OUTREACH May 2015

May Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, May 9, 2015 at Harry Bears All-American Grill, 2113 Riverwalk Dr., Moore, Oklahoma, (2 tenths of Mile South of S. 19th And West of I35 Frontage Road). The number is 405-799-2327.

Oklahoma Space Alliance Meeting

Program

2:00 PM

1) Guest Speaker— Michael Coffman from Greg Rasnake's office at FAA Office of Commercial Space Transportation
2) What's Happening
   Let's see and discuss articles, slides and videos of current Space and Space Industry news including launches, technology, developments, people and art. Great news this month includes ULA announcement of new rocket with innovative features and includes successful Blue Origin suborbital test.
3) Business Stuff
   a. Review Minutes
   b. New mail
   c. Treasurers Report
   d. Announcements
   e. Report on OSIDA
   f. Action and Status
      i. Lions Club Meeting Report
      ii. Meeting Sites
      iii. Speakers for OSA Meetings
         1. Congressman Bridenstine
         2. Dr. Stephen McKeever
         3. Greg Rasnake
      iv. Stafford Museum Joint Event
4) Informal Discussion and Departure

Minutes of April Meeting

Oklahoma Space Alliance met April 11 at the Norman Public Library. In attendance were Steve and Karen Swift, James and Peggy McBride, Gary, Rachelle and Stephanie Thibedeau, Tim Scott, Russ Davoren, Dennis Wigley, Dave Sheely, Craig Crawford, and Syd Henderson. We also had a guest named Michael.

This was the meeting closest to Yuri's Night (which is April 12), so we had our annual Celebration of Space Flight as part of the meeting, with a wide variety of food and refreshment. We watched a video on Yuri Gagarin, the first human in space, and also commemorated Alan Shepard, the first American in Space, and John Glenn, the first American (and third human) to orbit the Earth. Steve thinks it was a good thing that the first person in space was a Russian.

Space X's Dragon capsule is currently the only commercial spacecraft that can bring back a significant amount of material from the Space Station. Sierra Nevada's Dream Chaser will be the second.

What's Happening in Space (more details are in the April Update, which was posted a week after the meeting):

There were eight launches in six days in late March, by various nations. These included a Delta IV launch on March 25, a Russian launch of a South Korean satellite on March 25, a Japanese spy satellite launch on

March 26, the Soyuz 13 launch by Russia from Kazakhstan to the Space Station on March 27 (the one-year crew launch), an Ariane launch of a Galileo navigation satellite on March 27, India's Polar Science Launch vehicle on March 28, China's Long March 3C on March 30, and a Russian launch of navigation satellites on March 31.

Steve talked about electric propulsion keeping satellites' orbits from decaying. This lowers the mass of satellites.

A Cosmic Lifestyle Corporation's Kickstarter has produced a cocktail glass for zero-g. The glass (it actually looks like plastic to me, but it has the shape of a cocktail glass has a grooved surface to which liquid adheres and which direct the liquid to the astronaut's mouth. The glass can be fabricated with a 3D printer, though the drink (and the astronaut) cannot.

We watched a video, "Wanderers" originally narrated by Carl Sagan.

Dennis showed us amateur photography of the Space Station from the surface of the Earth by his astronomical partners, by processing images from other photographers.

We talked about possible meeting rooms. Room C at the Norman Public Library was quite full at the April meeting. Meeting room B is twice as big, and Steve would like to get it for our talk in May. (We didn't. This room is in great demand.)

Russ and Steve have had little contact with the Stafford Space Museum. The June event, the Apollo-Soyuz reunion, is quite pricey, with tickets over $100.

-Minutes by OSA Secretary Syd Henderson

Space News: Name the Exoplanets

The International Astronomical Union is allowing the general public to vote on names for exoplanets. The host stars can also be named unless they already have names. Of the original list of 20 stars, five have common names: Fomalhaut, Pollux, Errai (gamma Cephei), Ain (epsilon Tauri, the Bull's eye), and iota Draconis (Edasich), and these stars will not be renamed. The names are to be selected from a list compiled earlier by astronomy clubs, planetariums and other astronomy associated organizations. However, the final voting is open to the public, either as individuals or as organizations. (So Oklahoma Space Alliance could register as a group.)

The website to register is http://www.nameexoworlds.org/ and the deadline is June 11.

If you're interested in how the list was compiled and what the criteria were, visit http://www.nameexoworlds.org/the_process. You'll be thankful that they took precautions against people naming a star for their poodle.

International Space Development Conference

The 34th annual ISDC® is in Toronto, Canada May 21 – 24. The theme is Next Breakthrough Technologies. These include 3D printing, gene splicing, nuclear fusion, and electric and magnetic propulsion (and whatever that controversial reactionless drive is that NASA's studying). There is also the Space Innovation Business Summit on May 20, which is a separate registration from the ISDC®.

Guests include Anousheh Ansari, Lori Garver, physicist Kip Thorne and Buzz Aldrin. The website is isdc2015.nss.org/wordpress/, and you can register for both the ISDC® and the Summit.

Space News:

Italian astronaut Samantha Cristoforetti marked a new first for civilized space when she drank the first cup of coffee ever brewed on the Space Station. Specifically, it was the first cup of expresso in space. Previous

astronauts had to settle for instant. Ms. Cristoforetti donned a *Star Trek*'s captain's uniform for the occasion. (Janeway of *Voyager* I believe. Otherwise she might have to drink Earl Gray tea.) The ISSpresso machine can also make chocolate, broth and, yes, tea, Earl Grey or otherwise.

The ISSpresso machine can also be used to study fluid dynamics in space, but you know that's just an excuse. However, the coffee is dispensed into a transparent plastic pouch so the mixing of coffee and cream can be directly observed. The coffee can be drunk through a straw, but Cristoforetti actually dispensed it into a Zero-G coffee cup. This was created by a 3D printer, and is part of a study on capillary beverage flow. I believe the Zero-G Cocktail Glass we saw in the April *Update* may be part of the same study, although the coffee cup is transparent.

The *Messenger* space probe's four-years of orbiting Mercury ended at 2:36 CDT on April 30, when it was deliberately crashed into the surface of the planet. The spacecraft was expected to create a fifty-foot wide crater on the surface of Mercury. The ESA/Japanese *BepiColombo* probe will arrive in 2024 and observe the weathering of the crater.

In its mission, *MESSENGER* completed the map of Mercury begun by *Mariner 10*, the only previous probe to visit Mercury, and confirmed water ice and carbon compounds in craters near Mercury's poles. The ice and organic compounds likely come from comets and asteroids.

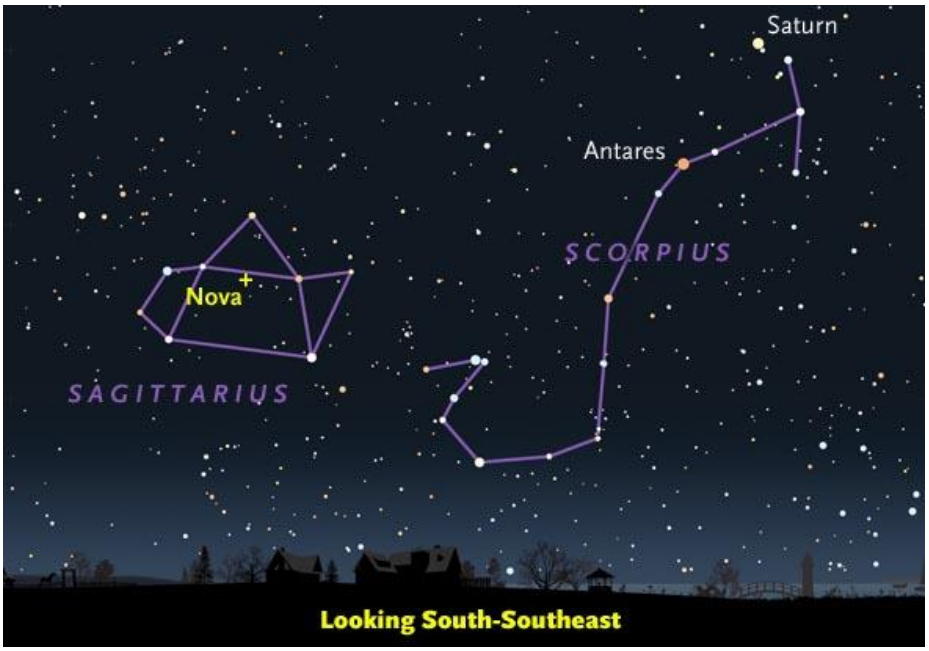
On the same day as the crash, five craters on Mercury were named as result of a contest. Craters on Mercury are named after figures from the arts, and in this case the craters were dubbed Carolan, Ebheduanna, Karsh, Kulthurn and Rivera. Rivera is named after famous artist Diego River. Enheduanna is named after a Sumerian princess who is the earliest known author and poet in history.

The *New Horizons* spacecraft will not reach Pluto until July 14, but it is already detecting broad features on the planet, including dark and light patches, including what seems to be a polar cap. [A comment: We already knew that Pluto had light and dark patches from observations by the Hubble Space Telescope, which were enhanced to create an extremely blurry map. As near as I can tell, we have no map of Charon yet.]

LEDs may be a godsend for mankind but one group of people is worried. This month's *Astronomy* has an article, "A New Fight for the Night, on how low-cost LED lighting is upsetting astronomers at the big observatories in Chile. In particular, the LEDS, including the new blue ones, produce broader spectrums and more pollution, and their low energy cost encourages more use than incandescent lights. Chile has a dark-sky ordinance, but the problem is enforcement, especially with improvements in the Panamericana Highway (LED streetlights).

Sky Viewing

Nova Sagittarii 2015 No.2 is currently fluctuating between magnitude 4.5 and 6.4, which means it's still visible to the naked eye under dark skies. There's some hope that it will be what is called a "slow nova," and possibly not reach peak brightness until July, possibly reaching second magnitude. It is located just under the lid of the Teapot asterism in Sagittarius, which gives me an excuse to rerun the star map from the March *Outreach*:



This is an excellent month for planet-gazing, with four of the planets near peak brightness and in the night sky simultaneously.

We are currently having the best appearance of **Mercury** of the year. Mercury reached greatest elongation on Wednesday, May 6, and, because of the angle the ecliptic makes with the western horizon at sunset this time of year, it is still 11 degrees above the horizon about 45 minutes after sunset. Although it is a bit dimmer than it was last week, it's also easier to see, since it is higher above the horizon. Unfortunately, Mercury fades rapidly at midmonth as it approaches inferior conjunction with the Sun on May 30. Mercury will also be half a magnitude brighter.

In June, Mercury will brighten through the month as it approaches greatest western elongation on June 24. It will be two degrees from the first-magnitude star Aldebaran on that date. Mercury will be slightly higher and to the left of Aldebaran

Venus is currently magnitude -4.2 and still dominates the evening sky when the Moon isn't present. At present, it's setting more than three hours after the Sun (and, in fact, is visible very soon after sunset if you know where to look). Venus is, in fact brightening as it approaches greatest elongation on June 6. However, since the ecliptic is making a sharper angle with the horizon this month, Venus is actually highest in the sky on May 8. At the end of May, Venus will be almost in a straight line with Castor and Pollux in Gemini. (Pollux is the star in the middle.) On June 6, Venus will be only one degree north of the Beehive Cluster in Cancer.

Jupiter meanwhile is high in the southern sky at sunset, shining magnitude -2.1 in the constellation Cancer. (This is actually a good way to find that dimmest constellation of the Zodiac.) Jupiter has been moving west from night to night, while Venus is moving east, at least until June 6. The two planets are in fact approaching a conjunction in late June and early July, when they will be within two degrees of each other. On the evening of June 30, Venus and Jupiter will be only twenty minutes of arc from each other, which is two-thirds the diameter of the Moon. This is the first in a set of three conjunctions between the two planets, the others being on the evening of July 31 and the morning of October 26.

Saturn is currently rising about sunset and is highest in the sky about midnight. It is currently near the head of Scorpius and at magnitude 0.1 is the brightest object in the constellation, nearly a full magnitude brighter than Antares. Saturn is also nearing opposition, which it will reach on May 22, at which point it will be magnitude 0.0 and located in Libra. This is an excellent time to view Saturn, since the rings will be tilted 24 degrees with respect to Earth.

In contrast to the other planets, **Mars** is not visible at all in May and June, and most of July as well, since it is approaching a conjunction with the Sun on June 14.

Uranus is also lost in twilight after its recent opposition, but will begin to be visible before dawn in June. It will still be low enough in the sky that binoculars will be required even under dark skies. It's also located in a nondescript region of Pisces, which makes it even harder to locate.

Neptune is low in the east-southeastern sky before dawn, and, at magnitude 7.9, requires binoculars at least. It's about two degrees southwest of Lambda Aquarii, in a region of stars which all look more or less like Neptune.

The asteroid **Pallas** reaches opposition on June 11, at which time it will reach 9th magnitude. Pallas has an unusually inclined orbit for an asteroid, and this time it will be spending the month of June in the constellation Hercules. On June 13, Pallas will be half a degree south of Lambda Herculis, which is admitted only magnitude 4.4, but on June 30, it will be half a degree south of Delta Herculis, which is magnitude 3.1 and even has its own name (Sarin). (A map is in on page 43 of the June issue of *Astronomy* magazine.)

[Material for this section of *Outreach* comes from the May and June issues of *Astronomy* and *Sky & Telescope*, and the *Sky & Telescope* web site. The star map is from that website.]

Viewing Opportunities for Satellites (May 9 – June 9, 2015)

You can get sighting information at www.heavens-above.com, which allows you to get satellite-viewing data for 10-day periods, and gives you a constellation map showing the trajectory of the satellite. Heavens Above has changed its detail view so that you can no longer get location coordinates. On the other hand, it does give useful maps.

http://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/JavaSSOP/JavaSSOP.html gives coordinates at 20-second intervals from when the satellite rises, not from when it peaks. I'm using its information for the International Space Station and Hubble Space Telescope, interpolating when necessary. (Note: I'm having problems accessing this from my home PC, but not from the Mac at work.) It doesn't give you information for Tiangong 1, so I'm using Heavens Above for that. The *Sky & Telescope* web site carries International Space Station observation times for the next few nights at skyandtelescope.com/observing/almanac.

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

Missions to and from the International Space Station may change its orbit. The next manned launch to the Space Station Expedition 44 on May 26.

The Hubble Space Telescope is in the morning sky around dawn for several days before June 7, but the one sighting opportunity listed is the only one where the sky is still pretty dark.

Tiangong 1 May 12, 2015

Time	Position	Elevation
9:44 p.m.	244°	10°
9:47	332	84
9:50	62	17

Tiangong 1 May 14, 2015

Time	Position	Elevation
9:24 p.m.	163°	10°
9:27	335	46
9:30	62	10

ISS May 13, 2015

Time	Position	Elevation
5:49 a.m.	247°	20°
5:50	262	37
5:51	320	56
5:51:45	18	37
5:52:18	29	26
Vanishes into Earth's Shadow		

ISS May 30, 2015

Time	Position	Elevation
10:07 p.m.	202°	20°
10:08	185	34
10:09	134	49
10:10	82	34
10:11	62	20

ISS June 1, 2015 (morning)

Time	Position	Elevation
5:21 a.m.	315°	22°
5:22	319	42
5:23	47	83
5:24	125	42
5:25	129	22

ISS June 1, 2015 (evening)

Time	Position	Elevation
9:59 p.m.	247°	20°
10:00	262	37
10:01	320	56
10:02	18	37
10:03	33	21

ISS June 2, 2015

Time	Position	Elevation
9:06 p.m.	213°	21°
9:07	202	39
9:08	134	65
9:09	69	39
9:10	58	21

ISS June 4, 2015

Time	Position	Elevation
4:20 a.m.	306°	22°
4:21	300	42
4:22	216	76
4:23	147	41
4:24	60	21

HST June 7, 2015

Time	Position	Elevation
5:42 a.m.	230°	20°
5:43	211	26
5:44	185	29
5:45	159	26
5:46	141	19

Key: Position is measured in degrees clockwise from north. That is, 0° is due north, 90° is due east, 180° is due south, and 270° is due west. Your fist held at arm's length is about ten degrees wide. "Elevation" is elevation above the horizon in degrees. Thus, to see the Hubble Space Telescope at 5:42 a.m. on June 7, you would measure four fist-widths south of due west, then two 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, 1:15 p.m.: Change of Command Ceremony on the ISS.
May 13: 1:00 Hatch closure coverage on the ISS. 5:15 Undocking coverage,. 6:15 p.m.: re-entry and landing coverage. Landing is at 8:03.

May 20 and 21, 7:00 a.m.: Live coverage of the 2015 Robot mining competition.

Mar 26, 1:45 p.m.: Launch of expedition 44 to the ISS (launch is at 2:47 p.m.) 8:00 p.m.: Docking coverage. 9:45 p.m.: Hatch opening.

Calendar of Events

May 8: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See http://www.okcastroclub.com/ for details.

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

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

May 20 – 24: International Space Development Conference in Toronto, Canada. For more information, visit http://isdc2015.nss.org. Focus is on "Next Breakthrough Technologies."

May 22: Saturn is at opposition.

May 26: Launch of Expedition 44 to Space Station 2:46 p.m. CDT.

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

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

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

June 12: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See http://www.okcastroclub.com/ for details.

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

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

June 14: Mars is in conjunction with the Sun.

June 14: The Moon occults Mercury.

June 19: Space X resupply mission to the Space Station.

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

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

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

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

July 10: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See http://www.okcastroclub.com/ for details.

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

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

July 18: The Moon occults Venus.

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

July 28: Peak of Delta Aquarid meteor shower.

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

August 12: Peak of Perseid meteor shower.

August 14: Oklahoma City Astronomy Club meets at Science Museum Oklahoma (formerly the Omniplex). There will be a novice session in the planetarium at 6:45 p.m., followed by a club meeting at 7:30 p.m. See http://www.okcastroclub.com/ for details.

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

August 17: Launch of JAXA's HTV5 Cargo Craft to the Space Station. This launch includes the Calorimetric Electron Telescope (CALET) and the Multi-User System for Earth Sensing (MUSES).

August 26: Jupiter is in conjunction with the Sun.

August 31: Neptune is in opposition.

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

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

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

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

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

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

October 11: Uranus is at opposition.

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

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

October 21: Peak of Orionid meteor shower.

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

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

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

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

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

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

November 17: Peak of Leonid meteor shower.

November 20: Launch of Expedition 46 to the Space Station.

November 29: Saturn is in conjunction with the Sun.

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

December 14: Peak of Geminid meteor shower.

December 22: Peak of Ursid meteor shower.

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

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

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

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

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

May 9, 2016: Mercury transits the Sun's disk. Oklahoma sees most of the transit, but it is visible in its entirety in the eastern US, western Europe and all of South America.

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

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

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

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

September 2016: Launch of *OSIRIS-REx*, the Origins Spectral Interpretation Resource Identification Security Regolith Explorer, which will orbit the near-earth asteroid 101955 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 [tentative]: China launches the *Chang'e 5* lunar sample return mission..

Sometime in 2017: India launches *Chandrayaan 2*. This mission will include a lunar rover. For more information, visit http://en.wikipedia.org/wiki/Chandrayaan-2. [Moved from 2014.]

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

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

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

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

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

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

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

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

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

Sometime in 2020: Launch of the European Space Agency's Euclid space telescope. This will map the distribution of dark matter and search for evidence of dark energy. The Euclid website is http://sci.esa.int/euclid.

Sometime in 2020: First launches of the modules of the Chinese space station *Tiangong-3*. The station should be finished by 2022.

Sometime in 2022: Proposed launch date of JUICE, the Jupiter Icy Moon Explorer, by the European Space Agency. The JUICE web site is http://sci.esa.int/juice.

January 2022: *BepiColombo* arrives at Mercury orbit.

Sometime in 2023: Arrival of OSIRIS-Rex at the near-earth asteroid 101955 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, 2015 (Area Code 405)

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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. Website is http://airspaceportok.com/#home,

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-mailnsshq@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 $20 introductory rate for new members ($35 for new international members). Regular membership rates are $55, international $65. Student memberships are $18 new, $25 renew. Senior memberships are $20 new, renew $40. 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.marssociety.org. One-year memberships are $50.00; student and senior memberships are $25, and Family memberships are $100.00. Their address is Mars Society, Box 273, Indian Hills CO 80454.

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