AOH OBSERVER
Fall 2016

The Newsletter of the Astronomers of Humboldt

We are finally back after a summer break. While the newsletter may have been on vacation, AOH members have been busy with travel to exotic places, performing outreach in the community, and sharing their love of the night (and day) sky with old and new friends. In this issue of the AOH Observer, we catch up with the club news of the summer, as well as some current events in astronomy. Our world traveller Ken Yanosko has written a very informative article about his visit to the solar observatory at Lake Baikal, and our resident artist Susie Christian has a whimsical take on how our four-legged friends see the night sky. Over the summer, the AOH participated in several outreach events including the Eureka Parks and Recreation "Third Annual Get out and Play Day", and a star party with the Humboldt County 4-H. Both are featured in the AOH Outreach section of the newsletter.

We have had several new people join this summer. A hearty welcome to Andrew Rask, H. Brent Howatt, Ryan Hurley, Jadon Troyner, Alison Brewer, Bill Hogoboom, and Frank Simpson and Margaret Siegfried.

The AOH Annual General Membership Meeting is scheduled at Babe's Pizza in Cutten on Saturday November 19th at 6 p.m. We hope to see you all there. Details regarding this event can be found at http://www.astrohum.org/upcoming.html

With the holidays coming up, here's a reminder to everybody that the AOH CafePress Store is open for business. The store has a variety of merchandise ranging from clothing to note cards to coffee mugs. The AOH receives a modest percentage of the purchase price; this is used to support our outreach and equipment purchases.
http://www.cafepress.com/astrohum

Thank you to Ken Yanosko and Susie Christian for their contribution to the AOH Observer. I am grateful to Ken and Don for proofreading the newsletter and making suggestions for improvement.

AOH Club Calendar

For the most updated information, check the “Upcoming Events” page at www.astrohum.org

Saturday October 1. **Autumn Sky Star Party**. There are two new moons in September, and October 1 is the closest Saturday to the second of those. October has its own new moon later in the month, so, weather permitting, we will get two observing sessions in October. For the first one, we are tentatively scheduled to meet at Kneeland Airport. Check back at http://www.astrohum.org/upcoming.html for updated information about this event, as well as links to the Kneeland weather forecast, and the Kneeland Airport Cam.

Saturday October 29. **Regular Monthly Meeting**. Time, location TBA.

Saturday November 12. **Nomination for Board of Directors**. Deadline for active members to submit names for nominations to the 2017 Board of Directors. The names will be presented at the November 19th General Membership Meeting. Submit names at secretary@astrohum.org

Saturday November 19. **Pizza Party / Annual Business Meeting / General Membership Meeting**. We will meet at Babe's Pizza in Cutten. Pizza at 6 p.m. The Business Meeting of the Board of Directors, at 7 p.m., which is open to all Members, will include the annual Treasurer's Report and updates on Club projects. This will be followed by the Annual AOH General Membership meeting. On the agenda for the General Membership meeting is the presentation of the slate of Nominees for the Board of Directors. Babe's Pizza is located at 4015 Walnut Drive in Cutten.

Saturday November 26. **Regular Monthly Meeting**.

Saturday December 3. **Public Observing at Arts Alive**.

Night Sky Network Webinars (Members only)

To participate in the live streaming of the NSN webinars go to the “For Members Only “page at www.astrohum.org and click on “NSN”. Select the webinar you would like to participate in and register. Past webinars are uploaded to YouTube and can be accessed at the NSN Webinar YouTube Channel
https://www.youtube.com/playlist?list=PLjLQn63Cw1AJ20U3iMY3dFaDga7Cn6G8R

Wednesday September 21. **Cassini’s Findings at Enceladus**. 6-7 p.m.

Wednesday October 26. **Citizen Science with Pamela Gay**. 6-7 p.m.

November TBA

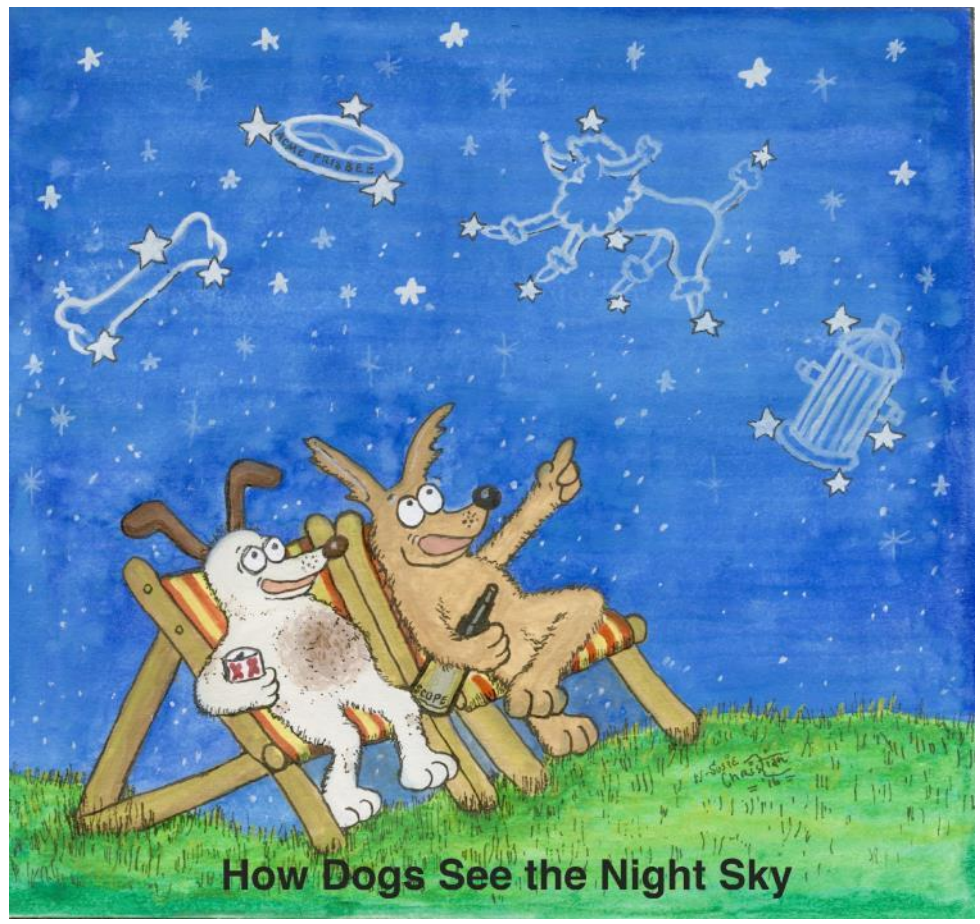
December TBA

Celestial Happening

The three visible planets in the evening sky are Mars, Venus, and Saturn. Saturn sets at 10 p.m. in early October and sets earlier each day by about 4 minutes. Saturn disappears in late November. Venus can be found in the western horizon after sunset, and reaches its greatest eastern elongation on January 12, 2017. Although Mars has dimmed considerably since its spring opposition, the planet remains in the night sky for the remainder of the year. The rise and set times of the planets, sun, and moon can be found at http://aa.usno.navy.mil/data/docs/mrst.php. A comprehensive list of events occurring in Northern California can be found at http://rfo.org/jackscalendar.html

10/3	Crescent Moon near Venus; 7:30 p.m.
10/15	Full Moon
10/18	Gibbous Moon near Aldebaran; 10:30 p.m.
10/29	Venus near Saturn; 7:30 p.m.
10/30	New Moon
11/2	Crescent Moon near Venus; 7:30 p.m.
11/14	Full Moon
11/25	Jupiter near the Moon; 4 a.m.
11/29	New Moon
12/2	Crescent Moon near Venus; 7:19 p.m.
12/12	Moon occults Aldebaran; 7:00 p.m.
12/13	Full Moon
12/22	Crescent Moon near Jupiter; 6:50 a.m.
12/28	New Moon

Heavenly Bodies **by Susie Christian**



AOH Summer Star Parties

By G. Wheeler

The first star party of the summer was clouded out, and we were disappointed to miss seeing Mars and Saturn at their closest approach. Although there was no observing that night, we still met at the Kneeland Observatory to do some much needed cleaning. Special thanks to Greg Deja who brought his shop vac and removed what seemed to be several pounds of dust and detritus from the Observatory . Ken Yanosko, Russell Owsley, and Don Wheeler did repairs, cleaning, and organizing. The place looked great once we were finished.

Russ, Ken, Don, and Greg. How many astronomers does it take to clean a mirror? Photo: GW

Our second and third summer star parties were held at the Kneeland Airport on July 2nd and July 30th, respectively. Both times we were treated to balmy temperatures, low humidity, and clear nights. The parties included AOH members and visitors, as well as some of our Cal Fire neighbors. On both occasions, Jupiter, Mars, and Saturn were visible at dusk and could be viewed throughout the night. Observing highlights for the July star parties included the following:

- M22 Sagittarius Cluster (GC), M8 Lagoon Nebula in Sagittarius
- M4 Globular Cluster, M6 Butterfly Cluster (OC) in Scorpius
- M13 Great Hercules Cluster in Hercules (GC)
- Albireo Double Star in Cygnus
- Epsilon Lyrae (Double Double star), M57 Ring Nebula in Lyra
- M11 Wild Duck Cluster (OC) in Scutum
- M51 Whirlpool Galaxy in Ursa Major
- M31 Andromeda Galaxy in Andromeda

Mark Mueller arriving in style to the July 30th Star Party. Photo: GW

With the help of Russ and Ken, Lou Lutticken got his GoTo reflector telescope working. It was fun watching Lou finding several deep sky objects on his own. New member Jadon Troyner brought his telescope and impressed with us with the views through it.

Jupiter on July 3, 2016. Photo: GW

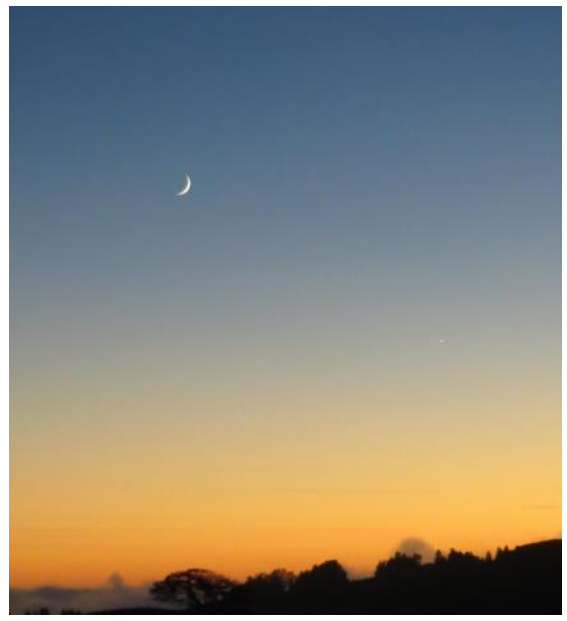
Our last star party of the summer was held on September 3rd at the Kneeland Airport. Many of us, remembering how warm the nights had been for the July star parties, came unprepared for the chilly conditions. The forecasted clouds never materialized, but there was high humidity and a fog bank on the hillside below.

At dusk, we set up our scopes and hoped for the best.
For the last summer party, we had on hand the Club's 17.5 inch Dob. Mark Mueller was kind enough to pack up it up in his trailer (with some help from Ken, Greg Deja, and Dan Eaton) and haul it from the Kneeland Observatory to the Airport.

We had a large turnout with about 20+ attendees. In addition to many regular members, we had several people show up from our Humboldt area, as well as some firefighters from Cal Fire next door.

Ken operated the 17.5 inch Dob and gave sky tours to the many visitors. Other members entertained small gatherings at their telescopes as well. In addition to observations of deep sky objects in Sagittarius and Scorpius, we also found globular clusters in Ophiuchus (Mark Mueller gave me a star hopping tour of Ophiuchus). Andromeda and Perseus were in the eastern horizon, and I was looking forward to seeing the Double Cluster in Perseus when the sky turned cloudy. Our last summer party came to an abrupt end at 10:30 p.m. By then, all of us had noticed the considerable accumulation of moisture on our equipment. We called it a night and hastily packed our equipment. About 15 minutes later it was crystal clear again. Such is life in Humboldt County.

Our summer star parties would not have been successful had it not been for our members who welcomed our visitors, and shared their telescopes and knowledge of the night sky. Special acknowledgement goes to Russ Owsley, Ken Yanosko, Mark Mueller, and Jadon Troyner for their help during these star parties. Thank you to all who attended, and let's hope for more clear skies in the Fall.



Three day crescent moon and Venus On 9/3/2016. Photo: GW

Dan, Ken, Greg, and Mark placing the mirror into the 17.5 inch Dob. Photo: GW

Assembling telescopes at dusk. Photo: GW

AOH Outreach: Eureka Get Out and Play and Humboldt 4-H Star Party

By G. Wheeler

This summer the AOH logged the six NASA Night Sky Network (NSN) events:

July 30	Eureka Get and and Play Day
July 30	Kneeland Star Party
August 3-4	Humboldt 4-H Star Party
August 5	Boys and Girls Club Camp Odyssey Presentation
August 12	Perseids Meteor Viewing
September 3	Kneeland Star Party

Special thanks to Russ Owsley, Ken Yanosko, Mark Mueller, Jadon Troyner, and Ali Brewer for participating in these outreach events. For information on how to get involved in our AOH Outreach, contact us at info@astrohum.org

Eureka Get Out and Play

The AOH was invited by the Eureka Parks and Recreation Department to participate in the “Third Annual Get Out and Play Day”. Russ Owsley and I showed up early that morning and set up our table at our assigned space near the gazebo at Sequoia Park. By noon there was a large crowd enjoying Zumba and playing Pokemon Go. The KEET table was next to ours and early on we had developed a collaborative relationship with them. KEET had sent the kids on an “alphabet” scavenger hunt, and the AOH table apparently had several items on display that were used to complete the hunt (especially for the letters “U” and “V”). No items were taken; they just had to write down the name of the object.

The AOH table had various astronomy-themed posters, models, and children’s activities. The visitors were impressed by the "scale model of the solar system” in which the planets were scaled down based upon the sun measuring one meter. One mother said that she liked the model because her autistic son could see and touch the planets (he did so very gently). The solar system map and the planet stickers were a big hit with the kids and parents. There was also a spectrometer that we had constructed from a box, the reflective side of a dvd, a cardboard tube, and tape. The spectrometers were used to show the visible spectrum of sunlight.

The area behind the table had various solar viewers and telescopes. Russ brought two types of pinhole projectors, and showed a projection of the solar disk through his reflector telescope. A refractor telescope with a sun funnel was also used to show the solar disk.

About 300 people came by our table and we were busy the entire afternoon. It was great meeting so many astronomy enthusiasts of all ages.

Our photo of the “Get Out and Play” event was featured in the September issue of the Night Sky Network Newsletter. Shown is a photo of Russ showing off the “scale model of the solar system”. Photo: GW

Russ showing the various ways to indirectly image the sun. Photo: GW

AOH Outreach: Humboldt 4-H Star Party at Maple Creek

Mark and I arrived at the 4-H Camp at 6 p.m. with a van packed with camping gear, telescopes, and other equipment. Prior to arriving at the camp, we were told that the inspiration of this year's 4-H camp was outer space. Right away, we noticed that most of the campers were wearing pullovers inscribed with "4-H is Out of this World". The space theme was carried through in the names of the cabins/groups: "Mercury", "Venus", "Earth", "Moon", "Mars", "Jupiter", "Neptune", "Pluto", and the obligatory "Uranus".

Dinner was with Jessalyn Kunkler, the camp director, and Dorina Espinoza, the Youth, Families, and Community advisor with UC Cooperative Extension. They told us that there were thirty-five 4-H youths ranging from 9 years of age to teenagers. At the camp, the kids were doing a mix of fun activities (swimming and archery) and science projects. The day of our arrival, they had built solar ovens using pizza boxes, foil, and clear cellophane. Other space-related activities included playing "Space Jeopardy" and building balloon rockets. Jessalyn and Dorina told us that everyone was excited that we had brought telescopes for the star party. For most, this would be their first time looking through one.

Our star party started shortly after sunset. Mark was able to find Jupiter through a finderscope that he had taken off one of his telescopes. Most of the campers were able to view Jupiter before it sank behind the mountains. My telescope was set up to find Saturn while Mark turned his telescope towards Mars. We talked about the relative distance of these planets to Earth, and why these planets were so different from each other. We then showed them examples of deep sky objects: globular clusters (M13, M10), an open cluster (M11), and a nebula (M17). The campers were divided into 3 groups and each had a 45 minute session of telescope viewing. Saturn and M13 were the favorites among all the groups. We were impressed by their curiosity. There were many questions about how scientists could know the age of the stars (globular vs. open clusters), about the distances to planets and the deep sky objects they had seen, and about how our sun was formed, and what will happen when it burns out.

The next morning before leaving, we showed a small group of campers our "scale model of the solar system". We also had our 60 foot solar system measuring tape with the planetary distances scaled accordingly. The campers were able see the relative sizes of planets, their distances from the sun, and the difference in the spacing of the inner and outer planets.

It was a very fun event, and we hinted to Dorina that we wouldn't mind being invited back again next year.

A month after the 4-H Star Party, I received a thank you note from Jessalyn. In the letter she wrote: *"When the teens who were the counselors came back from the telescope area saying 'I want to start an astronomy club at school next year', (this) pretty much confirms they learned and found things beyond interesting"*.

Many thanks to Dorina, Jessalyn, Glenda, and all the 4-H Youths for your hospitality. Your curiosity and enthusiasm are inspiring.

Dorina, Mark and the 4-H Campers with the solar system model. Photo: GW

Agustin (Right) and friend holding scale models of Saturn and Jupiter. Photo: GW

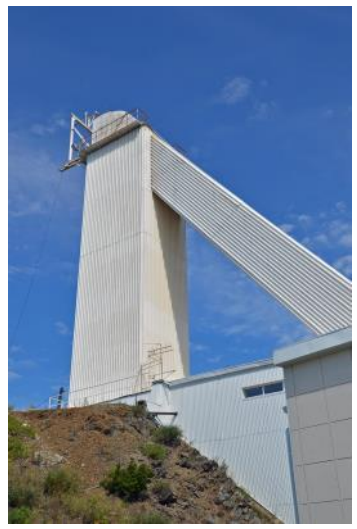
Saturn was a favorite of the star party. Photo: GW

The Large Solar Vacuum Telescope at Lake Baikal

By Ken Yanosko

Lake Baikal is located in southern Siberia, close to the Mongolian border. With a surface area of 12,000 square miles, and a maximum depth of just over one mile, it contains the world's largest collection of unfrozen fresh water.

Lake Baikal in southern Siberia. Map courtesy of Betchart Expeditions.



Left Photo. The Large Solar Vacuum Telescope near Lake Baikal. Photo by KY.

Right Photo. ISTP SB RAS (Institute for Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences) Baikal Astrophysical Observatory BIG SOLAR VACUUM TELESCOPE. Photo and translation by KY.

This large surface area has an effect on the local weather, keeping the daytime skies clear of clouds for most of the year, and attracting astronomers who study the sun. Accordingly, the Institute of Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences has founded the Baikal Astrophysical Observatory, which is a consortium of several facilities dedicated to solar research. These facilities include:

- the Siberian Solar Radio Telescope
- a Solar coronagraph
- a cosmic-ray spectrograph
- high-potential radar for measuring ionospheric plasma parameters by the method of incoherent scatter of radio waves

and the facility that I was recently able to visit:

- the Large Solar Vacuum Telescope (LSVT).

The LSVT is a refractor with an objective lens of diameter 760 mm and focal length 40 meters, equipped with a siderostat (flat tiltable mirror) of diameter 1 meter. The siderostat is located on a tower of height 20 meters on a steep mountain slope. The optical path begins with the siderostat, which reflects sunlight into the objective lens, which in turn sits atop a vacuum tank of length 40 meters which descends diagonally from the top of the tower to the observation room at ground level.

Climbing the tower. Photo by KY.

There a diagonal mirror reflects the light through a porthole in the side of the vacuum tank to a second diagonal mirror which sends the light along an optical bench equipped with various filters and a CCD-spectrophotometer. This equipment obtains high-resolution spectrographs of solar activity which are then correlated with data gathered by the various other facilities.

Dr. Aleksey Golovko of the Institute for Solar-Terrestrial Physics leaning on the siderostat cell at the top of the tower. Photo by KY.

The Institute is engaged in research on the origin and dynamics of solar magnetic fields, solar flares, and other active features on the Sun. Considerable attention is given to the solar wind and cosmic rays. The Institute's primary research purpose is to study the initiation and development of disturbances in the near-terrestrial environment, from the origin of the disturbance on the Sun and its propagation through the interplanetary medium to the high- and mid-latitude atmospheric response.

The 760 mm objective lens. Photo by KY.

The optical bench with spectrophotometer. Photo by KY.

The Institute has obtained a number of fundamental results:

- In the field of solar physics, considerable advances have been made in experimental and theoretical research on oscillations in the Sun's atmosphere and the origin of magnetic fields. New techniques were devised for diagnosing the state of solar activity and for predicting its development and its effects on the Earth.

- In the field of research on the magnetosphere, ionosphere, and magnetosphere-ionosphere coupling, work has been accomplished toward creating physical and mathematical models describing substorm processes, the response of high-latitude current systems to a change of solar wind and high-latitude ionospheric and plasmaspheric parameters, and dynamic processes in the lower ionosphere.

- In the field of ionospheric propagation of radio waves, a technique has been developed for a mathematical description of the HF signal propagation process.

The Institute participates in almost all international projects and programs on solar-terrestrial physics. It has entered into agreements with research groups from the USA, Germany, Great Britain, France, Sweden, Spain, Greece, Japan, and other countries.

The tour I was on was led in part by Dr. Aleksey Golovko of the Russian Academy of Sciences, who does research at the Institute of Solar-Terrestrial Physics. Dr. Golovko escorted us through the facility and led us up the narrow, steep ladders to the top of the tower. Since there were no active observations going on at the time our vibrations didn't interfere with their research. And since I was probably the only one in our tour with an active interest in astronomy, I spent the time looking at the mirror and lens arrangement, while most of the others just enjoyed the view.

View of Lake Baikal from the top of the solar telescope tower.
Photo by KY

The Jupiter and Venus Conjunction of 2016

By G. Wheeler

"A conjunction is a celestial event in which two planets or a planet and the moon or a planet and a star appear close together in the night sky. Conjunctions have no real astronomical value, but they are nice to view" (from W. Cooke, Watch the Sky NASA Blog)

Figure 1. Simulated view of Venus and Jupiter on August 27, 2016 at closest approach (3.9 arcminutes apart). This is the view from the east coast of the U.S. Credit: Astronomy Now Graphic by Ade Ashford

On August 27, 2016, Jupiter and Venus were separated from each other in the sky by four arcminutes (Fig. 1) in an extremely close conjunction that will not happen again for 50 years. Since May 9th, Jupiter had been moving closer to the sun in what appeared to be a westward migration. While Jupiter was still visible in the evening sky for most of the summer, by mid- August, Jupiter could be seen setting about an hour after sunset. Venus which was not visible for most of spring and early summer, finally appeared in mid-July and could be seen shortly after sunset. Throughout August, Jupiter and Venus seemed to be moving towards each in the sky with Jupiter moving westerly (descending) and Venus moving easterly (ascending). Normally the separation between Jupiter and Venus in the sky ranges from 0.5 to 3 degrees, and this depends on the relative positions of Earth, Venus, and Jupiter in their orbit around the sun. On August 27th, the Earth, Venus, and Jupiter were in a straight line such that, as viewed from Earth, there was little separation between Jupiter and Venus in the sky (Fig. 2). Even though Jupiter and Venus were actually 400 million miles apart, in the sky it appeared that these two planets were very close together.

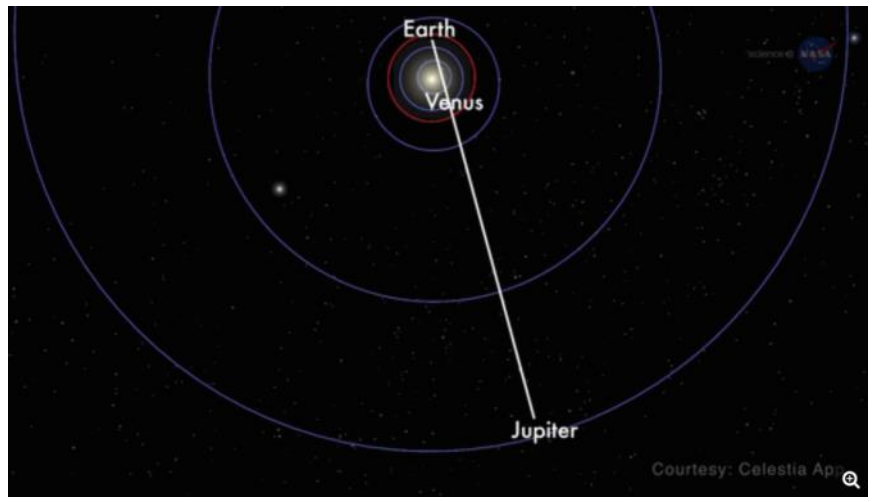


Figure 2. Graphic showing the planetary lineup of Earth, Venus, and Jupiter on August 27, 2016. Credit: Science@ NASA/Celestia App

Prior to the 2016 conjunction, the last very close conjunction of Jupiter and Venus took place on June 30, 2015. On that date, Jupiter and Venus were about a third of a degree apart and could be seen in the same field of view through a telescope (Fig. 3). The 2015 conjunction occurred in the evening (on the west coast), and Jupiter and Venus could easily be seen with binoculars or with the unaided eye. This would not the case with the August 27, 2016 conjunction when most of it would occur during daylight hours.

Figure 3. June 30, 2015 Conjunction. Venus and Jupiter could seen in the same field of view through a 40mm eyepiece on an 8 inch SCT. Image was taken by digiscoping with a Canon Powershot SD850. Photo: DW

Finding Jupiter and Venus in the Daytime

Viewing the August 27th conjunction between Jupiter and Venus was problematic in that it required finding the planets in daytime. My solution to this problem was to use a computerized GoTo telescope mount to generate a daytime sky map. For this, the Sun was used as a reference point in the "Solar System Alignment" program of the GoTo (note: a solar filter was placed onto the objective lens of the telescope before viewing the Sun). The resulting alignment was good enough to slew the telescope to the vicinity of Venus or Jupiter. Whereas Venus was bright and easy to find, Jupiter was ghostly and difficult to see against the hazy daytime sky.

Although I did not try this method, others (on astronomy forums such as Cloudy Nights) reported being able to find Venus and Jupiter by using Stellarium or other sky apps to determine the azimuth and altitude[1] of these planets during specific times during the day. They then used the information to manually point their telescopes to the designated area in the sky (Fig. 4).

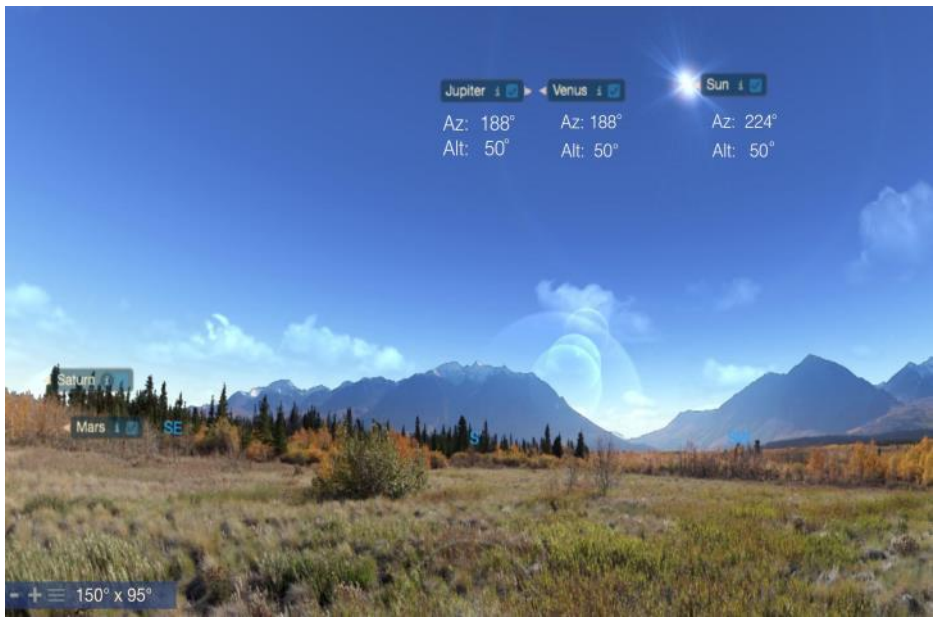


Figure 4. Graphic showing the azimuth and altitude of Venus and Jupiter on August 27, 2016 at 3 p.m. PDT. This was done using Starry Night Pro. The background is of Hoopa Valley (the only available background close to Eureka). The azimuth of Sun is also shown.

Viewing the Conjunction at Kneeland

On the day of the conjunction, the marine layer made it impossible to view the conjunction from my house on Humboldt Hill. I decamped to the Kneeland Airport where the skies were severe clear. By the time the telescope was aligned, it was already 3:30 p.m. This was the approximate time of the peak of the conjunction. On the first attempt, the telescope slewed to Venus and the planet could be seen through the 40mm eyepiece (FOV 50 arcminutes). With some minor adjustments, Venus and Jupiter were brought into the center of the field. The sight of Jupiter and Venus in the same field of view was impressive, especially when viewed through a 10mm eyepiece (FOV 15 arcminutes). For the next five hours, the planets could be seen moving apart (Figure 5). The separation of Venus and Jupiter as seen on the west coast ranged between 6 to 12 arcminutes (on the east coast, the separation was even smaller). http://www.space.com/33878-rare-venus-jupiter-conjunction-tonight.html.

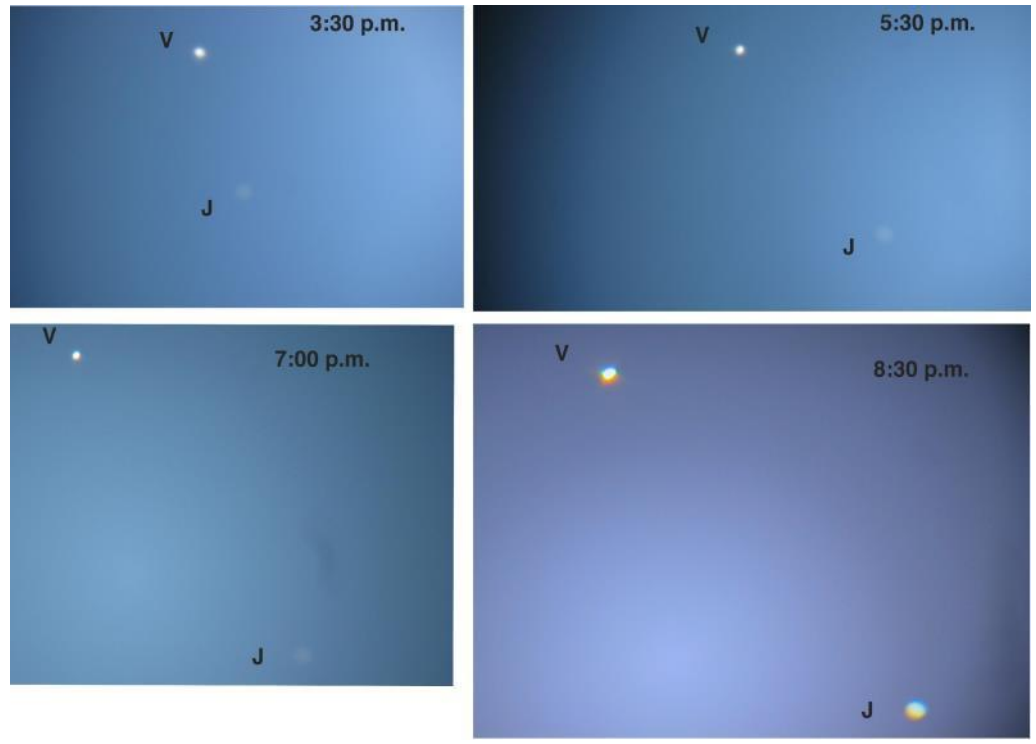


Figure 5. The August 27, 2016 conjunction of Venus and Jupiter between 3:30 to 8:30 p.m. Planets were viewed through a 40mm eyepiece on an 8 inch SCT. Images were taken by digiscoping with a Canon Powershot SD850. Photo: GW

1. Stellarium also gave right ascension and declination for each planet.

Sharing the Day and Night Sky

While I was at the airport, a gentleman named Don G. and his daughter came by to walk the runway. Don didn't quite believe me when I told him that Jupiter and Venus could be seen in the telescope. He told me that his father had been an amateur astronomer, and as a boy his father had once let him see the moon through the telescope. I invited Don to take a look at the conjunction which he did so eagerly. I was worried that he wouldn't be able to see the planets, but after a few seconds he had a big grin. Later I took pictures of him standing next to the telescope and jotted down his email address so that the photos of the conjunction could be sent to him. Don said he wanted to show these to his daughter as she didn't believe him when he had told her that he had just seen Venus and Jupiter. When it came time to say goodbye, I invited Don G. to come back in the evening to watch Venus and Jupiter set at the horizon, but he was uncertain if he could return.

(Left) Don G. looking at Venus and Jupiter. (Right) Mark Wilson, Ken Yanosko, and Don Wheeler. Notice the fog in the background. Photo: GW

I was joined by Don Wheeler at 5 p.m. Ken Yanosko and Mark Wilson showed up an hour later. Ken had brought his binoculars, and after some searching in the general direction of where my telescope was pointed, he was able to find Venus; Jupiter was still to dim to see. Right before sunset Jupiter appeared in the binocular's field of view. By sunset, both planets could be seen with the naked eye.

Venus (upper left) and Jupiter in the western horizon at 8:30 p.m. Photo: DW

For most of the conjunction, the ambient light washed out the belts of Jupiter and the Galilean moons. As twilight deepened we were finally able to see two equatorial belts and three of the four Galilean moons (Io, Europa, Ganymede). While we were watching the planets setting in the horizon, a car pulled up outside the gate. Ken walked over to find out who was there, and came back with Don G. We were quite happy to show him the views of Jupiter and Venus through the telescope (this time with greater detail) and binoculars. We ended the session by finding Saturn for him. Before leaving Don G. said he had never seen planets before through a telescope, and today he had seen three. It was the perfect way to end the evening.

To Read More about Jupiter-Venus Conjunctions:

https://blogs.nasa.gov/Watch_the_Skies/2015/06/30/jupiter-and-venus-conjunction/

https://astronomynow.com/2016/08/27/jupiter-and-venus-get-extra-extra-close-in-the-evening-sky/

http://www.space.com/33792-venus-jupiter-conjunction.html

https://jeffreylhunt.wordpress.com/2016/04/25/2016-august-27-a-venus-jupiter-epoch-conjunction/

THE CONVERSATION

Lift-off for NASA mission to collect grains from an asteroid that may be on collision course with Earth

Monica Grady, Professor of Planetary and Space Science, Open University

Artist's conception of the OSIRIS-REx spacecraft at Bennu asteroid. NASA/GSFC

It's been a great few weeks for missions to small, primitive bodies. We've just about digested the latest news from the Ceres asteroid (1) and rejoiced at the recovery of the comet-lander Philae (2), in time to wish a safe journey to NASA's exciting new mission to Asteroid 101955 Bennu (3). OSIRIS-REx (4) (short for Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorers – which is a bit of a mouthful) launched from Florida's Cape Canaveral at 7:05pm EDT on September 8.

This is a very special mission – it's not just going to map the composition of the asteroid, the mission is going to bring some of it back for us to study close up. The analysis of the precious grains may come in handy, as asteroid 101955 Bennu is on a collision course (5) with Earth.

That last sentence is maybe a tad of an exaggeration according to Dante Lauretta, the head of the mission, Bennu has around a 1 in 3000 or so chance of colliding with Earth in the late 22nd century (6). Although such odds may seem quite frighteningly probable, and Bennu is high up on NASA's Although such odds may seem quite frighteningly probable, and Bennu is high up on NASA's table of potentially hazardous objects (7) the first possible collision with Earth is not until September 2175. By that time, I'm sure we will have learnt so much about the asteroid from the material brought back by OSIRIS-Rex that we will know how to deal with it.

1. https://theconversation.com/ceres-asteroid-may-have-an-ice-volcano-and-other-signs-of-water-nasa-mission-reveals-64627
2. https://theconversation.com/philae-has-been-found-heres-why-its-important-64978
3. http://www.asteroidmission.org/why-bennu/
4. https://blogs.nasa.gov/osiris-rex/
5. http://neo.jpl.nasa.gov/risk/a101955.html
6. http://onlinelibrary.wiley.com/doi/10.1111/maps.12353/abstract
7. http://neo.jpl.nasa.gov/risk/a101955.html

There were three reasons why Bennu was selected as the target for OSIRIS-Rex: its orbital dynamics, its composition and its hazard potential. The orbital dynamics of Bennu are important because they will allow the spacecraft to get there in a reasonable timescale (estimated arrival date is August 2018) without requiring too much in the way of planetary swing-bys for gravitational assistance (it will make one Earth fly-by in September 2017). Bennu's composition is also interesting – it has been determined by instruments on ground-based telescopes to be rich in carbon, one of the most primitive of asteroid types. So Bennu might be almost unchanged since the solar system formed some 4.6 billion years ago, and may contain a variety of organic compounds that became the building blocks of life.

The United Launch Alliance Atlas V rocket is ready for launch. NASA

We have learned a huge amount about asteroids and comets from the Dawn and Rosetta missions – but both these missions have left many unanswered questions. It is quite frustrating to see some of the results and realise that the image resolution is just not quite sufficient to make out certain features. One of the first acts of a geologist, when examining rocks in the field, is to break open a sample, and look at the fresh surfaces of the interior material. Such an act is not an option on a mission that relies on remote sensing to identify different materials. But OSIRIS-Rex will make that possible when it returns the sample in 2023.

Sampling challenges

OSIRIS-Rex is not the first asteroid sample return mission: the Japanese Hayabusa mission (8) brought back several hundred grains from Asteroid 25143 Itokawa in late 2010. The grains came from a stony asteroid, not a carbon-rich body, and do not seem to contain much in the way of organic material. And although NASA Stardust mission (9) collected dust from the coma of comet Wild 2 in 2004, returning it to Earth in 2006, it has been very difficult to measure any organic compounds present in the dust because of the way the dust was collected (impact into aerogel).

But the sampling mechanism on-board OSIRIS-Rex is different: it is called the TAGSAM (for Touch-And-Go Sample Acquisition Mechanism). The TAGSAM is deployed at the end of an articulated arm and, when it touches the surface, a burst of nitrogen gas will fire down into the regolith. This will force material backwards and up into the TAGSAM. It is hoped that almost 100g of material with a variety of grain sizes will be collected for return to Earth. Analysis of the sample will be carried out by an international team of scientists; measurements will cover all aspects of the material's composition and structure, especially the organic and water contents of the soil.

One experiment that OSIRIS-Rex will carry out as it orbits Bennu is to determine the extent of the so-called "Yarkovsky effect" (10) on Bennu's rotation. This effect is a force that acts on a rotating body in space, caused by the uneven release of heat from the surface of the asteroid. Once this is known, it will be possible to investigate whether we could use this force to change the orbit of Bennu.

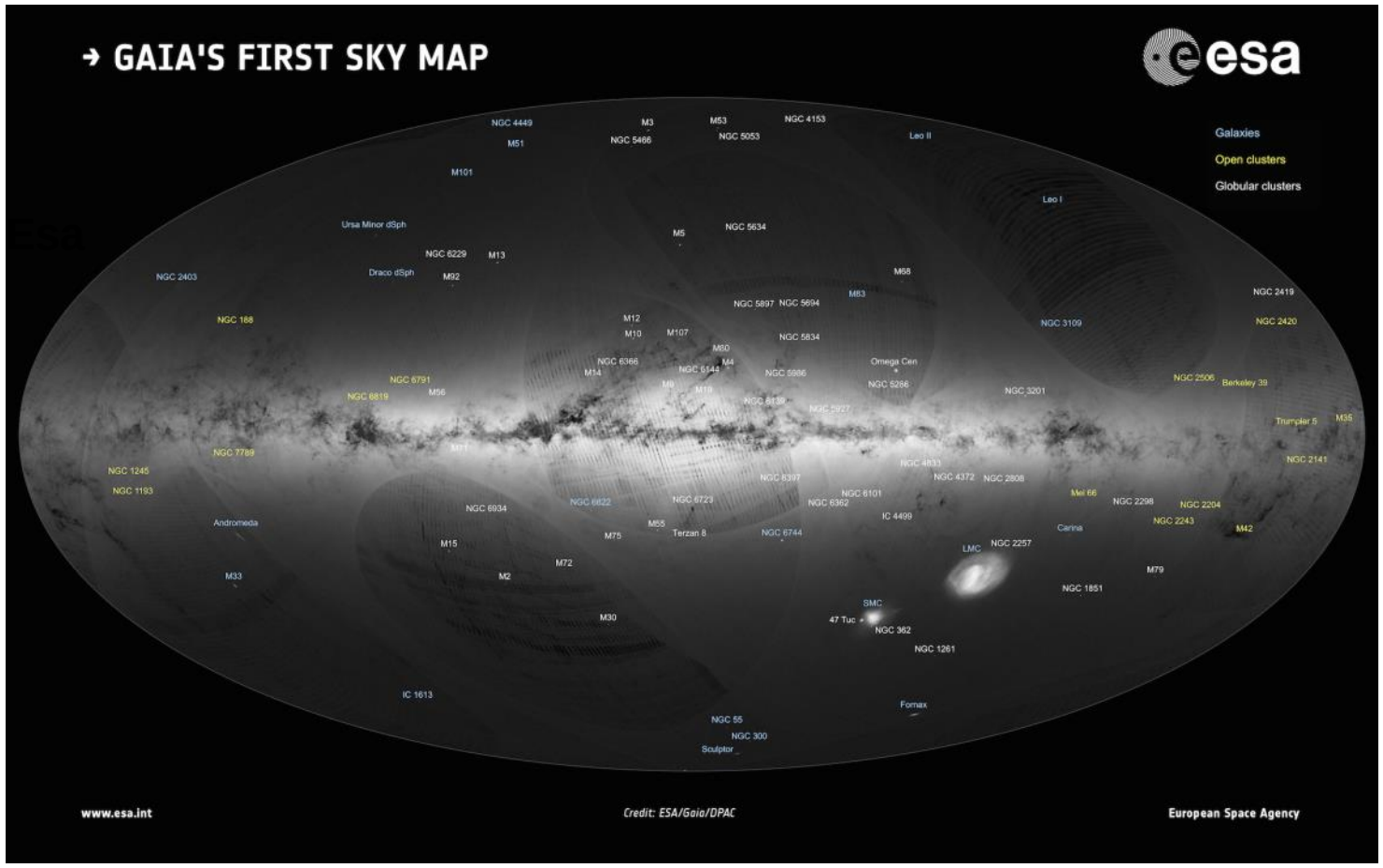
For example, this could be achieved by focusing solar radiation onto its surface, which would change the strength of the Yarkovsky effect and ever so slightly alter Bennu's course. Because the effect is so tiny, and difficult to measure precisely from Earth, the observations taken at Bennu will be the most accurate that have ever been made. This will allow engineers to calculate whether deflecting an asteroid using solar radiation is a realistic possibility, and the length of time it would take to shift an asteroid's orbit from "collision course" to "missed by a mile".

I have every faith that such calculations will be carried out before we get an even closer look at Bennu than we desire.

8. http://solarsystem.nasa.gov/missions/hayabusa2
9. http://stardust.jpl.nasa.gov/home/index.html
10. http://earthsky.org/astronomy-essentials/the-yarkovsky-effect-pushing-asteroids-around-with-sunlight

GAIA'S FIRST SKY MAP, ANNOTATED

ESA Press Release (Republished with Permission)



Date: 14 September 2016
Satellite: Gaia

An all-sky view of stars in our Galaxy – the Milky Way – and neighbouring galaxies, based on the first year of observations from ESA's Gaia satellite, from July 2014 to September 2015.

This map shows the density of stars observed by Gaia in each portion of the sky. Brighter regions indicate denser concentrations of stars, while darker regions correspond to patches of the sky where fewer stars are observed.

The Milky Way is a spiral galaxy, with most of its stars residing in a disc about 100 000 light-years across and about 1000 light-years thick. This structure is visible in the sky as the Galactic Plane – the brightest portion of this image –which runs horizontally and is especially bright at the centre.

Darker regions across the Galactic Plane correspond to dense clouds of interstellar gas and dust that absorb starlight along the line of sight.

Many globular and open clusters – groupings of stars held together by their mutual gravity – are also sprinkled across the image.

Globular clusters, large assemblies of hundreds of thousands to millions of old stars, are mainly found in the halo of the Milky Way, a roughly spherical structure with a radius of about 100 000 light-years, and so are visible across the image.

Open clusters are smaller assemblies of hundreds to thousands of stars and are found mainly in the Galactic Plane.

The two bright objects in the lower right of the image are the Large and Small Magellanic Clouds, two dwarf galaxies orbiting the Milky Way. Other nearby galaxies are also visible, most notably Andromeda (also known as M31), the largest galactic neighbour to the Milky Way, in the lower left of the image. Below Andromeda is its satellite, the Triangulum galaxy (M33).

A number of artefacts are also visible on the image. These curved features and darker stripes are not of astronomical origin but rather reflect Gaia's scanning procedure. As this map is based on observations performed during the mission's first year, the survey is not yet uniform across the sky.
These artefacts will gradually disappear as more data are gathered during the five-year mission.

High resolution versions of the Gaia map, without annotation and with a transparent background, are available to download from: http://sci.esa.int/gaia/58209

A version of this image without annotation is available http://sci.esa.int/gaia/58282-gaia-s-first-sky-map/

Credit: ESA/Gaia/DPAC

Acknowledgement: A. Moitinho & M. Barros (CENTRA – University of Lisbon), F. Mignard (Observatoire de la Côte d'Azur), on behalf of DPAC

Press Release: http://sci.esa.int/gaia/58283-gaia-s-first-sky-map-annotated/

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Is there a super-Earth in the Solar System out beyond Neptune?

By Ethan Siegel

A possible super-Earth/mini-Neptune world hundreds of times more distant than Earth is from the Sun.
Image credit: R. Hurt / Caltech (IPAC)

When the advent of large telescopes brought us the discoveries of Uranus and then Neptune, they also brought the great hope of a Solar System even richer in terms of large, massive worlds. While the asteroid belt and the Kuiper belt were each found to possess a large number of substantial icy-and-rocky worlds, none of them approached even Earth in size or mass, much less the true giant worlds. Meanwhile, all-sky infrared surveys, sensitive to red dwarfs, brown dwarfs and Jupiter-mass gas giants, were unable to detect anything new that was closer than Proxima Centauri. At the same time, Kepler taught us that super-Earths, planets between Earth and Neptune in size, were the galaxy's most common, despite our Solar System having none.

The discovery of Sedna in 2003 turned out to be even more groundbreaking than astronomers realized. Although many Trans-Neptunian Objects (TNOs) were discovered beginning in the 1990s, Sedna had properties all the others didn't. With an extremely eccentric orbit and an aphelion taking it farther from the Sun than any other world known at the time, it represented our first glimpse of the hypothetical Oort cloud: a spherical distribution of bodies ranging from hundreds to tens of thousands of A.U. from the Sun. Since the discovery of Sedna, five other long-period, very eccentric TNOs were found prior to 2016 as well. While you'd expect their orbital parameters to be randomly distributed if they occurred by chance, their orbital orientations with respect to the Sun are clustered extremely narrowly: with less than a 1-in-10,000 chance of such an effect appearing randomly.

Whenever we see a new phenomenon with a surprisingly non-random appearance, our scientific intuition calls out for a physical explanation. Astronomers Konstantin Batygin and Mike Brown provided a compelling possibility earlier this year: perhaps a massive perturbing body very distant from the Sun provided the gravitational "kick" to hurl these objects towards the Sun. A single addition to the Solar System would explain the orbits of all of these long-period TNOs, a planet about 10 times the mass of Earth approximately 200 A.U. from the Sun, referred to as **Planet Nine**. More Sedna-like TNOs with similarly aligned orbits are predicted, and since January of 2016, another was found, with its orbit aligning perfectly with these predictions.

Ten meter class telescopes like Keck and Subaru, plus NASA's NEOWISE mission, are currently searching for this hypothetical, massive world. If it exists, it invites the question of its origin: did it form along with our Solar System, or was it captured from another star's vicinity much more recently? Regardless, if Batygin and Brown are right and this object is real, our Solar System may contain a super-Earth after all.

Editor's Note: The search for Planet Nine is intensifying with Mike Brown and others searching the area in the constellation Orion in the coming weeks. The latest on the search for Planet Nine can be found on Mike Brown's and Konstantin Batygin's blog http://www.findplanetnine.com. MB and KB were also interviewed recently by the Los Angeles Times, and the interview can be accessed here: http://www.latimes.com/science/sciencenow/la-sci-sn-planet-nine-objects-snap-story.html