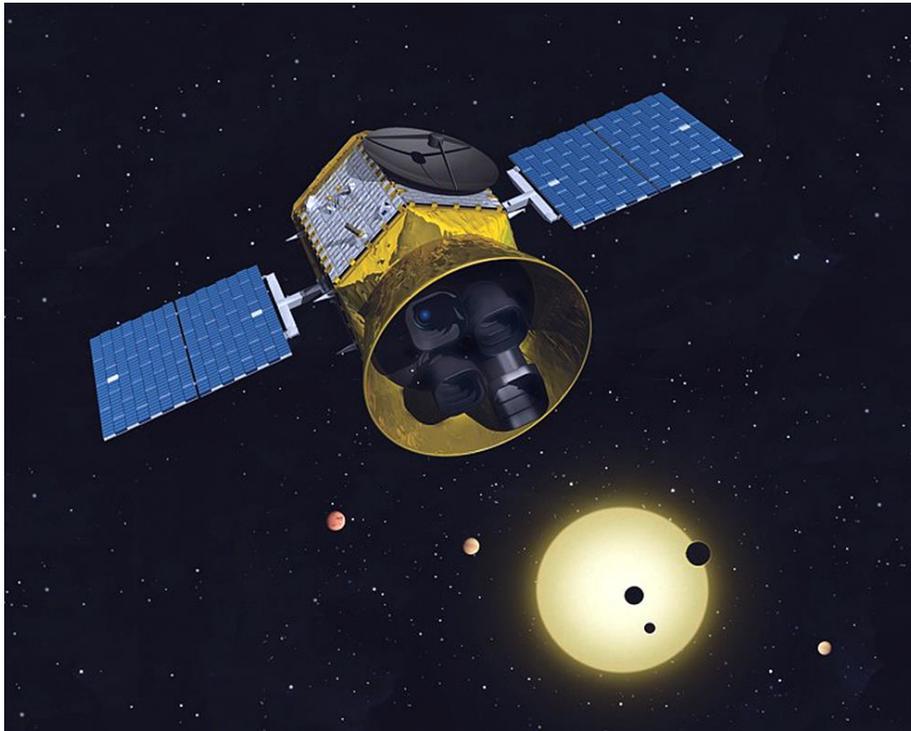


OKLAHOMA SPACE ALLIANCE

OUTREACH – May 2018

102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will meet
2:00 p.m. on May 12, 2018
at Earl's Rib Palace,
920 SW 25th St, Moore, OK.
Directions are inside



Artist's conception of TESS, the Transiting Exoplanet Survey Satellite (NASA Gallery)

OKLAHOMA SPACE ALLIANCE OUTREACH May 2018

May Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on May 12, 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 May 12, 2018

Program

Place: Earl's Rib Palace

Moore Oklahoma

2:00-5:00 PM

- 1) Introductions
- 2) What's Happening in Space, News, Pictures, and Videos by David Sheely
- 3) Break
- 4) Business Discussion
 - a. Review OSA treasurer's report
 - b. Summary of April meeting minutes
 - c. Review of All Chapters meetings held May-9~~th~~
 - d. Discussion of topics for future meetings
 - e. Discussion of a future trip to the Cosmosphere International Science Center & Space Museum in Hutchinson, KS 219 miles or 3 ½ hour drive from Moore, OK)
 - f. Other issues
- 5) Video 23 minutes, "Jeff Bezos on Rocket Reusability Keynote at SATELLITE
<https://www.youtube.com/watch?v=WNeXhPIwA58>
- 6) Video 2:21 "Administrator Bridenstine: InSight Will Map the Inside of Mars
https://www.youtube.com/watch?v=52A_Q-KY3-g
- 7) Explaining NASA's InSight Mars Lander And Its Mission video 12:04
https://www.youtube.com/watch?v=Poat_xlE0-g
- 8) Chat

Minutes of April Meeting

National Space Society's Oklahoma Space Alliance chapter held its regular monthly Meeting on April 14, 2018 at Earl's Rib Palace in Moore, Oklahoma. Attending were OSA President David Sheely, Russ Davoren, Syd Henderson, Mike Hopkins, Clifford McMurray, Eleanor Powell, Tim Scott, Brian Swift, Steve and Karen Swift. David presided over the meeting.

David did an *Update* last month that is online at <http://chapters.nss.org/ok/osanss.html> and contains links to his presentations, so I'll go over the highlights and videos.

We watched a video of the launch of SpaceShipTwo *Unity*. This was the first flight of a SpaceShipTwo since VSS *Enterprise* broke up on a test flight in October 2014, killing a pilot. I speculated whether the three-and-a-half-year delay may put Virgin Galactic at a disadvantage compared to other space tourism companies that are near launch.

We watched a video of a SpaceX launch to the ISS, and one of Ariane 5's return to action after a telemetry problem on a launch in January.

We watched a Trump video in which he was calling for the creation of a Space Force.

We watched an HBO video on Bob Walker, who is the President's space policy advisor. Walker is also a former congressman from Pennsylvania, serving from 1977 to 1997, and was Chair of the House Science Committee during his last term in office. Walker doesn't think NASA should be monitoring climate change, but that the monitoring should be transferred to a different agency such as NOAA. [NASA is an independent agency while NOAA is part of the Department of Commerce. On the other hand, NOAA already does quite a bit of monitoring of the atmosphere and oceans.]

We watched a video of SpaceX launching ten communications satellites on one flight, for the Iridium satellite constellation. [I have more on this in Space News.] We also watched the landing of the first stage. There will be eight SpaceX launches in total, at least under this contract.

Kip: Time delay for a satellite in geosynchronous orbit is about 0.2 seconds. [Which explains why the constellation orbits about 500 miles up instead of 26,000.]

It can cost a couple of hundred dollars to transport a gallon of gasoline to a forward military position, so beaming power could be an incredible savings.

We watched video of launch of a communications satellite from India.

We watched a video of the Soyuz MS-08 launch.

We watched a virtual tour of the Moon from images from the Lunar Reconnaissance Orbiter. You can watch this at <https://www.youtube.com/watch?v=nr5Pj6GQL2o> or <https://www.space.com/40274-nasa-moon-in-4k-video-tour.html> (with narration), and many other places.

After reimbursing Syd for Outreach and paying for our mailbox, we have \$1033.75 in the checking account and \$267 in cash for a total of \$1370.75.

Dave attends NSS All-Chapters meetings online.

We watched a video of Vice-President Pence at Kennedy Space Center as a keynote for the second meeting of the National Space Council.

We also watched a video on the State of NASA's Goals by acting NASA Administrator Robert Lightfoot.

Minutes by OSA Secretary Syd Henderson

Space News

The *InSight* Mars Lander was launched on the morning of May 5 from Vandenberg Air Force Base in California. It is the first interplanetary spacecraft ever launched from the West Coast. Actually, it shares that honor with the cubesats MarCO 1 and 2 (aka WALL-E and Eve), which shared the Atlas Rocket with *InSight*. These are the first interplanetary cubesats and will relay signals from *InSight* until they pass Mars. *InSight*'s main relay, however, is the Mars Reconnaissance Orbiter. *InSight* will land on Mars on November 26 and operate for approximately two years.

InSight is dedicated to probing the Martian interior. Its main instrument, SEIS, will detect seismic waves from deep-seated Marsquakes, finding their focus from the differences in arrival times. This is different from how the focus of an earthquake is usually located which requires three seismographs in different locations.

InSight also carries a probe to be shot into the Martian surface to measure the rate at which the planet is losing heat, and an instrument which will precisely measure Mars's rotational period, looking for evidence of precession of its axis (expected to complete a circle in about 165,000 years) and minor irregularities than can give insight into Mars's interior.

InSight also carries a chip with 2.4 million names, including that of William Shatner of *Star Trek* fame.

InSight was to have launched in March 2016, but a persistent leak in vacuum seal around SEIS forced a two-year delay in the mission, raising the US's part of the cost by \$150 million to around \$813 million (including launch costs) and, with the combined French and German contribution of \$180 million, and the \$18.5 million for the cubesats, this became a billion-dollar mission.

UPDATE: *InSight* signaled home a few minutes after beginning its journey to Mars. Both Cubesats called home on the afternoon of May 6. *InSight* and the cubesats will all arrive at Mars on November 26.

[Info for this article comes from *Sky & Telescope* and *Astronomy* websites, Space.com and Wikipedia.]

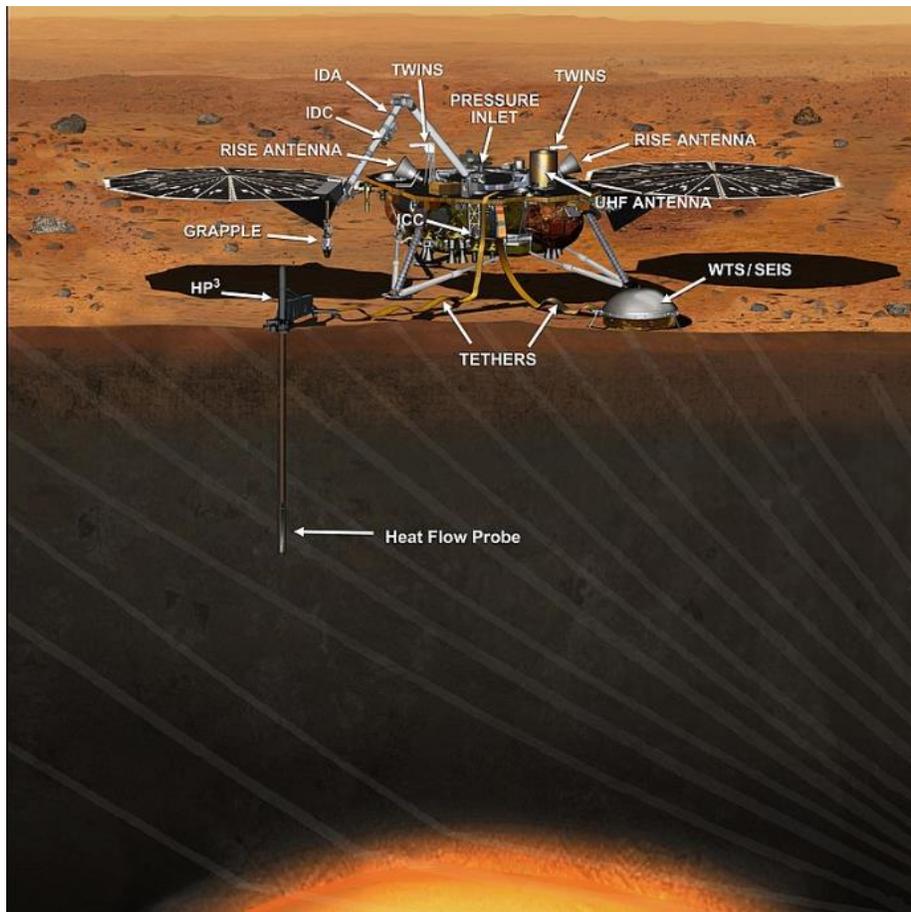


Figure 1 *InSight* Lander showing instruments. (NASA)

Congressman Jim Bridenstine was approved by the Senate as NASA Administrator on April 19 by a strictly partisan 50 – 49 vote and was sworn in on April 23. He becomes the first NASA Administrator to have been an elected official, which is part of the reason for the partisan vote. Senator Marco Rubio was also objecting, which stalled the nomination since Senator McCain is too ill to vote (otherwise Vice President Pence would break the tie). When acting Administrator Robert Lightfoot announced his upcoming retirement on March 12, to take effect Rubio was persuaded that it was better to have a NASA administrator he didn't approve of than no NASA administrator at all.

There were concerns that Bridenstine wasn't a scientist (although neither was James Webb) and some critics wanted an astronaut, although only of NASA's previous Administrators were astronauts. Bridenstine has written a manifesto on what he wants to do in space and has sponsored space-related

The dwarf nova V392 Persei unexpectedly went full nova on April 29, peaking at magnitude 6.2. Dwarf novae are thought to be due to fluctuations in the brightness of an accretion disk around a white dwarf star. Their outbursts are much smaller than those of novae, which result from the detonation of hydrogen accumulated on the surface of the white dwarf. If the white dwarf is large enough and the hydrogen accumulated too rapidly, the white dwarf is completely destroyed in a supernova.

Dwarf novae generally brighten over periods as short as a few days or as long as decades. V392 Persei brightens from magnitude 17.2 to magnitude 14 during a dwarf nova explosion. In other words, it increases in brightness by a factor of 19 during a dwarf nova explosion, and 25,000 during this nova explosion.

Although dwarf novae do sometimes turn into novae, the timescale for this happening is on the order of tens of thousands of years. Indeed, the only other time this has been observed happening was when V1213 Centauri exploded in 2009.

The March 30 launch referred to in the minutes was SpaceX's fifth launch for Iridium and the satellites were numbered 140 through 157, with some gaps for previous and future launches. This doesn't mean that Iridium currently has some 150 active satellites in orbit since some previous satellites in the constellation have died, most spectacularly in February 2009 when Iridium 33 and Kosmos 2251 collided. There are 66 active Iridium satellites, but a lot of backups, too. SpaceX has three more launches scheduled for Iridium, which will carry a total of 25 more satellites.

The *Transiting Exoplanet Survey Satellite (TESS)* was successfully launched on the afternoon of April 18. Unlike the highly successful *Kepler* mission, which in stage one concentrated on fairly distant stars in a tiny part of the sky, *TESS* is a whole-sky survey looking over 200,000 bright and relatively nearby stars. Like *Kepler*, *TESS* is expected to discover thousands of new worlds, including hundreds around Earth-size. Since *TESS* will only observe each piece of sky for a relatively short period of time, it will directly discover planets that are hot and near their stars (two observations are required to establish orbital period) but will also signal that these stars and possible planets should be followed up on by later and more powerful telescopes, including the James Webb Space Telescope.

Scientists at the University of Exeter in the United Kingdom have used the Hubble Space Telescope to detect helium escaping from the atmosphere of WASP-107b as the latter transited the disk of its parent star. The presence of helium itself was no surprise—it's the second commonest element in the Universe after all, and common in the atmosphere of gas giants, but the method was. Whereas previous scientists at looked at ultraviolet wavelengths to detect helium and failed, this study looked at the near-infrared, which helium strongly absorbs. WASP-107b has a mass about 0.12 that of Jupiter's but it's about the same in diameter, which means its density is extremely low (Technically it's a hot super-Neptune rather than a hot Jupiter.) It orbits its star with a period of 5.7 days and its temperature is around 930° F, which is low for a planet so close to its star. I'm surprised to find that WASP-107 is a K type star and not a red dwarf.

Sky Viewing

The next three months are an excellent time for planet viewing, with Venus growing brighter in the western sky, Jupiter at opposition this month, Saturn at opposition in June and Mars at opposition in July. All three will be near maximum brightness in June.

Mercury is not so cooperative, being lost in twilight through the end of May, with superior conjunction with the Sun on June 6. However, Mercury will become visible after sunset in mid-June, and by the end of the month will be setting 90 minutes after the Sun and at magnitude 0.1. Mercury will be at greatest elongation on July 12 but is at its brightest a week or two before that.

Venus is magnitude -3.9 and is highly visible in the western sky after sunset. It is in a gibbous phase, and, unlike Mercury, is actually brightest in the middle of its crescent phase, so it will be growing brighter over the next few months. Venus will reach its peak altitude on June 6, about 28 degrees above the horizon at sunset, and will be setting more than two hours after the Sun throughout June.

Mars is currently about magnitude -0.5 and brightening rapidly, but isn't rising until 1:30 a.m. It's on the eastern side of Sagittarius and is easily the brightest object in that part of the sky. By the end of May, it will be magnitude -1.2, and by the end of June it will be magnitude -2.2, which is brighter than any star (other than the Sun, of course) and almost as bright as Jupiter. Since it will be at opposition on July 27, it will be getting still brighter in July.

Jupiter was at opposition on May 8 and is at its maximum brightness of -2.5, and visible all night long in the constellation Libra. It's easy to spot because it's the brightest object in the night sky other than the Moon and Venus (although Mars will be actually be brighter in July). Even by the end of June, Jupiter will only have dimmed to magnitude -2.3.

If Mars is the brightest object in Sagittarius this month, there is another first magnitude object there, but farther west: **Saturn** is above the Teapot asterism maybe twenty degrees from Mars and, at magnitude 0.3, really stands out. Saturn is currently rising about midnight, but will be rising much earlier in late May and June, and on June 27, it will be at

opposition, and up to magnitude 0.0. Since the rings will be tilted at an angle of 27 degrees, Saturn will be near its maximum possible spectacularness.¹ Not only that, Saturn will have a conjunction with the Moon about twelve hours after opposition.

Uranus and **Neptune** are still lost in twilight at dawn but will be possible to locate by the end of June, Uranus by binoculars and Neptune by telescope.

You might have an easier time locating an asteroid. **Vesta**, the brightest asteroid, is at opposition on June 19 and is visible to the naked eye in dark skies. It will be magnitude 5.3, which means it should be visible from the Cheddar Ranch Observatory without binoculars or telescope. There's a finder chart in the June 2018 *Sky & Telescope*. Note that it's in Sagittarius not far from Saturn, which shouldn't be surprising with them reaching opposition so close together.

If you're impatient and have visual aids, the May issue of *Astronomy* has a finder chart for the dwarf planet **Ceres**, which is traversing Leo this month.

This newsletter comes out too late for the Eta Aquariid meteor shower, and there don't seem to be any other meteor showers in May or June. (Okay, the Arietids exist but tend to occur during twilight or daylight, and the June Boötids are too weak to bother with. The Southern Delta Aquariids in July can apparently be good², but I think the next major shower will probably be the Perseids in August.)

Information for this section comes from the May and June issues of *Sky & Telescope* and *Astronomy*, and from their websites.

Viewing Opportunities for Satellites (May 12 – June 16)

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, and making an exception for the site in the Java Control Panel.) 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 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 -3.8, which it will on March 18, 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. 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. There is an Orbital ATK cargo mission to the Station on the morning of May 20. The next manned launch is on June 6. I know of no scheduled manned flights to Tiangong-2. Tiangong-1 reentered the Earth's atmosphere on April 1 and the pieces can be viewed via submarine in the southeastern Pacific Ocean.

Tiangong 2, May 16, 2018		
Time	Position	Elevation
5:39 a.m.	302°	10°
5:42	24	62
5:45	106	10

Tiangong 2, May 18, 2018		
Time	Position	Elevation
5:16 a.m.	293°	10°
5:19	210	71
5:20	125	10

ISS, May 20, 2018		
Time	Position	Elevation
5:39 a.m.	319°	21°
5:40	338	40
5:41	36	72
5:42	114	41
5:43	123	22

ISS, May 20, 2018		
Time	Position	Elevation
10:16 p.m.	241°	21°
10:17	253	37
10:18	318	64
10:19	25	39

¹ If it wasn't a word, it is now.

² I'm skeptical. I figure if this was a good shower, it would simply be called the Aquariids. There are also the Northern Delta Aquariids, which seem to be truly puny.

10:20 37 21

ISS, May 21, 2018

Time	Position	Elevation
9:24 p.m.	208°	20°
9:25	194	37
9:26	135	57
9:27	76	37
9:28	62	20

Tiangong 2, May 21, 2018

Time	Position	Elevation
10:02 p.m.	243°	10°
10:05	334	88
10:07	62	24

Vanishes into Earth's Shadow

Tiangong 2, May 22, 2018

Time	Position	Elevation
9:02 p.m.	223°	10°
9:05	148	46
9:09	73	10

ISS, May 23, 2018

Time	Position	Elevation
4:39 a.m.	310°	22°
4:40	309	42
4:41	30	86
4:42	137	42
4:43	135	22

ISS, May 23, 2018

Time	Position	Elevation
9:16 p.m.	253°	20°
9:17	270	35
9:18	322	49
9:19	13	34
9:20	30	20

HST, May 31, 2018

Time	Position	Elevation
5:48 a.m.	225°	20°
5:49	206	27
5:50	179	31
5:51	152	27
5:52	133	20

HST, June 1, 2018

Time	Position	Elevation
5:37 a.m.	228°	20°
5:38	203	27
5:39	182	31
5:40	154	27
5:41	136	20

Tiangong 2, June 2, 2018

Time	Position	Elevation
9:23 p.m.	303°	10°
9:26	24	57
9:29	103	12

Vanishes into Earth's Shadow

ISS, June 8, 2018

Time	Position	Elevation
9:52 p.m.	317°	21°
9:53	322	40
9:54	32	78
9:55	120	42
9:56	126	22

HST, June 14, 2018

Time	Position	Elevation
10:10 p.m.	223°	20°
10:11	204	27
10:12	177	30
10:13	150	27

Vanishes into Earth's Shadow

HST, June 15, 2018

Time	Position	Elevation
9:59 p.m.	226°	20°
10:00	208	27
10:01	180	31
10:02:21	153	27
10:02:53	142	23

Vanishes into Earth's Shadow

HST, June 16, 2018

Time	Position	Elevation
9:49 p.m.	228°	20°
9:50	209	27
9:51	182	30
9:52	155	27
9:53	137	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 9:20 p.m. on May 23, measure three fist-width's east from 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:

May 14, 9:30 a.m.: ISS In-Flight Educational Event with the Tulsa Air & Space Museum.

May 20: 3:30 a.m. Coverage of the launch of Orbital ATK's cargo flight to the ISS. (Actual launch is 4:04 a.m.)

June 3: 3:45 a.m.: Coverage of undocking of Soyuz MS-07 from the ISS. Actual undocking is at 4:16 a.m. This begins the return of three astronauts to Earth.

6:15 a.m.: Coverage of ISS Expedition 55/Soyuz deorbit burn and landing. Deorbit burn starts at 6:47 a.m. and landing at 7:40 a.m.

June 6: 5:15 a.m. Coverage of launch of ISS Expedition 56-7. Actual launch is at 6:11 a.m.

June 8, 7:15 a.m. Docking coverage of ISS Expedition 56-7. Actual docking is at 8:05 a.m. 9:00 a.m.: Coverage of hatch opening and welcoming ceremony. Actual opening will be around 9:45 a.m.

Calendar of Events

May 11: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). 7:00 p.m., followed by a talk at about 7:45 p.m. See <http://www.okcastroclub.com/> for details.

May 12: Oklahoma Space Alliance meeting, 2:00 p.m., Earl's Rib Palace in Moore, Oklahoma.

May 20: Launch of Orbital ATK cargo ship to the Space Station. Launch will be approximately 4:04 a.m. Central Daylight Time

June 3: Expedition 55 returns from the Space Station.

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

June 6: Expedition 56 is launched to the Space Station.

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

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

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

July 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.

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

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

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

July 20: 49th Anniversary of *Apollo 11* landing on the Moon.

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

August: SpaceX Commercial Crew Demonstration mission 1. This mission will be uncrewed and launched by a Falcon 9.

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

August 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.

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

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 12: [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 14: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). 7:00 p.m., followed by a talk at about 7:45 p.m. See <http://www.okcastroclub.com/> for details.

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: India's *Chandrayaan-2* will be launched to the Moon. The mission includes a lander, rover and orbiter, the first two landing near the south pole of the Moon/

October 4: Mission 56 returns from the Space Station.

October 4: 61st Anniversary of launch of *Sputnik 1*.

October 6 – 13: Okie-Tex Star Party, Camp Billy Joe, Kenton OK 73946. Hosted by the Oklahoma City Astronomy Club. For more information, visit <http://www.okie-tex.com>.

October 10: [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 11: Mission 57 launches to the Space Station from the Baikonur Cosmodrome.

October 12: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). 7:00 p.m., followed by a talk at about 7:45 p.m. See <http://www.okcastroclub.com/> for details.

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: Boeing's CST-Starliner makes its first crewed flight. This will be the first American spacecraft to carry astronauts to orbit since 2011. 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: SpaceX will launch its first manned Dragon-2 capsule to the International Space Station.

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>.

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

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

April 12, 2019: Yuri's Night: 58th anniversary of orbital space flight.

July 20, 2019: 50th Anniversary of *Apollo 11* landing on the Moon.

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 ESA's *ExoMars Mars Rover*. For more information, visit en.wikipedia.org/wiki/Exo-mars.

May 2020: [Moved yet again]: Launch of the James Webb Space Telescope.

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 2021: 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 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.

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, 2018 (Area Code 405)

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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

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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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