OKLAHOMA SPACE ALLIANCE

OUTREACH –May 2021

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet at the
McMurray residence at 2:00 p.m.
on May 8 details inside

Apollo 11 Astronaut Michael Collins 10/21/1930 - 4/28/ 2021 (NASA)

OKLAHOMA SPACE ALLIANCE OUTREACH
May 2021

May Meeting

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, May 8. at Claire and Clifford McMurray's house. Prospective members are also welcome. Their house is at 2715 Aspen Circle in Norman.

Since our most vulnerable members have been vaccinated, we feel it should be safe to resume meeting in person. If you've not been vaccinated and wish to attend, be sure to bring a mask and distance yourself from any other people who have not been vaccinated.

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=R2hLS2R3RnVoUFVMcS9UaDRWMW9sUT09 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 May 8, 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
5. Video (to be announced)
6. Chat

Minutes of April 2021 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance chapter of National Space Society had its regularly scheduled meeting on April 10, 2021 at the McMurray residence. Attending in person were David Sheely, Adam Hemphill, Clifford and Claire McMurray, Tim Scott, and Syd Henderson. Attending via Zoom were Seth Potter, and Robin Scott. OSA president David 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/Update2104.pdf , so I'll cover the details that aren't covered there.

We watched a video on the Mars Helicopter Ingenuity, which was nearing its launch date at the time of the meeting.

We watched a video on #dearMoon the project with Japanese billionaire Yusaku Maezawa to send to ten to twelve people around the Moon on a SpaceX Starship, since the project has always been flexible. He's now looking for eight people to fill out the crew. Presumably one of the other members will be the pilot. Maezawa has been proposing various versions of this project for four years, usually using a Dragon capsule. Originally, it was to be two people and Maezawa was looking for a wife to accompany him. Then it was to be a larger crew of artists and writers. Now he's broadened his proposed crew to include a variety of professions. The launch will depend on Starship becoming ready for crewed flights, so it may be a few years yet.

Elon Musk says Starship will reach orbit many times by 2025.

We watched a video of the Astroscale space debris retrieval. They will be doing tests this month [April].

We watched a video of China and Russia plans to team up in running a Moon base. The European Space Agency has also expressed interest in teaming up with China on Moon missions. [They are also teaming up with the US.]

We discussed the plans to drop discounts for commercial use of the Space Station. Adam said that it may be good that NASA is dropping the discount now before companies using the Space Station had committed themselves to the lower cost.

We watched a video of the launch of China's new Long March 7A. This rocket is capable of carrying a five-ton satellite to geosynchronous orbit.

We watched a video of SpaceX's launch of Starship SN11 and its explosion while returning.

We now have $884.21 in our checking account and $267 in cash. $200 of this is earmarked for our contribution to the Colombia NSS chapter that is starting up.

Following the meeting, which took place two days before Yuri's Night, we watched the Russian video *Gagarin: First in Space*. This is a fictionalized account with some documentary footage.

--Minutes by OSA Secretary Syd Henderson

Minutes of March 2021 Oklahoma Space Alliance Meeting

Oklahoma Space Alliance chapter of National Space Society had its regularly scheduled meeting on March 13, 2021 at the McMurray residence. This was our first in-person meeting since February 2020 (due to the Covid-19 pandemic). Attending in person were David Sheely, Adam Hemphill, Clifford and Claire McMurray, John Northcutt, and Syd Henderson. Attending via Zoom were Seth Potter, Robin Scott, and Russ Davoren. OSA president David 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/Update2103.pdf, so I'll cover the details that aren't covered there.

We watched a video of the landing of the Perseverance rover and its video of the crash of the sky crane craft that landed it (or at least a view of the parachute. There was an excellent view of the landing site as Perseverance landed.

We watched a video of the Tianwen-1 entering Mars Orbit. We also watched a high-resolution video of Mars from the Chinese probe Tianwen-1, including views of the North Pole of Mars. There was an excellent view of a crater with lines on its bottom. Possibly produced by ice?

We watched a video of "Space" including images of Mars and Titan, the latter including the forthcoming Titan lander Grasshopper, and a video of LEMUR, the Limbed Excursion Mechanical Utility Robot, which, among other purposes will be a Spider on Mars.

Former Senator Bill Nelson is one of the favorites to be the new NASA Administrator. In 1986, while he was in the US House of Representatives, Nelson flew on the Space Shuttle Columbia, making him the second sitting member of Congress to fly in space. Kip met him once and thought he was oily. Other possibilities are a climate scientist or a (professional) astronaut, or perhaps former Oklahoma congresswoman Kendra Horn. [Nelson got the job.]

Seth: US Space Force is still based in Colorado Springs though the US Space Command moved to Huntsville, Alabama.

We watched a video on why Rocket Lab has decided to merge with the Vector Acquisition Corporation.

We watched a video on Axion Space.

We watched a video of the launch and landing of SpaceX's Starship SN10, followed by a video of its subsequent explosion.

Former NSS Executive Director George Whitesides has left Virgin Galactic.

We watched a video of the opening ceremonies of the 2005 International Space Development Corporation. Featured speaker was Burt Rutan.

--Minutes by OSA Secretary Syd Henderson

NASA Statement on the Passing of Michael Collins

April 28, 2021

The following is a statement from acting NASA Administrator Steve Jurczyk on the passing of Michael Collins:

"Today the nation lost a true pioneer and lifelong advocate for exploration in astronaut Michael Collins. As pilot of the Apollo 11 command module – some called him 'the loneliest man in history' – while his colleagues walked on the Moon for the first time, he helped our nation achieve a defining milestone. He also distinguished himself in the Gemini Program and as an Air Force pilot.

"Michael remained a tireless promoter of space. 'Exploration is not a choice, really, it's an imperative,' he said. Intensely thoughtful about his experience in orbit, he added, 'What would be worth recording is what kind of civilization we Earthlings created and whether or not we ventured out into other parts of the galaxy.'

"His own signature accomplishments, his writings about his experiences, and his leadership of the National Air and Space Museum helped gain wide exposure for the work of all the men and women who have helped our nation push itself to greatness in aviation and space. There is no doubt he inspired a new generation of scientists, engineers, test pilots, and astronauts.

"NASA mourns the loss of this accomplished pilot and astronaut, a friend of all who seek to push the envelope of human potential. Whether his work was behind the scenes or on full view, his legacy will always be as one of the leaders who took America's first steps into the cosmos. And his spirit will go with us as we venture toward farther horizons."

The following is a statement from the Collins family:

"We regret to share that our beloved father and grandfather passed away today, after a valiant battle with cancer. He spent his final days peacefully, with his family by his side. Mike always faced the challenges of life with grace and humility, and faced this, his final challenge, in the same way. We will miss him terribly. Yet we also know how lucky Mike felt to have lived the life he did. We will honor his wish for us to celebrate, not mourn, that life. Please join us in fondly and joyfully remembering his sharp wit, his quiet sense of purpose, and his wise perspective, gained both from looking back at Earth from the vantage of space and gazing across calm waters from the deck of his fishing boat."
For more information about Collins and his NASA career, visit https://www.nasa.gov/michael-collins.

Here's what I had to say about Michael Collins in the July 2019 *Outreach*:

"Michael Collins was thirty-eight at the time of Apollo 11, turning 39 that Halloween. (All three Apollo 11 astronauts were born in 1930.) His first spaceflight was Gemini 10 along with future moonwalker John Young. Collins began flight training in August 1952 but never served in the Korean War probably because he was training as a fighter pilot at the time the war ended. In 1960, he became a test pilot, By the time he was finally accepted to the astronaut pool, he had flown 2700 hours in jet aircraft. On this mission, Gemini 10 rendezvoused with two Agena target craft, docking with one of them. Collins later performed a spacewalk to the other.

"Collins was supposed to be on Apollo 9 (the mission which, due to a swap, became Apollo 8), but discovered he had a herniated disc, and the rehab time took him off that flight and put him aboard Apollo 11.

"So, for all three astronauts, this was their second mission, and it was the last for all three. Collins was offered chanced to fly on Apollo 14 and Apollo 17, but decided the strain was too much for his family and retired without a chance to become a moonwalker."

Michael Collins wrote several books including his autobiography, *Carrying the Fire*. He was appointed Assistant Secretary of State for Public Affairs and held the office from January 6, 1970 until April 11, 1971. He was one of the main advocates for the creation of the current National Air and Space Museum (part of the Smithsonian Institution) and served as director from its opening on July 1,1976 through 1978, when he became undersecretary for the Smithsonian.

Space News

It looks like Cosmonauts may not be flying on the Dragon Capsule until 2022. NASA and Roscosmos have been working on an agreement by which the United States and Russia will be using both SpaceX and Soyuz to take people back and forth to the Space Station. It was hoped the first cosmonauts might be boarding Dragon in October, but training will probably not be done by then, and three of the four seats have been assigned. The Crew 4 mission in early 2022 still has two seats unassigned and it's likely that mission will carry two cosmonauts. [Note that it is also possible that Boeing will be launching astronauts by then.]

Meanwhile SpaceX's Crew-1 Dragon capsule returned to Earth on May 2, making the first nighttime splashdown by a US crewed flight since 1968 (Apollo 8, if you're wondering.) the Crew 2 Dragon capsule was launched on April 23, and with the three crew members launched by Soyuz on April 9, there was a period of about a week when there were eleven people aboard the ISS. This is not a record, by the way. There was a period in 2009 when there were thirteen people on the ISS. With the return of Crew-1, the population of outer space is back to seven.

At 10:23 p.m. (CDT) on April 28, China launched the core module *Tianhe* ("Harmony of the Heavens") of their new space station *Tiangong-3*. This prepares the way for Chinese astronauts (taikonauts) to return to space in June, four and a half years after the return of Shenzhou-11 from *Tiangong-2*. A cargo launch to *Tianhe* will take place later this month.

Tiangong-3 will stay in space considerably longer than China's previous two space stations, and will, in addition to its scientific uses, will give China necessary experience for its future Moon launches. In addition, China is planning to launch a large space telescope in 2024 which will be capable of being serviced from *Tiangong-3*.

Since *Tianhe* is easily seen from Earth, I'm putting viewing times in *Outreach* starting this month. When the space stion is more complete, I'll change the name there to *Tiangong-3*.

Incidentally, you may recall that last September a Chinese booster came back to Earth uncomfortably near a schoolhouse, and the previously May a large piece of a Long March 5B booster landed in Cote'd'Ivoire (the former Ivory Coast). History may be repeating itself, since the Long March 5B booster that launched *Tianhe* is due to make an uncontrolled reentry in the next few days and the possible places the debris may land includes a good part of the inhabited part of the Earth ranging from New York to Chile, and Beijing to New Zealand (and, of course, a much larger area of ocean.)

Above: former Senator Bill Nelson (the third person from right side of picture) was sworn in on May 3 as the 14th Administrator of NASA. The oath was performed by Vice-President Kamala Harris (rightmost), who is chair of the National Space Council, which has become a traditional role for the Vice President of the United States. The other people in the photograph from left to right are Deputy Administrator nominee Pam Melroy, former NASA Administrator Charles Bolden, Bill Nelson, Jr., and Nan Ellen Nelson (former Senator Nelson's children), and, between Mr. Nelson and Ms. Harris, Mr. Nelson's wife Grace Nelson.

On April 19, Mars helicopter *Ingenuity* made its first flight, making the first powered flight of any aircraft on another planet. [Dave has more on this in *Update*.] After several successful more test flights, NASA has announced that it's ending the demonstration phase and commencing an operational phase for another month. *Ingenuity's* April 30 flight went for 266-meters (about 870 feet) and lasted just short of two minutes. This is slightly longer in distance than the longest of the four flights the Wright Brothers made on at Kittyhawk, and more than twice as long in time. (Indeed, it was longer in time than all four flights put together). So, it's a pretty good beginning.

The *Parker Solar Probe* continues to break its own records. On April 29, it made its closest pass yet to the Sun, coming about six million miles from the Sun's photosphere. In the process, it reached a velocity of 90 miles per second, which is the fast any space probe has ever reached. At this velocity, it travels the equivalent of the Earth-Moon distance in forty minutes. And yet, it is only 0.05 percent of the speed of light.

The *Parker Space Probe* continues to edge closer with each orbit. At its closest, it will be 4.2 million miles from the sun and travelling at 120 miles per second, three times faster than any other space probe (and six times closer to the Sun). The previous record holders were the twin *Helios* probes more than forty years ago.

Sky Viewing

On May 26, we will get the first **total eclipse of the Moon** since January 2019, and the first visible from the continental United States since July 27, 2018. (There were four partial lunar eclipses in 2020.) From Oklahoma, we will only get to see the beginning of totality, but the entirety of the eclipse will be visible from the west coast of the United States and most of the Pacific Ocean, Australia, New Guinea, eastern Indonesia, and Japan. In eastern China, it will be rising during totality, the reverse of our situation.

From Oklahoma, the partial eclipse begins at 4:45 a.m., with totality beginning at 6:11 a.m., and ending at 6:25 a.m. However, the Moon will begin to set in the middle of this, about 6:18 a.m. Also, the Sun will rise at 6:26 a.m., so this eclipse will be in twilight. However, the sky will look darker near the horizon because of the Earth's shadow projected against the western horizon. This eclipse also occurs near perigee, which is one reason it is so short.

On June 10, there will be an **annular eclipse of the Sun** visible in the far North. Since this is two weeks after the total lunar eclipse, the Moon will be near apogee and not large enough to cover the Sun's disk. This eclipse has an interesting trajectory. It begins in northern Ontario, crosses Hudson Bay, Baffin Island, northwestern Greenland, then crosses the Arctic in a long curve that ends in western Siberia north of Kamchatka. In the process, the path of the eclipse crosses the North Pole. This will be the last time this century that a total or annular solar eclipse will be visible from the North Pole. And yes, the North and South Poles do get total solar eclipses. Obviously during local spring or summer when the Sun is above the horizon.

If you're curious the next total eclipse at either pole is at the South Pole on January 16, 2094, so book your reservations now. The last total eclipse at either pole was on March 20, 2015, when the end of the path of totality was at the North Pole. I don't know when the next one will be at the North Pole. I note that since the sun is lower in the sky at the pole, the path of totality is much wider that closer to the equator, so there may be more eclipses visible at the poles than you might expect.

There are two minor and one semi-major meteor showers in May and June, not counting the Eta Aquariids, a major shower that has unfortunately has already occurred. The Eta Lyrids peak on May 8 and only features about three meteors per hour. The June Boötids peak on June 27 and usually only have a couple of meteors per hour, though some years they surprise.

The third shower is the daytime **Arietids**, which do produce about sixty meteors per hours but the radiant is close to the Sun, so the best viewing time is right before morning twilight. This shower peaks on the morning of June 7, but there are quite a few meteors for several weeks before and after. Warning: Since these meteors occur over a wide space of time, the radiant shifts a bit, moving from Aries into Taurus. However, on June 7, it will be in the inconspicuous constellation Aries, which is east of the distinctive constellation Taurus.

Mercury is currently having its best appearance of the year, appearing the western sky soon after sunset. Since the ecliptic is steep against the western horizon at Sunset, Mercury is almost directly above the Sun, which means that all its separation from the Sun is in altitude. In fact, on May 17, Mercury will be separated from the Sun by twenty-two degrees, meaning the sky will be dark by the time Mercury is 10-15 degrees above the horizon. It's also fading a bit and will magnitude -.5 on May 8 and magnitude 0 on May 15. On May 13, the very thin crescent Moon will be three degrees to the left of Mercury. On May 28 Mercury will be less than a half-degree (i.e., the width of the full Moon) from Venus, but since by then Mercury will be magnitude 1.9, it will be hard to see even with binoculars. Mercury is in inferior conjunction with the Sun on June 10 and will not be visible till the end of June, when it will be about eight degrees east of Aldebaran, the bright star in Taurus.

Venus is returning to the evening sky where you will be able to see it for most of the rest of the year. At the moment, this is tricky since Venus is rising soon after sunset. Oddly, you might be best off finding Mercury then looking directly below it near the horizon. Interestingly, Venus is occulted by the New Moon on May 13, but you must be in New Zealand to see it. By the end of May, Venus will be setting an hour after sunset, and will be around magnitude -4.0. Venus will have an encounter with a very thin crescent Moon on June 11, when the Moon will be three degrees to the right of Venus. However, Venus will still be low in the sky, as it will be into July.

Mars is currently located in the west in the constellation Gemini about halfway between the brilliant stars Capella in Auriga and Procyon in Canis Major. Capella is not only the sixth brightest star in the night sky, but also due north of Rigel and goes almost overhead as seen from Oklahoma. Procyon is north of Sirius. Mars, on the other hand, is magnitude 1.6, which means it's now second-magnitude, and is in fact about as bright as Castor, which is northeast of it. Mars is moving across Gemini in the direction of Pollux, which it will be five degrees south of at the end of May, which makes it even easier to compare with Pollux's twin Castor. Mars then moves into the next Zodiacal constellation, Cancer, where, on June 22 and 23 it will cross the Beehive star cluster. (Venus, by the way, will be less than three degrees south of this cluster on June 30, so it's closing in on Mars. They will be having a conjunction in mid-July, though Venus will be about six magnitudes brighter than Mars.)

Jupiter is currently rising about 3:30 a.m. (more than three hours before sunrise) so should be visible in the east before sunrise. It's not as high as you might expect because, unlike the situation at sunset, the ecliptic makes a shallow angle at dawn. By the end of May, Jupiter will be thirty degrees above the horizon when twilight begins, and on June 30 it will rising at midnight and forty degrees above the horizon by twilight. Jupiter is currently magnitude -2.2 (brighter than Sirius) and will be magnitude -2.6 by the end of June. Jupiter, by the way, just crossed from Capricornus to Aquarius, where it will remain for much of the year (except when retrograde motion takes it back into Capricornus,

Saturn is currently rising 45 minutes before Jupiter, which will increase to an hour in June. It's also getting brighter, increasing from magnitude 0.7 on May 1 to magnitude 0.1 on June 30. Moving more slowly against the stars than Jupiter, Saturn will still be in Capricornus at the end of June, and indeed for the rest of 2021

Neither **Uranus** nor **Neptune** are visible at night. Neptune will be the first to exit twilight, rising about an hour after Jupiter. It is also in Aquarius and by June 30 will be due south of the Circlet asterism in Pisces. It is also about the same distance from Jupiter as Saturn, but in the opposite direction.

Uranus, on the other hand, won't become reasonably visible even with binoculars until the end of June. It's not just its dimness, but the low angle of the ecliptic.

Viewing Opportunities for Satellites (May 8 – June 12, 2021)

You can get sighting information at www.heavens-above.com, which allows you to get satellite-viewing data for 10-day periods and 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. 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. Tianhe is the core module to the Chinese Space Station, making its first appearance in this newsletter. It currently gets up to magnitude 1.0 but will get brighter as more modules are added.

Missions to and from the International Space Station can change its orbit. The only mission to the ISS during this time intervals is a SpaceX resupply mission on June 3. China will be sending a cargo resupply mission to Tianhe sometime in May, with the first manned mission in June.

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. Note that their maps show the location of the ISS at one-minute intervals but doesn't give the position or altitude.

Tianhe 10 May 2021

Time	Position	Elevation
Appears from Earth's Shadow		
4:55:56 a.m.	300°	33°
4:57:12	22	81
5:00	112	10

ISS 14 May 2021

Time	Position	Elevation
5:17 a.m.	322°	10°
5:20	39	49
5:24	116	10

Tianhe 14 May 2021

Time	Position	Elevation
9:53 p.m.	248°	10°
9:56:40	333	82
9:57:21	62	25
Vanishes into Earth's Shadow		

ISS 14 May 2021

Time	Position	Elevation
9:58 p.m.	230°	10°
10:01	316	82
10:05	46	10
Goes through handle of Big Dipper		

ISS 15 May 2021

Time	Position	Elevation
9:10 p.m.	211°	10°
9:14	134	51
9:17	58	10

ISS 16 May 2021

Time	Position	Elevation
5:19 a.m.	300°	10°
5:22	226	44
5:25	153	10

Tianhe 16 May 2021

Time	Position	Elevation
9:20 p.m.	260°	10°
9:23	339	56
9:26	59	10

ISS 17 May 2021

Time	Position	Elevation
Appears from Earth's Shadow		
4:33:27 a.m.	311°	38°
4:34:38	221	87
4:38	134	10

ISS 17 May 2021

Time	Position	Elevation
9:12 p.m.	248°	10°
9:15:30	322	43
9:19	36	10

Tianhe 25 May 2021

Time	Position	Elevation
9:17 p.m.	298°	10°
9:20	22	68
9:23	106	13

ISS 1 June 2021

Time	Position	Elevation
10:18 p.m.	312°	10°
10:21:21	222	86
10:21:58	138	56
Passes very close to Arcturus		
Vanishes into Earth's shadow		

ISS 2 June 2021

Time	Position	Elevation
9:31 p.m.	322°	10°
9:34:46	39	50
9:36:18	112	15
Vanishes into Earth's shadow		

ISS 4 June 2021

Time	Position	Elevation
9:32 p.m.	300°	10°
9:35	226	44
9:38	156	13
Vanishes into Earth's Shadow		

HST 7 June 2021

Time	Position	Elevation
9:59 p.m.	235°	10°
10:02:26	174	30
10:03:40	142	25

HST 8 June 2021

Time	Position	Elevation
9:48 p.m.	239°	10°
9:51:25	176	31
9:53:26	130	20
Vanishes into Earth's Shadow		

HST 9 June 2021

Time	Position	Elevation
9:37 p.m.	242°	10°
9:40:24	179	32
9:43:06	123	16
Vanishes into Earth's Shadow		

HST 10 June 2021

Time	Position	Elevation
9:26 p.m.	244°	10°
9:29:23	181	32
9:32:41	121	12
Vanishes into Earth's Shadow		

HST 11 June 2021

Time	Position	Elevation
9:15 p.m.	246°	10°
9:18	184	31
9:22	121	

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 Hubble Space Telescope at 9:53:26 p.m. on June 8, you'd measure four fist-widths south of due east, then two fist widths 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.

Highlights (times are Central Standard Time)

Unfortunately, the most interesting events took place before this newsletter was printed.

May 10, 3:00 p.m.: Coverage of *Osiris-REx* departure from Asteroid Bennu.

NASA also has a weekly podcast, This Week @ NASA, which you can watch online at https://www.youtube.com/playlist?list=PL1D946ACB21752C0E . You can also get the most recent episodes at NASA.gov.

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://ptscientists.com/products/alina.

First Quarter of 2021: First flight of India's Small Satellite Launch Vehicle (or SSLV).

First Quarter of 2021: First commercial launch of the South Korean *Blue Whale 1* from Australia.

May 8 [Tentative]: Oklahoma Space Alliance meeting, 2:00 p.m., location to be announced.

May 17: Mercury is at greatest elongation, 22 degrees east of the Sun (hence is visible after sunset).

May 26: Total eclipse of the Moon, visible from all the Pacific Ocean and lands on its rim. In Oklahoma, totality will be occurring just before moonset

June: First launch of astronauts to China's *Tianhe* space station.

June 10: Annular eclipse of the Sun. The eclipse begins in central Ontario north of Lake Superior, crosses Baffin Island, northwestern Greenland, across Arctic Ocean, passing over the North Pole, and ending up in eastern Siberia. In other words, few people will be able to see the annular eclipse, though a partial eclipse will be visible in the northeastern United States, and eastern and central Canada, as well as much of Europe.

June 10: Mercury is in inferior conjunction with the Sun.

June 12 [Tentative]: Oklahoma Space Alliance meeting, 2:00 p.m., location to be announced.

July 4: Mercury is at greatest elongation, 21.6 degrees west of the Sun (hence can be seen before sunrise).

July 10 [Tentative]: Oklahoma Space Alliance meeting, 2:00 p.m., location to be announced.

July 13: Conjunction of Mars and Venus. Venus will be half a degree north of Mars, the diameter of a Full Moon.

July 17: Pluto is at opposition.

July 26 – August 7: 50th Anniversary of Apollo 15.

July 27: Peak of Delta Aquariid meteor shower.

July 30: *Juno* ends its mission to Jupiter with a fiery death in Jupiter's atmosphere.

August 1: Mercury is in superior conjunction with the Sun.

August 1: Saturn is at opposition.

August 12: Peak of Perseid Meteor shower.

August 14 [Tentative]: Oklahoma Space Alliance meeting, 2:00 p.m., location to be announced.

August 19: Jupiter is at opposition.

September: SpaceX's Dragon Crew 3 to the ISS.

September: First crewed flight of Boeing's *Starliner* space craft on a voyage to the Space Station.

September 11 [Tentative]: Oklahoma Space Alliance meeting, 2:00 p.m., location to be announced.

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.

Fourth quarter of 2021 [Moved from July]: 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) and https://en.wikipedia.org/wiki/Astrobotic_Technology#Peregrine_lander.

Fourth quarter of 2021: Launch of *Axiom Space Mission 1* which will carry a commercial crew of four to the ISS via SpaceX Crew Dragon.

Fourth quarter of 2021: SpaceX launches of *Space Adventures Crew Dragon* which will carry up to four tourists to orbit. For more information, see https://en.wikipedia.org/wiki/Space_Adventures_Crew_Dragon_mission.

October [Moved from February]: Maiden flight of KSLV-II (aka Nuri), the first South Korean indigenous orbital launch vehicle.

October 1: 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 and en.wikipedia.org/wiki/Luna-Glob.

October 7: Mars is in conjunction with the Sun.

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

October 11: The first Nova-C mission will carry the IM-1 lander and Moon Mark lunar rover to the Moon. To be launched by SpaceX.

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

October 21: Peak of Orionid meteor shower.

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: [Postponed from April] Launch of the James Webb Space Telescope. For more information, see https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

Late 2021 or early 2022: 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.

November: [Moved from 2020] Launch of 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, the Near-earth Asteroid Scout cubesat (https://en.wikipedia.org/wiki/Near-Earth_Asteroid_Scout)and a bunch of other satellites.

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

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 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 28: Mercury is in superior conjunction with the Sun.

December: First operational *Starliner* mission to the ISS.

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.

December 14: Peak of the Geminid meteor shower.

December 22: Peak of Ursid meteor shower.

Sometime in 2022 [tentative]: India launches its first manned orbital flight Gaganyaan-3.

Sometime in 2022: SpaceX plans to launch a human crew around the Moon. [This is speculative, reflected by this mission being postponed from 2018.]

Sometime in 2022: Launch of several crews to the Chinese Space Station and the addition of the second lab module.

Sometime in 2022 [Moved from October 2021]: 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.

January 2022: [Moved from 2020]: 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.

February 4, 2022: Fourth Crew Dragon mission to the ISS.

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

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 22 - June 10, 2022: Launch window for JUICE, the Jupiter Icy Moons Explorer, by the European Space Agency. The JUICE web site is https://sci.esa.int/web/juice .

June 2022 [approximate]: First crewed launch of an Orion space capsule.

July to December 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).

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

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.

December 2022: Launch via Falcon 9 of Masten Mission 1, a Commercial Lunar Payload Services mission to the lunar South Pole.

December 21, 2022: Launch of the *Nova-C* lander 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 (tentative): 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.

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

Sometime in 2023: (Tentative): Launch of the first module of the Lunar Orbiter Platform- Gateway.

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

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.

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

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

Sometime in 2024: Planned date of Artemis 3, which will land astronauts 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.

September 2024: Launch of Japan's Martian Moons Exploration, which includes a Phobos lander.

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 the Nancy Grace Roman Space Telescope [formerly known as WFIRST].

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).

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

Dave Sheely, President &Update Editor 405-821-9077 (C)
Clifford McMurray, Vice- President 405-329-4326 (H) 405-863-6173 (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:

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, new address)
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 Mars Society, Box 273, Indian Hills CO 80454. Their web address is 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. The Chapters Coordinator is Bennett Rutledge 720-641-7987, rutledges@chapters.nss.org. The address is: National Space Society, PO Box 98106, Washington DC 20090-1600 Web page is 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. 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 members. Regular membership rates are $52, Student memberships are $36, Senior $42. Part of the cost is for the magazine, *Ad Astra*. If you choose to receive the magazine digitally, memberships are $40 for regular, $24 for students and $30 for seniors. 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. 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_____

_____

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.**