

Oklahoma Space Alliance OUTREACH

May 2016

May Meeting:

Oklahoma Space Alliance will meet at 2:00 p.m. on Saturday, May 14, 2016 at Earl's Rib Palace, 920 SW 25th St, Moore, OK. This is between the 1-35 West Frontage Road and Telegraph Road, a couple of blocks south of Harry Bears. Telephone number is 793-7427.

Place: Earl's Rib Palace
Moore Oklahoma
2:00-5:00 PM

- 1) Introductions
- 2) Enjoy Meal or Snack During Meeting
- 3) What's Happening (Steve Swift)
 - a. See SpaceX Falcon 9 Booster Landings
 - b. See Pictures and Videos of Space News
- 4) Video: Chris Vorhees of Planetary Resources talk at Mars Society Conference
- 5) Discuss Business
 - a. Review OSA Accounts
 - b. Discuss Activities for 2016
- 6) OSIDA Report
- 7) Chat

Minutes of April Meeting

Oklahoma Space Alliance met at Earl's Rib Palace in Moore on April 9, 2016. Attending were Steve, Karen and Bryan Swift, Russ Davoren, Syd Henderson, Jasmine Kendricks, Claire and Clifford McMurray, Nico Cinocco, John Northcutt, Don Robinson, Tim Scott, Dave Sheely, Rob Stanley and Rosemary Swift. Our guest speaker for the meeting was Michael Coffman from the Federal Aviation Administration's Office of Commercial Space Transportation, and he brought two children.

There were eight FAA launch events in 2015, of which seven were successful, the exception being the loss of one of SpaceX's resupply missions to the International Space Station. There were three licensed re-entries, all by SpaceX. (Orbital ATK's resupply missions burn up in the atmosphere.) There were also three suborbital permits, two to Blue Origin and one to SpaceX. There were four launches from the United States to the Space Station, three by SpaceX and one by Orbital ATK. [Orbital had its own launch failure in 2014 and didn't really get back to launching until well into 2015.--Syd]

Blue Origin re-launched its New Shepard rocket on April 2, and we watched its third flight.

The Bigelow expandable space module was attached to the Space Station in its compressed state. [It will be expanded on May 26 with live coverage on NASA TV.--Syd] Bigelow wants to have free-flying space hotels to be destinations for commercial launches.

We watched a video on SpaceX's landing capabilities. They plan to have one-third of their landings on land and the rest in the ocean.

We watched a Bob Zubrin video. He mentions that the most important skills for a two-man crew landing on Mars are (1) the ability to fix things and (2) field geology. He didn't mention the ability to grow potatoes.

We have \$1075.89 in our checking account and \$207 in cash.

After the meeting, fourteen of us went to Claire and Clifford McMurray's house for a pizza party to celebrate Yuri's Night and manned spaceflight. Attending were Jasmine, Rosemary, Dave Sheely, Tim Scott, Kay Fiel, Bill Sheely, Steve, Karen, Bryan, Nico, John and Syd, in addition to our hosts.

NSS News

The winner of the 2016 Robert A Heinlein Memorial Award is science and science fiction writer Jerry Pournelle. Pournelle was very active in the L5-Society (one of the organizations that merged to become the National Space Society) in the 1970s and was co-chair of the first International Space Development Conference. He was also chair of the Citizen's Advisory Council on National Space Policy. (Info from the NSS Website.)

Pournelle is probably best known for his collaborations with Larry Niven, which include the novels *The Mote in God's Eye*, *Oath of Fealty*, *Lucifer's Hammer* and *Inferno*. I first knew of him, however, as the science columnist for *Galaxy* science fiction in the 1970s (a post formerly held by Willy Ley) where he introduced me to a lot of speculative space science, including the early work of Stephen Hawking on black holes. These were collected into his collection *A Step Farther Out* and are still worth reading.

Letter from NSS on 2016 International Space Development Conference®

May 7, 2016

Dear Space Enthusiast:

The National Space Society invites you to discover Space Beyond Borders at the International Space Development Conference® 2016 (isdc.nss.org/2016) this May 18-22 at the Sheraton Puerto Rico Hotel & Casino in San Juan, Puerto Rico.

Imagine for a moment... Tomorrow, for the first time ever, mankind was landing on Mars. That would be amazing! Leaping into Space Beyond Earth and landing on another planet will be the most exciting accomplishment of Our Time.

The International Space Development Conference® is for everyone interested in or involved in all things about Space including Space Exploration, Moon Settlement, Mars Exploration and Settlement, Living in Space, New Discoveries, Innovative Technologies, Commercialization of Space, Asteroid Harvesting, Space Solar Power, Space Tourism, and Space Law and Policy.

Our trip to Space, to the Moon, to Mars, and Beyond is happening NOW! Bear witness and be a part of the movement.

Come to Puerto Rico, where the Milky Way shines brightly and the blue Caribbean waters shimmer.

ISDC® 2016 is where space leaders, astronauts, professionals and the next generation of students convene to examine the technical, scientific, economic, and social challenges and potentials of space exploration.

Do not miss out on this great opportunity and register now at isdc.nss.org/2016

The **National Space Society** is looking forward to seeing you this May in Puerto Rico.

Sincerely,

Bruce Pittman

Senior Vice President & Senior Operating Officer,

National Space Society

Space News

The *Kepler* space telescope announced May 10 that of the 4302 candidate planets identified in their catalog of July 2015, 1284 are actually planets (to a probability of more than 99 percent), while another 1327 have a probability of 50 percent or greater to be planets. Even allowing that a few of the 99-percent probables are false alarms, that still brings the number of known exoplanets to more than 3200. 550 of the newly discovered planets appear to be rocky planets and nine are in their star's habitable zone.

Up until a couple of weeks ago, Ceres and Makemake were the only dwarf planets not known to have a moon. Ceres certainly doesn't (or else the *Dawn* space probe would have detected it), but observations by the Hubble Space Telescope have revealed that Makemake is not alone. Makemake has a diameter a little less than 900 miles, while the newly discovered moon appears to have a diameter of 100 miles. Since scientists have been looking for a moon of Makemake since its discovery, one this size must be very dark, which is odd because Makemake is quite shiny.

We now know in retrospect that the moon had actually betrayed its existence earlier. One odd thing about Makemake was that it appeared to have a variable albedo (reflectiveness) but it didn't vary in time with the rotational period of Makemake. This puzzle has now been solved: they were seeing the moon. The variability comes from the equator of Makemake is edge on to our point of view, so the moon is transiting its disk.

Makemake reflects about 86% of the light that reaches it, which allows it to be the second brightest Kuiper Belt object. Its moon, if it is the size indicated, reflects only four percent of the light reaching it. It's suspected it may have come from a different part of the Kuiper Belt.

The moon has a temporary name of MK2, but I'm sure that will change. Since Makemake is the name of an Easter Island creation deity, Mk2 will surely be named after another deity.

[Source is www.skyandtelescope.com “News” for May 5, which references “Coincidence of a high-fluence blazar outburst with a PeV-energy neutrino event,” by Kadler *et al.* on the *Nature* website. <http://www.nature.com/nphys/journal/vaop/ncurrent/full/nphys3715.html>. Warning: This is a very technical paper.]

Sky Viewing

Mars will be at opposition on the night of May 22, and will be magnitude -2.1, the brightest it’s been since 2005. In fact, it will be as bright as Jupiter, which was at opposition on March 8. Mars will actually be closest to Earth on May 30 when it is 47 million miles away. During May and June, Mars will be visible all night long, increasing from magnitude -1.5 to -2.1 and back again. This year’s approach is good, but Mars can come within 35 million miles of Earth, at which point it is magnitude -3.0. The last time this happened was 2003. Mars is currently within the northern part of the constellation Scorpius but its retrograde motion will carry it back into Libra before Mars returns to Scorpius later this year.

Saturn is also nearing opposition on June 2 at magnitude 0.0. Interestingly, it’s not in one of the classical Zodiacal constellations, but in the southern part of Ophiuchus, the Serpent-Bearer. This does not mean that Saturn has wandered off the Ecliptic; in fact much more of the Ecliptic runs through Ophiuchus than through neighboring Scorpius, but Scorpius has better press, and is much more prominent. In fact, the closest bright star to Saturn is Antares, which is not all that far from Mars. Being near opposition, Saturn is also visible all night long and is easy to find since nearby Mars is so prominent. Saturn’s rings are currently tilted at 26 degrees, which makes for good telescope viewing.

Jupiter is currently dominating the southern sky at sunset and the western sky until midnight. It’s located in the southern part of the constellation Leo. The bright star above and to the west of Jupiter is Regulus, which sits in the handle of the Sickle of Leo, and the bright star above and to the east of Jupiter is Denebola, the tuft on the tail of the Lion.

Mercury is not currently visible since it was at inferior conjunction with the Sun on May 9, but it still made headlines since it actually transited the Sun. Transits of Mercury happen far more often than those of Venus, but this was the first one since 2006 and the next one is on November 11, 2019. Venus had transits in 2004 and 2012 (they tend to occur in pairs), and the next one won’t be until 2117.

Mercury will not become otherwise visible until the end of the month, but it will be at greatest elongation in the morning sky on June 5. Mercury will get brighter for a week or two after that, peaking at magnitude -0.3, which you can see with the naked eye even in the twilight.

Venus is in superior conjunction with the Sun on June 6 and won’t be visible until late July, when it reappears in the evening sky.

Uranus and **Neptune** are both low in the eastern sky at dawn, but by the end of May, Neptune will be rising at 2:00 a.m. and Uranus an hour later.

Pluto is passing near the 2.7 magnitude star pi Sagittarii in June, approaching within five hundredths of a degree of the star. On the evening of June 26, Pluto will be directly south of the star, and, although it requires a powerful telescope to see it, this is the best opportunity in years to locate it. A finder map is on page 43 of the June issue of *Astronomy*.

[Material for this section of *Outreach* derives from the May and June issues of *Astronomy* and *Sky & Telescope*, and the *Sky & Telescope* and *Astronomy* web sites]

Space-Related Articles

“How We Discovered Planet Nine,” by Mike Brown, *Astronomy*, June 2016, pp. 20 – 25. A little background here: in 2014, astronomers Chad Trujillo and Scott Sheppard inferred from similarities in the orbits of Sedna and 2012 VP₁₁₃ that there might be another planet in the solar system farther than any we’ve observed. On January 20, Mike Brown and Konstantin Batygin used those two objects and four more to deduce a possible orbit (with an perihelion of 200 AU—almost seven times that of Neptune, and aphelion of 1200 AU, forty times

that of Neptune. The planet would have a mass about ten times that of Earth and orbit the Sun once every 20,000 years. (Other estimates say 15,000 years.)

I was still skeptical, but Rodney Gomes in Brazil found a second set of distant objects that had been perturbed into orbits perpendicular to the proposed orbit of Planet Nine. The six objects Brown and Batygin were investigating were approximately in the same orbital plane as Planet Nine and their perihelia had been pulled out of the Kuiper Belt. Gomes's objects were perturbed in the opposite direction, with their perihelia being pushed within the orbit of Saturn.

“On the Hunt for a Mystery Planet,” by Alexandra Witze, *Nature*, 17 March 2016, pp. 290 and 293. This article is a profile of Scott Sheppard and Chad Trujillo and their efforts to locate Planet Nine. Actually, they're doing more than that; they're doing a systematic search for faint objects beyond the Kuiper Belt that will uncover many other objects as well. In fact, the first object they discovered was 2012 VP₁₁₃. [Trujillo had an earlier claim to fame: he, Mike Brown, and David Rabinowitz are the co-discoverers of Eris and Sedna. In fact, you could say they are responsible for the demotion of Pluto to dwarf planet, and now Brown and Trujillo are potential discoverers of a different ninth planet.] At the beginning of this article, Trujillo and Sheppard have found a new object at a distance of 90 astronomical units, and last November they discovered one at 103 AU. If either of these were near perihelion, it would be the most distant observed object in the Solar System.

We also have a bit of a mystery. There should have been insufficient mass beyond the Kuiper Belt to produce a Sedna, so it was probably perturbed into its present orbit. Then how did Planet Nine, if it exists, get where it is? Theories include protoplanets thrown out of the inner Solar System coalescing beyond the Kuiper Belt, or possibly part of the Solar nebula being pulled out by a passing star.

The 18 March 2016 issue of *Science* has fourteen pages of science articles from the *New Horizons* Team detailing that space probe's discoveries at Pluto. Meanwhile, *New Scientist* gives details on some of the more recent findings.

Viewing Opportunities for Satellites (May 14 to June 14, 2016)

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.

<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. 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 launch to the ISS is that of Expedition 48 at 1:41 a.m. on June 22.

HST May 17, 2016			Tiangong-1 May 18, 2016		
Time	Position	Elevation	Time	Position	Elevation
10:07 p.m.	225°	20°	9:47 p.m.	305°	10°*
10:08	207	27	9:50	22	48
10:09	180	31	9:51:26	84	26
Vanishes into Earth's shadow			Vanishes into Earth's shadow		
			*Passes just above Capella		

Tiangong-1 May 20, 2016		
Time	Position	Elevation
9:22 p.m.	298°	10°
9:25	26	82
9:27:22	114	17*
Vanishes into Earth's shadow		
*Passes very close to Arcturus		

ISS May 26, 2016		
Time	Position	Elevation
10:03 p.m.	211°	21°
10:04	199	38
10:05	135	62
10:06	72	38
10:07	55	21

HST May 18, 2016		
Time	Position	Elevation
9:58 p.m.	228°	20°
9:59	209	27
10:00	182	31
10:01	154	27
Vanishes into Earth's shadow		

ISS May 28, 2016		
Time	Position	Elevation
5:16 a.m.	309°	21°
5:17	305	41
5:18	234	87
5:19	142	42
5:20	137	22

HST May 19, 2016		
Time	Position	Elevation
9:48 p.m.	229°	20°
9:49	211	26
9:50	184	30
9:51	158	26
Vanishes into Earth's shadow		

ISS May 28, 2016		
Time	Position	Elevation
9:54 p.m.	254°	20°
9:55	274	34
9:56	322	47
9:57	10	33
9:58	29	19

Tiangong-1 May 22, 2016		
Time	Position	Elevation
8:57 p.m.	289°	10°
9:00	211	54*
9:03	133	10
*Passes a couple of degrees south of Jupiter		

ISS May 29, 2016		
Time	Position	Elevation
9:01 p.m.	221°	21°
9:02	216	42
9:03	131	79
9:04	57	42
9:05	52	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 see the Tiangong 1 Space Station at 9:00 p.m. on May 22, measure three fist-widths west of due south, then five and a half 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 14, 1:00 p.m.: Astronaut Hall of Fame induction

May 26, time TBA: Expansion of the Bigelow Expandable Activity Module (BEAM) at the International Space Station

Calendar of Events

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

Sometime in 2016: First launch from Russia's Vostochny Cosmodrome in eastern Siberia, in Amur Oblast which is north of the northern tip of Manchuria.

May 13: 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. Paul Canton will speak on stellar life cycles and merging white dwarfs. See <http://www.okcastroclub.com/> for details.

May 14: Oklahoma Space Alliance Meeting, 2:00 p.m., Earl's Rib Palace in Oklahoma City.

May 18 – 22: International Space Development Conference® 2016 in San Juan, Puerto Rico. For more information, visit <http://isdc2016.nss.org/isdc>.

May 21: Launch of Expedition 48 to the Space Station.

May 22: Mars is at opposition.

May 31: Sixth Orbital Sciences Commercial Resupply Mission to the Space Station launches from Cape Canaveral.

June 2: Saturn is at opposition.

June 5: Mercury is at greatest elongation, 24 degrees west of the Sun (so can be seen before sunrise).

June 6: Venus is in superior conjunction with the Sun.

June 10: Launch of SpaceX's Dragon capsule on a resupply mission to the Space Station.

June 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.

June 11 [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

June 25: Peak of Delta Aquariid meteor shower.

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

July 6: Mercury is at superior conjunction with the Sun.

July 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.

July 9: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

July 2016-2020: The *New Horizons* probe visits the Kuiper Belt. For details, visit https://en.wikipedia.org/wiki/New_Horizons or <http://pluto.jhuapl.edu>. (Also see January 1, 2019.)

July 20: Moon Day: anniversary of the Apollo 11 landing on the Moon.

August 12: Peak of Perseid meteor shower.

August 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.

August 13: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

August 15: Launch of SpaceX's Dragon capsule on a resupply mission to the Space Station.

August 16: Mercury is at greatest elongation, 27 degrees east of the Sun (so can be seen after sunset).

September: 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/>.

September 1: Annular solar eclipse, visible in Africa on a path crossing Gabon the two Congos, southern Tanzania and northern Madagascar,

September 2: Neptune is at opposition.

September 9: 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.

September 10: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

September 12: Mercury is at inferior conjunction with the Sun.

September 22: Launch of Expedition 49 to the Space Station.

September 26: Jupiter is in conjunction with the Sun.

September 28: Mercury is at greatest elongation, 20 degrees west of the Sun (so can be seen before sunrise).

September 28: *InSight* lands on Mars (see March 4).

Late 2016: Launch of the Green Propellant Infusion Mission (GPIM) by a SpaceX Falcon Heavy rocket. This mission is “green” because the fuel it uses, hydroxylammonium nitrate produces nontoxic gases when it burns, unlike hydrazine.

October 4 – 10: World Space Week. See <http://www.worldspaceweek.org> for details.

October 4: Seventh Orbital Sciences Commercial Resupply Mission to the Space Station launches from Cape Canaveral.

October 8: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

October 15: Uranus is at opposition.

October 27: Mercury is at superior conjunction with the Sun.

November 12: [Tentative]: Oklahoma Space Alliance Meeting, location to be announced.

November 15: Launch of Expedition 50 crew to the International Space Station.

December: ESA’s *ExoMars Mars Orbiter* arrives at Mars, together with the Schiaparelli lander. (The rover will be launched in 2018.) For more information, visit en.wikipedia.org/wiki/Exomars.

December 10: Mercury is at greatest elongation, 21 degrees east of the Sun (so can be seen after sunset).

December 10: Saturn is in conjunction with the Sun.

December 10: [Tentative]: Oklahoma Space Alliance Christmas Party, location to be announced.

December 14: Peak of Geminid meteor shower.

December 19: Launch of SpaceX’s Dragon capsule on a resupply mission to the Space Station.

December 28: Mercury is in inferior conjunction with the Sun.

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).

January 27, 2017: The European Space Agency/JAXA *BepiColombo* Mercury Orbiter is launched. Home page is <http://sci.esa.int/bepicolombo>.

February 26, 2017: Annular solar eclipse touching the southern tip of South America, the south Atlantic Ocean, and Angola.

March 25, 2017: Venus is in inferior conjunction with the Sun.

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

August 2017: Proposed launch of TESS, the Transiting Exoplanet Survey Satellite. Unlike *Kepler*, TESS will (if approved) conduct a full sky search for exoplanets. For information, visit space.mit.edu/TESS.

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.

Late in 2017: SpaceX launches the Google Lunar X Prize Moon landing. This includes a lander and a rover. See <http://lunar.xprize.org/> and en.wikipedia.org/wiki/Google_Lunar_X_Prize for details. Sometime in 2018: Launch *InSight*, a lander that will probe the interior of Mars. For information, see <http://insight.jpl.nasa.gov/>. [Postponed from March 2016.]

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

July 31, 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.

October 2018: Launch from Cape Canaveral of the European Space Agency/NASA Solar Orbiter (SolO), which will orbit the Sun at a distance closer than Mercury. Web site is sci.esa.int/solarorbiter. [Moved from July 2017.]

January 2019: ESA's *ExoMars Mars Rover* arrives at Mars. For more information, visit en.wikipedia.org/wiki/Exomars.

January 1, 2019: *New Horizons* flies by the Kuiper Belt object 2014 MU₆₉.

September 2019: Arrival of OSIRIS-Rex at the near-earth asteroid 101955 Bennu to return samples. [See September 2016.]

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.

July 2020: United Arab Emirates launch the Mars probe *Hope*.

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.

December 19, 2024: *Solar Probe Plus* makes its first pass through the outer corona of the Sun. [See July 31, 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, 2016 (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)
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OSA E-mail Addresses and Web Site:

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 t_koszoru01 at cox.net (Heidi and Tom Koszoru, new address)
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 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. 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-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 \$20 introductory rate for new members. Regular membership rates are \$52, Student memberships are \$36, Senior \$42. Part of the cost is for the magazine, *Ad Astra*. If you choose to receive the magazine digitally, memberships are \$40 for regular, \$24 for students and \$30 for seniors. Mail to: National Space Society, PO Box 98106, Washington, DC 20090, 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, 11111 W. 8th Ave, Unit A, Lakewood, CO 80215.

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.**