

# OKLAHOMA SPACE ALLIANCE

## OUTREACH – July 2018

### 102 W. Linn #1, Norman, OK 73069

Oklahoma Space Alliance will travel to the Cosmosphere Air and Space Museum in Hutchinson, Kansas on July 14. Cars will leave Norman at 7:00 a.m. We will have lunch at the Museum Cafeteria at noon. See inside for cost and directions.

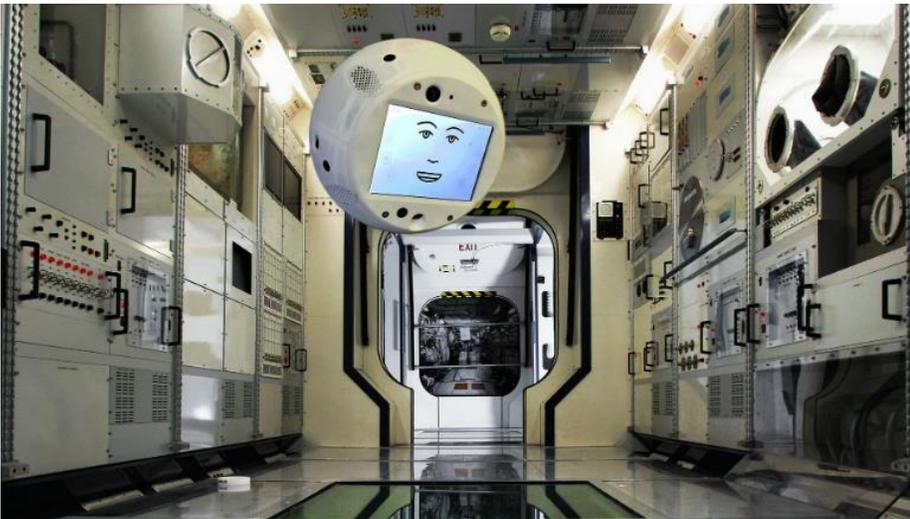


Figure 1 Cimon, the Crew Interactive Mobile Companion, now on board the ISS (Page 5) Picture is a mockup from the NASA website.

# OKLAHOMA SPACE ALLIANCE

## OUTREACH

### July 2018

#### July Meeting:

- 1) We will not meet at Earls Rib Palace on July 14th
- 2) The next meeting of the Oklahoma Space Alliance will be a trip to The Cosmosphere in Hutchinson, Kansas. You need to get there on your own.
- 3) David Sheely is driving his van, so he can share a ride with a few people. He plans to leave Norman around 7:00 am. Call him about a ride at (405) 821-9077.
- 4) We plan to eat dinner in Hutchinson at the end of the day, and then drive back that evening.

#### 5) Details

- 6) Cosmosphere: 1100 N Plum St, Hutchinson, KS 67501  
It's a 3 1/2 hour drive from Oklahoma City via I-35 & KS-96.
- 7) This is a major space museum. although it looks small and seems out-of-the-way. Exhibits, Omnimax dome theater (see cosmo.org for showtimes & titles) Planetarium, and "Dr. Goddard's Lab" (an explosive interactive live demo show on history of rockets) + museum shop.  
Phone 800.397.0330 ext. 347 to purchase advance tickets or use links from cosmo.org. Museum closes at 6 pm on weekends.

We can gather to eat lunch/snack at the museum cafe at noon-- "fresh deli sandwiches, chicken tenders, hamburgers, French fries, salads, soft pretzels and more!"

FULL-ACCESS TICKETS (less for fewer shows):

ADULTS \$26.00 + tax

SENIORS (60+) + MILITARY \$23.00 + tax

CHILDREN (4-12) \$17.00 + tax

CHILDREN 3 + UNDER\* FREE \*must sit in parent's lap in theaters

Directions: Get on I-35 N from wherever you start

Continue on I-35 N to Wichita. Take exit 13 from I-235 N

2 h 35 min (178 mi)

Follow KS-96 W and S Yoder Rd to E 11th Ave in Hutchinson

44 min (42.9 mi)

Continue onto KS-96 W 30.8 mi

Take the Yoder Rd exit 0.3 mi

Turn right onto S Yoder Rd 8.0 mi

Continue onto Airport Rd 0.8 mi

Turn left onto E 11th Ave 1.7 mi

Continue straight to stay on E 11th Ave

Destination will be on the right

Note: There are tolls in the Kansas part of this route. To avoid them, take the US 177 exit shortly before the Kansas border, and make sure you've printed off a route map from Google Maps or MapQuest, because it gets complicated.

## Minutes of June Meeting

National Space Society's Oklahoma Space Alliance chapter held its regular monthly Meeting on June 9, 2018 at Earl's Rib Palace in Moore, Oklahoma. In attendances were OSA president David Sheely, Russ Davoren, Claire and Clifford McMurray, John Northcutt, Tim Scott and Syd Henderson.

We watched a video of NASA Administrator Jim Bridenstine at the Humans to Mars Summit. It took 66 years from the Lewis and Clark Expedition to the first Transcontinental Railroad, and 49 years after Sputnik to build our first "rail-road" into space.

Dave, Claire and Cliff went to the ISDC in Los Angeles and reported on some things that they found there.

SEDS of University of San Diego at San Diego have a small rocket test stand which they displayed at ISDS. Their website shows small rocket launches.

We watched a video on how the Neumann Drive works. This is an ion drive that uses a wide variety of (mostly metallic) fuels to produce large specific impulse. (See Space News)

We saw a video on the Japanese ispace lunar rover.

We watched a video of the Chinese launch of the Queqiao communications satellite that will relay information from the Chang'e 4 lander and rover which will land on the far side of the Moon this December. Queqiao will be in a large "halo orbit" around the Earth-Moon L2 point (the one above the far side of the Moon).

We watched several shows of "This Week at NASA," and a video on GRACE-FO (Gravity Recovery and Climate Experiment Follow-On) which will use a laser interferometer between two spacecraft to measure fluctuations in the Earth's gravity, including those caused by melting glaciers and changing climate.

We watched the SpaceX launch of a communications for Bangladesh. They landed the first stage.

We watched a video of the first Chinese private rocket. This was a sounding rocket that didn't go into orbit, but it's a start.

You can find links to many of these and more in the June *Update*, which is online at <http://chapters.nss.org/ok/Update1806.pdf>.

We have \$1004.87 in our checking account and \$267 in cash, for a total of \$1271.87.

The July 14 meeting will be at the Cosmosphere in Hutchinson, Kansas. Plan is to carpool from Norman and return the same night. [See above.] We'll be having lunch at the Cosmosphere, so if you are not part of the carpool, you'll want to take off no later than 7:30 a.m.

Future topics: Tim: What nations are doing what in space?

The NSS chapters page still has Steve Swift as OSA president.

Since we had a relatively small meeting, we held off on the Bezos video mentioned in *Update*.

Minutes by OSA Secretary Syd Henderson

## Space News

The Neumann Drive mentioned at the June meeting is really interesting. It relies on the principle of an arc welder to heat up ions, producing a plasma of metal ions and electrons that are expelled from the drive, producing the thrust. This method has broken the record for specific impulse, i.e, the change of momentum produced by a given quantity of fuel, suggesting that this would be a suitable way to speed trips to Mars (if the drive scales up) or maintain satellites in orbit.

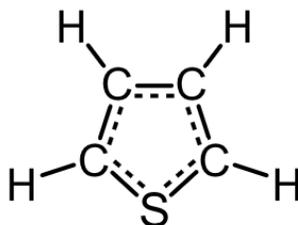
I'm more familiar with using xenon as a propellant in ion drives, but xenon is rare and expensive, not to mention that since it is a gas, it must be stored in containers under pressure. The Neumann Drive can use much more common materials, including molybdenum (for speed), magnesium (for long duration) and aluminum. It can even use the carbon in human waste, but I'd go with magnesium and aluminum and save the carbon for plant life.

The web page detailing this is <http://neumannspace.com/science>. Be sure to follow the links on the various fuels.

Several of the big space news stories over the last couple of months deal with organics on non-terrestrial bodies in the Solar System. For example, the Curiosity Mars rover has detected that atmospheric methane fluctuates seasonally on Mars, rising from a low of 0.24 parts per billion in winter to 0.65 parts per billion in summer, with random spikes up to 7 parts per billion. This suggests that the methane is coming from underground reservoirs, with the relative warmth of summer releasing methane bound in the soil. Since methane can be produced by biological process, this raised the usual speculations about possible Martian life, but methane is also produced through geological processes.

More interesting perhaps is the paper in the 8 June issue of *Science* announcing the *Curiosity*'s discovery of more complex organic molecules in the mudstone soils of Gale Crater. Mudstone is a sedimentary rock that was probably produced by water in Mars's distant past, and it is good at preserving organic materials in the harsh Martian environment. Gale Crater has what the authors call lake fed by a "fluviodeltaic sedimentary system," what we normal people call a river delta. Among the organic materials discovered are aromatic compounds (those containing an aromatic ring such as benzene, though other rings are possible, including some containing nitrogen or sulfur, and having five atoms or more than six; "aromatic" means that some electrons are free to move around the ring, which stabilizes it), and aliphatic (nonaromatic) compounds, including chains such as propane, butane, pentane and their derivatives.

One particularly interesting compound detected is thiophene, which consists of an aromatic ring with four carbons and a sulfur atom, with each of the carbons being attached to a hydrogen.:



The dotted lines around the ring indicate that some electrons are free to move from atom to atom around the ring. More complicated compounds containing this ring are also called thiophenes.

All these organic compounds (including relatives of thiophene) resemble the components of petroleum, in particular shale oil, and, in fact, shale is a form of mudstone. On Earth, these are the remnants of past life, so this discovery by *Curiosity* has yet again fueled speculation of past Martian life.

*Curiosity* had to drill into the mudstone to find these organic molecule, because the top few centimeters of Martian soils contain a lot of peroxides that destroy organics. Thus, it is of interest that the *ExoMars* rover will carry a core drill that will retrieve samples two meters deep

Finally, analysis of the *Cassini* spacecraft's observations of the plumes from Saturn's moon Enceladus reveal that they contain much more complex organic molecules than previously thought, some including nitrogen and oxygen. (Sulfur seems much more common in those found on Mars.) Three percent of the molecules detected had a mass about 200 atomic mass units, which would correspond to a pure hydrocarbon with 14 carbon atoms (although the molecules don't have to be hydrocarbons). This doesn't mean that those are the largest molecules either: the detector has a limit of 200 amu. It's also thought that the molecules may be fragments of even larger molecules.

Enceladus would be a good place to produce such molecules, since it contains water, ammonia and methane and a source of internal heat to combine them. (Sulfur seems to be locked up in iron compounds.)

'Oumuamua, the first interplanetary visitor known to come from outside the Solar System, turns out to be a comet after all—sort of. When 'Oumuamua flew past Mercury, there was no sign of outgassing at all, so it was assumed to be solid rock, but deviations in its trajectory appear to indicate that it was shedding mass as it passed the sun. Still, 'Oumuamua must be almost entirely rock, maybe shedding its ice before it came into the Solar System. Presumably the higher number of cosmic rays beyond the heliopause would affect interstellar visitors.

Meanwhile, Asteroid 2015 BZ<sub>509</sub>, which got some notoriety when it was discovered to have an orbit resonant with Jupiter, but in the opposite direction (and apparently passes through both clouds of Trojan asteroids when it does so, though, since its orbit is tilted to Jupiter's, it doesn't pass through the center of these regions), appears to have come from outside the Solar System as well. Computer simulations indicate 2015 BZ<sub>509</sub> has been in its retrograde orbit, for millions of years, and may have been in the Solar system since the Solar System formed. If so, it must have come from outside the Solar System since the objects in the Solar nebula all had prograde orbits.

An alternative theory is that it originated in the Oort cloud, but then you'd expect it to be more comet-like. It's worth noting though that comets often have retrograde orbits

Planets, moons, etc. are said to orbit in a prograde (forward) or retrograde (backward) direction depending on whether they orbit in the same direction as their primary's spin; this is usually because they form from the same cloud of gas and preserve its direction of spin. Objects in retrograde orbits are usually captured, except maybe for comets, which can get perturbed into a retrograde orbit. The only large satellite in the solar system that is in a retrograde orbit is Neptune's moon Triton, which is thought to be a captured dwarf planet (although in that case it's odd that its orbit is nearly circular.) Small satellites in retrograde orbits are thought to be captured asteroids. Triton is expected to pass within Neptune's Roche limit in 3.6 billion years and break up into an enormous, if retrograde, ring.

Having said all this, what are we to make that at least six "hot Jupiter" type exoplanets are known to be in retrograde orbits?

At least one nearby star, Kapteyn's star, is moving in a retrograde orbit. It is one of a number of stars with similar proper motion and are believed to be a remnant of a dwarf galaxy that was eaten by the Milky Way.

The crew of the International Space Station now has a robot companion called CIMON (The Crew Interactive Mobile CompanioN, demonstrating that one of NASA, or Airbus or IBM --who developed it-- have no talent for creating acronyms, and I call it Cimon from here on.)

From the NASA news bulletin: "Cimon will be the first artificial intelligence-based assistant used on station. Its primary design is to help with routine tasks. However, thanks to its neural ai network and ability to learn, Cimon may very well offer solutions to onboard problems should they occur.

"In order to serve as a test case for the new technology, the first mission for Cimon will only utilize a selected range of capabilities. If all goes well, ai-based assistants like Cimon will be a critical part of long-duration human space flight in the future. Until then, only time will tell what Cimon says."

Allegedly Cimon is based on Simon Wright's "Flying Brain" in *Captain Future*, and, as you can see from the cover of this issue, it is indeed the stuff of nightmares. Expect it to take over the ISS in the near future.

One strange type of space object appears not to exist. These are strange quark stars. The idea is that the interior of neutron stars can become a "quark soup," and under the enormous pressures, some of the up quarks and down quarks can convert into strange quarks. On Earth, these produce 'strange' particles which decay on the order of a ten-billionth of a second through the weak interaction. (The 'strange' part comes because that's trillions of times the length of the decay of particles through the strong interaction.) The idea is that in a neutron star, it might become advantageous for a lighter quark to convert into a strange quark, allowing the neutron star to contract further. This would create a stopping point between neutron stars made of normal quarks, and black holes.

However, according to calculations of Bob Holden of the University of Toronto, Canada, conversion of up and down quarks to strange quarks is energetically disadvantageous even under the pressures in a quark star.

Incidentally, this study also eliminates one scenario for the end of the world. There was a hypothesis that some stable strange particles, called strangelets, could exist, and, if one of them hit the Earth, would convert its entire mass into strange particles, which would be unpleasant. This scenario seemed unlikely anyways because if strangelets existed, they would have already eaten the Earth, not to mention the Sun.

"Neutron Stars Quark Matter Not So Strange," *Science*, 18 May 2018, p. 697

## Sky Viewing

Planet viewing during July and August is unusual good, with four planets easily visible in the night sky, and even Mercury making a couple of good appearances. And in August we have the Perseids. There is even a total lunar eclipse on July 27, but, alas, it isn't visible from the Western Hemisphere except for southern and western South America. Too bad, because it's the longest total lunar eclipse of the 21<sup>st</sup> Century. There's also a partial solar eclipse on July 13 if you happen to be in southern Australia, or somewhere between there and Antarctica.

**Mercury** is just barely visible on the western horizon after sunset and is two degrees below the Moon on July 14. It's approaching its August 9 inferior conjunction, but will become visible before dawn in late August, reaching greatest elongation on August 26, at which time it will be around magnitude 0. Mercury will grow brighter for a couple of weeks after that but will also be deeper in twilight.

**Venus**, on the other hand, is really prominent in the west after sunset, and in fact is easy to spot even when it is still twilight. Venus is in the constellation Leo and was in fact in conjunction with Regulus on July 9.<sup>1</sup> By July 14, they will be about four degrees apart.

Venus is approaching greatest elongation on August 17 and is getting brighter as it approaches Earth. Venus is brightest as a fat crescent and improves in brightness from its current magnitude -4.1 to magnitude -4.6 by the end of August.

**Mars** is currently magnitude -2.4, which makes it just a smidgen brighter than Jupiter, and will get even brighter as it approaches its closest opposition since 2003 on the night of July 26, when it will be magnitude -2.8. Because of orbital mechanics, Mars is closest to Earth on July 30. It's located in a dim part of Capricornus (which is a dim constellation to begin with).

Looking for features during this close opposition will be frustrating because Mars is in the middle of a planetwide dust storm which may last through opposition and beyond.

Currently, Mars is still rising about 10:15 p.m., but that will be around 9:00 p.m. at opposition. Note that at opposition, Mars will not be due south until 1:30 a.m. due to Daylight Saving Time and Oklahoma being at the western edge of the Central Time Zone.

**Jupiter** is currently magnitude -2.3 and easily visible in the south-southwest all evening after sunset. It is in the constellation Libra. Jupiter is past opposition and is slowly fading, falling to magnitude -1.9 by August 31, by which time it will be setting around 10:30 p.m.

**Saturn** is just past opposition and is visible all night long. However, at magnitude 0.1, it is not as conspicuous as Venus, Mars or Jupiter. It's also rather low in the sky comparatively speaking, since the middle-night ecliptic is at its lowest this time of year (and highest at midday: *i.e.*, it's just past the Summer Solstice).

If you time it right, you can go west to east along the ecliptic and see Jupiter, Antares, Saturn and Mars strung out. (Earlier in the evening, you can add Venus and Regulus in the west, but lose Mars.)

There are two meteor showers in the next two months. The Southern Delta Aquariids last a long time, peaking on July 30 with maybe 20 meteors per hour. Unfortunately, those must compete with the Moon, which will be a couple of days past full. In fact, the Moon will almost be on top of the radiant of the shower. (There is also a Northern Delta Aquariid meteor shower, which peaks a week or so later, but are comparatively minor.)

On the other hand, **The Perseid Meteor Shower** peaks on the night of August 12 – 13, which is only two days after new moon. The best viewing will be early morning on the 13<sup>th</sup>, when you can expect a couple of meteors per minute. However, there are meteors for several days before and after the peak.

### Viewing Opportunities for Satellites (July 14 – August 14)

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.

<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](http://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. (There were no good sightings during the time period.) I'm also including data for Tiangong 2, which can get up to magnitude 1.0 at least. I'm including the pass of July 12 because it goes straight over head, although it will probably be past by the time you get the printed copy of the newsletter. Also check out the July 24 pass, which does the same within a degree.

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<sup>1</sup> Regulus is only 0.47 degrees from the ecliptic so tends to get a lot of conjunctions with the planets and is often occulted by the Moon, and rarely by Venus or Mercury, not to mention the odd asteroid.

Missions to and from the International Space Station or Tiangong-2 may change its orbit. However, there don't appear to be any missions to either during the time period covered here. China was doing some maneuvering of Tiangong-2 in June, possibly as a prelude to its future reentry.

#### Tiangong-2, July 12, 2018

Time	Position	Elevation
9:47 p.m.	242°	10°
9:50	153	90
9:51	63	10

#### Tiangong-2, July 14, 2018

Time	Position	Elevation
9:29 p.m.	262°	10°
9:32	338	48

#### ISS, July 18, 2018

Time	Position	Elevation
11:02 p.m.	258°	19°
11:03	277	31
11:04	322	42
11:05	7	31
11:06	27	19

#### ISS, July 19, 2018

Time	Position	Elevation
5:32 a.m.	331°	20°
5:33	349	34
5:34	39	48
5:35	90	34
5:36	107	20

#### ISS, July 19, 2018

Time	Position	Elevation
22:10 p.m.	227°	21°
22:11	227	41
22:12	47	89
22:13	47	43
22:14	48	22

#### ISS, July 20, 2018

Time	Position	Elevation
21:18 p.m.	194°	18°
21:19	175	30
21:20	132	39
21:21	90	30
21:22	71	18

#### ISS, July 22, 2018

Time	Position	Elevation
9:10 p.m.	239°	21°
9:11	250	40
9:12	319	68
9:13	28	40
9:14	38	21

#### Tiangong-2, July 22, 2018

Time	Position	Elevation
9:53 p.m.	305°	10°
9:56	22	47
9:35	86	23

Vanishes into Earth's shadow

#### Tiangong-2, July 24, 2018

Time	Position	Elevation
9:35 p.m.	297°	10°
9:38	19	89
9:40	117	19

Vanishes into Earth's Shadow

#### Tiangong-2, July 26, 2018

Time	Position	Elevation
9:16 p.m.	285°	10°
9:19	213	42*
9:22	141	11

\*On this pass, Tiangong-2 passes a couple of degrees above Venus and Jupiter and a couple of degrees below Saturn.

#### ISS, August 10, 2018

Time	Position	Elevation
8:47 p.m.	319°	21°
8:48	327	40
8:49	38	73
8:50	115	41
8:51	124	21

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 9:11 p.m. on July 22, measure two fist-widths south of due west, then four fist-widths up from 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: Not much this month with no manned missions going to or from the Space Station.

July 15, 7:15 a.m. Coverage of the departure of the Cygnus CRS-9 Cargo Craft from the Space Station. Actual release is at 7:35 a.m.

August 2, noon: Coverage of the release of the SpaceX/Dragon CRS-15 Cargo Craft. Actual release is at 12:21 p.m.

## Calendar of Events

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: Oklahoma Space Alliance meeting, at the Cosmosphere in Hutchinson, Kansas. See “July Meeting” above.

July 20: 49<sup>th</sup> 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.

August 4 – 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](http://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 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 16: SpaceX Commercial Crew Demonstration mission 1. This mission will be uncrewed and launched by a Falcon 9.

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

September 30: SpaceX will launch 90 small satellites in one launch.

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: Boeing’s CST-Starliner makes its first automated test flight. See [https://en.wikipedia.org/wiki/CST-100\\_Starliner](https://en.wikipedia.org/wiki/CST-100_Starliner) for details.

October 4: Mission 56 returns from the Space Station.

October 4: 61<sup>st</sup> 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 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 19: Second launch of Falcon Heavy, this on the Space Test Program Flight 2 for the Air Force.

November 26: Jupiter in conjunction with the Sun.

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

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

December: China launches the *Chang'e 4* lunar lander and rover, which will be the first to land on the far side of the Moon. The Queqiao relay satellite was launched on May 20.

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.

Early 2019: 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 MU<sub>69</sub>.

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

January 17, 2019: SpaceX will launch its first manned Dragon-2 capsule to the International Space Station. [Postponed from December.]

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](http://sci.esa.int/solarorbiter)

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

July 20, 2019: 50<sup>th</sup> 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 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>.

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](http://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.

March 2021: [Moved yet again]: Launch of the James Webb Space Telescope.

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)

Dave Sheely, President & <i>Update</i> Editor	821-9077 (C)
Clifford McMurray, Vice President	329-4326 (H) 863-6173 (C)
Syd Henderson, Secretary & <i>Outreach</i> Editor	321-4027 (H) 365-8983 (C)
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cliffclaire at hotmail.com (Claire & Clifford McMurray)

sydh at ou.edu (Syd Henderson)

sswift42 at aol.com (Steve Swift)

ctscott at mac.com (Tim Scott)

t\_koszoru01 at cox.net (Heidi and Tom Koszoru, new address)

john.d.northcutt1 at tds.net (John Northcutt)

lensman13 at aol.com (Steve Galpin)

E-mail for OSA should be sent to [sydh@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, PO Box 98106, Washington DC 20090-1600 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.)

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\_\_\_\_\_ 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?

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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.**