

OUTREACH September 2013

September Meeting:

Oklahoma Space Alliance will meet on Saturday, September 14, 2013 at Denny's on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City. Our feature presentations will start at 2:30 p.m. with the business meeting following at 4:15 p.m. The street address is 1617 SW 74th Street and the phone number is 685-5414.

If you take the exit at Pennsylvania coming from the east, you pass right by the entrance. If you're coming on Pennsylvania itself, there's an entrance from the street to the north of Denny's.

Agenda:

2:30 p.m.

- 1) What's Happening: OSA will present recent news and events related to space technology and achievements. Videos and pictures will highlight what is happening.
- 2) The May 2013 ISDC conference in San Diego featured a number of excellent presentations about space exploration and habitation. We will view some of these presentations in our meetings for the next few months.
- 3) Business Meeting
 - a. Review Minutes and Agenda
 - b. New mail
 - c. Treasurers Report
 - d. Report on OSIDA
 - e. Old Business
 - f. New Business

We will be discussing alternate meeting spaces during the meeting.
- 4) Adjourn

Minutes of August Meeting

Oklahoma Space Alliance met August 10, 2013 at the Denny's on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City. Attending were Steve, Karen and Brian Swift, Vicky, Claire and Clifford McMurray, John Northcutt, Tim Scott and Syd Henderson.

Quote of the month: "The dinosaurs became extinct because they didn't have a space program," Larry Niven, quoted by Arthur C. Clarke, space.com interview, 2001.

Steve is printing calling cards for Oklahoma Space Alliance and asked the rest of us whether we wanted our own personalized OSA cards. Syd said yes.

Steve would like each of us to choose a space-related area to keep track of and report on at meetings as part of "What's Happening in Space."

What's Happening in Space?

SpaceX is continuing tests of the Grasshopper launch vehicle and in June achieved a milestone altitude of 1000 feet before coming to a controlled landing. We watched the video: <http://www.space.com/21876-spacex-grasshopper-jumps-over-1000-feet-hexacopter-video.html>.

The Grasshopper launch was filmed by their hexacopter, which has six rotors, each of which is at the end of a long strut. We watched a video of a model that went up to 2000 meters (6500 ft.).

A Hydrogen Rocket Injector was built using laser technology to melt and fuse metallic powders into a 3-D structure.

Jeff Bezos underwater expedition has recovered parts from the Saturn V engine thrust chamber that formed part of the first stage for the *Apollo 11* mission. See http://www.huffingtonpost.com/2013/07/20/apollo-11-rocket-engine-amazon-ceo-jeff-bezos_n_3628232.html for details.

The SpaceX F9-R (Falcon 9 Reusable) booster has completed a full mission duration test.

ISS Astronaut Luca Parmitano was forced to cut short a spacewalk when water began to pour into his helmet. It's uncertain where the water came from. There is about a gallon of water in the suit's coolant system, and another 32 ounces of water in a drink bag. Luca said the water tasted strange, which may indicate that it came from the coolant system. For details, see <http://spaceflightnow.com/station/exp36/16eva/index2.html#.Uiti2eDfbfg>.

The July 2 crash of a Proton-M rocket was caused by several angular rate sensors that were installed upside-down. Three Glosnass-M navigation satellites were destroyed in the crash. For details, see http://www.aviationweek.com/Article.aspx?id=/article-xml/asd_07_22_2013_p05-01-598920.xml.

"Virgin Galactic's Private Spaceship Offers Enticing Science Opportunities." SpaceshipTwo has 500 cubic feet available for experiments that need only a few minutes in zero-g. For more information, see <http://www.space.com/22024-virgin-galactic-spaceshiptwo-suborbital-research.html>.

"NASA Funds 12 Far-Out Space Tech Ideas." These include a Pulsed Fission-Fusion Propulsion System, Human Stasis to Mars, Two-Dimensional Planet Surface Landers, and Printing of Advanced Biocomposites. See <http://www.space.com/22042-nasa-advanced-concepts-selections-2013.html> for the complete list.

NASA is funding a 3-D Food Printer at a preliminary grant price of \$125,000. First thing to be printed will apparently be pizza.

Mattel has launched a Mars Explorer Barbie doll in honor of the first anniversary of the Curiosity Rover's landing on Mars. Her spacesuit is white and pink.

An Oklahoma State University team has been selected as part of NASA's X-Hab Innovative Challenge. See <http://tinyurl.com/15nd5e7> for details.



Japan has launched a talking humanoid robot to the ISS. Named Kirobo, it will be a companion to ISS Commander Koichi Wakata. Here are Kirobo's first words in space: www.youtube.com/watch?v=bL8ncrmeNa4.

Boeing has unveiled the CST-100 spacecraft interior. You can see it at <http://www.space.com/22057-boeing-unveils-commercial-space-capsule.html>. We also watched several NASA videos promoting Boeing's commercial crew program.

Clifford McMurray said that Armadillo Aerospace is suspending operations until they can secure more funding. The CEO is worried about "creeping professionalism."

We looked through a list of ISDC videos at nss.org. Mae Jemison did a presentation on the 100-Year Starship Project. Since astronauts going to another star system are obviously not coming back right away, there have to be enough astronauts to have the necessary skills required. Not just high-tech skills, but basic things like sewing. A copy of this video is at <http://www.nss.org/resources/library/videos/ISDC13jemison.html>.

Business meeting:

We now have \$730.20 in the checking account and \$267 in the cash box.

We went into some detail on the proposed children's art contest. We would need a judge, and David Lee Anderson was proposed. Will we attempt to post all submissions?

Steve is willing to help on the project but is not willing to do all of it. We will need some serious volunteer help.

There would have to be 3 – 4 gradations by age. The biggest job will be contacting teachers. John thinks we can get more interest with cash prizes. But Kip thinks we don't have sufficient financial resources to make prizes worthwhile.

We probably wouldn't include 3-D art.

How many schools are there in the area? Syd pointed out that there are many more elementary schools locally than one might expect.

We will have to set up rules.

In October we will discuss what we are doing for Yuri's night. April 12 will be on a Saturday.

[Minutes by OSA Secretary Syd Henderson.]

Notes on August 14 OSIDA Meeting

None of us were able to make it for this meeting. The next meeting is September 11, but the location hasn't been announced yet.

--Notes by OSA Secretary Syd Henderson

Space News

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

Lithium, the third element in the periodic table, has been making news again, which requires a bit of an explanation. According to theory, only three elements were created by the Big Bang, hydrogen and helium together with a smattering of lithium. Elements higher in the periodic table were made in the interior of stars or formed from these by radioactive decay or nuclear collisions. Hydrogen, helium and lithium have two stable isotopes apiece, each of which would have been formed in the Big Bang along with a few radioactive isotopes such as tritium that decayed soon after. However, observations of old stars indicate lithium-7 is about a third as common as it should be.

This however, was nothing compared with the Sun's lithium deficit. It has about 1/150th the lithium of those old stars, which were already deficient. Now a study by TalaWanda Monroe's team using spectrographs at the Very Large Telescope makes the Sun look like a little less of an oddball. HIP 102152 (in Capricornus) is a sun-like star which is 3.6 million years older than the Sun, and it has only a quarter of the lithium of the Sun, and 18 Scorpii is 2.9 billion years old (compared with the Sun's estimated age of 4.6 billion years) and has four times the amount of lithium. In other words, sun-like stars do eat their lithium.

This presents a challenge to theories of stellar dynamics. Lithium is destroyed by nuclear fusion at temperatures above 2.4 million degrees Celsius, by the reaction lithium-7 + proton \rightarrow 2 helium-4. This is an unusually low temperature for fusion, and is achieved in the center of the heaviest brown dwarfs. These heavy brown dwarf and red dwarf stars therefore don't contain lithium.

It might seem counterintuitive that larger, hotter stars such as the Sun should have lithium. The explanation is that red dwarf stars and some brown dwarfs are fully convective; that is, convection currents mix all the material in the star so that any lithium present will eventually find its way to the core to be destroyed. More massive stars like the Sun are not fully convective, so lithium in the surface layers should stay there and not go deep enough to be fused into helium. Except that apparently it does: it just takes billions of years to do so.

Unfortunately, this still doesn't explain the missing lithium in the old stars which are used to measure the composition of the early Universe.

Images from the Hubble Space Telescope suggest the major source of gold in the Universe may not be supernovae at all, or at least not directly. A gamma-ray burst detected by the satellite SWIFT last June is believed to have been caused by the collision of two neutron stars in a galaxy 3.9 billion years away. This collision produced heavy elements adding up to about one percent of the Sun's mass, including several Moon masses of gold. These collisions are rare, but still occur every few tens of thousands of years in a given galaxy, and may be sufficient to account for the amount of gold in the Universe as well as many heavy elements.

The results are still speculative, and there are supernova models that also produce heavy elements. [*Science News*, August 24, 2013, page 8.]

NASA lost contact with the *Deep Impact* space probe in mid-August when it began to spin out of control. The spacecraft's primary mission was launching a projectile into Comet Tempel 1 in 2005 but it was hoped that it might be able to photograph Comet ISON.

The tail of the Solar System has been detected, and, surprisingly, it looks like a four-leaf clover. The existence of the heliotail has long been expected: it is left behind as the Solar System moves through the Milky Way. The satellite IBEX has detected two lobes of slow-moving particles to the sides of the Solar System and two lobes of fast-moving particles above and below. The faster particles originate at the Sun's poles and the slower ones near its equator.

The *LADEE* Moon probe went into space in a spectacular night launch from Wallops Island, Virginia, on September 6. The launch was visible along much of the East Coast of the United States. Space.com has photos at www.space.com/22697-ladee-moon-mission-launch-reader-photos.html.

There was a reaction wheel glitch that briefly threatened the mission, but it was resolved a few hours after launch. LADEE is the Lunar Atmosphere and Dust Explorer and will analyze the environment around the Moon.

Instead of going directly to the Moon, LADEE will make a series of increasingly larger extremely elliptical orbits, the third of which has a perigee of 120 miles and an apogee of 173,000 miles. On October 6, during its fourth orbit, it will be captured by the Moon, eventually achieving an orbit about fifty miles above the lunar surface.

On September 5, Virgin Galactic successfully tested SpaceshipTwo's feather mechanism during its second supersonic flight. During the flight, SpaceshipTwo achieved an altitude of 69,000 feet.

Sky Viewing: Comet ISON Approaches

Comet ISON is still about twice as far from the Sun as Earth is, and is still well short of naked-eye visibility. When it was spotted again in August, it appeared a couple of magnitudes dimmer than expected, prompting speculation that it might not be as brilliant as expected. However, the editor of *Astronomy* reminds us that in fact we simply don't know at this point what will happen as Comet ISON approaches the Sun. Apparently this is Comet ISON's first visit to the inner solar system, and such virgin comets are notoriously unpredictable. Even pessimistic projections predict negative magnitudes at closest approach to the Sun, and naked-eye visibility from November through January. (There is also a slight possibility that it might disintegrate at perihelion, which would certainly be interesting.)

Also interesting is Comet ISON's path in mid-October, which, although it will still probably be magnitude 7 to 10, will make it relatively easy to locate with a telescope or even binoculars. It is currently passing through the dim constellation Cancer, but will move into Leo in a few weeks. At the same time, Mars is moving into Leo, and during the first three weeks of October, Mars and Comet ISON will be separated by less than two degrees, and for a few days around October 15, they will be separated by about one degree. What will make finding the comet even easier is that on October 14, Mars passes only one degree north of the first magnitude star Regulus, the base of the Sickle asterism in Leo, with Comet ISON about a degree north of Mars. Unfortunately, star, planet and comet will be rising about 2:45 a.m., but early birds should be able to spot them.

Sky Viewing: Planets

Mercury was in superior conjunction with the Sun on August 24 and is currently hidden in the sunset. In late September, Mercury will be low in the western sky just after sunset as it approaches greatest eastern elongation on October 8. On that date Mercury will be separated by 25 degrees from the Sun, which is not as good as it sounds because most of that distance will be horizontal. On September 24, Mercury will be separated by less than a degree from the first-magnitude star Spica in the constellation Virgo. Mercury will be the brighter of the two by almost two magnitudes.

However, the bright planet that is about fifteen degrees above the western horizon after sunset is **Venus**, which is currently at magnitude -4.0. Venus is going to dominate the western sky for a while as it approaches greatest elongation on Halloween night. Venus is approaching us and getting brighter. It's brightest during its crescent phase, which will be toward the end of the year.

Saturn is currently low in the western sky after sunset but still higher than Venus. The two are approaching each other, and will be separated by about four degrees on the night of September 17. Saturn, however, will be about magnitude 1 and much more difficult to see. It will still be visible to the naked eye through the middle of October, after which it will be lost to view as it approaches its November 6 conjunction with the Sun.

The bright star above Venus and Saturn actually is a star; it's Arcturus, the brightest star in the Northern Celestial Hemisphere.

Mars is currently a morning star, shining at a relatively faint magnitude 1.6. It's currently located in the faint zodiacal constellation Cancer, but will be moving into Leo toward the end of September, at which time it will be rising about 3:00 a.m. By mid-October Mars will be less than a degree from the magnitude 1.4 star Regulus and briefly form a

second star in the handle of the Sickle asterism. Of possible greater interest is that they will be joined by Comet ISON for several days (see above).

Jupiter is magnitude -2.1 and rising around 1:30 a.m. It's located in the constellation Gemini and is considerably brighter than Castor and Pollux. By early October, Jupiter will be rising shortly after midnight, and will be visible in late evening by the end of the month.

This is about the best time to look for **Uranus**, which will be in opposition to the Sun on October 3. It will also be at its brightest, magnitude 5.7, although, truth to tell, Uranus is so far away that its brightness only varies by a tenth of a magnitude. 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. It was at opposition on August 26, and is in the sky all night long, 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*.

For a real challenge, October is a particularly good time to look for Sirius B, the white-dwarf companion of the brightest star in the night sky. Alan Whitman has a guide on pages 30 – 31 of the October *Sky & Telescope*. The challenge here is not that Sirius B is especially dim, but that Sirius A is so bright it tends to drown out its companion's light. The comparative magnitudes are 8.5 and -1.5; in other words, Sirius A gives off ten thousand times as much light as its companion. Whitman used an eight-inch reflecting telescope and a lunar filter. He also suggests waiting until the beginning of twilight to reduce the glare from Sirius A.

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

Space-Related Articles

“Star Burst,” by Stuart Clark. *New Scientist*, 10 August 2013, pp. 46 – 49. In AD 774 or 775, a burst of radiation hit the Earth that raised carbon-14 levels by 1.2%, which doesn't sound like much, but is twenty times the normal rate of variation. According to the thirteenth century chronicler Roger of Wendover, “Fiery and fearful signs were seen in the heavens at night, and serpents appeared in Sussex, as if they were sprung out of the ground, to the astonishment of all.”

Certainly it must have been an impressive event to be remembered four centuries later, but what was it? The description sounds like unusually prominent aurorae, which can look like fiery serpents in the sky, which means there must have been an enormous number of charged particles hitting the Earth's atmosphere. An obvious candidate is a solar flare, but the amount of energy involved is a hundred times large that of any flare in the last century. A supernova has been proposed but no remnant dating back to AD 775 has been found [and you would expect any supernova recorded in Chinese sources in any case. —SFH]

The author considers a different kind of Sun-related event. David Eischer of Ben-Gurion University of the Negev postulates that a comet collided with the Sun, causing a super flare that dwarfed any ever observed.

Small comets collide with the Sun reasonably frequently with no harm done, but a comet the size of, say, Hale-Bopp is 25 to 50 miles in diameter, and would collide with the Sun at a velocity of 360 miles per second (or 1.3 million miles per hour). Eischer thinks such a collision could account for a huge flare.

In 1859, a superflare called the Carrington event caused huge aurorae and disrupted telegraph communications in North America. Such an event today would cause trillions of dollars in damage. The AD 775 event was much larger.

In case you're wondering, Comet ISON's core is about three miles in diameter and although it will pass within 700,000 miles of the Sun, there is no danger of a collision.

Viewing Opportunities for Satellites (September 13 – October 13, 2013)

You can get sighting information at 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.

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. The next manned mission to the Space Station launches on September 25, and there is an Orbital Sciences demonstration flight on September 17. Be sure to check Heavens Above or www.jsc.nasa.gov/sightings before going out to watch just in case.

Station September 14, 2013

Time	Position	Elevation
Appears from Earth's Shadow		
6:02:22 a.m.	241°	36°
6:02:42	245	44
6:04	323	74
6:05	33	41
6:06	41	22

Tiangong 1 September 17, 2013

Time	Position	Elevation
8:22 p.m.	303°	10°
8:25	24	59
8:26:28	99	21
Vanishes into Earth's Shadow		

Tiangong 1 September 20, 2013

Time	Position	Elevation
7:56 p.m.	283°	10°
7:59	213	37
8:02	143	10

Station October 1, 2013

Time	Position	Elevation
6:47 a.m.	303°	22°
6:48	293	41
6:49	222	68
6:50	155	40
6:51	145	22

Station October 2, 2013

Time	Position	Elevation
Appears from Earth's Shadow		
5:58:23 a.m.	338°	28°
5:59:32	11	60
6:01	101	38
6:02	115	21

Tiangong 1 October 5, 2013

Time	Position	Elevation
Appears from Earth's Shadow		
6:27 a.m.	210°	13°
6:30	147	34
6:32	79	10

Tiangong 1 October 6, 2013

Time	Position	Elevation
Appears from Earth's Shadow		
6:49 a.m.	248°	12°
6:52	334	75
6:55	60	10

Station October 7, 2013

Time	Position	Elevation
8:09 p.m.	200°	19°
8:10	184	32
8:11	134	45
8:12	87	34
Vanishes into Earth's Shadow		

Station October 9, 2013

Time	Position	Elevation
Appears from Earth's Shadow (?)		
8:08 p.m.	268°	38°
8:09	321	51
8:10	14	36
8:11	31	21

HST October 11, 2013

Time	Position	Elevation
8:36 p.m.	221°	20°
8:37	202	27
8:38	174	30
8:39	149	27
8:40	131	20

HST October 12, 2013

Time	Position	Elevation
Appears from Earth's Shadow		
8:31:27 a.m.	212°	26°
8:31:44	206	28
8:33	179	31
8:34	151	28
8:35	133	21

The Hubble Space Telescope also appears from Earth's Shadow at 8:27 on October 13 and 8:21 on October 14 and follows a similar track to that of October 12.

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 the International Space Station at 8:09 p.m. on October 9, measure just over four hand-widths west from due north, then just over five hand-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:

9/16, 9:20 a.m.: ISS Astronauts In-Flight Interview

9/17, 9:45 a.m.: Launch coverage of Orbital Sciences Cygnus demonstration mission to the Space Station. Launch is 10:16 a.m.

9/22, 3:30 a.m.: Rendezvous and capture coverage of Cygnus mission. Grapple is projected for 6:15 a.m.

9/24, 3:00 p.m.: Launch coverage of Expedition 37/38 to Space Station. Launch is scheduled for 3:58 p.m. Docking coverage begins at 9:00 p.m. with actual docking at 9:47 p.m. Hatch opening coverage begins at 11:00 p.m. with hatch opening at 11:25 p.m.

Calendar of Events

September 14: [Tentative] Oklahoma Space Alliance meeting at 2:30 p.m. at Denny's on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City.

September 17, 10:16 a.m.: Antares launch of Orbital Science's Cygnus cargo vehicle to the Space Station on a demonstration flight.

September 25: Launch of three Expedition 37/38 members via Soyuz from the Baikonur Cosmodrome in Kazakhstan to the Space Station.

October 3: Uranus is at opposition.

October 8: Mercury is at greatest eastern elongation, 25° from the Sun (hence can be seen after sunset)

October 9: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

October 12: [Tentative] Oklahoma Space Alliance meeting at 2:30 p.m. at Denny's on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City.

October 31: Venus is at greatest eastern elongation, 47° from the Sun (hence can be seen after sunset)

November 28: Comet C/2012 S1 (Comet ISON) will approach within 1.1 million miles of the Sun and be visible to the naked eye. It may well be visible during the daytime.

November: [Moved from October.] 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)).

November 3: Hybrid solar eclipse. This will begin as an annular eclipse east of Florida, and will be total on a path from the mid-Atlantic through central Africa.

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: [Tentative] Oklahoma Space Alliance meeting at 2:30 p.m. at Denny's on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City.

November 11: [Moved from September.] Space-X's third resupply flight to the ISS.

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

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).

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 29: Mercury is in superior conjunction with the Sun.

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 5, 2014: Jupiter is at opposition.

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

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.

July 2014: Launch date of *Hayabusa 2* sample return mission to asteroid 1999 JU₃. Web site is www.jspec.jaxa.jp/e/activity/hayabusa2.html.

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 or visit en.wikipedia.org/wiki/Rosetta_%28spacecraft%29.

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

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.

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/.

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

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: 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 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>.

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: 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 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 Bennu 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. Members who wish their e-mail addresses printed in *Outreach*, and people wishing space-related materials e-mailed to them should contact Syd. Oklahoma Space Alliance website is chapters.nss.org/ok/osanss.html. Webmaster is Syd Henderson.

Other Information

Oklahoma Space Industrial Development Authority (OSIDA), 401 Sooner Drive/PO Box 689, Burns Flat, OK 73624, 580-562-3500. 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 is LtCol Paul E. Damphousse 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.)

_____ \$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. (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. 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-September 2013

102 W. Linn #1, Norman, OK 73069



NOTE TIME AND LOCATION

Oklahoma Space Alliance will meet at 2:30 p.m. on Saturday, September 14 at Denny's Restaurant on the I-240 access road on the north side just east of Pennsylvania Avenue in southern Oklahoma City. Directions and an agenda are inside.