

OKLAHOMA SPACE ALLIANCE

OUTREACH – January 2018

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet
2:00 p.m. on January 13, 2018
at Earl's Rib Palace,
920 SW 25th St, Moore, OK.
Directions are inside.

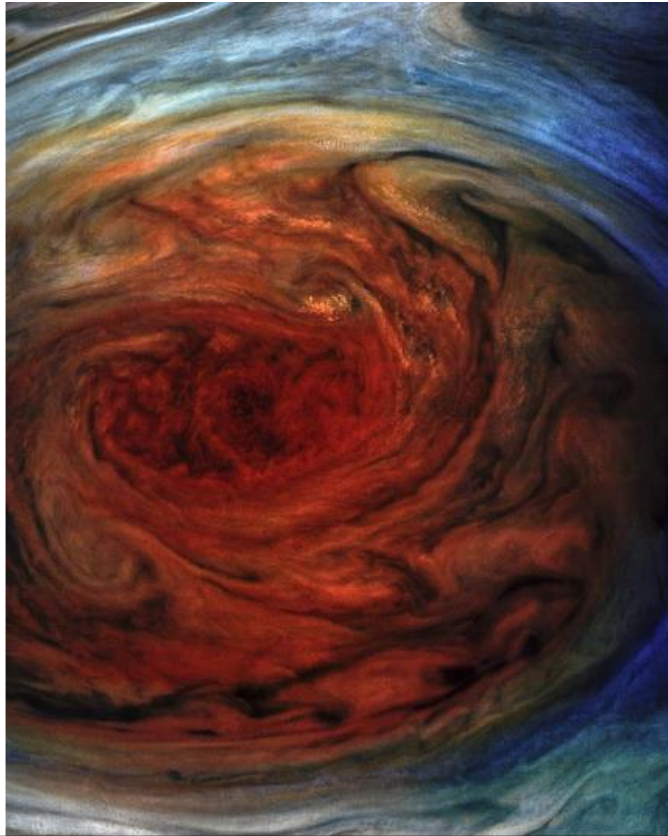


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OKLAHOMA SPACE ALLIANCE OUTREACH January 2018

January Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on January 13, 2018 at Earl's Rib Palace, 920 SW 25th St, Moore, OK. This is between the 1-35 West Frontage Road and Telegraph Road. Telephone number is 793-7427.

Saturday January 13, 2018 Program

Place: Earl's Rib Palace
Moore Oklahoma
2:00-5:00 PM

- 1) Introductions
 - a. What's Happening in Space, News, Pictures, and Videos by David Sheely
- 2) Break
- 3) Video 28 minutes, Jeff Greason, Chairman of the Tau Zero Foundation: Missions Enabled by Plasma Magnet Sails
- 4) Discuss Business
 - a. Review OSA Accounts
 - b. Summary of December Meeting
 - c. Review of Require annual report to NSS
 - d. Other issues
- 5) Chat

Minutes of December Christmas Party and Meeting

Oklahoma Space Alliance had its annual Christmas party on December 9, this year at Tom and Heidi Koszorus'. In attendance were Steve and Karen Swift, Mike Hopkins, Claire and Clifford McMurray, John Northcutt, Tim Scott, David St. John, Dave Sheely, Brian Swift, Rosemary Swift, and Syd Henderson.

Although this was a party, we had some business to take care of. First, Claire brought petitions for people who are running for the National Space Society, which we passed around to OSAs who are also NSS members.

We voted to thank Steve Swift for not only saving but improving OSA.

Finally, we elected officers. Dave Sheely as President, Syd Henderson as Secretary and Tim Scott as Secretary were unanimous. Clifford McMurray and Tom Koszoru were competing for Vice President, and Mr. McMurray was elected.

Clifford McMurray, Syd Henderson and Brian Swift volunteered to go through and modify our bylaws and bring up the changes at the next meeting.

--Minutes by OSA Secretary Syd Henderson

Report on December 13 OSIDA Meeting

Syd Henderson attended the December 13 meeting of the Oklahoma Space Industry Development Authority at the Department of Transportation building in Oklahoma City. Board members in attendance were Robert Cox (Chairman),

Michael Halsey (treasurer), Ben Robinson, and David Greer. OSIDA Secretary Bailey Siegfried was absent Also in attendance were Air and Spaceport Executive Director Bill Khourie, Deputy Executive Director Nicola Borghini, Secretary Kim Vowell and legal advisor Kindra White. There were only a couple of people in the audience besides Syd

Former OSIDA Board Chair and member Major General Jay Edwards died December 8 at the age of 86, and a memorial service was announced for December 18. General Edwards was an OSIDA board member at least as late as the spring of 2017, and I'd known him in that capacity for at least five years. Obituary is at Full obituary: <http://legacy.new-sok.com/obituaries/oklahoman/obituary.aspx?n=jay-edwards&pid=187483984>

Nicola went to SpaceCom 2017 in Houston, Texas in early December to look at technology for current space. It's no longer a question of returning to the Moon and going to Mars.

--Notes by OSA Secretary Syd Henderson

Between-Meeting Activities

Claire, Kip, Syd, Tim and Dave went to the TX-Central Regional Space Development Conference in Grapevine, Texas on November 18. (Grapevine is part of the Dallas metropolitan area). This was a lively conference featuring Dr. Camille Wardrop Alleyne, Wally Funk, Kurt Chankaya from the Mars Society, President Ken Murphy of the Moon Society, and Jeff Greason, the CEO of Agile Aero.

Dr. Alleyne worked as a lead system engineer and crew module systems engineer for the Constellation program, and test manager for the Orion Program, and is currently associate program scientist for the International Space Station, and as such is described as modern-day "Hidden Figure." She spoke to us on the benefits of the ISS, such as studying the human physiological response; physical science involving fluids, flames, and convection; technology development and demonstration; earth science between the latitudes of 51.6 degrees north and south (which includes 85 percent of the Earth's surface; astrophysics; enabling commerce in near-earth orbit; and study of the effects of long-term space missions. One negative effect Dr. Alleyne mentioned that I hadn't heard of is that 60 percent of astronauts on long-term missions have serious deterioration of eyesight, as have 29 percent of astronauts on short-term missions.

Jeff Greason is the CEO (and co-founder) of Agile Aero. He previously was the CEO of XCOR from 1999 until 2015. Mr. Greason spoke on the status of commercial space flight. The United States currently has 75 percent of commercial LEO capacity.

Small satellites are increasing in numbers but are not a big driver of capacity because they are usually launched as secondary payloads.

Ken Murphy of the Moon Society spoke of cislunar space. LEO is suitable for fueling depots, free-flying platforms and space docks.

Geosynchronous Earth Orbit (GEO) is a bit wavy due to differences in gravity above points on the Earth's Surface. This creates gravitational sinks over the Atlantic and Indian Oceans.

At LEO, you can change to any inclination for the same amount of energy (?). [I may have written this down wrong. He may have been talking about L1, since the next note I have is on placing a satellite in a Near-Rectilinear Halo Orbit (NRHO) around the Earth-Moon L1 point.]

Kurt Chankaya from the Mars Society spoke on Mars Direct, which we've mentioned here quite a few times. One thing he mentioned is that LEO and Moon spacesuits are not suitable for Mars. In fact, lunar space suits wear out after a few days (which is how long each mission stayed on the Moon), and used water for evaporative cooling. Suits on Mars would have to be much sturdier because of the nature of Martian dust [and the corrosiveness of Martian soil.]

Wally Funk was one of the Mercury 13; a group of women chosen at the same time as the Mercury 7 astronauts. 125 men took the tests and only seven were selected. Twice as many women passed but they were rejected from flying. Ms. Funk has become something of an ambassador to getting girls to choose engineering as a field. She gave a lively account of her experiences taking the NASA tests, and why a lot of them (such as squirting cold water into people's ears) were dropped, to the relief of future astronaut candidates.

Minutes of November Meeting

Oklahoma Space Alliance held its regular monthly Meeting on November 11, 2017 at Earl's Rib Palace in Moore, Oklahoma. In attendance were Steve, Karen and Brian Swift, Tom Koszoru, John Northcutt, Dave Sheely, Rosemary Swift, Rachelle Thibodeau, Dennis Wigley, and Syd Henderson. OSA President Steve Swift presided over the meeting. Steve did a "What's Happening in Space" for the meeting. It is online at <http://chapters.nss.org/ok/1711%20Whats%20Happening.pdf> so I'll cover the highlights.

Since the December meeting is the Christmas Party, this was Steve's last meeting as President, so we had some nostalgia along with this month's space news.

SpaceX tied the record for most commercial launches in one year. We watched a video of the record-breaking launch and the landing of the first stage on a platform.

Bigelow and United Launch Alliance are planning an orbital base that will orbit the Moon.

Christmas will be at Tom Koszoru. He will supply turkey and ham, while the rest of the meal is pot luck. We should arrive at 5:00 p.m. and eat at 6:00 p.m.

This was the meeting at which we nominated the officers for 2018. (Nominations are not closed until the Christmas party, but ballots go out on December 1.) Nominated were Dave Sheely for President, Clifford McMurray and Tom Koszoru for Vice-President, Syd Henderson for Secretary and Tim Scott for Treasurer. Kip and Tom both indicated that they would run if nobody else ran, but since both dropping out would leave us with no candidate, I left them both on the ballot.

We had a second round of voting for the Heinlein award, which, when added to the votes at the October meeting, resulted in

Neil de Grasse Tyson 15 points (and three firsts)

John Young, 13 points (and two firsts)

Michael Collins, 12 points (three firsts)

Which are our chapter nominees. Anousheh Ansari finished fourth with 9 points and two firsts.

Steve went over what he considered the most significant achievements during his six years as OSA President. These included:

Reusable launch vehicles

3D Printing

Robotics

Water on the Moon and Mars

The Kepler Survey that has discovered so many exoplanets

To which I added Detection of Gravitational waves.

Minutes by OSA Secretary Syd Henderson

Space News

Famed Astronaut John Young died Friday January 5, at the age of 87. Like many early astronauts, Young was a test pilot before he joined NASA in 1962, and he set several records for fastest ascent to 3,000 and 25,000 meters, using a Phantom jet.

John Young's 42-year career as a NASA astronaut is a record, as is his being the only person to command four different classes of space vehicles: Gemini, Apollo Command Module (Apollo 10), Apollo Lunar Module (Apollo 16), and the Space Shuttle. Young was the ninth man to walk on the Moon, and one of three men to travel to the Moon more than once. (The others were James Lovell and Eugene Cernan.) Since the Apollo 10 mission was the one that tested the Lunar Module, John Young was the first person to orbit the Moon alone. During that mission, Apollo 10 set a record for fastest speed attained by any manned vehicle.

Young flew six missions, Gemini 3 and 10, Apollo 10 and 16, and STS 1 and 9, and was launched into space seven times, six from Earth and once from the Moon. Gemini 3 was the first manned mission in the Gemini program, so Young was one of the first two Americans to orbit the Earth *not* alone.

And Young was also famous for sneaking a corned beef sandwich aboard *Gemini 3*.

SpaceX is scheduled to make its first test launch of the Falcon Heavy around the end of the month, with both admiration and controversy. If successful, Falcon Heavy will launch a spacecraft in a long elliptical orbit the aphelion of which will approach the orbit of Mars. The Dragon capsule will be carrying Musk's Tesla Roadster as a dummy payload (which is what is causing most of the controversy). It's not clear to me if the Roadster-bearing capsule will orbit Mars or do a flyby. It will, however, play David Bowie's "Space Oddity," which suggests to me that the car is named Major Tom.

An interesting aspect of this test flight, given that SpaceX now has a lot of practice landing Falcon first stages, is that the Falcon Heavy uses three Falcon 9 first stages, and Space X plans to land all three.

There's a moderate chance that this first Falcon 9 launch may end up in a really spectacular explosion, but it should be worth watching no matter what happens.

With each month, we're getting different explanations of the mysterious dimming of Tabby's Star. However, now dust seems a likely explanation although it was mostly ruled out before because dust would be bright at infrared wavelengths and that wasn't being observed in this case. (For this reason, I've suggested Tabby's Star may be passing behind a dust cloud some light-years closer to us.)

The oddly random dimmings have prompted speculations of an alien megastructure, but observations prompted by a Kickstarter campaign seem to have ruled it out. Observations of a dip in brightness caught in real time revealed that the dimming is much more pronounced at some wavelengths. This would not be expected if the dimming were produced by solid objects, but is not unlikely if its produced by something less opaque such as dust (although this still doesn't explain why the dust isn't bright in the infrared).

Top Space Stories of 2017

At the beginning of the year, science magazines like to do their top science stories of the year, some of which are related to space. *Discover*, for instance, features its top 100 science stories, while most magazines are content with 10. These stories among their top hundred are space-related.

Discover's #1 science story of the year is the Great American Eclipse last August 21 because of the great interest that it generated. It's estimated that 154 million Americans saw the eclipse (including, I imagine, those who contented themselves with seeing a partial), and another sixty million watched online. Although it wasn't a scientific discovery, this clearly was the event that affected the most people.

The #3 story is my choice for the most important scientific event of the year: the observation, first by gravitational waves, then at wavelengths of the electromagnetic spectrum from radio to gamma-ray frequencies, of the collision of two neutron stars, giving proof of the origin of heavy elements, eliminating all sorts of competing theories of astrophysics, and revealing the origin of most gamma-ray bursts. Incidentally, since the gravitational waves were detected a few seconds before any light reached us, this proved that they must travel at the speed of light in a vacuum. (Light moves slower than this through a medium such as the outer layers of an exploding star. Apparently gravitational waves do not.) This was fortunate for astronomers because they told astronomers where to aim their telescopes.

#7 "Seven Whole New Worlds" is about the TRAPPIST-1 planetary system which has seven terrestrial planets orbiting closely to a dim red star. Three of the planets are in the star's habitable zone, although their rotations are also tidally locked to the star.

#9: "Cassini is Dead, Long Live Cassini." The Cassini probe to Saturn finished 13 years of orbiting the ringed planet and visiting its moons, plunging into Saturn's atmosphere in a final plunge.

#11 "Life beneath Enceladus's Ice?" (Interview with Cassini researcher Hunter Waite.

#15 "Pinpointing a Fast Radio Burst." FRBs are milliseconds-long bursts of radio waves, and one set of nine have been traced to a dwarf galaxy 2.5 billion light-years away. But nobody knows what causes them.

#20: "Portable Neutrino Detector shakes up Neutrino World." Neutrinos are famously capable of passing through light-years of matter before being absorbed, yet they, along with electromagnetic and gravitational waves, provide a great tool for observing the Universe. Juan Collar of the University of Chicago has invented a detector that can measure the vibrations of atomic nuclei when neutrinos bounce off them. The detector is a hundred times more sensitive than previous neutrino detectors.

#23: "*Juno* Delivers Jupiter's Secrets."

#32: “Mice Born from Space Sperm.” NASA flew frozen mouse sperm to the ISS and stored it there for nine months to find out what would happen when it was used to fertilize mice on Earth. Answer: some mutations in the embryos but easily dealt with by cellular repair mechanisms that operate in very young embryos.

#46: “The Equator Could Be Uninhabitable” by the year 2100. Although the effects of climate change in the polar regions is getting a lot of attention, heat indices in the tropics could reach the limits of human tolerance for twenty days a year. (This already happens on the western shore of the Persian Gulf and the southern coast of the Caspian Sea where the heat index can hit 150 degrees Fahrenheit, and have even topped 170° F on one occasion.)

#47: “Asteroid hits Reverse” Asteroid 2015 BZ₅₀₉ travels in an orbit at the distance of Jupiter, but in the opposite direction, passing through both groups of Trojan asteroids. (It has an elliptical orbit so it doesn’t hit Jupiter.)

#49: “Weighing a White Dwarf.” Of course, we’ve already weighed white dwarfs orbiting other stars, but in this particular case, the star’s gravity caused the light of a background star to shift through gravitational lensing, and the star’s mass was found to be 0.675 solar masses, very highly accurate and verify Chandrasekhar’s theory of white dwarf structure.

#58: “The Pitter-Patter of Cosmic Dust.” Discovering micrometeorites in city dust.

#62: “Ice Storms on Mars” Simulations predict snow flurries on Mars at night.

#69: “Famous Galaxy Hosts Bonus Black Hole.” Cygnus A apparently has a second central supermassive black hole, and the two are only 1500 light-years apart. The second black hole was discovered when it sprang into life, enhancing what is already a very active galaxy.

#77: “To the Moon and Back: An Astronaut’s Loving Tribute Finally Acknowledged.” On Apollo 8, James Lovell mapped the Sea of Tranquility where Apollo 11, naming one of the features Mount Marilyn, which Neil Armstrong later used as a landmark for his landing. The International Astronomical Union, which is considered the official arbitrator of naming space, refused to recognize the name until last summer, when Lovell got to reveal it to his wife.

#78: “Super Solar Speeds.” The core of the Sun appears to spin four times as rapidly as the outer layers. Apparently, this is a remnant of the formation of the Sun, and the outer layers have slowed down. (This would happen naturally as the Sun expanded since it’s a gaseous body and wouldn’t have to spin in unison.)

#92: “The Moon’s Magnetic Personality.” Further analysis of the Apollo 15 Moon rocks reveal that the Moon may have had a strong magnetic field between 1 and 2.5 billion years ago. It was thought previously that the Moon’s magnetic field shut off more than 3.5 billion years ago.

Sky Viewing

The highlight this month is the **total eclipse of the Moon** on the morning of January 31. This lunar eclipse is best visible on the west coast of the United States, eastern Asia, Australia and the northern, central and southwestern Pacific. However, Oklahomans should be able to see the first partial phase beginning at 4:45 a.m., and the first part of the total phase, which begins at 5:51 a.m. The Moon will set around mid-eclipse.

Mercury was at greatest western elongation from the Sun on January 1, and is relatively visible low in the eastern sky at sunrise. On January 13, Mercury is only half a degree south of Saturn but you’ll probably need binoculars to see either because of the twilight. Mercury will reach superior conjunction on February 17 and will not be visible except for a day or two at the beginning and at the end of the month.

Venus was at superior conjunction with the Sun on January 9, hence is not currently visible. It is farthest from the Earth on January 11, and at aphelion on January 23, which factors combine to make it farther from Earth than most years. Thus when Venus reappears at the end of February, it will be magnitude -3.9 and about ten degrees above the horizon at Sunset.

Mars and **Jupiter** are rising about the same time, about 3:00 a.m., because they were in close conjunction on January 6. By January 13, they will be about three degrees apart, with Jupiter being much brighter at magnitude -1.8, while Mars is still first magnitude at 1.5. Mars will actually keep rising about the same time each night, until by the end of February it will be rising around 2 a.m. It will also gradually brighten to magnitude 1.1.

Jupiter, on the other hand, will be rising at 2:00 a.m. at the end of January, and around midnight on February 28. It will brighten during that time to magnitude -2.2.

The reason that Jupiter is moving away from the Sun so much rapidly is because it is farther from the Earth, and makes a circuit of the sky in a little more than a year while Mars takes nearly two years.

Saturn, as mentioned, is having a conjunction with Mercury on the morning of January 13, and, unlike Mercury, is rising earlier each night and separating from the Sun. By the end of January, Saturn will be rising around 5 a.m., and at 3 a.m. on February 28. Saturn is around magnitude 0.6.

Uranus is well up in the south at sunset, in a faint part of the constellation Pisces, and **Neptune** is one constellation west in Aquarius and quite a bit lower in the sky. Both are above the horizon through the evening, and will be through the end of December. Unfortunately, Uranus is magnitude 5.7, which makes it difficult to see with the unaided eye even in a pitch-black sky, and Neptune requires strong binoculars at least. If you wish to look for them, *Sky & Telescope* has finder charts on page 50 of their October issue, and at http://wwwcdn.skyandtelescope.com/wp-content/uploads/WEB_Uranus_Neptune17.pdf

Viewing Opportunities for Satellites (January 13 – February 13, 2018)

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.

<https://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/JavaSSOP/JavaSSOP.html> gives coordinates at 20-second intervals from when the satellite rises, not from when it peaks. (This program requires Java. I'm currently using Microsoft Explorer to run it. I'm using its information for the International Space Station and Hubble Space Telescope, interpolating when necessary. It doesn't give you information for Tiangong 1 or Tiangong 2, so I'm using Heavens Above for those. The *Sky & Telescope* web site carries International Space Station observation times for the next few nights at skyandtelescope.com/observing/almanac.

With the addition of the solar panels, the International Space Station can be as bright as magnitude -3.5, 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, although, since it is lower in the sky, it is more difficult to see. China's Tiangong 1 space station can get up to magnitude -0.6, which is brighter than all the night stars except Sirius and Canopus. With this issue, I'm also including data for Tiangong 2, which can get up to magnitude 0.4 at least.

Missions to and from the International Space Station or Tiangong-2 may change its orbit. The next manned launch to the ISS will be sometime in March, though there will be a crew return to Earth in February. I know of no scheduled manned flights to Tiangong-2. Tiangong-1 has been abandoned and will reenter the Earth's atmosphere sometime in the next six months.

Tiangong-1 January 13, 2018			ISS January 15, 2018		
Time	Position	Elevation	Time	Position	Elevation
6:28 p.m.	243°	10°	6:09 a.m.	306°	20°
6:30	327	87	6:10	343	35
6:31:33	62	20	6:11	38	50
Vanishes into Earth's Shadow			6:12	92	35
			6:13	108	20

ISS January 14, 2018			Tiangong-1 January 23, 2018		
Time	Position	Elevation	Time	Position	Elevation
7:02 a.m.	306°	22°	6:29 p.m.	306°	10°
7:03	298	41	6:31	23	49
7:04	220	74	6:33	98	13
7:05	149	40	Vanishes into Earth's shadow		
7:06	141	21			

Tiangong-1 January 14, 2018			Tiangong-2 January 17, 2018		
Time	Position	Elevation	Time	Position	Elevation
6:28 p.m.	263°	10°	Appears from Earth's Shadow		
6:31	338	43	6:39 a.m.	240°	12°
6:32	45	18	6:42	153	85
Vanishes into Earth's shadow			6:45	64	10

Tiangong-1 January 24, 2018		
Time	Position	Elevation
6:28 p.m.	295°	10°
6:31	208	82
6:33	120	10

Tiangong-2 February 12, 2018		
Time	Position	Elevation
6:43 p.m.	252°	10°
6:46	335	66
6:49	59	11

ISS January 25, 2018		
Time	Position	Elevation
6:54 p.m.	228°	21°
6:55	229	41
6:56	281	88
6:57	46	43
6:58	47	22

ISS February 12, 2018		
Time	Position	Elevation
7:19 p.m.	304°	21°
7:20	294	40
7:21	225	69
7:22	154	40
7:23	144	21

Tiangong-2 February 10, 2018		
Time	Position	Elevation
7:04 p.m.	233°	10°
7:07	150	64
7:08:41	75	25

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 see the International Space Station at 7:20 p.m. on February 12, measure two-and-a-half fist-widths north of due west, then four fist-widths above the horizon.

All times are rounded off to the nearest minute except for times when the satellite enters or leaves the shadow of the Earth. The highest elevation shown for each viewing opportunity is the actual maximum elevation for that appearance.

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.) Hardly anything this month. We're between crew changes.

January 13, 3:30 a.m.: Coverage of the departure of the Space X Dragon Capsule from the ISS. Release is at 4:09 a.m.

Calendar of Events

Sometime in 2018: Launch of Japan's *SELENE-2* spacecraft to the Moon. This mission includes an orbiter, lander and rover. For more information, visit <https://en.wikipedia.org/wiki/SELENE-2>

January 13: Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

January 15: Earliest date for the maiden launch of Falcon Heavy. On board will be Elon Musk's Tesla Roadster and its orbit will go out as far as Mars.

February 10: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

February 17: Mercury is in superior conjunction with the Sun.

March 2018: India launches *Chandrayaan-2* to the Moon. The mission consists of an orbiter, lander and rover.

March: Launch of TESS, the Transiting Exoplanet Survey Satellite. Unlike *Kepler*, TESS will conduct a full sky search for exoplanets. For information, visit space.mit.edu/TESS.

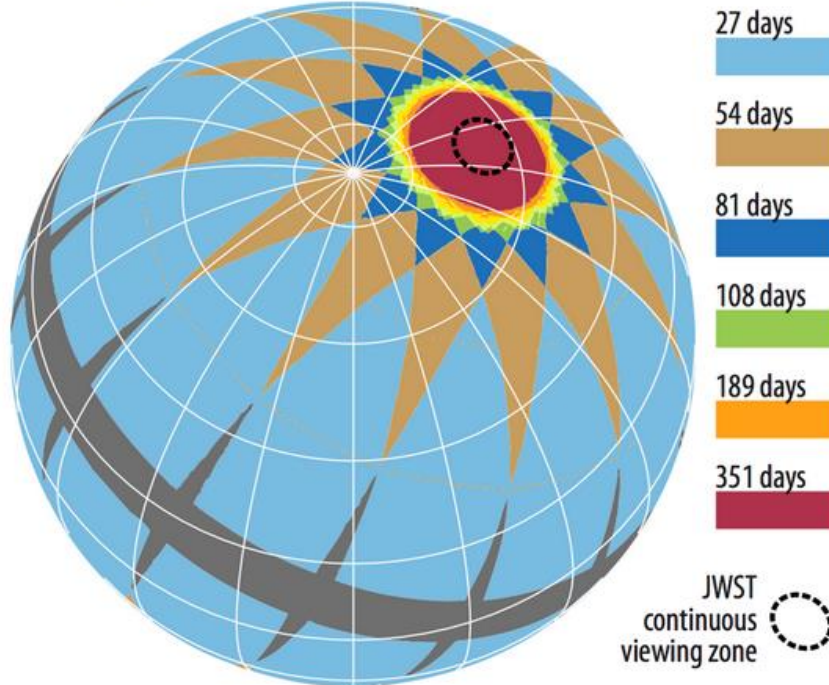
March 4: Neptune is in conjunction with the Sun.

March 10: Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

March 14: [tentative] Oklahoma Space Industry Development Authority [OSIDA] meets at 1:30 p.m. the Oklahoma Department of Transportation Building in Oklahoma. Call 580-562-3500 to verify.

March 13: SpaceX resupply mission to the Space Station using a Falcon 9 rocket.

TESS 2-year sky coverage map



March 15: Mercury is at greatest eastern elongation, 18 degrees east of the Sun, and is visible after sunset in Pisces.

April: [Moved from September 2017.] Launch of the Green Propellant Infusion Mission (GPIM) by a SpaceX Falcon Heavy rocket. This mission is “green” because the fuel it uses, hydroxylammonium nitrate produces nontoxic gases when it burns, unlike hydrazine

April: [Moved from February.] Demonstration flight of SpaceX’s Dragon 2 spacecraft (apparently not aboard a Falcon 9 Heavy).

April 1: Mercury is in inferior conjunction to the Sun.

April 11: [tentative] Oklahoma Space Industry Development Authority [OSIDA] meets at 1:30 p.m. the Oklahoma Department of Transportation Building in Oklahoma. Call 580-562-3500 to verify.

April 12: Yuri’s Night. 57th anniversary of the first man in space.

April 14: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl’s Rib Palace in Moore, Oklahoma.

April 18: Uranus is in conjunction with the Sun.

April 29: Mercury is at greatest western elongation, 27 degrees west of the Sun, and is visible before sunrise in the constellation Cetus.

April 30: Air Force EELV Certification launch for SpaceX’s Falcon Heavy with a variety of secondary payloads.

May 5: Launch of *InSight*, a lander that will probe the interior of Mars. For information, see <http://insight.jpl.nasa.gov/>.

May 9: Jupiter is at opposition, 409 million miles from Earth.

May 9: [tentative] Oklahoma Space Industry Development Authority [OSIDA] meets at 1:30 p.m. the Oklahoma Department of Transportation Building in Oklahoma. Call 580-562-3500 to verify.

May 11: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl’s Rib Palace in Moore, Oklahoma.

June 6: Mercury is in superior conjunction with the Sun,

June 13: [tentative] Oklahoma Space Industry Development Authority [OSIDA] meets at 1:30 p.m. the Oklahoma Department of Transportation Building in Oklahoma. Call 580-562-3500 to verify.

June 9: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl’s Rib Palace in Moore, Oklahoma.

June 27: Saturn is at opposition, 840 million miles from Earth.

July 11: Mercury is at greatest eastern elongation, 26 degrees east of the Sun, and is visible after sunset in Cancer.

July 14: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl’s Rib Palace in Moore, Oklahoma.

July 27: Mars is at opposition. This will be the closest Mars opposition since 2003, and until the 2030s although Mars is closest to Earth on July 31. Mars will be 36 million miles from Earth.

July 31 – August 19: Launch date range for *Parker Solar Probe* (formerly *Solar Probe Plus*), which will study the corona of the Sun from within four million miles. For information, see en.wikipedia.org/wiki/Parker_Solar_Probe or <http://parkersolarprobe.jhuapl.edu/>. (This spacecraft will fly by Venus seven times to refine its orbit.)

August: [Moved from May.] SpaceX will launch a Dragon-2 capsule to the International Space Station. This mission will be the first American spacecraft to carry people to orbit since 2011.

August: Boeing's CST-Starliner makes its first automated test flight. See https://en.wikipedia.org/wiki/CST-100_Starliner for details.

August 8: Mercury is in inferior conjunction with the Sun.

August 11: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

August 17: Venus is at greatest eastern elongation, 46 degrees east of the Sun, and is visible after sunset in Virgo

August 26: Mercury is at greatest western elongation, 28 degrees west of the Sun, and is visible before sunrise in the constellation Cancer.

September 7: Neptune is at opposition.

September 8: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

September 20: Mercury is in superior conjunction with the Sun.

October: The European Space Agency/JAXA *BepiColombo* Mercury Orbiter is launched. On its way to Mercury, *BepiColombo* will make two flybys of Venus and one of Earth, and six flybys of Mercury before settling into orbit. Home page is <http://sci.esa.int/bepicolombo>.

October 13: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

October 24: Uranus is at opposition.

October 26: Venus is in inferior conjunction with the Sun.

November: [Moved from August 2018.] Boeing's CST-Starliner makes its first crewed flight. If the SpaceX mission is delayed, this will be the first American spacecraft to carry astronauts to orbit since 2011, otherwise it will be the second. See https://en.wikipedia.org/wiki/CST-100_Starliner for details.

November 6: Mercury is at greatest eastern elongation, 23 degrees east of the Sun, and is visible after sunset in Scorpius

November 10: [Tentative] Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

November 26: Jupiter in in conjunction with the Sun.

November 27: Mercury is in inferior conjunction with the sun.

December 7. Mars is only two seconds of arc south of Neptune at 8:55 p.m. CST. In other words, this is the best possible time to find Neptune.

December 15: Mercury is at greatest western elongation, 21 degrees west of the Sun (hence is visible before sunrise), in the constellation Libra.

Late in 2018: Launch of the European Space Agency's CHEOPS space telescope, which will study exoplanets, which transit their star's disc. Project website is <http://sci.esa.int/cheops>.

Late in 2018: SpaceX hopes to launch two human tourists on a flight around the moon. This would be the first time humans have gone beyond low-Earth orbit since 1972.

Sometime in 2019: Maiden flight of the Space Launch System.

Spring 2019: [Moved from October 2018]: Launch of the James Webb Space Telescope.

Sometime in 2019: China launches the *Chang'e 5* lunar sample return mission. This will be the first spacecraft to return material from the Moon since 1976 (the Soviet Union's *Luna 24*.)

January 1, 2019: *New Horizons* flies by Kuiper Belt object 2014 MU₆₉.

January 2, 2019: Saturn is in conjunction with the Sun.

February 2019: Launch from Cape Canaveral of the European Space Agency/NASA Solar Orbiter (SolO), which will orbit the Sun at a distance closer than Mercury. Web site is sci.esa.int/solarorbiter

September 2019: Arrival of *OSIRIS-REx* at the near-earth asteroid 101955 Bennu to return samples. For more information, visit <http://en.wikipedia.org/wiki/OSIRIS-REx> or <http://science.nasa.gov/missions/osiris-rex/>.

November 11, 2019: Mercury transits the Sun.

Sometime in 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 <http://sci.esa.int/euclid>.

Sometime in 2020: Launch of ESA's *ExoMars Rover*. For more information, visit en.wikipedia.org/wiki/Exo-mars.

July 2020: United Arab Emirates launch the Mars probe *Hope*.

July 2020: ESA launches the *ExoMars Mars Rover*. [Postponed from May 2018.] For more information, visit en.wikipedia.org/wiki/Exomars.

July 2020: Launch of the *Mars 2020* space rover, which will arrive on Mars at the beginning of 2021.

October 13, 2020: Mars is at opposition, 39 million miles from Earth.

Sometime in 2021: India hopes to launch its first manned spaceflight, but 2024 is more likely.

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: Proposed launch date of JUICE, the Jupiter Icy Moon Explorer, by the European Space Agency. The JUICE web site is <http://sci.esa.int/juice>.

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

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.

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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 202-429-1600. 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 www.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

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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.

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