

# OUTREACH November 2013

## November Meeting:

Oklahoma Space Alliance will meet at 3:30 on Saturday, November 9, 2013, at Harry Bear's 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.

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 on the Christmas Party in December.

## November 9, 2013 Meeting Agenda, 3:30 p.m.

- 1) Business Meeting
  - a. Review Minutes and Agenda
  - b. New mail
  - c. Treasurers Report
  - d. Report on OSIDA
  - e. Old Business
    - i. Art Contest
    - ii. Other
  - f. New Business
    - i. Christmas Event
    - ii. Yuri's Night
    - iii. Officer Nominations
- 2) Russ Davoren Autographs and Stories—His work and travels gave Russ opportunity to meet and collect autographs of people having significant roles in space activities. He will share some of his interesting experiences.
- 3) A Slide Show will present selected photographs taken by Astronaut Karen Nyberg from the International Space Station.
- 4) What's Happening  
The momentum of space technology and commerce continues to progress with events and developments. The What's Happening segment presents current news through slides, videos and stories.
- 5) Elon Musk  
This segment will show a video interview with the visionary founder of SpaceX and Tesla Motors.
- 6) Adjourn

## Minutes of October Meeting

Oklahoma Space Alliance met at Harry Bear's All-American Grill in Moore on October 12, 2013. In attendance were Steve, Karen and Brian Swift, Vicky, Tim Scott, Dave Sheely, Dennis Wigley, Claire and Clifford McMurray and Syd Henderson.

Quote of the month: "The future can be better than the past. We can leave better worlds for our children," Jeff Greeson.

### What's Happening in Space?

We watched the Astra 2E launch for International Launch Services by a Russian Proton Rocket from Baikonur. Video of this can be found at <http://www.youtube.com/watch?v=plpsodmQ2oc>.

MIT scientists have developed robot cubes that jump and snap together, self-assembling into various shapes. There is video on this on various sites, including <http://www.youtube.com/watch?v=6aZbJS6LZbs>. Known as M-Blocks, these have no external moving parts, but rely on internal flywheels and magnets to move.

The San Diego chapter of SEDS (Students for the Exploration and Development of Space) has used a 3-D printer to fabricate a rocket engine. The engine is 6 -7 inches long and weighs about ten pounds. It is made out of cobalt and chromium and can generate a thrust of 200 lb. The article is at [http://www.jacobsschool.ucsd.edu/news/news\\_releases/release.sfe?id=1423](http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=1423). The engine was successfully tested, and video of that is at <http://www.space.com/23107-3d-printed-rocket-engine-student-video.html>.

The SpaceX Falcon 9 version 1.1 blasted off from California on September 29. We went through the article by Irene Klotz at [news.yahoo.com/spacex-falcon-9-blasts-off-california-160719211--finance.html](http://news.yahoo.com/spacex-falcon-9-blasts-off-california-160719211--finance.html). The Falcon 9 launched the Canadian science and communications satellite Cassiope into a polar orbit.

The LADEE spacecraft has arrived at the Moon to begin studying the extremely tenuous lunar atmosphere.

Boeing's CST-100 spacecraft's thrusters were tested at Las Cruces, New Mexico, bringing the spacecraft one step closer to reality. The CST-100 will be a piloted spacecraft that carries seven astronauts into orbit, is part of NASA's Commercial Crew Integrated Capability Initiative (CCiCap) and should make its first flight into orbit sometime in 2016. For article, see <http://www.americaspace.com/?p=42846>.

The *Juno* spacecraft passed Earth for a gravitational assist on October 9, coming within 350 miles of the surface of the Earth. *Juno* went into safe mode twice since the flyby, but recovered from the second one on October 18.

Soyuz TMA-10M took three astronauts to the space station, and landed in Kazakhstan, returning an ISS crew who completed their 165-day mission on the Space Station. For launch video, see <http://www.youtube.com/watch?v=PvkP0r2cKs0>.

Mercury Astronaut Scott Carpenter, the fourth American in Space and second American to orbit the Earth, died on October 10 at the age of 88. The last survivor of the Mercury 7 is John Glenn, who was also the oldest. Carpenter was an aviator, astronaut, aquanaut and author, and spent time on SEALAB II.

We watched an Inspiration Mars video. To meet their deadline, they would have to launch in January 2018. The round trip would be 501 days and they would not be using a Hohmann transfer orbit.

#### Business meeting:

The treasury is unchanged since last month.

Steve gave a report on the OSIDA meeting.

Steve has come up with a flyer for the Space Art Contest. Claire thinks we could have the winners posted at SoonerCon next June. What prizes should we offer? What are we going to say to teachers about the contest? We might want to start small in one school district. We should invite David Lee Anderson to a meeting.

The next meeting will be at Harry Bear's at 2:30. [We've since changed it to 3:30 p.m. We're going to move the business meeting back to the beginning of the meeting.]

For Yuri's night, we need a larger venue. We could do it at the Moore Library. Yuri's Night will fall on a Saturday. Perhaps we could simply do a dinner.

--Minutes by OSA Secretary Syd Henderson

#### Space News

[See minutes of October meeting for news presented in What's Happening in Space.]

India's Mars Orbiter Mission took off at 3:08 a.m. on the morning of Tuesday, November 5. The *Mangalyaan* ("Mars Craft") is India's mission to Mars, and, if successful, will make India the fourth space agency to reach Mars, after Roscomos (the Russian space agency), NASA, and the European Space Agency. *Mangalyaan* represents an incremental upgrade of *Chandrayaan 1*, India's first lunar probe. *Mangalyaan* will arrive at Mars on September 24, 2014, a couple of days after *MAVEN*'s arrival.

The plan is to use six rocket firings to put *Mangalyaan* into a highly elliptical orbit around the Earth, with take-off to Mars scheduled for November 30.

The total cost of the mission is around \$70 million. The orbiter will do atmospheric studies, including looking for methane, and surface imaging, and is intended as an illustration of India's space capability. For information, visit [en.wikipedia.org/wiki/Mangalyaan](http://en.wikipedia.org/wiki/Mangalyaan) or [www.isro.org/pslv-c25/mission.aspx](http://www.isro.org/pslv-c25/mission.aspx)

China will launch its Chang'e 3 spacecraft to the Moon sometime in early December. This mission consists of a lander and rover. The landing site is believed to be Sinus Iridum, the Bay of Rainbows. If this mission is successful, it will be the first time China has landed a spacecraft anywhere than the Earth. There's also a Chang'e 4 spacecraft ready for backup.

Headlines in September had *Voyager 1* leaving the Solar System, which is a question of definition; they also had it entering interstellar space, which is true. More specifically, it has passed through the heliopause, which is the boundary at which it leaves the region around the Sun primarily influenced by the Solar wind. *Voyager 1* took the short route, heading in more or less the same direction as the Sun. If it had gone in the opposite direction, the heliopause would have been ten times as far.

The heliopause is marked by a sudden drop in charged particles. There was some confusion for a while, because *Voyager 1* had detected a drop in charged particles on July 28, 2012, but the levels rebounded a few days later. On August 25, 2012, the number of charged particles suddenly dropped to a thousandth those of a few years earlier, this time apparently permanently, and this is taken as the day *Voyager 1* entered interstellar space.

There are several possible boundaries for the Solar System, of which the heliopause is just one. These include the orbit of Neptune (30 AU), the Kuiper belt (which extends to 50 AU at least), the orbit of Eris (at 96.6 AU the outermost known dwarf planet orbiting the Sun), the heliopause (122 AU in the direction *Voyager 1* is going, but a thousand AU in the opposite direction), and the Oort Cloud, which extends out to 100,000 AU, and supplies us with comets. The last distance is also about the distance at which the Sun's gravitational field begins to be dominated by that of Alpha Centauri.

### **Sky Viewing: Comet ISON Approaches**

Comet ISON passed Earth's orbit on October 30 on the way toward a conceivably fatal rendezvous with the Sun on November 28. It wasn't especially bright, partly because it didn't pass that close to Earth, and partly because it's behaving oddly and is not as bright (yet) as expected. The brightness depends partly on what wavelength it's being observed at. Visual and CCD-V observations (which are dominated by emitted gas), show it brightening normally, but it's hardly brightening at all in CCD-R observations, which concentrate on dust emission. In other words, gas emissions are increasing, dust emissions are not, and nobody really knows what this means.

There's been some speculation that Comet ISON is hardly rotating at all, which would mean that it's been presenting the same side to the Sun all the way in. Meanwhile, Comet ISON has turned green.

That is actually a good sign, because it means the comet is getting more active. The green color comes from emission of cyanogen gas and diatomic carbon, which glow green under ultraviolet light.

Comet ISON is expected to be brighter than Venus when it reaches perihelion; unfortunately it will also be too close to the Sun to see from the Northern Hemisphere, though it may be possible using a solar telescope. It may reach naked eye visibility for a few days in late November, but the best viewing is expected in the first half of December. It may still be as bright as Jupiter on December 1, but will still be fairly close to the Sun. Its trajectory during December takes it almost on a straight line toward the North Celestial Pole, which it will reach in early January. By then, however, it will not be visible to the naked eye.

Estimates of its brightness in the first half of December vary wildly, with upper estimates putting it in the category of Hale Bopp and Hyakutake (but brighter than either at perihelion), while others question whether it will be highly visible at all. It's certain to be a wonder in telescopes and binoculars, but how it will appear to the naked eye is anyone's guess.

Meanwhile, Comet C/2012 X1 (LINEAR) suddenly shot from magnitude 14 to 8 on October 23, making it briefly brighter than Comet ISON. In addition Comet Encke and Comet 2013 R1 (Lovejoy) are also around 8<sup>th</sup> magnitude.

### **Sky Viewing: Planets and Meteors**

The **Leonid Meteor Shower** peaks on the night of November 17. There are expected to be about twenty meteors per hour. Unfortunately, the Moon is almost full on November 17 and will drown out a lot of the meteors.

The **Geminid Meteor Shower** peaks on the night of December 13, and may peak at 100 meteors/hour. Once again, the Moon will be near full. Jupiter is near the radiant, the point the meteors tend to shoot out from, but the meteors are brightest 90 degrees from the radiant.

Note: The Moon will not interfere with the Quadrantid meteor shower on January 3, which will peak at about 80 meteors per minute. The Quadrantids' radiant is between the handle of the Big Dipper and the head of the constellation Draco. The radiant is actually located in Boötes; the meteor shower gets its name from an obsolete constellation named Quadrans Muralis, and retains the name partly because there is another meteor shower in June called the Boötids,

**Mercury** was in inferior conjunction with respect to the Sun on November 1, and is still lost in the glare of the Sun, It is moving away from the Sun, however, and will be at greatest western elongation on November 18, which will put it ten degrees above the horizon 45 minutes before sunrise. It will be at magnitude -0.6 and should be relatively easy to find. Mercury will remain about that bright through the end of the November. (Mercury gets brightest after elongation.) However, Mercury will become much less visible in mid-December as it approaches superior conjunction with the Sun on December 29.

**Venus** is brilliant in the western sky at sunset at magnitude -4.5. It becomes visible shortly after sunset and sets about an hour after it gets darker. Venus reached greatest western elongation with respect to the Sun on Halloween night, but, unlike Mercury, gets brighter in its crescent phase, peaking at magnitude -4.9 in early December. This is the brightest Venus ever gets. Venus fades badly in late December as its crescent narrows, finally disappearing altogether on January 11, 2014 when it is in inferior conjunction with the Sun.

**Mars** is currently magnitude 1.5 and in the constellation Leo, which rises about 2:00 a.m. Mars will gradually brighten to magnitude 1.2 by the end of November and magnitude 0.9 by the end of December, at which time Mars will be rising at midnight.

**Jupiter** is currently rising about 9:00 p.m. and is magnitude -2.4 in the constellation Gemini. By the end of November, it will rise at 7:00 p.m., and Around sunset at the end of December.

**Saturn** is in conjunction with the Sun on November 6 and will be difficult to see until the end of the month, at which time it will be rising around 5:00 a.m. By the end of December it will rise at around 3:30 a.m. and shine at magnitude 0.6.

**Uranus** is magnitude 5.7, and is in the southeastern sky at sunset in the constellation Pisces. Nothing much changes in December, except that it will be more to the south at sunset. Uranus is actually visible to a (sharp) naked eye in a very dark sky, but I recommend binoculars, or even a small telescope. Unfortunately, it is also near the border of Pisces and Cetus, which is a pretty barren region of sky.

**Neptune** is magnitude 7.9 and one constellation over in Aquarius, where it will be for quite a few years yet, and is in the south at sunset. Although you need binoculars or a telescope to see it, it does have the advantage that if you find it once, it will be in about the same position for a week or two afterward.

*Sky & Telescope* has a finder chart online for Uranus and Neptune, <http://media.skyandtelescope.com/documents/Uranus-Neptune-2013.pdf> and there are finder charts on page 81 of the August issue of *Astronomy*. But if you're really feeling ambitious and have access to a powerful telescope, there is a large finder map for **Pluto** on pages 52-53 of the June issue of *Sky & Telescope*.

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

### Viewing Opportunities for Satellites (November 7 – December 14, 2013)

You can get sighting information at [www.heavens-above.com/](http://www.heavens-above.com/). Heavens Above 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 very 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. It doesn't give you information for Tiangong 1, so I'm using Heavens Above for that. Sky Online (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.

Missions to and from the Space Station may change its orbit, which is especially possible this month with a crew change launching November 6. Be sure to check Heavens Above or [www.jsc.nasa.gov/sightings](http://www.jsc.nasa.gov/sightings) before going out to watch just in case.

Station November 10, 2013			Station November 11, 2013		
Time	Position	Elevation	Time	Position	Elevation
6:31 a.m.	243°	23°	5:42 a.m.	214°	20°
6:32	257	42	5:43	205	39
6:33	332	63	5:44	153	66
6:34	26	37	5:45	72	43
6:35	37	20	5:46	58	23

Tiangong 1 November 21, 2013		
Time	Position	Elevation
Appears from Earth's shadow		
4:25:22 a.m.	204°	41°
4:26	134	68
4:29	51	10

Station November 28, 2013		
Time	Position	Elevation
6:31 a.m.	320°	23°
6:32	329	44
6:33	63	73
6:34	117	38

HST November 29, 2013		
Time	Position	Elevation
6:50 p.m.	219°	21°
6:51	200	28
6:52	173	31
6:53	146	27
Vanishes into Earth's shadow.		

HST November 30, 2013		
Time	Position	Elevation
6:45 p.m.	224°	21°
6:46	205	29
6:47	176	32
6:48	149	28
Vanishes into Earth's shadow		

Station December 1, 2013		
Time	Position	Elevation
6:39 p.m.	227°	21°
6:40	208	29
6:41	179	32
6:42	151	28
6:43	133	21

Station December 2, 2013		
Time	Position	Elevation
6:34 p.m.	229	21°
6:35	210	28
6:36	182	31
6:37	155	27
6:38	137	20

Station December 9, 2013		
Time	Position	Elevation
7:01 p.m.	256°	22°
7:02	277	36
7:03	331	46
Vanishes into Earth's shadow		

Station December 10, 2013		
Time	Position	Elevation
6:12 p.m.	226°	24°
6:13	256	46
6:14	50	83
6:15	48	39
6:16	48	21

Tiangong 1 December 10, 2013		
Time	Position	Elevation
7:04 p.m.	210°	10°
7:06:45	135	47
7:06:59	117	46
Vanishes into Earth's shadow		

Tiangong 1 December 12, 2013		
Time	Position	Elevation
7:25 p.m.	225°	10°
7:26	325	84
7:27	44	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 find Tiangong 1 at 7:04 p.m. on December 10, measure three fist-widths west of south, and one fist-width 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 8, 7:50 a.m.: ISS Expedition 37/38 news conference. This will be replayed at 9:15 a.m.

November 9, 8:00 a.m.: Russian Spacewalk Coverage. The walk begins at 8:30 a.m.

November 10: 5:00 p.m.: Expedition 37 Undocking Coverage. Undocking is scheduled for 5:26 a.m. 7:30 p.m.: Re-entry and landing coverage. Deorbit burn begins at 7:56 p.m.

## Space-Related Articles

With the arrival of Comet ISON, the November and December issues of astronomy magazines are full of articles on comets.

“The Black Widows,” by Roger W. Romani, *Sky & Telescope*, November 2013, pp. 16 – 21. We’re used to the concept of neutron stars taking matter from their companions. However, in addition to shooting off energy from their poles, neutron stars also emit particles at large fractions of the speed of light that bend along magnetic field lines. This “wind” is a bit like the solar wind except much more powerful, and can strip the mass from a companion star until the star is down to planetary mass.

## Calendar of Events

November 6: Saturn is in conjunction with the Sun.

November 6: Launch of three Expedition 38/39 members via Soyuz from the Baikonur Cosmodrome in Kazakhstan to the Space Station.

November 9: Oklahoma Space Alliance meeting, 3:30 p.m. at Harry Bear’s in Moore Oklahoma.

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

November 17: Peak of the Leonid meteor shower.

November 18: Launch of the Mars Atmosphere and Volatile Evolution orbiter (*MAVEN*). (Launch windows extend through December 7.) The project web site is <http://lasp.colorado.edu/home/maven/>.

November 18: Mercury is at greatest western elongation, 19° from the Sun (hence can be seen before sunrise).

November 28: Comet C/2012 S1 (Comet ISON) will approach within 730,000 miles of the Sun and be visible to the naked eye. It may well be visible during the daytime.

Early December: Launch of China’s Chang’e 3 moon lander.

December 8: Launch of Orbital Services first supply mission to the International Space Station from Wallops Flight Facility in Virginia,

December 9: Launch of SpaceX’s third commercial supply mission to the ISS.

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

December 13: Peak of the Geminid meteor shower.

December 14: Oklahoma Space Alliance Christmas Party and elections.

December 29: Mercury is in superior conjunction with the Sun.

December 2013 or January 2014: [Moved from November.] Launch of *Gaia* (Global Astrometric Interferometer for Astrophysics), the European Space Agency successor to *Hipparcos*. *Gaia* will provide data on one billion stars in the Milky Way, including distances, proper and radial motion, and spectroscopic info burying astronomers in data. *Gaia* will also observe asteroids closer than the Earth to the Sun. For more information, visit the project webpage at <http://sci.esa.int/gaia> or [http://en.wikipedia.org/wiki/Gaia\\_\(spacecraft\)](http://en.wikipedia.org/wiki/Gaia_(spacecraft)).

Sometime in 2014: First test flight of the Orion Multi-Purpose Crew Vehicle.

January 2014: Comet C/2012 S1 (Comet ISON) approaches with 37.2 million miles of Earth. It may be much brighter than Venus at this point. On January 8, it will be within two degrees of the North Star assuming Comet ISON survives its solar encounter.

January 1, 2014: Pluto is in conjunction with the Sun.

January 3, 2014: Peak of Quadrantid meteor shower.

January 5, 2014: Jupiter is at opposition.

January 11, 2014: Venus is in inferior conjunction with the Sun.

February 11, 2014: [Moved from November.] Earliest launch date for Space-X’s third resupply flight to the ISS.

February 15, 2014: Mercury is in inferior conjunction with the Sun.

February 23, 2014: Neptune is in conjunction with the Sun.

March 13, 2014: Mercury is at greatest eastern elongation, 27 degrees from the Sun (so can be seen before sunrise).

March 27, 2014: Venus is at greatest western elongation, 47 degrees from the Sun (so can be seen before sunrise).

May 25, 2014: Mercury is at greatest western elongation, 27 degrees from the Sun (so can be seen before sunrise).

April 2, 2014: Uranus is in conjunction with the Sun.

April 6, 2014: Space-X’s fourth resupply flight to the ISS.

April 8, 2014: Mars is at opposition.

April 14-15, 2014. Total eclipse of the Moon visible from North America.

April 15, 2014: The asteroids Vesta and Ceres are both at opposition.

April 25, 2014: Mercury is in superior conjunction with the Sun.

May 10, 2014: Saturn is at opposition.

May 25, 2014: Mercury is at greatest eastern elongation, 23 degrees from the Sun (so can be seen before sunrise).

June 19, 2014: Mercury is in inferior conjunction with the Sun.

July 2014: Launch date of *Hayabusa 2* sample return mission to asteroid 1999 JU<sub>3</sub>. Web site is

[www.jspec.jaxa.jp/e/activity/hayabusa2.html](http://www.jspec.jaxa.jp/e/activity/hayabusa2.html).

July 4, 2014: Pluto is at opposition.

July 12, 2014: Mercury is at greatest western elongation, 21 degrees from the Sun (so can be seen before sunrise).

July 24, 2014: Jupiter is in conjunction with the Sun.

August 8, 2014: Mercury is in superior conjunction with the Sun.

August 12, 2014: Peak of Perseid Meteor Shower,

August 2014 - December 2015: The European Space Agency's *Rosetta* space probe orbits comet Churyumov-Gerasimenko. In November 2014, it will release the Philae lander. Web page is [www.esa.int/SPECIALS/Rosetta](http://www.esa.int/SPECIALS/Rosetta) or visit [en.wikipedia.org/wiki/Rosetta\\_%28spacecraft%29](http://en.wikipedia.org/wiki/Rosetta_%28spacecraft%29).

August 29, 2014: Neptune is at opposition.

September 21, 2014: Mercury is at greatest eastern elongation, 26 degrees from the Sun (so can be seen after sunset).

September 22, 2014: *MAVEN* arrives at Mars.

September 24, 2014: *Mangalyaan* arrives at Mars,

October 7, 2014: Uranus is at opposition.

October 8, 2014: Total eclipse of the Moon visible from almost all of the Pacific Ocean, eastern Australia and western North and South America.

October 16: Mercury is in inferior conjunction with the Sun.

October 19, 2014: Comet Siding Spring will pass within 65,000 miles of Mars. There is a 0.01% probability of an actual collision.

November 21, 2014: Mercury is at greatest western elongation, 19 degrees from the Sun (so can be seen before sunrise).

October 25, 2014: Venus in superior conjunction with the Sun.

November 18, 2014: Saturn is in conjunction with the Sun.

December 8, 2014: Mercury is in superior conjunction with the Sun.

Sometime in 2015: India launches *Chandrayaan II*. This mission will include a lunar rover. For more information, visit <http://en.wikipedia.org/wiki/Chandrayaan-2>. [Moved from 2014.]

Sometime in 2015: China launches the Tiangong-2 and 3 space stations. Tiangong-3 will eventually become the core of a large Chinese space station in the 2020s.

Sometime in 2015: 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>. [Moved from 2014.]

Sometime in 2015: Launch of Japan's *Astro-H* X-ray astronomy spacecraft. For details, visit <http://astro-h.isas.jaxa.jp/index.html.en>.

February 2015: *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.

June 6, 2015: Venus is at greatest eastern elongation, 45 degrees from the Sun (so can be seen after sunset).

July 2015: 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 14, 2015: The *New Horizons* probe passes through the Pluto-Charon system. The New Horizons web site is [pluto.jhuapl.edu/](http://pluto.jhuapl.edu/).

August 15, 2015: The European Space Agency/JAXA BepiColombo Mercury Orbiter is launched. Home page is <http://sci.esa.int/bepicolombo>.

August 15, 2015: Venus is in inferior conjunction with the Sun.

October 26, 2015: Venus is at greatest western elongation, 46 degrees from the Sun (so can be seen before sunrise).

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

Sometime in 2016: Russia launches the orbiter of the "Luna-Glob" mission. [See 2015 for the lander launch.]

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/>.

July 4, 2016: *Juno* arrives at Jupiter. The NASA *Juno* page is [http://www.nasa.gov/mission\\_pages/juno](http://www.nasa.gov/mission_pages/juno).

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

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

October 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>.

January 2017: Proposed launch date for 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>.

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

June 6, 2015: Venus in inferior conjunction with the Sun.

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

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

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

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](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.)

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

### Oklahoma Space Alliance Officers, 2013 (Area Code 405)

Steve Swift, President	496-3616 (H)
Claire McMurray, Vice President	329-4326 (H) 863-6173 (C)
Syd Henderson, Secretary & Outreach Editor	321-4027 (H) 365-8983 (C)
Tim Scott, Treasurer	740-7549 (H)

### 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)

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. Web site [www.state.ok.us/~okspaceport](http://www.state.ok.us/~okspaceport).

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 \$30 introductory rate for new members (\$35 for new international members). Regular membership rates are \$55, international \$65. Student memberships are \$25. Part of the cost is for the magazine, *Ad Astra*. Mail to: National Space Society, 1155 15th Street NW, Suite 500, Washington, DC 20005, 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.marsociety.org](http://www.marsociety.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.

Do you want to be on the Political Action Network?

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

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_ ZIP \_\_\_\_\_

Phone (optional or if on phone tree) \_\_\_\_\_

E-mail address (optional) \_\_\_\_\_

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

**OKLAHOMA SPACE ALLIANCE**

**OUTREACH-November 2013**

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

**NOTE TIME AND LOCATION**

Oklahoma Space Alliance will meet  
at 3:30 on Saturday, November 9  
at Harry Bears Restaurant,  
2113 Riverwalk Dr., Moore, Oklahoma,