°	10°
	9:52	339	59
	9:55	60	10

Tiangong 7/19 mag. -0.9			
	Time	Position	Elevation
	5:42 a.m.	304°	10°
	5:45	17	42
	5:48	91	10

ISS 7/28 mag. -3.4			
	Time	Position	Elevation
	10:13 p.m.	302°	10°
	10:16:26	226	50*
	10:16:55	194	45
	*Passes very close to Arcturus		
	Vanishes into Earth’s shadow		

Tiangong 7/21 mag. -1.8			
	Time	Position	Elevation
	5:13 a.m.	200°	10°
	5:16	22	63
	5:19	104	10*
	*Passes just below Mars		

ISS 7/29 mag. -3.8			
	Time	Position	Elevation
	9:25 p.m.	314°	10°
	9:27:51	42	80
	9:30:18	129	17
	Vanishes into Earth’s shadow		

Tiangong 8/5 mag. -2.2				Tiangong 8/7 mag. -2.2			
Time	Position	Elevation		Time	Position	Elevation	
9:56 p.m.	297°	10°		9:24 p.m.	290°	10°	
9:58:38	23	74		9:26:56	207	70	
9:59:10	89	55		9:28:40	127	23	

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 the Tiangong Space Station at 9:24 p.m. on August 7, measure two first-widths right of due south, then one fist-width above the horizon.

### Programming Notice: NASA TV on the Web

Watch NASA TV (Public, Media and Education Channels) on your computer using Flash, Windows or QuickTime at <http://www.nasa.gov/multimedia/nasatv/index.html>.

NASA TV Schedules are available at <http://www.nasa.gov/multimedia/nasatv/schedule.html>.

July 12: 5:30 a.m.: Coverage of release of Cygnus NG-20 Cargo Craft from the ISS. Actual release is at 6:00 a.m.

July 29: time TBA: coverage of spacewalk at the ISS.

Presumably NASA-TV will cover the release of *Starliner*, currently projected for July 31.

### Calendar of Events

Sometime in 2024: Maiden flight of the Aurora rocket. This will be the first orbital launch from Spaceport Nova Scotia. (Note: there is also an Aurora launch in July as part of a rideshare. That one is being launched by a Falcon 9 from Vandenberg AFB in California.)

Sometime in 2024: *UK Pathfinder* launch, from SaxaVord Spaceport on Unst in the Shetland Islands to low Earth orbit. This, amazingly, will be the first orbital launch from the ground in the history of the United Kingdom. (This is not to be confused with *GEO Pathfinder*, which is part of the IM2 lunar mission.)

Third quarter of 2024: First launch of Firefly's *Blue Ghost* lunar lander delivering payloads to Mare Crisium. For more information, see [https://en.wikipedia.org/wiki/Firefly\\_Aerospace#Blue\\_Ghost\\_lunar\\_lander](https://en.wikipedia.org/wiki/Firefly_Aerospace#Blue_Ghost_lunar_lander).

July: First (uncrewed) *Gaganyaan* flight test. For more information, see [https://en.wikipedia.org/wiki/Gaganyaan\\_1](https://en.wikipedia.org/wiki/Gaganyaan_1).

July: 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.

July 12: 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](http://www.okcastroclub.com) for details.

July 13: Oklahoma Space Alliance meeting, 2:00 p.m., Norman Computers. Meeting information will be posted at <http://osa.nss.org>.

July 18: Transporter 11 flight by Falcon 9, carrying a slew of small satellites, many technology demonstrations, by many countries. In addition to the usual suspects, this has satellites from Argentina, Croatia, Finland, Poland, Spain, and the United Arab Emirates

July 22: Mercury is at its greatest eastern elongation, 26.9 from the Sun (hence can be seen before sunset).

July 23: Pluto is at opposition.

July 27: Peak of Delta Aquariid meteor shower.

July 31: Launch of *Polaris Dawn* flight carrying Jared Isaacman and three other civilians into space. For more information, visit [https://en.wikipedia.org/wiki/Polaris\\_Dawn](https://en.wikipedia.org/wiki/Polaris_Dawn)

August 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](http://www.okcastroclub.com) for details.

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

August 12: Peak of the Perseid meteor shower.

Mid-August: Ninth *Crew Dragon* mission to the ISS.

August 18: Mercury is at inferior conjunction with the Sun.



September [Tentative] Flight test of Tianlong-3, Space Pioneer's orbital launch vehicle. The first test launch in early July ended in a spectacular explosion.

Early September: ULA will launch a *Mass Simulator* mission with an inert payload and some experiments. This is the second certification mission of the Vulcan launcher, but its scheduled cargo has been delayed and ULA wants Vulcan certified now.

September 1: 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.

September 4: Mercury is at greatest western elongation, 18.1° from the Sun (hence can be seen before sunrise).

September 7: Saturn is at opposition.

September 11: Launch of Expedition 71/72 to the ISS by Soyuz.

September 13: 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](http://www.okcastroclub.com) for details.

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

September 20: Neptune is at opposition.

September 27 – October 4: Okie-Tex Star Party, Camp Billy Joe, Kenton, Oklahoma. Hosted by the Oklahoma City Astronomy Club. For more information, visit <https://www.okie-tex.com>.

September 29 *ESCAPADE Blue* and *Gold Mars Orbiters* launch by New Glenn. This is the maiden flight for Blue Origin's New Glenn rocket. For more information, see [en.wikipedia.org/wiki/EscaPADE](https://en.wikipedia.org/wiki/EscaPADE).

September 30: Mercury is in superior conjunction with the Sun.

Fourth quarter of 2024: Maiden flight of Perigee Aerospace *Blue Whale 1* reusable launch vehicle from Jeju Space Center in South Korea.

Fourth quarter of 2024: Second (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>.

Fourth quarter of 2024 Launch of the *IM-2 South Pole Mission*, including the Polar Resources Ice Mining Experiment 1 (PRIME-1), the IM-2 Lunar Lander, the Lunar Trailblazer orbiter, the Micronova Lunar Hopper, and the M1-MAPP demo lunar rover. The last is a joint US/Finnish mission. Also on this flight is Tanker-002, an in-space refueling satellite from Orbit Fab. This is the second NOVA-C mission.

Fourth quarter of 2024: *Hakuto R* Mission 2 carrying iSpace's Resilience lunar lander and a Luxembourg (!) iSpace Europe lunar mini-rover. [*Hakuto R* mission 1 was the one that crash landed with a UAE rover aboard.]

October 2: Annular eclipse of the Sun. This one is almost entirely over the South Pacific Ocean, touching land in Easter Island and southern tips of mainland Chile and Argentina. It will be partial in Hawaii, southern South America, and a bunch of small South Pacific islands as well as Western Antarctica.

October 8: Launch of the *Hera* asteroid orbiter by the ESA, which contains the *Juventas* and *Milani* asteroid probes. Destination is the binary asteroid Didymos/Dimorphos to evaluate the results of the DART asteroid impact mission. For more information, visit [https://en.wikipedia.org/wiki/Hera\\_\(space\\_mission\)](https://en.wikipedia.org/wiki/Hera_(space_mission)).

October 10: Launch of *Europa Clipper* orbiter to Jupiter's moon Europa. For more information, [https://en.wikipedia.org/wiki/Europa\\_Clipper](https://en.wikipedia.org/wiki/Europa_Clipper),

October 21: Peak of the Orionid meteor shower.

Late October: 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](https://en.wikipedia.org/wiki/Axiom_Space).

November: Maiden flight of *Pallas-1* launch vehicle by Galactic Energy in China. For information, see [en.wikipedia.org/wiki/Pallas-1](https://en.wikipedia.org/wiki/Pallas-1).

November 16: Uranus is at opposition.

November 16: Mercury is at greatest eastern elongation, 22.5° from the Sun (hence can be seen after sunset) .

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

December 5: Mercury is at inferior conjunction with the Sun.

December 7: Jupiter is at opposition.

December 13: Peak of Geminid meteor shower.

December 22: Peak of Ursid meteor shower.

December 24: Mercury is at greatest western elongation, 22.0° from the Sun (hence can be seen before sunrise).

December 24: *Parker Solar Probe* makes its first pass through the outer corona of the Sun. For more information, see <http://parkersolarprobe.jhuapl.edu>.

December 30: 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](https://en.wikipedia.org/wiki/Venus_Life_Finder)

Sometime in 2025 (moved from November 2024): Launch of NASA's *VIPER* lunar rover, which will hunt for ice near the Nobile Crater at Moon's South Pole. *VIPER* is landing aboard Astrobotic's *Griffin* lunar lander. They leave Earth on a Falcon 9. For information, see [en.wikipedia.org/wiki/VIPER\\_\(rover\)](https://en.wikipedia.org/wiki/VIPER_(rover))

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](https://en.wikipedia.org/wiki/Beresheet_2).

Sometimes 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: 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](https://en.wikipedia.org/wiki/DESTINY%2B).

Sometime in 2025: China will launch an Asteroid Impactor and Orbiter and flyby to asteroid 2019 VL5. For more information, see <https://spacenews.com/china-to-target-asteroid-2019-vl5-for-2025-planetary-defense-test/>.

Sometime in 2025: Uncrewed Starship lunar landing demonstration.

Sometime in 2025 [maybe]: India launches its first crewed orbital flight *Gaganyaan*. For more information, [en.wikipedia.org/wiki/Gaganyaan](https://en.wikipedia.org/wiki/Gaganyaan).

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

First quarter of 2025: India launches its third uncrewed orbital flight *Gaganyaan-3*. For more information, [en.wikipedia.org/wiki/Gaganyaan](https://en.wikipedia.org/wiki/Gaganyaan). [Note: this was previously supposed to be crewed.]

First quarter of 2025: A SpaceX Nova-C mission to the Moon takes Intuitive Machines' IM-3 lander, NASA's Lunar Vertex rover, and several NASA Cadre rovers.

First quarter of 2025: First operational crewed mission of *Starliner 1* to the ISS. For more information, visit [https://en.wikipedia.org/wiki/Boeing\\_Starliner-1](https://en.wikipedia.org/wiki/Boeing_Starliner-1).

First quarter of 2025: Launch of the *Mission Robotic Vehicle* (MRV) which carries the RSGS (Robotic Servicing of Geosynchronous Satellites) to attach jet packs to remove dying satellites from orbit. For more information, see [https://en.wikipedia.org/wiki/Mission\\_Extension\\_Vehicle](https://en.wikipedia.org/wiki/Mission_Extension_Vehicle).

January 16, 2025: Mars is at opposition, 60 million miles from Earth. In other words, this is a poor opposition.

February 2025: Launch of *IMAP* heliophysics probe and *Solar Cruiser* to the Earth-Sun L1 Lagrangian point (the one between us and the Sun). For more information, visit [https://en.wikipedia.org/wiki/Interstellar\\_Mapping\\_and\\_Acceleration\\_Probe](https://en.wikipedia.org/wiki/Interstellar_Mapping_and_Acceleration_Probe) and [https://en.wikipedia.org/wiki/Space\\_Weather\\_Follow\\_On-Lagrange\\_1](https://en.wikipedia.org/wiki/Space_Weather_Follow_On-Lagrange_1)

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

April 20, 2025: *Lucy* flies by asteroid 52246 Donaldjohanson.

May 2025: Launch of *Tianwen-2* (formerly *Zheng He*), China's asteroid sample return mission and comet orbiter. For more information, see <https://en.wikipedia.org/wiki/Tianwen-2>.

June 2025: Maiden flight of LandSpace's *Zhuque-3* orbital launch vehicle.

Second half of 2025 (not in July!): first crewed mission to Vast's *Haven-1* space station. For more information, <https://en.wikipedia.org/wiki/Haven-1>.

August 2025: launch of Vast's *Haven-1* space station. For more information, <https://en.wikipedia.org/wiki/Haven-1>.

Third quarter of 2025: First flight test of ESA's uncrewed Space Place *Vega-C*.

September 2025: *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](https://en.wikipedia.org/wiki/Artemis_2).

Fourth quarter of 2025: *Mission Possible*, a demonstration flight of the Nyx reusable spacecraft by the Exploration Company a French-German enterprise.

November 2025: 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.

December 2025: *BepiColombo* arrives at Mercury orbit.

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

Sometime in 2026: Launch and landing of Japan/India *LUPEX* (Lunar Polar Exploration) lander. For more information, see [https://en.wikipedia.org/wiki/Lunar\\_Polar\\_Exploration\\_Mission](https://en.wikipedia.org/wiki/Lunar_Polar_Exploration_Mission).

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 2024]: India launches *Mars Orbiter Mission 2* (MOM 2 or *Mangalyaan 2*). For information, see [https://en.wikipedia.org/wiki/Mars\\_Orbiter\\_Mission\\_2](https://en.wikipedia.org/wiki/Mars_Orbiter_Mission_2).

Sometime in 2026: Maiden flight of Terran R mission to Mars from Impulse Space. For more information, [en.wikipedia.org/wiki/Terran\\_R](https://en.wikipedia.org/wiki/Terran_R).

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, to launch in 2024, or Intuitive Machines GEO Pathfinder, which is a variant of SHERPA.)

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.

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

Mid-2026: Uncrewed *Starship* mission to Lunar South Pole, carrying Astrolab's FLEX lunar rover.

Second half of 2026: ClearSpace-1 will capture PROBA-1 and deorbit it.

July 2026: *Hayabusa 2* flies by asteroid 2001 CC<sub>21</sub>.

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](https://en.wikipedia.org/wiki/Artemis_3).

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](https://en.wikipedia.org/wiki/Chang%27e_7).

Fourth quarter of 2026 [Moved from 2024]: 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>

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](https://en.wikipedia.org/wiki/Nancy_Grace_Roman_Space_Telescope).

Sometime in 2027: Launch of NEM-1, the core module of the Russian Orbital Service Station. For more information, see [https://en.wikipedia.org/wiki/Russian\\_Orbital\\_Service\\_Station](https://en.wikipedia.org/wiki/Russian_Orbital_Service_Station).

Sometime in 2027: Launch of the ESA's *Earth Return Orbiter* to Mars. This vehicle will bring the *Perseverance* Mars samples to Earth.

Sometime in 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](https://en.wikipedia.org/wiki/Luna_26).

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](https://en.wikipedia.org/wiki/Demonstration_Rocket_for_Agile_Cislunar_Operations).

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

Possibly in 2028 (moved from December 2024): Launch of India's *Shukrayaan-1* Venus orbiter. For more information, see <https://en.wikipedia.org/wiki/Shukrayaan-1>.

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](https://en.wikipedia.org/wiki/Luna_27#Science_payload).

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

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: Launch of the *Sample Retrieval Lander* to Mars. This is part of a joint NASA/ESA mission and will include Ingenuity class helicopters. [There's a very good chance that this will be delayed for up to a decade.]

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](https://en.wikipedia.org/wiki/Bharatiya_Antariksha_Station).

First half of 2028: 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](https://en.wikipedia.org/wiki/NEO_Surveyor).

March 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.]

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.

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

Sometime in 2029: *DESTINY+* flies by asteroid 3200 Phaethon, the parent body of the Geminid meteor shower.

Sometime in 2029: Launch of the *ARIEL Space Telescope* and the *ESA/JAXA Comet Interceptor* mission via Ariane 62 to the Sun-Earth L<sub>2</sub> point, where the Interceptor will wait for a long-period comet to come by.

Sometime in 2029: 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)).

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.

June 2029: Launch of *DAVINCI+* to Venus. For more information, see <https://en.wikipedia.org/wiki/DAVINCI>

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 *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.

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 [Moved from November 2028]: Launch of China’s *Tianwen-3* Mars sample return mission.

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: Launch of ESA’s *EnVision* Venus orbiter.

September 2030: Launch of *Artemis 6* to the Moon.

July 2031: Hayabusa 2 arrives at asteroid 1998 KY26.

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

September 2031: Launch of *Artemis 7* to the Moon. This will include the crewed Lunar Cruiser rover build in Japan.

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 first South Korean lunar lander.

Sometime in 2032: 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 visible in Oklahoma City. This one is also visible in Salt Lake City, Denver, Little Rock (again), Tampa Bay and New Orleans.

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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](http://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](http://www.tulsaairandspacemuseum.com). Phone (918) 834-9900.

The Mars Society address is The Mars Society, 11111 West 8<sup>th</sup> Avenue, Unit A, Lakewood, CO 80215. Phone: (303) 980-0890 Their web address is [www.marsociety.org](http://www.marsociety.org).

The National Space Society's Headquarters Executive Director e-mail [nsshq@nss.org](mailto:nsshq@nss.org). The Chapters Coordinator is Bennett Rutledge 720-641-7987, [rutledges@chapters.nss.org](mailto:rutledges@chapters.nss.org). The address is: National Space Society, 1300 I Street NW, Suite 400E, Washington, DC 20005. Phone (321)452-2448. Web page is [space.nss.org](http://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](http://www.planetary.org). E-mail is [tps@planetary.org](mailto:tps@planetary.org).

NASA Spacelink BBS 205-895-0028. Or try [www.nasa.gov](http://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]

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