

OUTREACH May 2014

May Meeting:

Oklahoma Space Alliance will meet at 3:30 on Saturday, May 10, 2014, at Harry Bears All-American Grill, 2113 Riverwalk Dr., Moore, Oklahoma, (2 tenths of Mile South of S. 19th And West of I35 Frontage Road). The number is 405-799-2327.

Steve and Karen Swift will be not be able to make the meeting this month, so OSA vice-president David Sheely will be directing the meeting. Claire McMurray will also be absent although we can still discuss the Art Contest and discuss other possible projects for the coming year Possible discussion topics: The United Kingdom's pro-business space plans; The ban on importing RD-18-0 engines form Russia; Space X 's recoverable rocket, the Status of the Space Fence procurement.

Celebration of Spaceflight

Oklahoma Space Alliance didn't have their regular meeting in April. Instead on April 12, we co-sponsored a celebration of spaceflight the Stafford Air and Space Museum in Weatherford, Oklahoma. The occasion was the 53rd anniversary of Yuri Gagarin's flight into space which made him the first human to orbit the Earth. It was also the 33rd anniversary of the first flight of Space Shuttle *Columbia*, the first shuttle to orbit the Earth. And, as it happens, April 11 was the 44th anniversary of the launch of *Apollo 13*, whose accident occurred on April 13.

We toured the museum, after which Stafford Museum Director Max Ary gave a speech on the anniversaries, and Oklahoma Space Alliance President Steve Swift also gave a brief talk on the occasion, then Ary introduced the feature attraction, a showing of the movie *Apollo 13*. There were well over a hundred people attending the movie showing. I estimated 150, but officially it was about 120.

The museum has a new feature attraction, a full-scale mock-up of an Apollo command module. Ary was formerly director of the Cosmosphere, which he left under unfortunate circumstances. The Cosmosphere's SpaceWorks team worked on the restoration of the *Apollo 13* and *Liberty Bell 7* space capsules, and both Jim Lovell and Gene Krantz visited the *Apollo 13* capsule when they visited the Cosmosphere. It was the first time Lovell had seen the capsule since it was lifted onto the carrier after splashdown. The reunion was a very emotional experience for Lovell.

Ary was still the director of the Cosmosphere when Ron Howard contacted him about making an accurate movie about the *Apollo 13* space flight. All the reconstructions of the Apollo spacecraft were made by SpaceWorks. During the movie, facts about the spaceflight were projected on the side of the command module mock-up.

I counted seven members of Oklahoma Space Alliance attending the celebration, but there may have been some that I missed.

Space News

The biggest space news since the last *Outreach* was the announcement in March of the discovery in the Cosmic Background Microwave Radiation of wrinkles and polarization. This was hailed to be confirmation of the inflationary theory of the expanding universe. (Actually, it confirms several different versions inflationary theories.) Essentially, any quantum fluctuations in the first 10^{-32} seconds would leave an imprint on the background radiation. But even more, the microwaves were found be polarized in swirls in a manner that can only be accounted by gravitational waves. This is the strongest proof of the existence of gravitational waves ninety-eight years after Einstein predicted them as part of his General Theory of Relativity. With the enormous expansion that's part of the inflationary universe, the swirls of polarization now measure billions of light-years across. This is the strongest evidence that gravity must be quantized.

A brilliant fireball enlivened the daytime skies of Toronto and New York State on May 4, lasting about 24 seconds until it disappeared in a puff of smoke. This is the third fireball seen in three days, the other two being over Arkansas on the night of May 2, and over North Carolina on the night of May 3. The meteors appeared right before the peak of the Eta Aquarid meteor shower, but it's uncertain whether the meteors are related to the meteor shower (although it does seem to me that they may be related to each other).

As near as I can tell, none of these meteors caused any damage. The Toronto event was caught live on many car cameras, much like the Russian meteor that hit in February 2012.

For the first time, scientists have measured the rotational speed of a planet outside the solar system. Beta Pictoris b has somewhere between 4 and 11 times the mass of Jupiter, and spins at 15 miles per second. In comparison, Jupiter spins at 8 miles per second and Earth at a paltry 0.3 miles per second. This doesn't tell you the length of the day unless you know Beta Pictoris b's diameter, but we can make some guesses: Beta Pictoris b is far enough from its star that it probably isn't much bloated by heating, and planets more massive than Jupiter aren't much larger, the extra mass going into increasing the density rather than the diameter. So Beta Pictoris b likely has a 5-6 hour day.

In case you're wondering how they measured this, what they did is measure the Doppler shift of the light from the side of the planet approaching us and the light from the side of the planet moving away from us. The Doppler shift gives you the speed of rotation.

Data from the WISE spacecraft has uncovered yet another new neighbor of the Sun. Brown dwarf WISE J0855-0714 is around 7.2 light-years from the Sun, making it closer than any other stellar system other than the Alpha Centauri triplet, Barnard's Star and the brown dwarf twins WISE J1049 (not counting the Solar System itself).

SpaceX has achieved another milestone, with some caveats. On April 22, they made a launch to the Space Station during which they successfully achieved a soft landing in the ocean by the first stage of a Falcon 9. Alas, the stage couldn't be recovered because of high and dangerous seas, but they did get eight seconds of data after splashdown, indicating that it did indeed make a soft landing.

Sky Viewing

As I mentioned in the March *Outreach*, there's a good chance we'll have a really good meteor shower on the morning of May 24. This is a new shower linked to Comet 209P/LINEAR, and doesn't seem to have a firm name, although I've heard it referred to as the Camelopardalids. What's happening is the small short-period Comet 209P/LINEAR is making an unusually close pass by the Earth. Although this doesn't mean much for comet viewers – this comet is mostly burnt out from its many passes and won't be brighter than 10th magnitude at best--Earth will be passing directly through the rubble that trails the comet. The reason we're getting this shower now, when the comet wasn't even discovered until 2004, is the comet passed about 54 million miles of Jupiter in 2012, and this perturbed it into this new orbit. I've seen prediction of between 100 and 400 meteors an hour, which would certainly make it about the best shower of the year, but this is a new shower and there's lots of guesswork.

Mercury was in superior conjunction with the Sun on April 25, but is heading for its best apparition of the year for viewers in the Northern Hemisphere. From May 16 through 28, Mercury will be more than 10 degrees above the horizon 45 minutes after sunset. On May 22, Mercury will be setting two hours after the Sun, but it will also be only magnitude 0.4. It will be around magnitude -6 on May 13, but will also be lower in the sky. Mercury will fade in June and not be visible as it approaches inferior conjunction at mid-month.

Venus is currently low in the eastern sky just before sunrise, but at magnitude -4 is easy to spot even in twilight. It will be rising a couple of hours before the Sun through the end of June, and doesn't fade much over the next two months.

Mars was at its brightest in mid-April, when it was at opposition, but it is still magnitude -1.2 at the beginning of May, and will be magnitude -0.5 at the end of the month, and magnitude 0 at the end of June. It's effectively in the sky all night long, in the constellation Virgo. Virgo's not a particularly bright constellation except for the first-magnitude star Spica, and Mars is currently about two magnitudes brighter than Spica, so it rules the constellation at the moment.

Jupiter is still dominating the early evening sky, and at magnitude -2, is brighter than any celestial object at that hour other than the Moon. (Venus is brighter, but it's a morning star this month.) It's in the middle of Gemini. Those two bright stars north of it are Castor and Pollux, with Pollux being the brighter. The bright star south of it is Alhena, aka Gamma Geminorum. Castor, Pollux and Alhena form a distinctive triangle which is great for locating planets.

Saturn is at opposition on May 10, and this is a perfect opportunity for viewing the ringed planet. Saturn will be magnitude 0.1 and its rings will be tilted 22° to our line of sight. It is currently in the constellation Libra and the brightest object in that constellation. On May 10, it will be about half-way between the first-magnitude stars Spica and Antares, with Mars being on the other side of Spica. In fact, in the early evening, you can follow the ecliptic through Mercury (maybe) Jupiter, Regulus, Mars, Spica and Saturn.

If you are watching Saturn this month, look for the Seelinger effect, which will make the rings brighten for a couple of days around May 10. This is caused by the sunlight being reflected directly back at us by the ring particles combined with Saturn's shadow being directly behind Saturn, so we see more of the rings. A similar effect makes the Moon brighten about 40% when it is full.

The asteroids **Vesta** and **Ceres** were both at opposition on April 15, which suggests they must be close in the sky, and indeed they are, located in Virgo not that far from Mars. They are also approaching each other. At the moment they are less than three degrees apart (about the distance across your little and ring fingers held at arm's length), but on July 5, they'll be just ten minutes of arc apart. In comparison, the Moon is thirty minutes of arc in diameter. Unfortunately, the two asteroids will have dimmed to magnitudes 7.1 and 8.4 by then.

Luckily, Virgo is a pretty barren constellation, so it may still be possible to find them.
[Data for this section from *Astronomy, Sky & Telescope*, Wikipedia and NASA.]

Viewing Opportunities for Satellites (May 10 – June 10, 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, interpolating when necessary. (Note: I'm having problems accessing this from my home PC, but not from the Mac at work.) It doesn't give you information for Tiangong 1, so I'm using Heavens Above for that. The *Sky & Telescope* web site carries International Space Station observation times for the next few nights at skyandtelescope.com/observing/almanac.

With the addition of the solar panels, the International Space Station can be as bright as magnitude -3.5, making it brighter than all the stars other than the Sun and all the planets other than Venus, although magnitude -2 to -3 is more likely. The Hubble Space Telescope can get up to magnitude 1.5, which is brighter than the stars in the Big Dipper, although, since it is lower in the sky, it is more difficult to see. China's Tiangong 1 space station can get up to magnitude -0.6, which is brighter than all the night stars except Sirius and Canopus.

Missions to and from the Space Station may change its orbit. The next manned launch to the Space Station is that of Expedition 40/41 on May 28. The Dragon capsule currently attached to the ISS will leave on May 18, but I don't know that that will affect the Station's orbit.

Tiangong 1 May 13, 2014

Time	Position	Elevation
5:29 a.m.	298°	10°
5:32	26	81
5:35	115	10

ISS May 14, 2014

Time	Position	Elevation
5:51 a.m.	213°	21°
5:52	202	39
5:53	138	65
5:54	70	40

Vanishes into Earth's shadow

ISS May 17, 2014

Time	Position	Elevation
Appears from Earth's shadow		
5:03 a.m.	248°	41°
5:04	318	70
5:05	29	41
5:06	39	22

Tiangong 1 May 17, 2014

Time	Position	Elevation
10:09 p.m.	247°	10°
10:12:09	334	78
10:12:39	45	57

Vanishes into Earth's shadow

Tiangong 1 May 18, 2014

Time	Position	Elevation
9:01 p.m.	220°	10°
9:04	148	42*
9:06	75	10

*Passes between Mars and Spica

Tiangong 1 May 19, 2014

Time	Position	Elevation
9:28 p.m.	255°	10°
9:31	336	59
9:34	57	10

ISS June 1, 2014

Time	Position	Elevation
10:31 p.m.	218°	22°
10:32	210	41
10:33	137	73

Vanishes into Earth's shadow

ISS June 2, 2014

Time	Position	Elevation
9:42 p.m.	191°	18°
9:43	171	28
9:44	133	35
9:45	94	28
9:46	75	18

Hubble June 3, 2014

Time	Position	Elevation
10:11 p.m.	220°	20°
10:12	201	26
10:13:00	175	30
10:13:27	162	29

Vanishes into Earth's shadow

ISS June 3, 2014

Time	Position	Elevation
10:30 p.m.	266°	18°
10:31	286	28
10:32	324	35
10:33	1	28
10:34	21	18

ISS June 4, 2014

Time	Position	Elevation
5:01 a.m.	321°	22°
5:02	332	41
5:03	40	68
5:04	110	41
5:05	120	22

ISS June 4, 2014

Time	Position	Elevation
9:42 p.m.	242°	22°
9:43	254	40
9:44	320	65
9:45	25	40
9:46	37	22

Hubble June 4, 2014

Time	Position	Elevation
10:04 p.m.	224°	21°
10:05	205	27
10:06	178	31
10:07	151	27

Vanishes into Earth's shadow

Hubble June 5, 2014

Time	Position	Elevation
9:58 p.m.	226°	21°
9:59	208	28
10:00	181	31
10:00:49	154	27
10:01:15	144	25

Vanishes into Earth's shadow

Hubble June 6, 2014

Time	Position	Elevation
9:51 p.m.	229°	20°
9:52	211	27
9:53	184	30
9:54	157	27
9:55	139	20

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 Hubble Space Telescope at 10:11 p.m. on June 3, measure four fist-widths west of due south, then two 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:

May 12, 2:00 p.m.: Change of command ceremony on the ISS.

May 13, 5:15 p.m. Undocking coverage of Expedition 39 from the ISS. (Undocking is scheduled for 5:33 p.m.)

7:45 p.m.: Deorbit and landing coverage of Expedition 39. (Deorbit burn is at 8:03 p.m., with landing at 8:57 p.m.)

May 18, 8:00 a.m.: Coverage of the departure of the Dragon cargo craft from the Space Station. Release is scheduled for 8:30 a.m.

May 28, 2:00 p.m.: Launch coverage begins for the Expedition 40/41 to the Space Station, via Soyuz from Baikonur, Kazakhstan. (Launch is 2:57 p.m.) 8:00 p.m.: Expedition 40/41 arrives at the Space Station. Docking is scheduled for 8:47 p.m. 10:00 p.m. Hatch opening coverage begins. (Hatch opening is 10:30 p.m.)

June 10, 12:15 a.m. Launch coverage begins for Orbital Sciences' Antares Rocket and Cygnus Cargo Craft going to the ISS. Launch is scheduled for 1:07 a.m.

June 13, 5:30 a.m.: Coverage begins of the arrival of the Cygnus Cargo Craft at the ISS. Grapple is scheduled for 7:26 a.m.

Space-Related Article

"Rocketman," by Steve Nadis, *Discover*, May 2014, pp 36 – 41. A revolutionary new rocket engine that can get you to Mars in six weeks? Chang Diaz's rocket uses high pressure plasma as a propellant, with strong magnetic fields forcing out the plasma, and no chemical reactions at all. It's been tested on the small scale. But what do you use to generate the fields. A (relatively) lightweight nuclear fission reactor. Yep, it's just another variation of the nuclear rocket.

Calendar of Events

May 10: Oklahoma Space Alliance meeting, 3:30 p.m. at Harry Bear's in Moore, Oklahoma.

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 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.

No earlier than August [Moved from June]: SpaceX resupply mission to the Space Station.

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: 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/>.

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

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

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

July 9, 2016: [Moved from 2015.] The European Space Agency/JAXA BepiColombo Mercury Orbiter is launched. Home page is <http://sci.esa.int/bepicolombo>.

September 2016: Launch of *OSIRIS-REx*, the Origins Spectral Interpretation Resource Identification Security Regolith Explorer, which will orbit the near-earth asteroid 101955 Bennu 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 12, 2017: Venus is at greatest eastern elongation, 47 degrees from the Sun (so can be seen after sunset).

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

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

August 21, 2017: The next total solar eclipse visible in the United States, on a pretty straight path from Portland, Oregon to Charleston, South Carolina. St. Louis is the biggest city in-between.

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

Sometime in 2018: Russia launches the 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.)

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

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 Okla-homa. 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 – May 2014

102 W. Linn #1, Norman, OK 73069

NOTE TIME AND LOCATION

Oklahoma Space Alliance will meet

At 3:30 on Saturday, May 10

at Harry Bears Restaurant,

2113 Riverwalk Dr., Moore, Oklahoma,