

OUTREACH January 2015

January Meeting:

Oklahoma Space Alliance will meet from 4:00 to 6:00 p.m. on Saturday, January 10, 2015, at Harry Bears All-American Grill, 2113 Riverwalk Dr., Moore, Oklahoma, (2 tenths of Mile South of S. 19th And West of I35 Frontage Road). The number is 405-799-2327.

Saturday January 10, 2015

Program

Place: Harry Bears in Moore, OK

4:00 p.m.

- 1) Discuss Activities
 - a. Summary of December Meeting
 - b. Student Projects
 - c. December OSIDA Meeting
 - d. Treasurers Report
 - e. Annual Report
 - f. Meetup and finances
- 2) What's Happening (Dave Sheely this month)
 - a. Space News, Pictures, Videos & Links
- 3) Chat

Minutes of December Christmas Party

The December 13 meeting of Oklahoma Space Alliance was actually our Christmas party at the Koszorus, and the only business was electing officers, who, for 2015, are Steve Swift, president, Dave Sheely vice-president, Syd Henderson, secretary, and Tim Scott, treasurer. We had around 25 people at the party, including Tom and Heidi Koszoru, Chris Carson, Russ Davoren, Syd Henderson, Kip and Claire McMurray, Don Robinson, Tim Scott, Dave Sheely, David St. John, Vickey Richartz, Don Robinson, Steve and Karen Swift, Brian Swift and Dennis Wigley, and I believe Peggy and James McBride. There were at least a half-dozen people I don't know. Chris is no longer Region 3 director, but still kept us up to date.

Minutes of November Meeting

Oklahoma Space Alliance met November 8 at Harry Bear's in Moore, Oklahoma. Attending were Steve and Brian Swift, Claire McMurray, Tim Scott, the Thibodeaux family, McBride families, Dave Sheely, John Northcutt, Craig Crawford, Vickey Richartz and Syd Henderson.

This was the meeting at which we nominate officers, and we renominated Steve for President, Dave for Vice-president, Syd for Secretary and Tim for Treasurer.

Our proposed student project was put on hold due to organizational changes within XCOR. No further progress to report at this point.

We currently have just over a thousand dollars in the treasury, and many people renew their memberships at the Christmas party.

There was an article critical of the Oklahoma Spaceport in the *Daily Oklahoman*, coming in the wake of the explosion of an Orbital Services cargo launch to the Space Station and the crash of SpaceShipTwo. The Spaceport is an \$800,000,000 asset built by the military and given to the State of Oklahoma. It also operates as a general aviation airport with 35,000 flights per year. The runway was the longest approved for landing a space shuttle.

We watched a trailer for *Interstellar*, which is involved in a contest involving a free space trip.

Blue Origin is working on the BE-4 engine, which uses methane and liquid oxygen. This engine is designed for the successor of the Atlas V rocket, and will be used by the United Launch Alliance.

John Harrington will be at the Weatherford museum on Saturday, November 22 at 7:00 p.m.

Tom Koszoru has agreed to host the OSA Christmas Party.

Report on November OSIDA Meeting

The Oklahoma Space Industry Development Authority met at the Oklahoma Department of Transportation building in Oklahoma City. Board members present included Jack Bonny, Jay Edwards, Don Wetekam, Alan Goodbary and Robert Connor. Steve Swift, Syd Henderson and Claire McMurray attended for OSA. Greg Rasnake, who was our speaker at our October meeting, also attended.

The website is nearly complete. [However, as of January 4, 2015, it is still not up.] The old website was done by Western Technology. The new one is being done by the state, hence has taken much longer.

DARPA is bringing X Plane research back online. This will have a significant impact on space research and technology.

Mr. Rasnake attended the FAA session on the Virgin Galactic disaster. The pilot has no recollection of ejecting himself. The parachute deployed automatically.

The National Space Transportation Policy was updated in 2013 for the first time in ten years.

Dates were approved for 2015 meetings. Bill would not be able to attend a January 14 meeting. The November meeting will fall on Veterans Day.

I was unable to make the December OSIDA meeting and Steve wasn't able to get his notes to me, so they'll be presented at the January meeting,

Space News:

On the evening of January 23/24, three of the Galilean satellites, will cast their shadows simultaneously on Jupiter. Callisto will cast its shadow from 10:11 p.m. to 2:00 p.m., Io from 10:35 p.m. to 12:52 a.m., and Europa from 12:27 until 3:22 a.m., the triple shadow casting lasting from 12:27 until 12:52 a.m. All three moons will transit Jupiter, doing it simultaneously from 1:08 until 1:12 a.m.

It's also noteworthy that from 11:41 until 11:59, Callisto will actually eclipse Io (that is, Io will be in Callisto's shadow).

What's happening is that the moons' mutual orbital plane is edge-on to Earth, and there will be a number of transits, eclipses, and occultations. Triple shadow transits are rare: the next one isn't until 2032. [A quadruple transit is impossible, since when Jupiter, Ganymede, Io and Europa are in a straight line, Io is on the opposite side of Jupiter from Europa.]

The European spacecraft *Venus Express* was launched on November 9, 2005 and arrived at Venus in April 2006. It has successfully operated for more than nine years, most of them in Venus orbit, but, alas, it has finally run out of fuel, contact was lost on December 3 and the mission was declared over in mid-December. It will burn up in Venus's atmosphere in January. Last summer, the spacecraft was used to test aerobraking in the upper atmosphere of Venus, a maneuver it survived by more than four months.

With the demise of *Venus Express*, there will be no spacecraft orbiting Venus. In November, Japan's *Akatsuki* space probe will make a second attempt at achieving Venus orbit. India is also planning a mission to Venus which would arrive in September but details are lacking.

The *MESSENGER* space probe is also nearing the end of its mission and will impact Mercury sometime in March. The only upcoming Mercury probe I know of is BepiColombo, which will be launched in 2016 and arrive at Mercury orbit in 2024.

One startling result from the *Rosetta* comet probe is that the proportion of deuterium to regular hydrogen in one in 1900, the highest ever measured in the solar system, and more than three times that on Earth. If this is common, then it indicates Earth's water probably did not come from comets, although it still may have come from asteroid impacts.

NASA is showing off robots: <http://www.space.com/28106-nasa-robosimian-robot-darpa-challenge.html>. RoboSimian is supposed to be ape-like but it looks like a tarantula to me.

Sky Viewing

We have a (barely) naked-eye comet this month, as **Comet Lovejoy** glows at fourth magnitude. It should be brightest around the middle of the month, when the sky will be moonless. The comet will be swooping east of Orion and Taurus in January, and pass well east of the Pleiades. Its peak magnitude, 4.1, isn't enough for it to conquer city lights,

but it should be visible to the naked eye in really dark skies. A finder chart is at <http://tinyurl.com/ne42u4p> (which links to *Sky and Telescope*).

If you are getting a feeling of déjà vu, comets are named for their discoverers, and there was another naked-eye Comet Lovejoy just over a year ago. This one is designated C/2014 Q2 (Lovejoy).

Mercury and **Venus** are near in the sky now, with closest approach on January 9 and 10, when they will be less than a degree apart. They are visible, weather permitting, in the southwest about 45 minutes after sunset. Venus is magnitude -3.9, which is not as bright as it gets but much brighter than any other planet. Mercury is magnitude -0.8, which is nearly as bright as it gets. The planets will be separated by less than a degree for several days after that. Mercury will be at greatest elongation on January 14, after which it fades rapidly as it approaches inferior conjunction with the Sun on January 30. Mercury will be at greatest elongation on the other side of the Sun on February 26, but will also be low in the sky before dawn.

Venus, on the other hand, will be getting higher in the evenings, and gradually brighten. Venus is also approaching a conjunction with Mars in February, with them being less than two degrees apart from February 17 – 25, and less than a degree apart from February 20 – 23. At closest approach, they will be 0.4 degrees apart on February 21. That's a little less impressive than it sounds, because, although Venus will be magnitude -3.9. Mars is only magnitude 1.2.

Mars is currently setting two or three hours after sunset and will continue to do so for another month, then gradually approach the Sun for a conjunction in June.

Jupiter is currently rising about 8:00 p.m., and is magnitude -2.4 in the constellation Leo, making it easily the brightest object in that part of the sky (which includes the first-magnitude star Regulus). It's rising earlier each month, and will soon be visible all night long as it approaches its February 6 opposition. (Jupiter's moons are also doing noteworthy things this month. See "Space News" above.)

Saturn is magnitude 0.6 and is visible in the southeast before dawn near the head of the Scorpion. Saturn is currently rising about 4:00 a.m., but will be rising about 2:30 a.m. at the end of the month, and 12:30 a.m. by the end of February. The first magnitude star about a fist-width south of it is Antares.

Uranus is magnitude 5.8 and in the constellation Pisces. It's still pretty high in the southwest at sunset. **Neptune** is magnitude 7.8 and low in the sky at sunset. Neptune will be largely invisible in February as it approaches conjunction with the Sun. Note, though, on January 19, Mars will be only a quarter-degree below Neptune, giving people with telescopes a good chance to find Neptune. A finder chart is at www.skyandtelescope.com/wp-content/uploads/WEB_Uranus_Neptune_2014.pdf.

[Data for this section from *Astronomy*, *Sky & Telescope*, space.com Wikipedia and NASA.]

Space-Related Articles

The January/February issue of *Discover* presents that magazine's top 100 science stories of the year. The top story this year is the Ebola epidemic in West Africa. Space related stories include:

3: *Rosetta's Comet Rendezvous Makes Space History*. *Rosetta* is the first space probe ever to orbit a comet. The Philae lander didn't land until their press deadline. It landed in a shadowy location and only operated for three days. It's hoped that Philae will wake up when it gets close to the Sun.

[See "Space News" for more on Rosetta and Philae.]

5: What Made the Bang so Big? [This story may already be obsolete since the results that indicated gravitational waves may have been due to cosmic dust. However, they're also being followed up on.]

16: New Dwarf Planet Redefines Solar System. Minor planet 2012 VP₁₁₃ is the object in the solar system with the largest known perihelion, 80.5 AU (or 7.5 billion miles, about half a billion miles farther than Sedna, the previous record holder). Its aphelion is about 42 billion miles from the sun, slightly less than Sedna's, and much less than those of long-period comets such as Hyakutake (but more than Hale-Bopp). The redefinition here is that previously only one dwarf planet, Sedna, was known to have its entire orbit outside the Kuiper Belt. We don't know for sure if 2012 VP₁₁₃ is a dwarf planet (i.e., we don't know if it's round), but its existence and that of Sedna points to the presence of hundreds of similar objects beyond the Kuiper Belt.

Note: The minor planet doesn't have an official name yet, but since its name is usually abbreviated "VP," it's nicknamed "Biden."

19: The Lives of the Galaxies: Astronomers are using infrared telescopes to view the birth of elliptical galaxies. These babies are so dusty, they are almost invisible at visual wavelengths, and formed massive stars that burned out very quickly. The galaxies are dimmer now, partly because they have massive black holes that eat dust before it can form stars.

31: The discovery of the rings around asteroid Chariklo, which is only 154 miles long.

39: Europa's Icy Jigsaw Puzzle Solved. Astronomers using photographs from the *Galileo* probe are piecing together the sections of the icy surface of Europa, discovering that they fit together, firm evidence of plate tectonics on Europa.

44: Saturn's moon Enceladus has a subsurface liquid ocean the area of Lake Superior and five miles deep.

48: This Drive Might Defy Physics. NASA's investigating the Cannae Drive, which allegedly works without propellant. This drive is controversial among physicists, who think it violates the conservation of momentum, but it's possible the thrust is generated by the directed emission of microwaves.

56: Jupiter's Great Red Spot is shrinking in diameter at the rate of 580 miles per year, and nobody knows why. It's still 10,250 miles wide, which is still big enough to swallow Earth, but in a couple of years it won't be.

59: Beneath the Moon's Two Faces. The far side of the Moon looks much different than the near side: all the maria are on the near side and the crust is much thinner there. It's often assumed that this is due to early impacts, but now it appears the Earth may be the cause. When the Moon first formed, its crust was liquid, and it was much closer to Earth, whose crust was also molten. The Moon's rotation was locked early so that one side always faced Earth. At this point, the Earth was emitting enough heat to keep the near side of the moon molten longer, so that rock preferentially crystallized on the far side, while volcanism persisted on the near side, forming the maria.

61: The Living Lakes of Mars' Recent Past. Two hundred years ago, Mars's Arsia Mons melted glaciers on its surface, producing two lakes each twice as big as the Great Salt Lake,

72: Quasar Illuminates Cosmic Web. The web joins clusters of galaxies and is normally invisible. Hence it's normally a kind of dark matter.

74: The Smallest Planet Gets Smaller. Well, Mercury's not much smaller, just four miles off its diameter in 4.5 billion years.

88: The explosion of the supernova SN2014J in M82 (the "Cigar Galaxy"), which at 12 million light-years is the closest type Ia supernova in decades. [It's the closest of any type in 10 years.] Details indicate it was produced by two colliding white dwarf stars.

98: Venus Glory Reveals Cloud Qualities. A glory is a rainbow effect produced by the Sun shining through water droplets; a halo appears directly opposite the sun from the observer. Venus's atmosphere does the same thing, but the particles are different, and include sulfur and iron chloride, both of which vaporize at the temperatures on Venus's surface.

100: Meet the Exoplanet Class of 2014. These include OGLE-2013-BLG-0341LBb, which was the first earthlike planet orbiting a double star, Kepler-10c, a rocky planet 17 times the mass of the Earth, Kepler-186f, the first Earth-sized planet found to be orbiting in another star's habitable zone, and Kapteyn b, which is within its star's habitable zone and is only thirteen light-years away. That makes it the second closest such planet (after Tau Ceti e),

Note: The explosion of the Orbital Services rocket and the disintegration of SpaceShipTwo came after their press deadline.

Viewing Opportunities for Satellites (January 9 – February 14)

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. Heavens Above has changed its detail view so that you can no longer get location coordinates. On the other hand, it does give useful maps.

<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. (Note: I'm having problems accessing this from my home PC, but not from the Mac at work.) 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.

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.

Missions to and from the Space Station may change its orbit. SpaceX is launching its fifth resupply mission on January 6. The next manned launch to the Space Station will be in March.

Tiangong 1 January 21, 2015

Time Position Elevation

Appears from Earth's shadow

6:19:42 a.m.	286°	43°
6:20:32	209	77
6:23	122	10

Passes close to Arcturus

ISS January 24, 2015

Time	Position	Elevation
7:12 a.m.	220°	21°
7:13	331	41
7:14	43	69
7:15	111	36
7:16	121	31

ISS January 26, 2015

Time	Position	Elevation
7:05 a.m.	287°	18°
7:06	268	29
7:07	227	38
7:08	186	29
7:09	167	18

4ISS January 27, 2015

Time	Position	Elevation
Appears from Earth's shadow		
6:15 a.m.	308°	42°
6:16	204	85
6:17	138	42
6:18	135	22

HST February 1, 2015

Time	Position	Elevation
6:29 p.m.	217°	19°
6:30	199	26
6:31	173	29
6:32	141	26
6:33	130	19

Tiangong 1 February 1, 2015

Time	Position	Elevation
6:47 p.m.	216°	10°
6:50:31	147	37
6:51:48	87	19

Passes close to Rigel

HST February 2, 2015

Time	Position	Elevation
6:21 p.m.	222°	20°
6:22	203	27
6:23	186	30
6:24	150	27
6:25	131	20

Tiangong 1 February 2, 2015

Time	Position	Elevation
7:17 p.m.	253°	10°
7:19:53	336	63
7:20:32	33	46

Vanishes into Earth's shadow

Tiangong 1 February 4, 2015

ISS February 4, 2015

Time	Position	Elevation
7:12 p.m.	217°	21°
7:13	208	41
7:14	135	71
7:15	64	40

Vanishes into Earth's shadow

ISS February 6, 2015

Appears from Earth's shadow

Time	Position	Elevation
7:06:44 p.m.	277°	29°
7:07	323	40
7:08	6	30
7:09	21	19

Tiangong 1 February 12, 2015

Time	Position	Elevation
7:30 p.m.	299°	10°
7:33:06	26	79
7:33:23	82	72

Vanishes into Earth's shadow

Passes south of Aldebaran and north of Orion's belt

Tiangong 1 February 14, 2015

Time	Position	Elevation
6:53 p.m.	293°	10°
6:56	209	70
6:59	125	10

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 Tiangong 1 at 6:56 p.m. on February 14, measure just under three fist-widths west from due south, then ten++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:

January 8, 3:30 a.m.: Grappling of SpaceX Cargo Ship by the ISS (actual grappling at 4:00). 7:15 a.m.: Installation of Cargo Ship.

January 29, 7:50 a.m.: Live coverage of launch of SMAO.

Calendar of Events

January 9: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See <http://www.okcastroclub.com/> for details.

January 10: Mercury and Venus are separated by 0.7 degrees in the western sky at sunset.

January 10: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

January 14: Mercury is at greatest elongation, 19 degrees east of the Sun (so can be seen after sunset).

January 14: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

January 30: Mercury is in inferior conjunction with the Sun.

February: *Dawn* space probe arrives at Ceres. Operations are scheduled to continue through July. *Dawn* may continue on to other asteroids if it is still operational. [See March 6.]

February 6: Jupiter is at opposition.

February 11: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

February 13: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See <http://www.okcastroclub.com/> for details.

February 14: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

February 17: Launch of Progress module to Space Station at 5:00 a.m.

February 25: Neptune is in conjunction with the Sun.

February 27: Mercury is at greatest western elongation, 26.7 degrees from the Sun (so can be seen before sunrise).

March: Launch of Expedition 43 to the Space Station.

March: *MESSENGER* Mercury Probe impacts the planet.

March 6: *Dawn* enters orbit around Ceres. For more information, visit

http://en.wikipedia.org/wiki/Dawn_%28spacecraft%29 or <http://dawn.jpl.nasa.gov/>.

March 11: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

March 13: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See <http://www.okcastroclub.com/> for details.

March 14: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

March 20: Total eclipse of the Sun visible in the North Atlantic between Iceland on the one hand and Scotland and Norway on the other. The total eclipse will pass over the Faroe Islands and Svalbard in the Arctic Ocean.

April 4: Total eclipse of the Moon visible over the Pacific Ocean, west coast of United States, the east coast of Asia, Australia and New Zealand.

April 6: Uranus is in conjunction with the Sun.

April 8: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

April 8: Launch of 6th SpaceX resupply mission to Space Station.

April 9: Mercury is in superior conjunction with the Sun.

April 11: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

April 12: Yuri's Night

April 22: Peak of Lyrid meteor shower.

April 28: Launch of Progress resupply mission to Space Station.

May 5: Peak of Eta Aquarid Meteor shower.

May 6: Mercury is at greatest elongation, 21 degrees east of the Sun (so can be seen after sunset).

May 9: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

May 13: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

May 22: Saturn is at opposition.

May 26: Launch of Expedition 44 to Space Station.

May 30: Mercury is in inferior conjunction with the Sun.

June 6: Venus is at greatest eastern elongation, 45.4 degrees from the Sun (so can be seen after sunset).

June 10: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

June 13: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

June 13: Launch of 7th SpaceX resupply mission to the Space Station.

June 14: Mars is in conjunction with the Sun.

June 14: The Moon occults Mercury.

June 24: Mercury is at greatest western elongation, 22 degrees from the Sun (so can be seen before sunrise).

June 30: Venus and Jupiter are having very close conjunction, approaching to 0.3 degrees from each other.

Sometime in July: The European Space Agency launches *LISA Pathfinder*. LISA=Laser Interferometer Space Antenna, a gravitational wave detector that is a joint ESA/NASA project. Web site is <http://sci.esa.int/lisapf>.

July 8: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

July 11: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

July 14: The *New Horizons* probe passes through the Pluto-Charon system. The New Horizons web site is pluto.jhuapl.edu/.

July 18: The Moon occults Venus.

July 23: Mercury is in superior conjunction with the Sun.

July 28: Peak of Delta Aquarid meteor shower.

August 8: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

August 12: Peak of Perseid meteor shower.

August 15: Venus is in inferior conjunction with the Sun.

August 26: Jupiter is in conjunction with the Sun.

August 31: Neptune is in opposition.

September 1: Launch of Expedition 45 to the Space Station.

September 2: Launch of 8th SpaceX supply mission to the Space station.

September 4: Mercury is at greatest elongation, 27 degrees east of the Sun (so can be seen after sunset).

September 12: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

September 28: Total lunar eclipse visible from most of North America (including Oklahoma), all of South America, all but the eastern part of Africa, western Europe and the entire Atlantic Ocean.

September 30: Mercury is in inferior conjunction with the Sun.

October 11: Uranus is at opposition.

October 15: Mercury is at greatest western elongation, 18 degrees from the Sun (so can be seen before sunrise).

October 10: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

October 21: Peak of Orionid meteor shower.

October 26: Venus is at greatest western elongation, 46 degrees from the Sun (so can be seen before sunrise).

November: Launch of Expedition 46 to the Space Station.

November: Launch of *ASTRO-H* (or NeXT), the Japanese X-ray astronomy satellite.

November: Japan's *Akatsuki* space probe flies by Venus and there will be a second attempt to achieve orbit.

November: Venus, Mars and Jupiter will be close together in the sky, with a couple of conjunctions.

November 14: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

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

November 17: Peak of Leonid meteor shower.

November 29: Saturn is in conjunction with the Sun.

December 12: [Tentative] Oklahoma Space Alliance meeting, location to be announced.

December 14: Peak of Geminid meteor shower.

December 22: Peak of Ursid meteor shower.

December 28: Mercury is at greatest elongation, 20 degrees east of the Sun (so can be seen after sunset).

Sometime in 2016: ESA launches the *ExoMars Mars Orbiter*. This mission will include a static lander, but the rover will be launched in 2018. For more information, visit en.wikipedia.org/wiki/Exomars.

Sometime in 2016: Launch of the Chinese space station *Tiangong-2*.

March 2016: Launch of Expedition 47 to the Space Station.

March 8 – 17, 2016: Proposed launch date for *InSight*, a lander that will probe the interior of Mars. For information, see <http://insight.jpl.nasa.gov/>.

June 6, 2016: Venus in superior conjunction with the Sun.

July 4, 2016: *Juno* arrives at Jupiter. The NASA *Juno* page is http://www.nasa.gov/mission_pages/juno.

July 2016-2020: The *New Horizons* probe visits the Kuiper Belt.

July 9, 2016: The European Space Agency/JAXA *BepiColombo* Mercury Orbiter is launched. Home page is <http://sci.esa.int/bepicolombo>.

September 2016: Launch of *OSIRIS-REx*, the Origins Spectral Interpretation Resource Identification Security Regolith Explorer, which will orbit the near-earth asteroid 101955 Benu and return samples. For more information, visit <http://en.wikipedia.org/wiki/OSIRIS-REx> or <http://science.nasa.gov/missions/osiris-rex/>.

Sometime in 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>.

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).

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

July 2017: Launch of the European Space Agency/NASA Solar Orbiter (SolO), which will orbit the Sun at a distance closer than Mercury. Web site is <http://sci.esa.int/solarorbiter>.

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.

Sometime in 2018: ESA launches the *ExoMars Mars Rover*. For more information, visit en.wikipedia.org/wiki/Exomars.

Sometime in 2018: Russia launches the lander of the “Luna-Glob” mission, which will deploy 13 mini-probes upon the lunar surface. For more information, see <http://en.wikipedia.org/wiki/Luna-Glob>. Sometime in 2018 or 2019: Russia launches the orbiter of the “Luna-Glob” mission.

July 30, 2018: Proposed launch date for *Solar Probe Plus*, which will study the corona of the Sun from within four million miles. For more information, visit http://en.wikipedia.org/wiki/Solar_Probe_Plus or <http://solarprobe.jhuapl.edu/>. (This spacecraft will fly by Venus seven times to refine its orbit.)

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

Sometime in 2019 or 20: Russia launches the “Luna-Resurs mission, which will deploy 13 mini-probes upon the lunar surface. For more information, see <http://en.wikipedia.org/wiki/Luna-Glob>.

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 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.

Sometime in 2023: Arrival of OSIRIS-Rex at the near-earth asteroid 101955 Benu to return samples. [See September 2016.]

April 8, 2024: A total solar eclipse crosses the US from the middle of the Mexico-Texas border, crosses Arkansas, southern Missouri, Louisville, Cleveland, Buffalo and northern New England.

December 19, 2024: *Solar Probe Plus* makes its first pass through the outer corona of the Sun. [See July 30, 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 Okla-homa. This one is also visible in Salt Lake City, Denver, Little Rock (again), Tampa Bay and New Orleans.

Oklahoma Space Alliance Officers, 2015 (Area Code 405)

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Other Information

Oklahoma Space Industrial Development Authority (OSIDA), 401 Sooner Drive/PO Box 689, Burns Flat, OK 73624, 580-562-3500. Web site www.state.ok.us/~okspaceport.

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, 1155 15th Street NW, Suite 500, Washington DC 20005 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.)

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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, Box 273, Indian Hills CO 80454.

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