

# OKLAHOMA SPACE ALLIANCE

## OUTREACH -September 2021

**102 W. Linn #1, Norman, OK 73069**

Oklahoma Space Alliance will meet at the McMurray residence at 2:00 p.m. on September 11 details inside



**Figure 1 SpaceX Crew 3 with mission badge. Crew are Raja Chani, Thomas Marshburn, Matthias Maurer (ESA) and Kayla Barron, (Public Domain, Robert Markowitz) Launch is October 31**

## OKLAHOMA SPACE ALLIANCE OUTREACH

### September 2021

#### July Meeting

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, September 11, at Claire and Clifford McMurray's house. Prospective members are also welcome. Their house is at 2715 Aspen Circle in Norman.

To get to the meeting either: (1) Take the Lindsey Street east exit from I-35, turn right at Berry, and proceed to Imhoff Road. Turn right at Imhoff, right at Poplar Lane, left at Aspen Lane, and right at Aspen Circle. The turns at Poplar, Aspen Lane and Aspen Circle are the first you can take, or (2) Take the Highway 9 east off I-35, turn left at Imhoff Road, left at Poplar, left at Aspen Lane, and right at Aspen Circle.

We will try to have this meeting on Zoom for those who cannot attend in person: To join the meeting, go to <https://us04web.zoom.us/j/79444489279?pwd=R2hLS2R3RnVoUFVMcS9UaD-RWMW9sUT09> If for some reason the link doesn't work, contact Dave Sheely at 821-9077 (email sheely at sbcglobal.net) or Syd Henderson at 365-8983 (e-mail sydh at ou.edu) and we will send you updated information.

Please note if you are on our e-mail list, the superlong URL is in the meeting announcement and you can click on it. I've also created a tinyurl version, <https://tinyurl.com/y2qtab28>, that you can click on and is much easier if you have to type it in

#### Saturday September 11, 2021, 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/Update2105.pdf> for items to be discussed
3. Break
4. Oklahoma Space Alliance Chapter Business Discussion
  - a. Review OSA treasurer's report
  - b. Minutes of April meeting
  - c. International Space Development Conference Review (Syd)
  - d. Chapters Assembly (Syd)
  - e. October Chapter movie event (Dune)
5. Video (to be announced)
6. Chat

#### Minutes of August 2021 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance chapter of National Space Society had its regularly scheduled meeting on August 14, 2021, at the McMurray residence in Norman, Oklahoma. Attending were David Sheely, Adam Hemphill, Tom and Heidi Koszoru, Clifford and Claire McMurray, Tim Scott, and Syd Henderson. Robin Scott and Seth Potter attended by Zoom. OSA president Dave Sheely presided over the meeting. He did an Update discussing links to material covered in the meeting and this is online at <http://osa.nss.org/Update2108.pdf>, so I'll cover the details that aren't covered there.

We watched a video of the launch VSS Unity (the operational SpaceShipTwo vehicle) carrying Richard Branson, two pilots and three other passengers to the edge of space. (I believe all the passengers were employees of Virgin Galactic). There's a mild dispute as to whether the crew went into space. They went more than 50 miles up (the US definition) but not 100 km (about 61 miles), which is the international definition.

We watched a video of the flight of the first crewed flight of Blue Origin's *New Shepard* rocket carrying four passengers more than 100 km into space [so there's no dispute that they went into space. In addition to Jeff Bezos and his brother, this flight carried 82-year-old Mercury astronaut candidate Wally

Funk and 18-year-old Oliver Daemen from the Netherlands, making them respectively the oldest and youngest people to go into space. Unlike *Unity*, the Blue Origin capsule is automated, so there was no pilot.

News 9 in Oklahoma City reported on the Oklahoma Spaceport talking about commercial space, since Oklahoma was the first landlocked state to get a launch license, although New Mexico, where *Unity* launched from, is also landlocked. *New Shepard* launched from West Texas, which is also far from the sea.

The Russian module *Pirs* is the first module of the Space Station to be discarded.

We watched a video of the contract for Gateway to Northrup Grumman.

We watched a video of the launch of a reusable spaceplane. The video included a history of USAF 37B.

We watched an NSS video on asteroid detection and deflection,

We watched video taken on July 24 by the *Ingenuity* Mars helicopter which appears to show signs of past water courses.

We watched a video by "A Day in Space" featuring Buzz Aldrin.

Motion: We are willing to support a chapter whether is by supporting members of it or by some other method.

Arvest Bank has not been sending us bank statements since the fiasco with the mailbox. Tim Scott will check and find out what is going on.

The new Dune movie [which will be part one of two] is opening in late October and Kip thinks we should go as a group

Minutes by OSA Secretary Syd Henderson

### Minutes of July 2021 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance chapter of National Space Society had its regularly scheduled meeting on July 10, 2021, at the McMurray residence in Norman, Oklahoma. Attending were David Sheely, Russ Davoren, Adam Hemphill, Tom and Heidi Koszoru, Clifford McMurray, and Syd Henderson. We had no attendees by Zoom this time. Dave Sheely had suffered an injury, so Clifford presided over the meeting. He did an Update discussing links to material covered in the meeting and this is online at <http://osa.nss.org/Update2107.pdf>, so I'll cover the details that aren't covered there.

We watched a video of Virgin Galactic's SpaceShipTwo launch which was upcoming the day after the meeting. This was going to be the first launch into space from New Mexico.

We watched a video on Jeff Bezos, who is going into space on July 20. Mercury 13 selectee Wally Funk, who is going to be a passenger on that launch, also has a ticket for Virgin Galactic so may go up twice. We watched a video with Jeff Bezos and Wally Funk.

We watched a video on the *Unity* astronauts. [*Unity's* the Virgin Galactic spaceplane.] We also watched a video from the Today show about Richard Branson.

We watched a video of the launch of a cargo module to Tianhe, the core module for China's space station, then the launch of three astronauts to Tianhe, followed by their spaceship, Shenzhou 12, docking and their first spacewalk. Kip commented that this was the first time there have been two space stations in orbit at the same time since Mir came back to Earth. He doesn't count Tiangong-1 and 2, which were admittedly much smaller and less capable than Mir or the ISS and the upcoming Tiangong 3, and were really demos for the major Chinese space station they're building now. [I do count them so for me we had two space stations in 2016. However, Tiangong-3 is a different order of magnitude and will be inhabited long-term.]

We watched an animated video of the landing of the Zhurong Mars Rover.

We watched the fifth and successful launch of Starship, SN15, and its landing. I note there is still a small exhaust fire on landing.

We watched a video on the Canadian robot arm that was hit by a piece of space debris. Function of the robotic arm was not affected, though the puncture is obvious. [Note: The European Space Agency launched a robotic arm on July 23. This will service the new Russian module Nauka. There's also a Japanese robotic arm, so we have an "arms race" in space.]

We watched a video on Venus robots.

Syd attended the Chapters Assembly on June 26 and commented on a resolution of complaint there that the Chapters Assembly meeting was mentioned nowhere on the virtual ISDC site or schedule.

Since it was closing in on 5:00, we didn't do a video this time.

Minutes by OSA Secretary Syd Henderson

## Space News

Space Resilience Launch (Inspiration4) is scheduled to launch on September 15. This will be the first all-civilian mission for SpaceX and will orbit the Earth for three days. In a sense, this one-betters the private spaceflights of *Unity 22* and *New Shepard*, since it's going to orbit, but it does not have Elon Musk aboard. Instead the billionaire aboard will be Jared Isaacman, who founded Shift4 Payments. The flight is part of a publicity effort to raise money for St. Jude Children's Research Hospital. In fact, one of the other astronauts, Haley Arceneaux is a cancer survivor who is also a physician's assistant at St. Jude's. The other two passengers, Sian Proctor and Chris Sembroski, won their seats through a global contest. Isaacman is the commander of the flight.

Arceneaux also a new record, becoming, at 29, the youngest American astronaut to go into space, breaking the record of Sally Ride, who went into space at age 29. Gherman Titov, the second cosmonaut to orbit the Earth, is still the youngest person to orbit the Earth. He was 25 years 11 months old. Oliver Daemen, however, was 18 years old when he went up on Blue Origin. He's Dutch so Arceneaux is the youngest American. She is also the first person to go into space with a prosthesis, since her left femur was replaced by a titanium rod (although I gather her leg is otherwise normal). By the way, her position is Chief Medical Officer.

Since this Dragon capsule will not be docking with the Space Station, the docking port has been replaced by a window. I hope the passengers remember to take selfies.

Astronomer Carolyn Shoemaker died on August 13. She discovered some 500 asteroids, but she is most famous for one of her 32 comets, Shoemaker-Levy, which spectacularly collided with Jupiter in 1992. Her co-discoverer and husband, Eugene Shoemaker, died in 1997. Her other collaborator, David H. Levy, is still alive. As near as I can tell, there are eight comets Shoemaker-Levy, of which the famous one is Shoemaker-Levy 9. It's worth noting that she first became an astronomer in 1980 at age 51.

According to a report in the September 3 *Science*, astronomers may have detected a rare type of stellar cannibalism: a burst of radio waves as bright as a supernova and a tremendous outpouring of material that seems to have resulted from a neutron star (or possibly black hole) companion falling through the outer layers of a star and devouring its core. This produced a flash of x-rays and energy jets that blew the star apart.

This is an extreme example of what happens when one of a pair of stars becomes a supergiant and its companion is engulfed and continues to orbit inside the star. In that case, the supergiant usually dies before the cores merge, and you wind up with some combination of white dwarfs, neutron stars or black holes. In this case the cores managed to merge while one star was still alive, resulting in an explosion equal but different to a hypernova.

## Space-Related Articles

“The Case of the Dead Dinosaurs,” by Shannon Hill, *Sky & Telescope*, October 2021, pp. 18 – 25. There are two main theories of what killed off the non-avian dinosaurs and much of the other life at the Cretaceous-Paleogene boundary around 66 million years ago. The more familiar is that a 10 km wide asteroid (or possibly comet) that hit the Yucatan peninsula created a cloud of debris that blocked the sun for months or probably years. The other is that the eruption of the Deccan Traps in India did the dinosaurs in. There is also a combination theory that the Deccan Traps eruption caused environmental stress and the Chicxulub impact was the fatal bullet. This article gives you a decent overview.

I tend to advocate the combination theory, that either event alone may have caused a large number of species to go extinct, it takes a double whammy to produce a mass extinction. (This comes from a book I read on the great extinctions.) The fact is that the mass extinction comes at a sharp boundary that coincides with the asteroid impact while an extinction from volcanic eruptions would be more drawn out (at least 30,000 years and probably several hundred thousand years). It’s been suggested that the Chicxulub impact may have aggravated the Deccan Traps eruption, which eventually covered half of India with lava up to a mile deep. The Traps eruption appears to have started a quarter million years before the impact.

## Sky Viewing

There is only one meteor shower I know of in September or October, and that’s the **Orionid Meteor Shower**, which peaks on the night of October 20 – 21. There are about twenty meteors per hour in most years, with the radiant northeast of Betelgeuse in the direction of Gemini. This is a great meteor shower when viewing conditions are right. Unfortunately, the Moon is still mostly full on October 20 and will overpower a lot of the meteors.

The Orionids are one of the two meteor showers associated with Halley’s Comet, the other being the Eta Aquariids in May.

Although **Mercury** is at greatest eastern elongation on September 14, this is a particularly poor apparition since the ecliptic is at a shallow angle to the horizon at sunset which means that although Mercury is above the horizon for longer, it isn’t high enough to escape twilight. The best chance is to look fifteen degrees below Venus and hope there is nothing on the horizon. And use binoculars.

When Mercury comes back in the morning in October, on the other hand, the exact opposite is true. The ecliptic is at a steep angle, and Mercury is already 12 degrees above the horizon at the start of twilight, shining at magnitude -0.7. It is twenty degrees east of Arcturus, which is the third brightest star in the night sky and the brightest north of the Celestial equator.

**Venus**, on the other hand is very easy to see in the west after sunset although it still is relatively low (for the same reason as Mercury), and, at magnitude -4.0, is still getting brighter. By the end of October, it will be high in the sky and a half-magnitude brighter. Venus also has a minor conjunction with Antares on October 16 when they are separated by about three times the Moon’s width.

**Mars** is finally approaching its October 7 conjunction with the Sun, and even worse has that shallow ecliptic angle burying it in twilight. It won’t be visible until mid to late November

**Jupiter**, on the other hand, is high in the southeast after twilight and, at magnitude -2.8, is far brighter than anything in the night sky except Venus, the Moon, and the ISS. **Saturn**, at magnitude 0.3, is about one and a half fist-widths to the right of Jupiter as you look south. That big empty space between them is the constellation Capricornus, the least conspicuous of the Zodiacal constellation. Both stars will be about equally bright through October and will still be in Capricornus. In Jupiter’s case, this is because it is in retrograde motion against the stars until mid-October. Saturn is no longer moving retrograde, but it moves slowly and has to go all the way across Capricornus to get to the next constellation (Aquarius).

**Uranus** is high in the southeast after sunset in an inconspicuous part of Aries. **Neptune** is at opposition on September 14 and is near the border of Aquarius and Pisces. However, at magnitude 5.7, Uranus probably requires binoculars and at magnitude 7.8, Neptune definitely requires very strong binoculars or a small telescope.

### Viewing Opportunities for Satellites (September 11 – October 11, 2021)

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 [skyandtelescope.com/observing/almanac](http://skyandtelescope.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, although magnitude -2 to -3 is more likely. The Hubble Space Telescope can get up to magnitude 1.5, which is brighter than the stars in the Big Dipper. *Tiangong (or Tiangong-3)* is the Chinese Space Station. It currently gets up to magnitude 1.0 but will get brighter as more modules are added, at which point I will start referring to it as *Tiangong-3*. The “mag.” beside the date indicates the brightest magnitude the satellite gets during the pass. All the ISS passes get between -3 and -4, which is brighter than Jupiter ever gets, but not quite as bright as Venus.

Missions to and from the International Space Station can change its orbit. There will be a Russian space tourism mission from October 5 till around October 17, when a Russian filmmaker and an actress will shoot scenes aboard a Soyuz and on board the ISS. There is also manned mission to the ISS is SpaceX’s Crew-3 mission on October 31. There will also be a Progress resupply mission on October 28.

The Tiangong 3 space station’s second crew will be launched on October 3 and they will stay for six months. A cargo flight will precede them on September 20. The precise day the current crew will return is to be determined but should be around September 17.

There are no good sightings for the Hubble Space Telescope between September 11 and October 11. Some vanish before peaking or occur a few days outside the limits.

The NASA website that I was using for sightings information has been retired as of February 25, 2021. The information below is from Heavens Above.

ISS 15 September 2021 mag. -3.9		
Time	Position	Elevation
8:42 p.m.	218°	10°
8:45:47	136	67
8:47:39	58	24

ISS 18 September 2021 mag. -3.2		
Time	Position	Elevation
7:58 p.m.	218°	10°*
8:01	319	62
8:05	41	10
*Passes just west of Venus		

Tiangong 25 Sept. 2021 mag. 2.2		
Time	Position	Elevation
Appears from Earth’s shadow		
6:02:34 a.m.	196°	26°
6:03:48	149	38
6:07	79	10

Tiangong 26 Sept. 2021 mag. 1.2		
Time	Position	Elevation
Appears from Earth’s shadow		
6:37:22 a.m.	258°	14°
6:39:58	338	63
6:43:01	61	10

Tiangong 28 Sept. 2021 mag. 1.8		
Time	Position	Elevation
Appears from Earth’s shadow		
6:14:28 a.m.	296°	29°
6:15:33	343	40
6:19	56	10

Tiangong 4 Oct. 2021 mag. 2.0		
Time	Position	Elevation
Appears from Earth’s shadow		
6:36:57 a.m.	306°	13°
6:39:36	17	41
6:43	90	10

Tiangong 6 Oct. 2021 mag. 1.3		
Time	Position	Elevation
Appears from Earth's shadow		
6:13:51 a.m.	311°	34°
6:14:59	22	65
6:18	105	10

ISS 6 October 2021 mag. -3.2		
Time	Position	Elevation
8:24 p.m.	304°	10°
8:27:21	225	54
8:28:47	161	29
Vanishes into Earth's shadow		

Tiangong 7 Oct. 2021 mag. 1.8		
Time	Position	Elevation
6:48:29 a.m.	277°	13°
6:50:56	212	36
6:54	143	10

ISS 7 October 2021 mag. -3.8		
Time	Position	Elevation
7:37 p.m.	315°	10°
7:40	42	78
7:43	129	10

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 is about ten degrees wide. "Elevation" is elevation above the horizon in degrees. Thus, to find the International Space Station at 8:01 p.m. on September 18, look just over four fist-widths west of due north, then a bit more than six fist-widths up from 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>.

Not much showing on NASA TV this month, although there is a spacewalk on September 12. Coverage begins at 6:00 a.m., with the walk itself beginning at 7:30 a.m. and lasting roughly until 1:00 p.m.

Things should be lively in October with the Russians launching a film director and actress on October 5, and the SpaceX crewed mission on October 31. I imagine NASA-TV will be covering those missions and the return of the Russian filmmakers at mid-month, but I don't have the schedule yet.

## Calendar of Events

Sometime in 2021 [Moved from 2020].: ALINA, the Autonomous Landing and Navigation Module will be launched aboard an Ariane rocket, and land near the Apollo 17 landing site in the Taurus-Littrow valley. It will carry two Audi lunar rovers which will try to locate Apollo 17's Lunar Rover. For more information, see <https://ptsScientists.com/products/alina>.

Sometime in 2021: First commercial launch of the South Korean *Blue Whale 1* from Australia. This is the smallest orbital rocket in the world with a mass less than two tons.

September: Return of first crew from *Tianhe*.

September: First launch of EcoRocket into low Earth Orbit. This will be the first attempt by Romania to launch an orbital spacecraft. This is a partially submerged sea launch from the Black Sea

September 11 Oklahoma Space Alliance meeting, 2:00 p.m., McMurray residence

September 13: Mercury is at greatest elongation, 26.8 degrees east of the Sun (hence can be seen after sunset).

September 14: Neptune is at opposition.

September 15: Launch of SpaceX's Inspiration 4, carrying four passengers into orbit. This will be the first human spaceflight to orbit with exclusively private citizens on board. For more information, see <https://en.wikipedia.org/wiki/Inspiration4>.

October: Launch of second crew to *Tianhe*. This crew will stay six months.

October: First flight of India's Small Satellite Launch Vehicle (or SSLV).

October 5: Launch of Soyuz MS-19 to ISS. Among the passengers are actress Yulia Peresild and filmmaker Klim Shipenko.

October 7: Mars is in conjunction with the Sun.

October 9: Mercury is in inferior conjunction with the Sun.

October 16: Launch of Lucy, a mission to explore Jupiter's Trojan Asteroids. See [https://en.wikipedia.org/wiki/Lucy\\_\(spacecraft\)](https://en.wikipedia.org/wiki/Lucy_(spacecraft)) for details.

October 21: Peak of Orionid meteor shower.

October 21 [Moved from February]: Maiden flight of KSLV-II (aka Nuri), the first South Korean indigenous orbital launch vehicle. For more information, see [https://en.wikipedia.org/wiki/Nuri\\_\(rocket\)](https://en.wikipedia.org/wiki/Nuri_(rocket)).

October 24: Mercury is at greatest western elongation, 18 degrees west of the Sun (hence is visible before sunrise).

October 29: Venus is in greatest eastern elongation 47 degrees from the Sun (hence is visible after sunset.)

October 31: Launch of SpaceX Crew-3 carrying three NASA astronauts and one ESA astronaut to the ISS. For more information, see [https://en.wikipedia.org/wiki/SpaceX\\_Crew-3](https://en.wikipedia.org/wiki/SpaceX_Crew-3)

October 31 [but more probably November or December]: Launch of the James Webb Space Telescope. For more information, see [https://en.wikipedia.org/wiki/James\\_Webb\\_Space\\_Telescope](https://en.wikipedia.org/wiki/James_Webb_Space_Telescope).

November [maybe]: First operational *Starliner* mission to the ISS.

November 4: Uranus is at opposition.

November 5: Peak of South Taurid meteor shower.

November 12: Peak of North Taurid meteor shower.

November 17: Peak of Leonid meteor shower (unfortunately coinciding with the Full Moon).

November 17 [Moved from September]: Launch of the IXPE X-Ray Telescope by Falcon 9. For more information, see <https://en.wikipedia.org/wiki/IXPE>.

November 19: Partial lunar eclipse, 3:02 a.m. peak, visible from Oklahoma. Since the moon is 97% covered, this is not far from being a total lunar eclipse.

November 24: Launch of DART, the Double Asteroid Redirection Test to 65803 Didymos (which is the double asteroid). For more information, see [https://en.wikipedia.org/wiki/Double\\_Asteroid\\_Redirection\\_Test](https://en.wikipedia.org/wiki/Double_Asteroid_Redirection_Test).

November 28: Mercury is in superior conjunction with the Sun.

December: SpaceX will launch a whole bunch of small satellites on one launch, including two Sherpa space tugs, two cubesat dispensers, and a bunch of Earth observation satellites.

December 4: Total eclipse of the Sun. Unfortunately, this one is only visible from West Antarctica and the ocean around it.

December 8: Soyuz crew mission to the ISS from Baikonur. This includes one professional cosmonaut and two tourists.

December 14: Peak of the Geminid meteor shower.

December 16 [Moved from November 22]: Earliest launch date for *Artemis 1* the first launch of the Space Launch System. On this launch NASA launches the Lunar IceCube, Lunar Polar Hydrogen Mapper, and Lunar Flashlight lunar orbiters, in addition to Japan's OMOTENASHI cubesat lunar lander. For more information, see [https://en.wikipedia.org/wiki/Lunar\\_IceCube](https://en.wikipedia.org/wiki/Lunar_IceCube), the Near-earth Asteroid Scout cubesat ([https://en.wikipedia.org/wiki/Near-Earth\\_Asteroid\\_Scout](https://en.wikipedia.org/wiki/Near-Earth_Asteroid_Scout)) and a bunch of other satellites.

December 22: Peak of Ursid meteor shower.

Sometime in 2022 [Moved several times]: Maiden flight of the Vulcan Centaur, ULA's new heavy launch vehicle. which will carry the Peregrine lunar lander. For more information, visit [https://en.wikipedia.org/wiki/Vulcan\\_\(rocket\)](https://en.wikipedia.org/wiki/Vulcan_(rocket)) and [https://en.wikipedia.org/wiki/Astrobotic\\_Technology#Peregrine\\_lander](https://en.wikipedia.org/wiki/Astrobotic_Technology#Peregrine_lander).

Early 2022 [moved from October 2021]: The first Nova-C mission will carry the IM-1 lander and Moon Mark lunar rover to the Moon. To be launched by SpaceX.

January 2022: Launch of *Axiom Space Mission 1* which will carry a commercial crew of four to the ISS via SpaceX Crew Dragon.

January 2022: India launches Aditya-L1 to the Earth-Sun L1 point, on a mission to study the Sun's corona. For more information, visit <https://en.wikipedia.org/wiki/Aditya-L1>.

January 2022: Launch of *Axiom Space Mission 1* which will carry a commercial crew of four to the ISS via SpaceX Crew Dragon.

January 3, 2022: Peak of Quadrantid meteor shower.

January 7, 2022: Mercury is a greatest eastern elongation, 19.2 degrees from the Sun (hence can be seen after sunset).

January 8, 2022: Venus is in inferior conjunction with the Sun.

January 23, 2022: Mercury is in inferior conjunction with the Sun.

February 4, 2022: Saturn is in conjunction with the Sun.

March 5, 2022: Jupiter is in conjunction with the Sun.

March 20, 2022: Venus is at greatest western elongation, 46.6 degrees from the Sun (hence can be seen before sunrise).

Second Quarter of 2022 [Moved from late 2021.]: India launches Chandrayaan-3, which will include a lander and a long-lived rover which will explore craters around the Moon's South Pole in search of ice. See <https://en.wikipedia.org/wiki/Chandrayaan-3>

April 2022: Launch of Boeing Starliner-1 to the ISS,

April 1, 2022: Launch of SpaceX Crew-4 mission to the ISS. [Note: only one of these last two will launch in April and the other later.]

April 16 – 27, 2022: 50th anniversary of Apollo 16.

May 2022: Second flight of South Korea's *Nuri*, and the first with a commercial payload.

May 2022 [Moved from October 2021]: Launch of the Luna 25 lunar lander, the first mission of Russia's Luna-Glob lunar exploration mission. For more information, visit [en.wikipedia.org/wiki/Luna\\_25](https://en.wikipedia.org/wiki/Luna_25) and [en.wikipedia.org/wiki/Luna-Glob](https://en.wikipedia.org/wiki/Luna-Glob).

May 2022: Third crew to the Chinese Space Station. Also launch of Wentian, the first lab module to the station.

June 2022: First test flight of Gaganyaan, which will eventually become India's first manned spacecraft. For more information, see <https://en.wikipedia.org/wiki/Gaganyaan>.

June 2022 [Moved from March]: Launch of *Eris*, the first Australian rocket to launch an Australian payload. *Eris* is the launch vehicle for Gilmour Space.

Second half of 2022: Launch of *Hakuto-R* mission 1, Japan's lunar lander. (Hakuto is Japan's Moon rabbit, so is equivalent to China's Jade Rabbit). For more information, see <https://en.wikipedia.org/wiki/Hakuto>.

Second half of 2022 [Moved from 2020.] Launch of the European Space Agency's Euclid space telescope. This will map the distribution of dark matter and search for evidence of dark energy. The Euclid website is <https://sci.esa.int/web/euclid>.

August 2022: Launch of Psyche, which will orbit a large metallic asteroid also named Psyche. For more information, visit [https://en.wikipedia.org/wiki/Psyche\\_\(spacecraft\)](https://en.wikipedia.org/wiki/Psyche_(spacecraft)).

August 2022: Launch of Mengtian, the second laboratory module to the Tiangong space station.

August 1, 2022 (postponed from December 2020): Launch of the Korea Pathfinder Lunar Orbiter (KPLLO) and lunar impactor from Naro Space Center in South Korea. For more information, see [https://en.wikipedia.org/wiki/Korea\\_Pathfinder\\_Lunar\\_Orbiter](https://en.wikipedia.org/wiki/Korea_Pathfinder_Lunar_Orbiter).

August 26, 2022: [Moved from March] Launch of JUICE, the Jupiter Icy Moons Explorer, by the European Space Agency. The JUICE web site is <https://sci.esa.int/web/juice>.

September 20, 2022 [postponed from 2020]: ESA launches the ExoMars Mars Rover, which has been christened Rosalind Franklin, and the Exomars 2020 surface platform. For more information, visit <https://en.wikipedia.org/wiki/ExoMars>.

Fourth quarter of 2022: [Tentative] Launch of the Israeli Lunar Surface Access Service (LSAS). Tentative because they are looking for a launch to hitch a ride on.

Fourth quarter of 2022: First flight of Blue Origin's *New Glenn* orbital rocket.

November 2022: Launch of fourth crew to the Tiangong space station.

December 2022: Launch via Falcon 9 of the *Nova-C* lander and other cargos to the Lunar South Pole.

December 7 – 19, 2022: 50th anniversary of Apollo 17. This, to date, is the last manned mission to the Moon.

Sometime in 2023: OSIRIS-REx returns samples from Asteroid Bennu.

Sometime in 2023: India launches its first manned orbital flight *Gaganyaan-3*.

Sometime in 2023 (Really, really tentative): launch of #dearMoon, which will carry six to eight artists on a lunar free-return mission.

April – July 2023: The ExoMars Mars landers land on Mars. This includes the Russian Kazachok surface platform and the ESA's Rosalind Franklin Mars rover.

June 2023 [approximate, moved from 2022]: First crewed launch of an Orion space capsule.

September in 2023: 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.

Fourth quarter of 2023: Launch of *Hakuto-R* mission 2, Japan's lunar lander and rover. For more information, see <https://en.wikipedia.org/wiki/Hakuto>.

November 2023: Launch of NASA's VIPER lunar rover, which will hunt for ice near the Moon's South Pole.

November 2023: Launch of Masten Mission One lander and MoonRanger rover on the Moon via Falcon 9.

December 15, 2023: uncrewed test launch of *Orel*, Russia's new crewed spacecraft.

Sometime in 2024: India launches its Mangalayaan-2 Mars mission, which includes an orbiter, lander, and rover.

Sometime in 2024: China launches its *Xuntian* space telescope, which will orbit close to orbit close to *Tiangong* for easy servicing.

First half of 2024: Israel launches its *Beresheet 2* lander and orbiter on the Moon.

April 8, 2024: Next total eclipse of the Sun visible in the United States. This one will be visible on a path through northern Mexico (making landfall opposite the tip of Baja California), passes through

Texas (including Dallas, Arlington, and Waco), touches the southeastern corner of Oklahoma, then crosses Arkansas, eastern Missouri, Illinois, western Kentucky, Indiana, Ohio (including Cleveland), Erie in Pennsylvania, upper New York (including Buffalo and Niagara Falls), Burlington in Vermont, New Hampshire, and Maine, then into Canada.

May 2024: Commercial Lunar Payload Services mission delivers a lunar lander in Schrödinger Basin,

September 2024: Launch of Japan's Martian Moons Exploration, which includes a Phobos lander and sample return. For more information, see [https://en.wikipedia.org/wiki/Martian\\_Moons\\_eXploration\\_\(MMX\)](https://en.wikipedia.org/wiki/Martian_Moons_eXploration_(MMX)).

October 2024: Planned date of Artemis 3, which will land astronauts on the Moon for the first time since 1972.

October 2024: Launch of *Europa Clipper* orbiter. For more information, [https://en.wikipedia.org/wiki/Europa\\_Clipper](https://en.wikipedia.org/wiki/Europa_Clipper),

November 2024: (Tentative): Launch of the first two modules of the Lunar Orbiter Platform- Gateway. These were originally going to be launched on separate spacecraft but are now bunked together.

December 19, 2024: Parker Solar Probe (formerly Solar Probe Plus) makes its first pass through the outer corona of the Sun. For more information, see <http://parkersolarprobe.jhuapl.edu>.

Sometime in 2025: First crewed flight of Russia's Orel (formerly called Federatsiya).

Sometime in 2025: 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).

December 2025: Launch of the Nancy Grace Roman Space Telescope [formerly known as WFIRST]. For more information, see [https://en.wikipedia.org/wiki/Nancy\\_Grace\\_Roman\\_Space\\_Telescope](https://en.wikipedia.org/wiki/Nancy_Grace_Roman_Space_Telescope).

December 2025: BepiColombo arrives at Mercury orbit.

April 2026: Launch of Dragonfly to Titan.

January 31, 2026: The Psyche asteroid probe arrives at the asteroid 16 Psyche. For more information, visit [https://en.wikipedia.org/wiki/Psyche\\_\(spacecraft\)](https://en.wikipedia.org/wiki/Psyche_(spacecraft)).

June 2027: Launch of *Dragonfly*, the Titan helicopter mission.

Sometime in 2028: Launch of *VERITAS* to Venus.

Fourth quarter of 2029: Launch of *DAVINICI+* to Venus.

October 2029: JUICE achieves Jupiter orbit. [See 2022.]

Sometime in 2033: JUICE achieves Ganymede orbit. [See 2022.]

December 2034: *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.

### **Oklahoma Space Alliance Officers, 2021**

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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 Mars Society, Box 273, Indian Hills CO 80454. Their web address is [www.marsociety.org](http://www.marsociety.org).

The National Space Society's Headquarters phone is 202-424-2899 (new as of May 2019). 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, PO Box 98106, Washington DC 20090-1600 Web page is [space.nss.org](http://space.nss.org).

The Planetary Society phone 626-793-5100. The address is 65 North Catalina, Avenue, Pasadena, California, 91106-2301 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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A Chapter of the National Space Society  
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To join the Mars Society, visit [www.marssociety.org](http://www.marssociety.org). One-year memberships are \$50.00; student and senior memberships are \$25, and Family memberships are \$100.00. Their address is Mars Society, 11111 W. 8<sup>th</sup> Ave, Unit A, Lakewood, CO 80215.

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