

# Oklahoma Space Alliance OUTREACH

## November 2016

### November Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, November 12, 2016 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.

OSA President Steve Swift has recovered from his illness and will preside at the meeting.

This is the meeting at which we nominate officers. If you wish to serve as an officer of Oklahoma Space Alliance, please let us know at the meeting or contact Syd by e-mail at [sydh@ou.edu](mailto:sydh@ou.edu). Syd will be sending out election ballots around the beginning of December by both e-mail and snail mail. If you wish to be an officer, please contact him by December 1. Elections will be held at the Christmas Party.

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

- 1) Introductions
- 2) What's Happening (Steve Swift)  
(Pictures, Videos & Links)
  - a. Pictures and Videos of Current Events in Space,
  - b. Comparison of Current and Planned Boosters and Spacecraft.
- 3) Discuss Business
  - a. Review OSA Accounts,
  - b. Nomination of Officers for 2017,
  - c. Discuss Holiday Event.
- 4) OSIDA Meeting Report.
- 5) Videos from TED (Technology, Entertainment, Design) Conference:
  - a. *Why Space* by Rick Tumlinson,
  - b. *Colonizing our Next Frontier* by Rick Tumlinson,
  - c. *Space Exploration* (tongue in cheek) by Emily Calandrelli.
- 6) Chat

## Minutes of October Meeting

Oklahoma Space Alliance met at Earl's Rib Palace in Moore on October 8, 2016. Attending were Dave Sheely, Claire McMurray, Tim Scott, Rosemary Swift, and Syd Henderson. OSA President Steve Swift was out due to illness; in his absence OSA Vice-President Dave Sheely presided.

Dave did an *Update* for October with links to most videos shown at the meeting. You can find it here: <http://chapters.nss.org/ok/Update1610.pdf>. Some highlights are below.

We watched a videos on the colonization of Mars including one by Elon Musk.

Blue Origin tested the abort system for the New Shepherd vehicle. The abort system worked and any astronauts aboard would have survived. We watched a video of the test. There's no link in *Update* since the test was after that went out.

We watched a video of the August 19 ULA launch.

We now have \$1024.50 in out checking account and \$257 in cash for a total of \$1291.50.

What can we do to celebrate Space Week next year? That will be the 60th anniversary of the launch of *Sputnik*. Perhaps we can find headlines of how people reacted to *Sputnik*. [For example, Nikita Khrushchev was *Time* Man of the Year.] Do we have any recordings of the launch of *Sputnik*?

What do we have for an exhibit at next year's ISDC®?

Congressman Bridenstine won't be able to come in November because he is in the Reserves.

Is SEDS still at OU? [Apparently not. They are not listed among the student organizations. —Syd]

Officer nominations are at the November meeting with installation at the Christmas party. If the Koszorus are unable to host, Claire is willing.

What other satellites are being launched? There are 1100 active satellites, and another 2600 that no longer work.

--Minutes by OSA Secretary Syd Henderson

## Notes on October 12 OSIDA meeting

The Oklahoma Space Industry Development Authority met at the Oklahoma Department of Transportation building in Oklahoma City on October 12. OSIDA board members attending were James Cunningham, David Greer, Ben Robinson and Bailey Siegfried. Not present were Michael Halsey, Donald Wetekam and Robert Cox. Syd attended on behalf of OSA and there was one in the audience. Bill Khourie presented information about the Spaceport.

Not much business at this meeting. China is competing with American commercial space companies such as Space X, Blue Origin and Virgin Galactic. [See "Space News" for details.]

Oklahoma Spaceport Facility Manager Chuck Haden is leaving and will be replaced by November 1.

Meeting calendar for 2017 was established. They will be on the second Wednesday of each month, usually at the Department of Transportation building.

## Space News

SpaceX has pinpointed the cause of the September 1 explosion of a Falcon 9 rocket. The liquid oxygen accidentally froze, causing a chemical reaction with a carbon composite container holding liquid helium that is located inside the oxygen tank. [It would seem to me that liquid oxygen would be more likely to react with carbon dioxide.] The rupture of the helium tank presumably caused the helium to become gas, causing a series of explosion.

NASA had problems with composite carbon tanks and liquid oxygen during the X33 spaceplane project. NASA has advised SpaceX to use a recirculation pump to deal with the problems.

The explosion caused the postponement of future Falcon 8 flights until mid-December.

NASA officials announced November 2 that the James Webb Space Telescope is complete. It now undergoes two years of testing before launch in 2018. The James Webb Space Telescope (JWST) will be the largest space telescope ever launched. Unlike the Hubble Space Telescope, the JWST is an infrared telescope, and will be at the Earth-Sun L2 point, which lies about a million miles farther from the Sun than the center of the Earth-Moon system. Since it won't be serviceable from Earth (though it would be exciting to try), the JWST will have to be gotten right from the beginning.

The JWST is so sensitive that it could detect a bee at the distance of the Moon by the heat of its body. It should be able to directly detect planets around other stars and analyze the composition of their atmospheres, as well as see through dust clouds to look at early galaxies. Seeing this from the Earth's surface is impossible because the Earth's atmosphere emits infrared radiation, and putting it a million miles away helps protect it from the heat emitted by the Earth. (It has a sunshield to protect it from the Sun.)

*New Scientist* points out that with the Hubble Space Telescope and James Webb Space Telescope both in space from 2019 until 2021, we will be able to get 3D images of the Solar System. The two telescope will be a million miles apart, giving them quite a baseline for binocular vision.

<https://www.newscientist.com/article/2110845-space-telescope-duo-will-showcase-the-solar-system-in-3d/>

The Chinese space station *Tiangong-2* was launched on the evening of September 15 (Chinese time). The first crew, consisting of Jing Haipeng and Chen Dong, arrived on October 19. The station has thirty days of life support, so the crew should be returning in the next couple of weeks.

Meanwhile, *Tiangong-1*, which hasn't been visited since June of 2013, is now out of contact with ground stations and will reenter the Earth's atmosphere late next year. Parts of the space station weighing up to a couple hundred pounds are expected to reach the Earth's surface.



Figure 1 Tiangong-2 space station in Spacecraft ATI Centre (Chinaspacereport.com)

On the evening of November 3 (Beijing time) China launched its first heavy-lift Long March 5 rocket. The rocket launched a satellite, but it was also a test of the rocket that will carry the pieces of *Tiangong-3* to orbit sometime in the early 2020s. Long March 5 is about as powerful as a Delta IV, but has slightly less than half the cargo capacity of the Falcon Heavy.

*New Scientist* reports that the China Academy of Launch Vehicle Technology has designed a rocket plane that would be capable of carrying five people to over 100 km, and potentially can be scaled up to carry twenty people. They also claim to be able to have it ready for testing in 2018, and carry payloads by 2020. Interestingly, the craft would take off vertically and land horizontally.

There's a lot of skepticism in the space community that they'll be able to get this design to work, especially since the larger version would weigh 100 tons and use no staging. If it does work, ticket prices will be about a quarter of a million dollars.

The Schiaparelli EDM Lander, part of the ExoMars program, was destroyed on October 19 as it was attempting to land on Mars. Indications are that lander jettisoned its heat shield and parachute before it was supposed to, then the braking rockets burned for only three seconds rather than a full minute, apparently due to a navigational system error that misestimated the distance to the surface. The spacecraft fell from more than a mile above the surface and hit at an

estimated 186 miles per hour. The *Mars Reconnaissance Rover* found the impact site a couple of days later, including the crater formed by the impact and a white spot which is apparently the parachute.

The ExoMars mission also consists of an orbiter, which is apparently healthy, and a rover to be launched in 2020.

On October 25, the last of the data from the *New Horizons* flyby of Pluto was transmitted to Earth. *New Horizons* transmitted about sixteen billion gigabytes of data over fifteen months at a rate of one to four kilobytes per second. (It actually transmitted fifty gigabytes of data so some of it may have been sent more than once.)

New Horizons next objective is the Kuiper Belt object 2014MU69, which it will pass in January 2019.

Kuiper Belt object and probable dwarf planet 2007 OR<sub>10</sub> is the third largest Kuiper belt object (after Pluto and Eris) and now is known to have a moon. This means Sedna is the largest object beyond Pluto not known to have a moon, but at least it has a name.

Kuiper Belt Object 2003L91 (hence referred to as L91, is one of the most distant Kuiper Belt Objects yet discovered, with an orbit that takes it from 45 to 1300 billion miles from the Sun, which gives it an orbital period of 20, 000 years. (Note though 2005 VX<sub>3</sub> gets almost three billion miles from the Sun, but is probably a comet.) L91 is interesting because its orbit is almost in the plane of the ecliptic, which is a bit of evidence against the existence of Planet 9, but its orbit is also slowly shifting, which suggests something out there is affecting it gravitationally.

Virgin Galactic has begun flight tests of *Spaceship Two*, but so far the spaceplane has remained attached to its carrier vehicle during flights. The November 1 flight was supposed to include a glide test for VSS *Unity*, but high winds forced a postponement. It has now been two years since VSS *Enterprise* broke up during a powered spaceflight test.

The *Juno* spacecraft went into safe mode on October 18, which meant NASA got no data during its second flyby of Jupiter. It recovered from safe mode on October 24. An orbital burn was also postponed when two helium check valves acted up; these are used to control the pressurization of the fuel. Another attempt will be made when *Juno* next approaches Jupiter on December 11. *Juno*'s present orbit takes it from 2600 miles to 5 million miles above Jupiter's clouds.

IRS 43 is a binary star in the constellation Ophiuchus that has not one or two planet-forming disks, but three: one around each star and a third encircling both of them—and the three disks are all tilted with respect to each other. Although both stars are about as massive as the sun, they are still in the process of formation, and their cores haven't even started fusing helium. The outer disk is expected to align itself with the orbits of the stars over the next million years or so, except by then the inner disks will be dispersed or possibly form planets.

## Sky Viewing

There's a lot of fuss this month about a Supermoon. These happen any time that the **Moon** is near perigee, and we're actually getting three in a row, this being the biggest. [We get several in a row because the Moon's orbital period is only a couple of days off the length of time between Full Moons.] Second, this is occurring 2.5 hours after the closest perigee of the year, and only a couple of months before the Earth reaches perihelion. These all combine to make this the brightest Full Moon in sixty-eight years, thirty percent brighter than a typical Full Moon (though not that much brighter than the October and December supermoons, or other supermoons in previous years).

The technical term is "perigee-syzygy" (of the Earth, Moon and Sun), though that would also be the term if the New Moon occurred near perigee. [Indeed supermoons also occur at both New Moon and Full Moon.] Another, simpler term is "perigee Full Moon" (or New Moon).

The **Leonid Meteor Shower** peaks on the morning of November 17, which is unfortunately only a couple of days after the Full Moon. The Leonids are expected to produce about fifteen meteors an hour, but the Moon will drown them out.

The same thing will happen to the **Geminids**, which peak on December 13 and 14. The Geminids produce more meteors than the Leonids, but they'll be drowned out as well.

That leaves the **Ursa Minorids**, or, more familiarly the **Ursids**. These peak on the night of December 21-22, and the Moon doesn't rise until 1:00 a.m. The Ursids are a minor shower, with peaks about 10 meteors per hour, but have the advantage that their radiant is close to Kochab in Ursa Minor, which means that it's fairly close to the North Celestial Pole.

**Venus** is visible in the western sky after sunset, shining at magnitude -4.0 in evening twilight and a bit into night. It's setting further behind the Sun each night, and will be setting three hours behind the Sun by the end of November and nearly four hours behind the Sun by the end of December. By then it will be magnitude -4.4 as it approaches greatest brightness in early 2017. Venus just moved into Sagittarius and will move across that constellation until mid-December when it passes into Capricornus,

**Saturn** is still somewhat visible about ten degrees below and to the right of Venus and is magnitude 0.5. However, Saturn will disappear into the sunset later this month as it approaches conjunction with the Sun on December 10, and won't be visible again until next year. Saturn is in the southern part of the constellation Ophiuchus not far from the head of Scorpius, and will be in Ophiuchus until next February.

**Mars** is about three fist-widths to the upper left of Venus, and is moving from Sagittarius into Capricornus. It's moving away from us and getting dimmer. Currently it is magnitude 0.4, and will dim to magnitude 0.6 by the end of November and 0.9 by the end of December. It's one constellation ahead of Venus, crossing Capricornus until mid-December, when it moves into Aquarius, where it will find **Neptune**. Mars and Neptune have a conjunction on December 31.

**Jupiter** is magnitude -1.7 and is in the constellation Virgo a fist-width above Spica. (This is handier for locating Spica than Jupiter.) Jupiter is a morning star, visible just before twilight. By December 1, it will be rising about 2:30 a.m., and by December 31, it will be rising at 1:00 a.m.

**Uranus** is magnitude 5.7 as always, and in Pisces, while **Neptune** is magnitude 7.9 and in Aquarius. Finder charts are at [http://www.skyandtelescope.com/wp-content/uploads/WEB\\_UrNep16\\_Finders.pdf](http://www.skyandtelescope.com/wp-content/uploads/WEB_UrNep16_Finders.pdf). Both are high in the sky in the evening.

The asteroid **Ceres** is also near maximum brightness and is a smidgeon brighter than Neptune this month. It's located in an inconspicuous part of the constellation Cetus. There's a finder chart on page 43 of the November *Astronomy*.

[Sources *Sky & Telescope* and *Astronomy* magazines and websites and Wikipedia]

### Viewing Opportunities for Satellites (November 12 to December, 2016)

You can get sighting information at [www.heavens-above.com](http://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.

<http://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. 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, so I'm using Heavens Above for that. The *Sky & Telescope* web site carries International Space Station observation times for the next few nights at [skyandtelescope.com/observing/almanac](http://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 so far apparently only gets up to magnitude 1.

Missions to and from the International Space Station or Taingong-2 may change its orbit. The next launch to the ISS is on November 17. There is currently a crew aboard Tiangong-2 and they should be returning within the next two weeks.

The Hubble Space Telescope has no good viewing opportunities during this time period.

Tiangong-1 November 11, 2016

Time	Position	Elevation
Appears from Earth's Shadow		
5:49:35 a.m.	236°	28°
5:51	153	80
5:54	65	10

Tiangong-2 November 13, 2016

Time	Position	Elevation
6:37 p.m.	302°	10°
6:40:04	24	61
6:40:50	83	42

Vanishes into Earth's Shadow

## Tiangong-2 November 15, 2016

Time	Position	Elevation
6:11 p.m.	295°	10°
6:14	209	77
6:17	122	10

## Station November 18, 2016

Time	Position	Elevation
6:35 a.m.	327°	21°
6:36	343	37
6:37	39	55
6:38	97	40

Vanishes into twilight

## Station November 20, 2016

Time	Position	Elevation
6:28 a.m.	294°	20°
6:29	276	34
6:30	226	41
6:31	175	34
6:32	158	20

## Tiangong 1 November 22, 2016

Time	Position	Elevation
Appears from Earth's Shadow		
6:24 a.m.	228°	10°
6:25	210	60
6:29	129	10

## Tiangong-2 November 28, 2016

Time	Position	Elevation
6:25 a.m.	225°	10°
6:28	149	49
6:31	72	10

## Station November 29, 2016

Time	Position	Elevation
6:31 p.m.	203°	20°
6:32	187	35
6:33	134	50
6:34	82	35

Vanishes into Earth's Shadow

## Tiangong-2 November 30, 2016

Time	Position	Elevation
Appears from Earth's Shadow		
6:00 a.m.	242°	35°
6:01	212	90
6:04	63	10

## Station December 1, 2016

Time	Position	Elevation
6:23 a.m.	248°	20°
6:24	264	37
6:25	320	54
6:26	165	37
6:27	32	21

## Tiangong-1 December 6, 2016

Time	Position	Elevation
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6:18 p.m.	255°	10°
6:21	336	60
6:22:30	49	24

Vanishes into Earth's Shadow

Tiangong-2 December 10, 2016

Time	Position	Elevation
6:57 a.m.	291°	10°
7:00	210	61
7:04	129	10*

\*Passes very close to Jupiter

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 Tiangong-2 Space Station at 7:00 a.m. on December 10, measure three fist-widths west from due south, then six 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:

November 11, 9:00 a.m.: Heroes and Legends Grand Opening Ceremony.

November 16, 3:00 p.m.: Launch coverage of GOES-R.

November 17, 1:30 p.m.: Launch coverage of ISS Expedition 50-51 launch to the Space Station. Actual launch is at 2:20 p.m.

November 19, 3:00 p.m. Coverage of the docking of the Soyuz Capsule carrying ISS Expedition 50-51. (Actual docking is 4:00 p.m.) 5:40 p.m.: Hatch opening coverage. (Opening starts around 6:35 p.m.)

### Calendar of Events

November 11: 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 12: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

November 17: Launch of Expedition 50/51 crew to the International Space Station.

December: ESA's *ExoMars Mars Orbiter* arrives at Mars, together with the Schiaparelli lander. (The rover will be launched in 2018.) For more information, visit [en.wikipedia.org/wiki/Exomars](http://en.wikipedia.org/wiki/Exomars).

Mid-December: Test flight of SpaceX's Falcon Heavy.

December 9: 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 10: Mercury is at greatest elongation, 21 degrees east of the Sun (so can be seen after sunset).

December 10: Saturn is in conjunction with the Sun.

December 10: [Tentative]: Oklahoma Space Alliance Christmas Party, location to be announced.

December 14: Peak of Geminid meteor shower.

December 19: Launch of SpaceX's Dragon capsule on a resupply mission to the Space Station.

December 28: Mercury is in inferior conjunction with the Sun.

December 30: Antares launch to the ISS.

Sometime in 2017 [tentative]: China launches the *Chang'e 5* lunar sample return mission.

Sometime in 2017: India launches *Chandrayaan 2*. This mission will include a lunar rover. For more information, visit <http://en.wikipedia.org/wiki/Chandrayaan-2>. [Moved from 2014.]

January 12, 2017: Venus is at greatest eastern elongation, 47 degrees from the Sun (so can be seen after sunset).

February 26, 2017: Annular solar eclipse touching the southern tip of South America, the south Atlantic Ocean, and Angola.

March 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.

March 11, 2017: Launch of Expedition 51/52 to the Space Station.

March 25, 2017: Venus is in inferior conjunction with the Sun.

May 12, 2017: First demo flight of SpaceX’s Dragon 2 Spacecraft, 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.) Possibly may be postponed after the launch pad explosion earlier next month.

May 29, 2017: Launch of Expedition 52/53 to the Space Station.

June 3, 2017: Venus is at greatest western elongation, 46 degrees from the Sun (so can be seen before sunrise).

August, 2017: First crewed demo flight of SpaceX’s Dragon 2 Spacecraft.

August 21, 2017: The next total solar eclipse visible in the United States, on a pretty straight path from Portland, Oregon to Charleston, South Carolina. St. Louis is the biggest city in-between.

September 15, 2017: The *Cassini* spacecraft will end its mission with a plunge into Saturn’s atmosphere.

September 30, 2017: Launch of Expedition 53/54 to the Space Station.

November 2017: Launch of Expedition 54/55 to the Space Station.

December 2017: 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](https://en.wikipedia.org/wiki/CST-100_Starliner) for details.

December 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>.

December 2017: Proposed 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](http://space.mit.edu/TESS).

Late in 2017: SpaceX launches the Google Lunar X Prize Moon landing. This includes a lander and a rover. See <http://lunar.xprize.org/> and [en.wikipedia.org/wiki/Google\\_Lunar\\_X\\_Prize](http://en.wikipedia.org/wiki/Google_Lunar_X_Prize) for details. Sometime in 2018:

Launch of *InSight*, a lander that will probe the interior of Mars. For information, see <http://insight.jpl.nasa.gov/>. [Postponed from March 2016.]

Sometime in 2018: Possible unmanned SpaceX mission to Mars.

February 2018: Crewed orbital test flight of Boeing’s CST-100 Starliner to the ISS. See [https://en.wikipedia.org/wiki/CST-100\\_Starliner](https://en.wikipedia.org/wiki/CST-100_Starliner) for details. April 2018: The European Space Agency/JAXA *Bepi-Colombo* Mercury Orbiter is launched. [Postponed from January 2017.] Home page is <http://sci.esa.int/bepicolombo>.

May 2018: ESA launches the *ExoMars Mars Rover*. For more information, visit [en.wikipedia.org/wiki/Exomars](http://en.wikipedia.org/wiki/Exomars).

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](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.)

October 2018: Earliest date for the launch of the James Webb Space Telescope.

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](http://sci.esa.int/solarorbiter). [Moved from July 2017.]

January 1, 2019: *New Horizons* flies by the Kuiper Belt object 2014 MU<sub>69</sub>.

September 2019: Arrival of OSIRIS-Rex at the near-earth asteroid 101955 Benu to return samples. [See September 6, 2016.]

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](http://en.wikipedia.org/wiki/Exomars).

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

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>.

January 2022: *BepiColombo* arrives at Mercury orbit.

December 19, 2024: *Solar Probe Plus* makes its first pass through the outer corona of the Sun. [See July 31, 2018.]

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. This one is also visible in Salt Lake City, Denver, Little Rock (again), Tampa Bay and New Orleans.

### Oklahoma Space Alliance Officers, 2016 (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)

### OSA E-mail Addresses and Web Site:

sswift42 at aol.com (Steve Swift)  
 cliffclaire at hotmail.com (Claire McMurray)  
 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](mailto: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](http://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](http://www.sciencemuseumok.org). Main number is 602-6664.

Tulsa Air and Space Museum, 7130 E. Apache, Tulsa, OK 74115.

Web Site is [www.tulsaairandspacemuseum.com](http://www.tulsaairandspacemuseum.com). Phone (918) 834-9900.

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

The National Space Society's Headquarters phone is 202-429-1600. Executive Director e-mail [nsshq@nss.org](mailto:nsshq@nss.org). The Chapters Coordinator is Bennett Rutledge 720-641-7987, [rutledges@chapters.nss.org](mailto:rutledges@chapters.nss.org). The address is: National Space Society, 1155 15th Street NW, Suite 500, Washington DC 20005 Web page is [www.nss.org](http://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](http://www.planetary.org). E-mail is [tps@planetary.org](mailto:tps@planetary.org).

NASA Spacelink BBS 205-895-0028. Or try [www.nasa.gov](http://www.nasa.gov).

Congressional Switchboard 202/224-3121.

Write to any U. S. Senator or Representative at [name]/ Washington DC, 20510 (Senate) or 20515 [House].

# 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](http://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](http://www.marssociety.org). One-year memberships are \$50.00; student and senior memberships are \$25, and Family memberships are \$100.00. Their address is Mars Society, 11111 W. 8<sup>th</sup> Ave, Unit A, Lakewood, CO 80215.

Do you want to be on the Political Action Network?

\_\_\_\_\_ Yes\_\_\_\_\_ No. [See brochure for information.]

Name\_\_\_\_\_

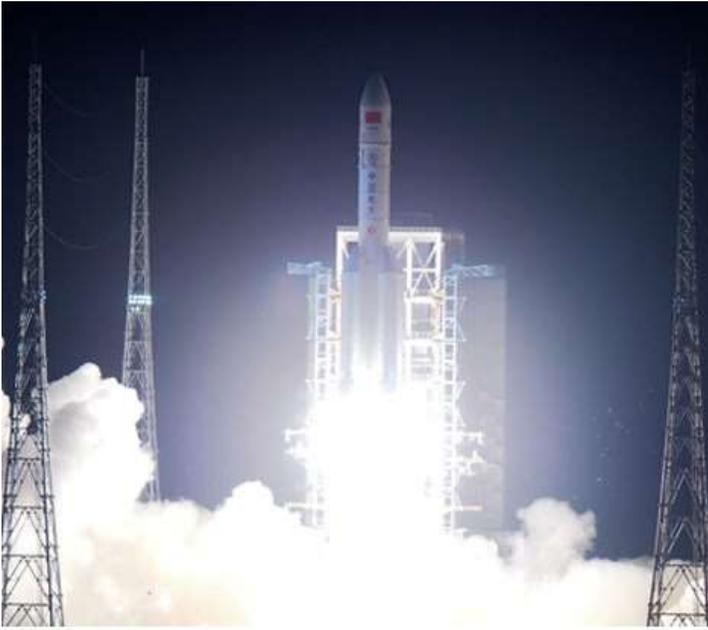
Address\_\_\_\_\_

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.**



**Long March 5 Rocket (China Aerospace Science and Technology Corporation)**