

Oklahoma Space Alliance OUTREACH

September 9, 2017

September Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, September 9, 2017 at Earl's Rib Palace, 920 SW 25th St, Moore, OK. This is between the 1-35 West Frontage Road and Telegraph Road, a couple of blocks south of Harry Bears. Telephone number is 793-7427.

Saturday September 9, 2017 Program

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

- 1) Introductions
- 2) Eclipse in Wyoming (Dennis Wigley)
- 3) What's Happening (Steve Swift) (Pictures, Videos & Links)
- 4) Discuss Business
 - a. Review OSA Accounts
 - b. Summary of August Meeting
 - c. OSIDA Meeting Report
 - d. New Business
- 5) Feature Topic – Bridenstine
 - a. Nomination as NASA Administrator
 - b. Pros and Cons
 - c. American Space Renaissance
- 6) Discussion and Videos
- 7) OSA Member Presentations/Discussions
- 8) Chat

Minutes of August Meeting

Oklahoma Space Alliance held its regular monthly Meeting on August 12 at Earl's Rib Palace in Moore, Oklahoma. Attending were Mike Hopkins, Claire and Clifford McMurray, Brent Shambaugh, Dave Sheely, Tim Scott, and Syd Henderson. OSA President Steve Swift could not attend the meeting. In his absence, OSA Vice-President David Sheely presided over the meeting.

Dave provided an *Update* for this meeting, which covered most of the "What's Happening in Space" part of the meeting. You can find it here: <http://chapters.nss.org/ok/Update1708.pdf>. I'll go over a few highlights.

Oklahoma University has been awarded a \$161,000,000 contract for measuring carbon-based greenhouse gases and plant health with the goal of advancing understanding of the natural carbon cycle. The contract began in July, and is the largest contract in the University's history. Although there are other carbon-based gases in the atmosphere, the most important for the study are carbon dioxide, methane, and carbon monoxide. [Although carbon monoxide is not itself a greenhouse gas (all greenhouse gases must have at least three atoms, the greenhouse effect coming from resonant effects on the bonds), it is oxidized to carbon dioxide, which is. Water, nitrous oxide, ozone and sulfur dioxide are examples of greenhouse gases that do not contain carbon.] The satellite OU will be developing is the Geostationary Carbon Cycle Observatory (Geocarb) and will continuously monitor the Western Hemisphere.

We watched a video on Space Medicine, and a video on the launch of the Soyuz-21.a which carried 73 satellites. The main payload was the Kanopus-V-IK remote sensing satellite; the rest was mostly cubesats.

We watched a video of Congressman Bridenstine on the Space Renaissance and the return of the Space Council, given at the University of Washington, DC. Different agencies and branches of the government each have their own agenda. [This talk becomes even more important since Bridenstine is slated to be the next head of NASA.]

Robert Cox is the new Chairman of the OSIDA board.

Dave: There is a great need for medical research in space. To date, we've only sent the healthiest humans into space. Health problems have been minimal so far.

Some space-manufactured pharmaceuticals have high potential due to their high value per mass. Gold is worth \$55 million per metric ton, but some pharmaceuticals are worth over a billion dollars per metric ton. [An aside: a metric ton is about 2205 pounds, or about ten percent larger than a short ton.]

Clifford: Manufacturing aboard the Space Station has problems due to vibrations, since it is a crewed vehicle. A Google search revealed only one program in Space Medicine at any University, namely Baylor University. Cislunar Explorers will launch a cube sat beyond low-earth orbit.

We have \$1058.26 in checking and \$267 in cash.

We need a list of paying members for approval of bylaws. Proposed bylaws will be sent by e-mail.

NASA Statement on Nomination for Agency Administrator

The following is a statement from acting NASA Administrator Robert Lightfoot on Friday's announcement of the intended nomination by President Donald Trump of U.S. Rep. Jim Bridenstine to serve as the 13th NASA administrator:

"I am pleased to have Rep. Bridenstine nominated to lead our team. Of course, the nomination must go through the Senate confirmation process, but I look forward to ensuring a smooth transition and sharing the great work the NASA team is doing.

"I look forward to working with a new leadership team, and the administration, on NASA's ongoing mission of exploration and discovery. Our history is amazing, and our future is even brighter, as we continue to build on this nation's incredible global leadership in human exploration, science, aeronautics and technology."

Bridenstine, a pilot in the U.S. Navy Reserve and former executive director of the Tulsa Air and Space Museum and Planetarium, was elected to the U.S. Congress in 2012 to represent Oklahoma's First Congressional District. He currently serves on the House Armed Services Committee and the Science, Space and Technology Committee.

For information about NASA's missions, discoveries and activities, visit: <https://www.nasa.gov>

[From nasa.gov.]

National Space Society Congratulates Representative Jim Bridenstine on His Nomination to be NASA Administrator

(from nss.org)

The National Space Society (NSS) congratulates Representative Jim Bridenstine (R-OK-1) on his nomination to be the next NASA Administrator.

"NSS looks forward to working with Representative Bridenstine in his new role as the NASA Administrator," said Dale Skran, NSS Executive Vice President and Chair of the NSS Policy Committee. "Representative Bridenstine over his years in Congress worked with NSS to advance America's space program. He has introduced the American Space Renaissance Act, which has been a powerful tool for advancing new ideas to improve America's position in space."

Representative Bridenstine brings to his new job both political and aeronautical experience. A three-term member of Congress, Bridenstine served as a naval aviator from 1998-2007, and in the naval reserve from 2010-2015, mainly flying the E-2C Hawkeye. Additionally, Bridenstine was the Executive Director of the Tulsa Air and Space Museum & Planetarium. Bridenstine has degrees from Rice University (triple major in Economics, Psychology, and Business), and an MBA from Cornell.

“Representative Bridenstine is one of a growing group in Congress that fully appreciates the importance of space commerce and space resources to the human future,” said NSS Senior Vice President Bruce Pittman. “We look forward with great anticipation to working with Jim Bridenstine to lead America back to the Moon and to develop a thriving economy in space.”

Mark Hopkins, Chair of the NSS Executive Committee, added, “Some may be concerned that Representative Bridenstine is not an engineer or scientist. We should all recall that one of the greatest NASA administrators, Jim Webb, was a lawyer. America is lucky to have Jim Bridenstine as NASA Administrator.”

Members of Oklahoma Space Alliance have met with Representative Bridenstine of the last few years and we’ve presented the paper he presented on how he views the future of the Space Program, which he has been putting into legislation. He’s clearly a man with a clear vision of what he wants us to do in space, and most of it coincides with what NSS wants to do. I think he should be easily confirmed, but the Senate confirmation process takes a couple of months. President Trump also must appoint a deputy administrator for NASA, especially since the acting deputy administrator, Lisa Roe, is expected imminently to be named Chancellor of the University of North Texas.

Space News

The *Cassini* space probe to Saturn will end its mission in a fatal plunge into Saturn’s atmosphere on the morning of September 15, one month short of the 20th anniversary of its launch. *Cassini* made an eventful six-year 261 trip to Saturn, flying twice by Venus, one return to Earth, and once by Jupiter, finally reaching Saturn on July 1, 2004, and orbiting it for the next thirteen years. It carried the *Huygens* space probe, which landed on Titan on January 14. *Cassini* made numerous flybys of Saturn’s satellites, including Titan and Enceladus, discovering the latter’s plumes which make it an unlikely possible abode of life. Titan could conceivably have two biospheres, one methane-based on its surface (though there’s no indication of any) and a water-based one in an interior ocean. In fact, Titan and Enceladus are two reasons for the doom of *Cassini*: there is a fear that if it eventually collided with one of them, it might contaminate the satellite with Earth germs. (If that were going to happen to Titan, you would think *Huygens* would already have done it.) Apparently, there is no such concern about possible life forms in Saturn’s atmosphere.

The Earth had a fairly close encounter with the Amor asteroid 3122 Florence on September 1, coming within four-and-a-half million miles. Amor asteroids are those which come closer to Earth than any other planet, but whose orbits lie outside the Earth’s and do not cross it. Eros is the most famous of these. Florence’s perihelion is only two million miles outside of Earth’s orbit, so, although Florence must have been near perihelion, there was no danger of a collision. The asteroid has a diameter of three miles and is pretty round, so it would cause catastrophic damage if it ever is perturbed into a collision with Earth.

During its flyby, Florence reached magnitude 8.5, making it easy to see through small telescopes. It was discovered during the flyby that Florence has two tiny satellites, which are estimated to be between 300 and 1000 feet across.

Astronauts Peggy Whitson and Jack Fisher and Cosmonaut Fyodor Yurchikhin returned from the International Space Station on September 2. For Whitson, this was her third stint about the Space Station, and the 288 days she spent there brought her total time in Space to 665 days, which is the record for any American astronaut. The 288-day mission was the longest by a woman astronaut from any nation. On an earlier mission, she became the first woman to command the Space Station, and she’s the only woman to do it twice.

This landing required a bit of improvisation. Normal procedure is for a NASA plane to take off from Houston and pick the American astronauts up in Kazakhstan, but since Houston is spectacularly flooded from Hurricane Harvey, NASA arranged with the European Space Agency for an ESA plane to pick astronauts Whitson and Fisher up in Karaganda, Kazakhstan and fly them to Cologne, Germany, which is where the ESA’s astronaut center is located. They underwent their medical examinations there. They will fly from there to Houston.

The next launch to the Space Station will be on September 12, when a Soyuz MS-06 spacecraft will carry Russian commander Alexander Misukin along with NASA astronauts Mark Vande Hei and Joe Acaba. Presumably they are safely in Kazakhstan.

The Girl Scouts have added six new space science badges. These are for Space Science Explorer (Daisies) to Space Science Master (Ambassadors), and include Science Adventurer (for Brownies), Space Science Investigator (for Juniors), Space Science Researcher (for Cadettes) and Space Science Expert (for Seniors). The badges will become available in 2019.

Johnson Space Center was closed through Labor Day to all but mission essential personnel due to the lingering effects of Tropical Storm Harvey. Mission Control remained open, but road conditions were dangerous, with many streets under several feet of water and bridges and roads damaged.

Johnson Space Center is 13 feet below sea level at its lowest point and 22 feet at its highest, so it was effectively on an island during the storm, although entranceways were flooded. There were some leaks in Building 32, but not apparently in Chamber A, the vacuum chamber where the James Webb Space Telescope is currently housed.

On March 11, 1437, a nova exploded in the tail of Scorpius and was observed by the Royal Astronomers of Korea. Which star exploded has been a mystery to modern astronomers, especially since such novae tend to recur. Michael Shara of the American Museum of Natural History has finally found it, to his embarrassment only a couple of stars away from where people were looking. However, the star also challenges conventional views of novae. The 1437 explosion was a classical nova, brightening the star millions of times. But there is another kind of nova, the dwarf nova, which is less bright but recurs most frequently. The nova had undergone dwarf nova explosions in 1934, 1935 and 1942. Now it appears that dwarf novae and classical novae are the same nova at different stages of development, with the smaller explosions occurring in between the major outburst.

The Kepler Space Telescope may have detected the largest known satellite of any planet. During its regular mission, it observed three transits of the planet Kepler 1625b across the face of its star. When they eliminated the dimming of the star's light caused by the planet, they found a second dimming that, if confirmed, must be that of a satellite. Kepler 1625b is about the size of Jupiter, and its satellite would have to be the size of Neptune. The star is being observed by the Hubble Space Telescope in hopes of confirming or denying the existence of the satellite, which would be called Kepler 1625b-i.

Observations of the occultation of a star by Kuiper Belt 2014 MU₆₉ indicate that *New Horizons* may be approaching a double asteroid, or a large asteroid with a narrow neck. If it's a double asteroid, the two halves are about 15 miles across. If it's a single asteroid, it's up to 18 miles long.

How to get a close look at lunar features when low orbits decay? A NASA proposed mission, BOLAS, solves this problem with two cubesats connected by a 110-mile long tether. The lower satellite skims along six miles above the Moon's surface while the other is 116 miles up; they are kept in this position by the tether and since the center is sixty miles up, its orbit is much slower to decay. The purpose of BOLAS is to examine bright swirls on the Moon's surface associated with localized magnetic fields, which are particularly interesting since most of the Moon's surface has no magnetic field at all. <https://www.newscientist.com/article/2143447-tethered-satellites-could-see-the-moons-weird-swirls-up-close>.

Sky Viewing

Mercury is currently a morning star and about as visible as it gets, brightening to about magnitude 0, and is about 15 degrees below **Venus**. By September 14, that will shrink to 11 degrees. On September 16, Mercury will be separated from **Mars** by three-tenths of a degree, which is less than the width of a full Moon, but Mars is about two magnitudes dimmer. Regulus is between Venus and Mars and is currently brighter than Mars.

Mercury will disappear into the twilight toward the end of September, and is in superior conjunction with the Sun on October 8. It will reappear in the western sky in late October, but is only a couple of degrees above the horizon a half hour after sunset.

Venus is magnitude -3.9 and is easily visible in the eastern sky before sunrise. It is currently rising at about 4 a.m. and will still be rising at 5 a.m. on October 1. By the end of October, Venus will be rising about 90 minutes before the Sun.

Mars is just emerging from conjunction with the Sun and is still only magnitude 1.8. Visibility will improve in late October, when Mars will be rising two-and-a-half hours before the Sun. These means it's passing Venus as well as Mercury, and indeed Venus and Mars are only a quarter of a degree apart on October 5.

Jupiter is low in the western sky, setting about ninety minutes after the Sun, and by the end of the month will be setting an hour after the Sun. It's still magnitude -1.7, so it's easy to see, but will be disappearing into twilight in early October, and is in conjunction with the Sun on October 26.

Saturn is well up in the south-southwestern sky at sunset. Look for it about 25 degrees (2.5 fist-widths) above the horizon. Saturn is in southern Ophiuchus and magnitude 0.4, which makes it the brightest object in its part of the sky. Antares is about a fist-width below and to the right of Saturn, but is noticeably dimmer, not to mention redder. Saturn's rings are tilted 27° to our point of view through the end of October, which is just about the maximum tilt we get. Saturn is currently setting around 11:30 p.m., and even by the end of October will still be setting two-and-a-half hours after the Sun.

Uranus reaches opposition on October 19 and is magnitude 5.7 in the constellation Pisces. **Neptune** was at opposition on September 4 and is magnitude 7.8 in Aquarius. This month is their peak visibility. *Sky & Telescope* has finder charts on their website at http://www.wcdn.skyandtelescope.com/wp-content/uploads/WEB_Uranus_Neptune17.pdf.

An interesting coincidence is that, at the moment, despite Mars being four magnitudes brighter than Uranus, they appear about the same size in the sky. The difference in brightness is entirely due to Uranus being twelve times further away from the Sun. Uranus even reflects higher percentage of sunlight reaching it.

The Orionid meteor shower peaks on October 21. This isn't one of the super meteor showers, but this year it takes place a couple of days after the full Moon, so expect to see ten to fifteen meteors per hour on the mornings of October 20 through 22. Their parent is considerably more famous; the Orionids are the spawn of Halley's Comet and appear when the Earth's orbit crosses the path of that comet. We also cross the path of Halley's Comet in May and the meteor shower that time is called the Eta Aquariids.

[Information for this section comes from the September and October issues of *Sky & Telescope* and *Astronomy*, and www.skyandtelescope.com.]

Viewing Opportunities for Satellites (September 9 -October 14, 2017)

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, which causes problems with some web browsers. In fact, I'm currently using Microsoft Explorer until I can get it working in Firefox on my new computer. 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 flight to the Space Station launches on September 12, so may affect the sighting times below. 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 September 14, 2017

Time	Position	Elevation
Appears from Earth's Shadow		
5:57:24 a.m.	231°	37°
5:57:51	154	83
6:03	64	10

Tiangong-2 September 18, 2017

Time	Position	Elevation
8:44 p.m.	297°	10°
8:47	218	88
8:48	119	44
Vanishes into Earth's Shadow		

Station September 21, 2017

Time	Position	Elevation
Appears from Earth's Shadow		
5:43:56 a.m.	326°	78°
5:44:09	62	87
5:45	127	41
5:46	131	21

Tiangong-1 September 24, 2017

Time	Position	Elevation
6:43 a.m.	293°	10°
6:45	209	69
6:48	125	10

Station September 25, 2017

Time	Position	Elevation
8:27 p.m.	228°	21°
8:28	228	41
8:29	286	88
8:30	46	43
8:31	47	22

Tiangong-1 October 3, 2017

Time	Position	Elevation
8:12 p.m.	231°	10°
8:15	149	46
8:16	103	37
Vanishes into Earth's Shadow		

HST October 4, 2017

Time	Position	Elevation
6:43 a.m.	224°	20°
6:44	204	27
6:45	181	31
6:46	164	30
Vanishes into Earth's Shadow		

Tiangong-1 October 4, 2017

Time	Position	Elevation
8:25 p.m.		
	253°	10°
8:27:34	335	62
8:27:58	21	52
Vanishes into Earth Shadow		

HST October 5, 2017

Time	Position	Elevation
6:33 a.m.	227°	20°
6:34	208	27
6:35	181	31
6:36.48	153	27
Vanishes into Earth's Shadow		

HST October 6, 2017

Time	Position	Elevation
6:23 a.m.	229°	20°
6:24	210	27
6:25	184	30
6:26	158	27
Vanishes into Earth's Shadow		

Tiangong-2 October 8, 2017

Time	Position	Elevation
Appears from Earth's Shadow		
6:25 a.m.	241°	27°
6:27	151	80
6:30	64	10

Station October 14, 2017

Time	Position	Elevation
7:57 p.m.	330°	20°
7:58	347	35
7:59	62	49
8:00	92	34
8:01	108	20

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 7:57 p.m. on October 14, measure three fist-widths west of due North, then two 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:

September 12, 3:00 p.m.: (CDT) ISS Expedition 53/54 Launch Coverage (actual launch is at 4:17 p.m.). 9:00 p.m.: Docking Coverage (actual docking is 9:57 p.m.). 11:00 p.m.: Hatch Opening Coverage (actual hatch opening is at 11:30 p.m.).

September 13, noon, *Cassini* Pre-end of mission news conference.

September 15, 6:00 a.m.: Coverage of the end of the *Cassini* mission. 8:30 a.m.: *Cassini* end-of-mission news conference.

Calendar of Events

September 8: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex), 7:00 p.m., followed by a talk at 7:45 p.m. See <http://www.okcastroclub.com/> for details.

September 9: Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

September 12: Mercury is at greatest western elongation, 18 degrees from the Sun (so can be seen before sunrise).

September 12: Launch of Expedition 53 to the Space Station, 4:17 p.m. CST, by Soyuz from the Baikonur Cosmodrome in Kazakhstan.

September 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.

September 15: The *Cassini* spacecraft will end its mission with a plunge into Saturn's atmosphere.

October 4: 60th anniversary of the launch of *Sputnik 1*, the first spacecraft to orbit the Earth.

October 8: Mercury is at superior conjunction with the Sun.

October 11: Peak of Orionid meteor shower.

October 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.

October 13: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex), 7:00 p.m., followed by a talk at 7:45 p.m. See <http://www.okcastroclub.com/> for details.

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

October 19: Uranus is at opposition.

October 26: Jupiter is in conjunction with the Sun.

November: Launch of Expedition 54/55 to the Space Station.

November: First (unmanned) flight of SpaceX's Falcon 9 rocket and Dragon 2 Spacecraft. Dragon 2 which will be the first commercial spacecraft capable of carrying humans to orbit (as well as the first human-rated space vehicle capable of making a soft landing on Earth.) This flight will take it to the Space Station.

November 8: [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.

November 10: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex), 7:00 p.m., followed by a talk at 7:45 p.m. See <http://www.okcastroclub.com/> for details.

November 10: Launch of an Orbital ATK resupply mission

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

November 17: Peak of Leonid meteor shower

November 24: Mercury is at greatest eastern elongation, 22 degrees from the Sun (so can be seen after sunset).

December: Launch of Expedition 54 to the Space Station, by Soyuz from the Baikonur Cosmodrome in Kazakhstan.

Early December: Launch of SpaceX resupply mission to the ISS.

December 8: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex), 7:00 p.m., followed by a talk at 7:45 p.m. See <http://www.okcastroclub.com/> for details.

December 13: Mercury is in inferior conjunction with the Sun.

December 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.

December 14: Peak of Geminid meteor shower.

December 21: Saturn is in conjunction with the Sun.

December 22: Peak of Ursid meteor shower.

December 28: Launch of the Team Indus and Hakuto missions by the Indian Space Research Organisation (ISRO). These are two of the five competitors for the Google Lunar X Prize see lunar.xprize.org/teams/team-nidus and lunar.xprize.org/teams/hakuto for details.

Late in 2017: SpaceX launches SpaceIL Google Lunar X Prize Moon lander. This includes a lander and a rover. See lunar.xprize.org/teams/team-spaceil and en.wikipedia.org/wiki/Google_Lunar_X_Prize for details.

Late in 2017: Synergy Moon will use a Neptune 8 rocket to launch a lunar lander and rover as part of the Google Lunar X Prize contest. See lunar.xprize.org/teams/synergy-moon for details.

Late in 2017: Moon Express will launch one of three missions to the Moon to study lunar resources, using Rocket Lab to launch them from New Zealand. See <https://lunar.xprize.org/teams/moon-express> for details.

Sometime in 2018: Possible unmanned SpaceX mission to Mars.

Sometime in 2018: 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.)

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

February 2018: Demonstration flight of SpaceX's Dragon 2 spacecraft (apparently not aboard a Falcon 9 Heavy).

March 2018: Launch of TESS, the Transiting Exoplanet Survey Satellite. Unlike *Kepler*, TESS will (if approved) conduct a full sky search for exoplanets. For information, visit space.mit.edu/TESS.

April 2018: [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 12, 2018: Yuri's Night. 57th anniversary of the first man in space.

May 2018: 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. [See August.]

May 5, 2018: Launch of *InSight*, a lander that will probe the interior of Mars. For information, see <http://insight.jpl.nasa.gov/>.

June 2018: Orbital test flight of Boeing's CST-100 Starliner, which will be capable of carrying humans to orbit. See https://en.wikipedia.org/wiki/CST-100_Starliner for details.

July 31, 2018: Proposed launch date for *Solar Probe Plus*, which will study the corona of the Sun from within four million miles. For more information, visit http://en.wikipedia.org/wiki/Solar_Probe_Plus or <http://solarprobe.jhuapl.edu/>. (This spacecraft will fly by Venus seven times to refine its orbit.)

August 2018: Boeing's CST-Starliner makes its first crewed flight. If the May SpaceX mission is delayed, this will be the first American spacecraft to carry astronauts to orbit since 2011, otherwise it will be the second.

October 2018: Launch of the James Webb Space Telescope.

October 2018: The European Space Agency/JAXA *BepiColombo* Mercury Orbiter is launched. Home page is <http://sci.esa.int/bepicolombo>.

October 2018: 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

December 2018: Boeing's CST-100 Starliner carries two astronauts to the Space Station. See https://en.wikipedia.org/wiki/CST-100_Starliner for details.

Late in 2018: SpaceX plans to launch a human crew around the Moon.

Late in 2018 [Moved from 2017.]: 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>.

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

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/>.

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: First launches of the modules of the Chinese space station *Tiangong-3*. The station should be finished by 2022.

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

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.

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>.

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.

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>.

December 2025: *BepiColombo* arrives at Mercury orbit.

Sometime in 2030: JUICE achieves Jupiter orbit. [See 2022.]

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

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, 2017 (Area Code 405)

Steve Swift, President & <i>Update</i> Editor	496-3616 (H)
David Sheely, Vice President	821-9077 (C)
Syd Henderson, Secretary & <i>Outreach</i> Editor	321-4027 (H) 365-8983 (C)
Tim Scott, Treasurer	740-7549 (H)
Claire McMurray, Communications	329-4326 (H) 863-6173 (C)

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 sydh at ou.edu (Syd Henderson)
 ctscott at mac.com (Tim Scott)
 t_koszoru01 at cox.net (Heidi and Tom Koszoru, new address)
 sheely at sbcglobal.net or david.sheely.1 at us.af.mil (David Sheely)
 john.d.northcutt1 at tds.net (John Northcutt)
 lensman13 at aol.com (Steve Galpin)

E-mail for OSA should be sent to sydh@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 chapters.nss.org/ok/osanss.html. 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 202-429-1600. 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

_____ 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 _____

Address _____

City _____ State ___ ZIP _____

Phone (optional or if on phone tree) _____

E-mail address (optional) _____

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

OKLAHOMA SPACE ALLIANCE

OUTREACH – September 2017

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet
2:00 p.m. on September 9, 2017
at Earl's Rib Palace,
920 SW 25th St, Moore, OK.
Directions are inside.



Figure 1 Representative Jim Bridenstine, appointed Administrator of NASA