

OUTREACH January 2014

January Meeting:

Oklahoma Space Alliance will meet at 4:00 on Saturday, January 11, 2014, at Harry Bears All-American, 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

.January 11, 2014

Meeting Agenda

Place: Harry Bears in Moore, OK

4:00 PM

- 1) Business Meeting
 - a. Review Minutes and Agenda
 - b. New mail
 - c. Treasurers Report
 - d. Report on OSIDA
 - e. Old Business
 - i. Yuri's Night
 - ii. Art Contest
 - iii. Annual Report
 - f. New Business
 - i. Discuss candidate subjects for OSA 'Feature Presentations' in 2014.

4:30

- 2) A Slide Show will present selected photographs of spacecraft launches in 2013.
- 3) What's Happening
The pace of space related events continues to accelerate through November and December. This segment will include slides and videos of recent events including launches and innovations.
- 4) Adjourn

Minutes of November Meeting

Oklahoma Space Alliance met at Harry Bear's All-American Grill in Moore on November 9, 2013. In attendance were Steve, Karen and Brian Swift, Vicky, Dave Sheely, Claire McMurray, Russ Davoren, Dennis Wigley, John Northcutt, Tim Scott and Syd Henderson.

Annual reports will be done in a new format.

Report on OSIDA meeting: They have finally moved into the new operations center. They are spending money on runways and taxi lights. [See notes on OSIDA meeting below.]

Art Contest: Claire talked to Leonard Bishop, who is running the art contest at SoonerCon. He's willing to help. David Lee Anderson says all artists have digital capacity. We can probably get a table. David says we can start with one city. One of David Lee's friends is an art teacher. We should invite David Lee to our December meeting.

Our treasury has \$957.37 between our bank account and cash.

Our nominations for 2014 officers are Steve Swift for President, David Sheely for Vice President, Syd Henderson for Secretary, and Tim Scott for Treasurer.

Christmas Party: Claire can't have it at her house. We need to come up with an option in the next couple of weeks.

Yuri's Night is on a Saturday this year, which would be our regular meeting day. Options are (1) Moore Library, (2) an enhanced meeting, or (3) a dinner (not at Harry Bear's). We could have a catered dinner at

Science Museum Oklahoma, or the Stafford Museum in Weatherford. We should also check out the Sam Noble Oklahoma Museum of Natural History. We will decide at our January meeting. Someone needs to find out what would be possible. Russ volunteered to do some preliminary inquiries.

Russ Davoren did a presentation of autographs, slides and stories involving his experiences with people in the space program. These included Neil Armstrong, John Glenn, Wally Schirra, Gordon Cooper, James Lovell, Tom Stafford, Gene Cernan, Dick Gordon, space engineer Guenter Wendt, Rusty Schweibert, Al Worden, Sally Ride, Shannon Lucid, Burt Rutan, Anousheh Ansari, and many others,

We watched a slideshow by ISS astronaut Karen Nyberg.

What's Happening in Space?

On October 7. SpaceX's Grasshopper launcher made its final test hop to 744 meters. For details and video, see

www.space.com/23193-spacex-grasshopper-rocket-highest-hop-video.

Sierra Nevada's first flight test of its Dream Chaser test flight suffered failure of its landing gear. Prior to that, the test had proceeded perfectly. For article see <http://tinyurl.com/m2zura7>. (The link goes to aerotechnews.com but is too long to print in full.)

We watched a promotional video for SpaceShipTwo, Virgin Galactic's suborbital space tourist vehicle. Details and video at <http://tinyurl.com/mg6nd5v>. (Link to space.com article).

Gwynne Shotwell, the President and Chief Operating Office of SpaceX was profiled as one of the movers and shakers in space industry.

SpaceShipTwo had a tail stall event in its September 29, 2013 test flight. For a follow-up report from New Space Journal, see <http://tinyurl.com/n242on6>.

The European Space Agency sent Albert Einstein to the ISS <http://phys.org/news/2013-11-mission-europe-cargo-freighter.html>.

A NASA laser communication test set a new data rate record of 622 megabytes per second between the Earth and the Moon. See gizmodo.com/nasa-has-a-622-mbps-data-connection-to-the-moon-1450623457.

NBC teams up with Virgin Galactic for 'Space Race' Reality Show: <http://tinyurl.com/mawsw9v> (link to NBC news). NBC has rights to broadcast Virgin Galactic's first passenger flight. 'Space Race' features a competition for a seat aboard SpaceShipTwo.

Shanghai built lunar rover that is part of China's Chang'e 3 mission, <http://tinyurl.com/ka7urpt> (link to spacetravel.com).

Spaceflight Joins with NanoRacks to Deploy Satellites from the ISS: <http://nanoracks.com/spaceflight-joins-to-deploy-satellites>.

India successfully launched its first probe to Mars: www.space.com/23464-india-launches-mars-orbiter-mission.html.

A crew was launched to the International Space Station, carrying an (unlit) Olympic torch. See, for instance, <http://www.spaceflightnow.com/station/exp38/launch/>.

We watched a video with Elon Musk. "Life has to be more than just solving problems... The future has a chance of being much better than the present."

"Mars is a real fixer-upper of a planet."

--Minutes by OSA Secretary Syd Henderson

Notes on OSA Christmas Party

Oklahoma Space Alliance held its Christmas Party at the Koszoru's house on December 14. We also had a brief meeting to elect officers. The OSA officers for 2014 are Steve Swift President, David Sheely Vice President, Syd Henderson Secretary, and Tim Scott Treasurer. We also discussed a potential chapters project to put together a manual on how to throw an International Space Development Conference.

I didn't keep track of how many people arrived and left, but it must have been around 20, several of whom weren't OSA members.

Claire received a box full of winter issue of *Ad Astra* and several of us took copies to distribute.

--Notes by OSA Secretary Syd Henderson

Notes on OSIDA Meeting

The Oklahoma Space Industrial Development Authority met on November 15, 2013. Board members present were Jack Bonny, Jay Edwards, Donald Wetekam, R. Allen Goodbary, Robert Conner and Robert Cox. There were five people in the audience in addition to Executive Director Bill Khourie, secretary Kim Vowell, and legal advisor Brinda White. Steve Swift, Dave Sheely and Syd Henderson attended on behalf of Oklahoma Space Alliance.

Bill is meeting with officials (from Oklahoma Department of Commerce, I believe) about the development of a marketing website. What will be on the site, in addition to pictures of buildings and facilities?

Dr. Stephen McKeever gave an overview of the International Space Summit. Technology has not kept up with the development of spaceports. Military airspace is allocated for specific purposes by the FAA and that's not commercial space. Commercial spaceflights at spaceports associated the military cannot guarantee that they can fly when scheduled because military needs may interfere. One advantage the Oklahoma Spaceport has is that it has what it says it has. However, the spaceport cannot rely on space commerce exclusively and will need to diversify.

The demise of Rocketplane was discussed.

Goodbary: We could do point to point flights (from one spaceport to another).

McKeever: We can look at current launch sites that always have a site for emergency landings.

General Edwards is concerned that the vehicle may not have enough fuel both to get up and to get anywhere.

There was a discussion on whether to let Bill try to set up an International Space Summit in Oklahoma. Mr. Wetekam's not sure we're ready to do that, although he would support investigating and going forward enough to decide whether to commit to the summit. The board voted to let exploration begin.

How can OSIDA let the state know that it is generating revenue while still requiring state money for operations?

The OSIDA board approved their budget unanimously.

--Notes by OSA Secretary Syd Henderson

Space News

SpaceX launched a Falcon 9 on January 6, sending a three-ton Thai communications satellite into geosynchronous orbit. The satellite, interestingly, was built by Orbital Sciences, which is SpaceX's rival for supplying the Space Station. By coincidence, Orbital Sciences is launching its first Station resupply mission on January 8. An article on the SpaceX launch, complete with a spectacular launch photo, is at www.nbcnews.com/science/blastoff-spacex-launches-thai-satellite-orbit-2D11870018.

This month marks the tenth anniversary of the landing of the Mars Exploration Rovers MER-A and MER-B, or, as they are better known, *Spirit* and *Opportunity*. *Spirit* landed on Mars on January 4, 2004, and *Opportunity* on the following January 25. NASA lost contact with *Spirit* on March 22, 2011, and after failed attempts to regain communications, its mission was declared over on May 25, 2011. However, *Opportunity* is still active, if now overshadowed by *Curiosity*.

Last May, *Opportunity* broke the record for the most miles traveled by a NASA vehicle on another world, which was only was 22.2 miles, set by the rover on *Apollo 17* (which, however, did it in days rather than 9 years). The record for any vehicle on another world is somewhere between 23 and 26 miles, held by the Russian Lunokhod 2 lunar rover.

Opportunity is currently sunning itself on the western ridge of Endeavour crater in preparation for the long Martian winter.

The European Space agency's *Gaia* spacecraft was launched on December 19. It will be placed in a Lissajous orbit around the L_2 Lagrangian point of the Sun-Earth system, which lies on a straight line joining the Sun and the Earth, but 930,000 miles farther away from the Sun than the Earth.

(The Earth-Sun's L_1 and L_3 points also lie on this line, with L_1 lying between and 930,000 miles closer to the Sun and L_3 lying 93 million miles from the Sun on the opposite side as Earth. The L_4 and L_5 points form equilateral triangles with the Sun and Earth, and lie in the plane of Earth's orbit. The L_4 and L_5 points are stable, and it's possible to orbit around them. Lissajous orbits are unstable but require little fuel to maintain.)

Gaia is the ambitious follow-up to the *Hipparcos* mission which produced high-precision maps of more than a hundred thousand stars, and lower precision maps of 2.5 million Stars. *Gaia* will map over a billion stars, down to the 20th magnitude, which is about one percent of all the stars in the Milky Way. *Gaia* is capable of measuring the distance of a star 30,000 light-years away to an accuracy of 10%; that's the same distance as the center of the Milky Way. Nearer stars will have their distances measured with correspondingly greater precision. Together with measuring other characteristics, of the stars, this will give astronomers a better handle on stellar evolution.

In the process, *Gaia* will discover tens of thousands of exoplanets, and will be able to detect every Jupiter-sized planet within 150 light-years whose periods are longer than 1.5 times Earth's but less than twice of Jupiter's. It may also detect ten of thousands of brown dwarfs if they are there to be discovered. (There seems to be a shortage.)

A team of astronomers led by Sergio Dieterich of Georgia State University may have found a size gap between the smallest stars and the most massive brown dwarfs. For normal stars, increased fusion in the core tends to make stars' diameters increase with mass. For brown dwarfs, diameters tend to *decrease* as you add more mass. This results in a size gap for objects with temperatures around 2100°, which appears to be the boundary between stars and brown dwarfs. A star with this temperature would have a radius 0.087 that of the sun. The smallest stars are actually smaller in radius than brown dwarfs, though they are more massive, hence denser. They're also smaller in radius than the planet Jupiter. There must be some internal structural differences as well. The luminosity of these smallest stars, by the way, is 0.000125 that of the Sun, corresponding to absolute magnitude 14.5.

Pulsar J0337+1715 is a member of a triple star system, the other two of which are white dwarfs. One of the white dwarfs is in an orbit three million miles with the pulsar, while the other is closer to Earth's distance. This is remarkable when you consider that each of the three stars is a stellar remnant and must have been a red giant at some point in its evolution. The pulsar must have gone supernova at some point but its companions survived. One hypothesis is that the more distant star engulfed the other two when it became a red giant, causing the other two stars to spiral inward. At the moment, though, that's more of a guess than a fact.

Sky Viewing

Well, comet ISON did manage to make into the negative magnitudes as it neared perihelion, then disappeared except for some bits of residual dust, so no bright comet in December. So the pessimists proved correct on this one. Meanwhile the astronomy magazines are looking forward to a possibly bright meteor shower.

It's very possible that the best meteor shower of the year will turn out to be one you've never heard of because it's never occurred before. On May 24, the Earth is expected to pass through the path of short period comet 209P Linear, the next perihelion of which is May 6. The comet itself isn't especially bright, but will pass within 5.2 million miles of the Earth, and our orbit will intersect all the trails of the comet from 1803 through 2004. Predictions range from 100 to 1000 meteors per hour. Since the radiant is in the comet Camelopardalis (the Giraffe), the unofficial name of the meteor shower is the "Camelopardalids." However, there are several minor meteor showers also referred to as the Camelopardalids, so the name may be refined.

Camelopardalis is rather a faint, but large constellation that almost extends to the North Celestial Pole (which is, not surprisingly, near Polaris). It lies between Cassiopeia on one side, and Draco, Ursa Major (containing the Big Dipper) and Ursa Minor (the Little Dipper) on the other. Camelopardalis is always above the horizon from Oklahoma, so this should be an easily visible meteor shower.

We just finished with the Quadrantid meteor shower, and we have a gap until the Lyrids in late April, which unfortunately occur near the full Moon. However, the Eta Aquariids in early May and the “Camelopardalids” in late May should both be easily visible, as should the Orionids around October 21 and the Geminids around December 14. The Eta Aquariids and Orionids, by the way, are both associated with Comet Halley.

Mercury was in superior conjunction with the Sun on December 29, and won’t be visible for a few days left. It will be barely visible after sunset after mid-January, and will reach greatest elongation on January 31. At its peak, Mercury will reach magnitude -0.6, but will not be separated by more than 18 degrees from the Sun.

Venus, which was bright all fall, is now pulling a disappearing act, appearing several degrees lower each sunset as it approaches inferior conjunction with the Sun on Saturday, January 11. However, it will return to the morning sky just as quickly as it vanished from the evening, will be easily visible before sunrise by the end of the month, and will rule the morning sky for several months beginning in February, reaching magnitude -4.9 at mid-month, which is as bright as it ever gets.

Mars is currently magnitude 0.8 and is rising around midnight. However, it is now brightening rapidly as it approaches its April opposition, and will reach magnitude 0.3 by the end of January and -0.4 by the end of February. Mars is in the constellation Virgo and will be there through February.

Jupiter, meanwhile, was at opposition on January 5, and will be ruling the night for several months to come. Jupiter is shining at magnitude -2.7, which is close to its maximum brightness. It’s currently located in Gemini, but not near Castor and Pollux. Really, since it’s the brightest object in the night sky other than Venus and the Moon, you’d be using Jupiter to locate Gemini rather than the other way around. Since it’s currently in retrograde motion, Jupiter will be in Gemini for a while yet.

Saturn is currently rising about 3:00 a.m. and is magnitude 0.6 in the constellation Libra, but will be rising around 1:30 a.m. by the end of January and before midnight by the end of February. It won’t brighten much, however, and will remain in Libra.

Uranus is magnitude 5.8, and is a bit west of due south at sunset in the constellation Pisces. Nothing much changes in January, 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. By mid-February, Uranus will be only twenty degrees above the horizon at the end of twilight.

Neptune is magnitude 7.9 and one constellation over in Aquarius, where it will be for quite a few years yet, and is low in the southwest as twilight ends. Neptune will not be visible at all in February since it is in conjunction with the Sun on February 23.

Sky & Telescope has a finder chart online for Uranus and Neptune, <http://media.skyandtelescope.com/documents/Uranus-Neptune-2013.pdf> (still good for early 2014). 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 (January 11 – February 11, 2014)

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. Orbital Services will be launching an unmanned supply capsule to the ISS on January 8. Be sure to check Heavens Above or www.jsc.nasa.gov/sightings before going out to watch just in case. The next mission after that is another supply mission on February 22.

Station January 10, 2014

Time	Position	Elevation
6:03 a.m.	212°	41°
6:04	123	75
6:05	61	42
6:06	54	22

Tiangong 1 January 26, 2014

Time	Position	Elevation
6:31 a.m.	300°	26°
6:32:28	28	83
6:35	115	10

Station January 27, 2014

Time	Position	Elevation
6:42 a.m.	225°	16°
6:44	335	64
6:47	58	10

Time	Position	Elevation
6:51 a.m.	311°	23°
6:52	310	43
6:53	186	87
6:54	135	42
6:55	134	22

Hubble January 15, 2014

Time	Position	Elevation
7:41 p.m.	224°	21°
7:42	206	27
7:43	178	31

Vanishes into Earth's shadow.

Station February 5, 2014

Time	Position	Elevation
7:28 p.m.	215°	22°
7:29	205	41
7:30	135	69
7:31	66	40

Vanishes into Earth's shadow

Hubble January 16, 2014

Time	Position	Elevation
7:35 p.m.	223°	21°
7:36	208	27
7:37	181	31

Vanishes into Earth's shadow.

Station February 6, 2014

Time	Position	Elevation
6:39 p.m.	189°	17°
6:40	170	27
6:41	133	34
6:42	96	27
6:43	76	18

Hubble January 17, 2014

Time	Position	Elevation
7:30 p.m.	229°	20°
7:31	211	27
7:32	185	30
7:33	158	26

Vanishes into Earth's shadow.

Tiangong-1 February 6, 2014

Time	Position	Elevation
7:17 p.m.	223°	10°
7:20:16	148	45
7:20:34	127	43

Vanishes into Earth's shadow

Station February 7, 2014			Tiangong 1 February 8, 2014		
Time	Position	Elevation	Time	Position	Elevation
7:27 p.m.	264°	18°	6:29 p.m.	227°	10°
7:28	284	29	6:31	149	52
7:29	323	39	6:34	71	10
7:30	2	29			
7:31	22	18			
Station February 8, 2014			Tiangong 1 February 9, 2014		
Time	Position	Elevation	Time	Position	Elevation
6:38 p.m.	239°	21°	6:52 p.m.	259°	10°
6:39	249	40	6:54	337	51
6:40	319	68	6:57	52	15
6:41	28	41	Vanishes into Earth's shadow		
6:42	38	22			

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 6:39 p.m. on February 8, measure slightly more than two fist-widths south of west, and four 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 12, 4:00 a.m. Coverage of rendezvous and grapple of Orbital Services Cygnus Starship with ISS (Grapple at 5:02 a.m.)

6:00 a.m.: Coverage of Cygnus installation (scheduled at 6:20 a.m.)

January 27, TBD: Coverage of ISS Russian Spacewalk

February 3, 9:00 a.m.: Space Station Live

Space-Related Articles

"Pluto and the Kuiper Belt," by Emily Lakdawalla, *Sky & Telescope*, February 2014, pp 18 – 25. The Kuiper Belt is a collection of mostly icy objects lying from the orbit of Neptune out to 50 astronomical units (or 45 million miles), although many of the objects have eccentric orbits that take them well outside this zone. Eris, for instance can be more than 97 AU from the Sun and approach to 38.25 AU. One oddball, Sedna, is not technically within the Kuiper Belt at all, since it never approaches within 76 AU of the Sun, and its aphelion is 937 AU. It may be Sedna is the first of a new class of planetoids.

Despite the KBOs being generally described as being ice-coated planetoids, they occur in several populations, with some like Eris and Haumea being very reflective, and others such as 2007 OR₁₀ being darker than coal. Pluto is somewhat brighter than average, with an albedo that varies between 0.49 and 0.66. Since it also the second largest member of the Kuiper Belt, and currently one of the closest, Pluto is the brightest Kuiper Belt Objects.

A dwarf planet is defined to be a planetary type object that does not orbit a planet, is rounded by gravity, but which has not cleared its orbit of other objects. Pluto and Eris and the asteroid Ceres are examples (but not Vesta, which isn't round), but smaller KBO objects such as Makemake, 2007 OR₁₀, Quaoar, and Orcus also qualify, and there may be hundreds of dwarf planets in the Kuiper Belt. It's easier for an ice to be rounded by gravity than a rock. Sedna also qualifies, as does another oddball, Haumea, which spins so rapidly that it has been distorted into an ellipsoid which is half as wide from pole to pole that it is across the equator. However, it is a smooth ellipsoid hence a dwarf planet.

Kuiper Belt Objects tend to fall in orbital resonance with Neptune. Pluto and Orcus, for instance, are in a 3-2 orbital resonance with Neptune, as are Ixion and Huya; objects in this resonance class are called "plutinos" and comprise something like 10% of all KBOs. Most of the larger objects in the Kuiper Belt are either not in resonance orbits, or are in more exotic resonances with Neptune like 12:7 (Haumea), 11-6 (Makemake) or 17-5 (Eris) [figures from Wikipedia]. By the time we're getting 17-5 ratios, though, I'm wondering whether we're searching for fractions to fit the data rather than finding actual resonance. That said, there are lots of KBOs in orbital resonances such as 2:1, 5:2, 5:3 and even 7:4. In other words, Neptune's gravity determines the orbital periods of much of the KBOs.

Neptune is believed to have formed closer to the Sun and moved out. When it met the inner edge of the Kuiper belt, it scattered KBOs throughout the Solar system. These may have been the source of the Late Heavy Bombardment of the planets of the inner Solar System (and the Moon). [This occurred about four billion years ago, and evidence was discovered during the last three Apollo missions. The Caloris basin on Mercury may also have resulted from the same bombardment.]

Discover's January/February issue is their annual list of the top 100 science stories of the year. Space-related stories:

1: New Signs of Long-Gone Life on Mars. *Curiosity* has found evidence that Mars was indeed once habitable, and found carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorus all in a location that apparently was an ancient streambed. All these elements are vital in the formation of life.

6: Voyager 1 Goes Interstellar.

16: To Russia, From Above: The explosion of the Chelyabinsk meteorite.

18: Baby Pictures of the Cosmos – In HD: Observations from the Planck Telescope of the Cosmic Background Radiation.

21: Worlds Without End: More and more exoplanets.

31: Clues from the Comet of the Century. [As it turned out, it wasn't, but Comet ISON was one of the most studied comets in history.]

37: Thirteen New Solutions to an Age-Old Physics Problem: The problem being the three-body problem. The five Lagrangian points are the most famous solutions to the problem of finding an orbit for a small object in the presence of two larger masses; actually three of those are unstable, while the other two are stable, and the points remain in the same geometric location with respect to the two masses. There are thirteen new periodic "orbits" where the third object doesn't have to stay in the same position relative to the other two. Note though that these orbits may only repeat after ten or so passes around the center of gravity of the system.

38: Our Black Hole Lights Up: The black hole at the center of the Milky Way got a snack, a gas cloud named G2.

44: The Secret Origins of Cosmic Rays: In this case, it's protons accelerated by the magnetic fields of supernovae.

47: Where Moon Water Comes From: The hydrogen/deuterium ratio is the same as in Earth's oceans and asteroids, so apparently Moon water comes from the Earth and was supplemented by asteroids.

52: Down to the Core: by duplicating the conditions at the Earth's center, scientist showed the temperature of the core of the Earth turns out to be 11,000 degrees Fahrenheit, 2,000 degrees hotter than previously thought.

78: Our Solar System has a Tail.

87: Storm Over Saturn. Actually the presentation of new images of the storm over Saturn's North Pole is the story. The hurricane was discovered in 2004 by the *Cassini* space probe.

90: The Tiniest Galaxy in the Universe. Segue 2 contains only 150,000 solar masses of material, one ten-millionth that of the Milky Way.

92: Third Radiation Belt Discovered Around Earth. Note, though, the third belt only lasted a couple of months in 2012.

99: Pluto's Crowd-Sourced Moons: Two more moons of Pluto were discovered in 2011 and 2012 and were named Kerberos and Styx by a 2013 internet poll.

Calendar of Events

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

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

January 11: Oklahoma Space Alliance meeting, 4:00 p.m. at Harry Bear's in Moore Oklahoma.

January 30: Mercury is at greatest eastern elongation, 18 degrees from the Sun (so can be seen after sunset).

February 8: Oklahoma Space Alliance meeting, 3:30 p.m. at Harry Bear's in Moore Oklahoma.

February 12: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Spaceport.

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

February 22: Launch date for Space-X's third resupply flight to the ISS.

February 23: Neptune is in conjunction with the Sun.

March 8: Oklahoma Space Alliance meeting, location to be announced.

March 12: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

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

March 26: Expedition 39/40 is launched to the Space Station.

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

April 2: Uranus is in conjunction with the Sun.

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

April 8: Mars is at opposition.

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

April 12: Yuri's night. 53rd anniversary of manned space flight.

April 12: Oklahoma Space Alliance Yuri's Night Celebration, details to be announced.

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

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

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

May 1: Orbital Services second Antares launch to the ISS.

May 10: Saturn is at opposition.

May 10: Oklahoma Space Alliance meeting, location to be announced.

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

May 24: May Camelopardalids. This is a new meteor shower, and may turn out to be the best of the year.

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

May 28: Expedition 40/41 is launched to the Space Station.

June 6: SpaceX resupply mission to the Space Station.

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

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

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

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.

July 4: Pluto is at opposition.

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

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

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

July 20: 45th Anniversary of first moon walk.

July 24: Jupiter is in conjunction with the Sun.

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

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

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

August 12: 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 or visit en.wikipedia.org/wiki/Rosetta_%28spacecraft%29.

August 29: Neptune is at opposition.

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

September 12: SpaceX resupply mission to the ISS.

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

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

September 22: *MAVEN* arrives at Mars.

September 24: *Mangalyaan* arrives at Mars.

September 30: Expedition 41 launched to the ISS.

October 7: Uranus is at opposition.

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

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

October 15: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

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

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

October 25: Venus in superior conjunction with the Sun.

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

November 12: [Tentative.] Oklahoma Space Industry Development Authority Meeting at 1:30 p.m., Oklahoma Department of Transportation Building in Oklahoma City.

November 18: Saturn is in conjunction with the Sun.

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

December 1: Expedition 42 launched to the space station.

December 5: SpaceX resupply mission to the ISS.

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

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

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: 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/.

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: 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 2015 after being moved from 2014.]

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.

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.

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

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

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: 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.]

January 2017: Proposed launch date for the European Space Agency/NASA Solar Orbiter (SoHO), 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 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.

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

Sometime in 2018: Russia launches the orbiter of the “Luna-Glob” mission. [See 2016 for the lander launch.]

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 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, 2014 (Area Code 405)

Steve Swift, President & <i>Update</i> Editor	496-3616 (H)
David Sheely, Vice President	821-9077 (C)
Syd Henderson, Secretary & <i>Outreach</i> Editor	321-4027 (H) 365-8983 (C)
Tim Scott, Treasurer	740-7549 (H)

Claire McMurray, Communications 329-4326 (H) 863-6173 (C)

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sswift42 at aol.com (Steve Swift)

cliffclaire at hotmail.com (Claire McMurray)

sydh at ou.edu (Syd Henderson)

ctscott at mac.com (Tim Scott)

t_koszoru01 at cox.net (Heidi and Tom Koszoru, new address)

sheely at sbcglobal.net or david.sheely.1 at us.af.mil (David Sheely)

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

lensman13 at aol.com (Steve Galpin)

E-mail for OSA should be sent to sydh@ou.edu. 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 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.)

_____ \$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 – January 2014

102 W. Linn #1, Norman, OK 73069

NOTE TIME AND LOCATION

Oklahoma Space Alliance will meet
at 4:00 on Saturday, January 11
at Harry Bears Restaurant,
2113 Riverwalk Dr., Moore, Oklahoma,