The Astronews

HUI KILOLANI

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www.hawastsoc.org

VOLUNTEERS WANTED:

HAS needs members to staff our club table at IfA annual public event (see flyer below).

NO EXPERIENCE NECESSARY, JUST DESIRE TO INTERACT WITH KIDS AND FAMILIES.

Inside this issue:

Upcoming Events:

☆The next meeting is 7:30PM on **Tues., Apr. 1** at the Bishop Museum.

☆Bishop Museum's next evening planetarium shows are every Saturday of the month at 8:00 p.m. www.bishopmuseum.org/calendar

☆The next Board Meeting is Sun., **Mar 30** at 3:30 p.m. at the POST building at UH.

Up To The Minute:

Editor's Note:

There are no Minutes filed for last month's club meeting, so what follows is an article on research by Gemini astronomer Chad Trujillo and Scott Sheppard of Carnegie Institute for Science.

They discovered an Inner Oort cloud object in the distant reaches of the solar system. This is the first Inner Oort cloud object found since the discovery of Sedna about a decade ago. This discovery confirms that Sedna is not a unique object, but Sedna and 2012 VP113 are actually both members of the Inner Oort cloud, a solar system population that could outnumber the Kuiper Belt Objects.

REDIFINING THE EDGE OF THE SOLAR SYSTEM

The Solar System has a new most-distant family member.

Scientists using ground based observatories have discovered a dwarf planet that is believed to have the most distant orbit found beyond the known edge of our solar system. Named 2012 VP113, the dwarf planet's observations were obtained and analyzed with a grant from NASA. The detailed findings are published in the March 27 edition of Nature.

This discovery adds the most distant address thus far to our solar system's dynamic neighborhood map," said Kelly Fast, discipline scientist for NASA's Planetary Astronomy Program, Science Mission Directorate (SMD) at NASA Headquarters, Washington. "While the very existence of the inner Oort Cloud is only a working hypothesis, this finding could help answer how it may have formed."

The observations and analysis were led and coordinated by Chadwick Trujillo of the Gemini Observatory in Hawaii and Scott Sheppard of the Carnegie Institution in Washington. They used the National Optical Astronomy Observatory's 13-foot

(Continued on page 7)

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I'm writing this from Houston after the conclusion of the 45th Lunar and Planetary Science Conference. As usual, this year's meeting was filled with fascinating talks on the latest results of planetary science research. I'll tell you just a little of what there was to hear.

On the weekend before the conference there is a Microsymposium on a selected topic. This year's theme was "Scientific Destinations for Human Exploration" and featured talks by Jack Schmitt, Apollo 17 Lunar Module Pilot, and David Scott, Apollo 15 Commander. Schmitt was the only geologist to walk on the Moon, and he always brings unique insight into discussions about the samples he collected from the Moon's surface and his observations from lunar orbit. Scott recounted some of his experiences as well as reporting on work he is involved with in conjunction with students who are exploring ways of improving on Apollo-era technology to return to the Moon.

Planetary Scientist Jim Head told the audience of his experience as a grad student and fresh Ph.D. scientist working on the training of the Apollo astronauts who were preparing to explore the Moon. Another speaker who joined us by remote audio hookup was Sergei Khrushchev, son of Nikita Khrushchev, the leader of the Soviet Union at the time of the race to the Moon. Sergei was involved with the Soviet effort and brought a unique perspective on the (then secret) competition to be first to land a human on the Moon. Alexander Basilevsky, a Soviet scientist at the time, provided a detailed look at the Soviet Union's program of robotic missions to the Moon that were supposed to be precursors to human landings.

The conference itself consisted of oral and poster presentations covering the latest research on all classes of objects in the solar system. Many talks reported on the latest results from numerous spacecraft missions. Other talks reported on the results of analysis of samples of meteorites and lunar material returned by the Apollo crews. I'll talk a little about some of the talks I attended at our April meeting.

Chris

Balloon-Bourne Observatories

by Rob Landis, NASA

Nearly four decades have passed since NASA has attempted observations of Solar System targets via balloon-borne platforms. Through the 1960s and early 1970s, the Stratoscope II and other telescopes lofted into the stratosphere made fundamental observations of the Moon, Venus, Mars, Jupiter, Io and Uranus. For a fraction of the cost of a spacecraft instrument along with the recent developments of improved pointing devices [to compensate for balloon and gondola motion], a balloon-borne platform offers a unique vantage point from which new compelling planetary science observations can be accomplished.

Observations at ~38 km (~125,000 feet) and higher are above 99% of the Earth's atmosphere. In fact, the air mass stability at this science 'float altitude' is truly a space-like environment in which diffraction-limited performance can be achieved (sans adaptive optics) at visible wavelengths – better than many ground-based facilities which house much larger aperture telescopes. After flying which amounted to a technology demonstration (BRRISON- Balloon Rapid Response [for Comet] ISON) last year with mixed results, NASA's Planetary Science Division is assessing the value of a balloon-borne observatory. (see accomapnying image on back cover) ☆

Old Tool, New Use: GPS and the Terrestrial Reference Frame

By Alex H. Kasprak

Flying over 1300 kilometers above Earth, the Jason 2 satellite knows its distance from the ocean down to a matter of centimeters, allowing for the creation of detailed maps of the ocean's surface. This information is invaluable to oceanographers and climate scientists. By understanding the ocean's complex topography—its barely perceptible hills and troughs—these scientists can monitor the pace of sea level rise, unravel the intricacies of ocean currents, and project the effects of future climate change.

But these measurements would be useless if there were not some frame of reference to put them in context. A terrestrial reference frame, ratified by an international group of scientists, serves that purpose. "It's a lot like air," says JPL scientist Jan Weiss. "It's all around us and is vitally important, but people don't really think about it." Creating such a frame of reference is more of a challenge than you might think, though. No point on the surface of Earth is truly fixed.

Artist's interpretation of the Jason 2 satellite. To do its job properly, satellites like Jason 2 require as accurate a terrestrial reference frame as possible.
Image courtesy: NASA/JPL-Caltech.

Last month I described the Phoenicids (PHO) meteor shower which peaked around The two showers in April are majorly affected by the Moon this month. The Lyrids (LYR) are reliable, albeit not abundant, but will be challenging to observe after midnight with a last quarter Moon in the way. Meteor shower specifications are found in the table below.

The annual gathering of solar system scientists occurred during the week of March 16, 2014. Chris Peterson and I attended the Lunar and Planetary Science Conference (LPSC) and listened in at the various talks. I was pleasantly surprised to hear several talks that discussed meteor showers, which is not a normal occurrence at this conference. The reason was that there was a special session on the latest mission to the moon involving the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission. Now the stated mission objectives were to:

1) Determine the composition of the lunar atmosphere, investigate processes controlling distribution and variability – sources, sinks, and surface interactions.

2) Characterize the lunar exospheric dust environment, measure spatial and temporal variability, and influences on the lunar atmosphere.

Now, these goals don't really scream out that meteor showers will be examined, however, the careful reader will notice that the lunar "atmosphere" also includes a dust component. As it turns out, impacts on the lunar surface from meteoroid streams encountered by the Moon were anticipated to produce enhancements to the lunar atmosphere and dust environment.

For fun, I tried to capture a few pictures of the results with my phone camera, which is tough in the darkened room. I tried to crop out the heads in front of me in this image that compares dust measurements over different time intervals – you can can see some of the major meteor showers listed (Geminids, Quandrantids), and it's interesting note that there was virtually no signal for the Leonids. I need to check, but this may confirm that the Leonids were weak this last year. (See images on pg. 9)

MOON PHASES

New Moon	*First Quarter*	*Full Moon*	*Last Quarter*
Apr 29	**Apr 07**	**Apr 15**	**Apr 22**

Shower	Activity	Max Date	λ 2000	Radiant α	Radiant δ	V∞ km/s	*r*	ZHR
Lyrids (LYR)	04/16 - 04/25	Apr 22	32.32°	271°	+34°	49	2.1	18
π -Puppids (PPU)	04/15 - 04/28	Apr 23	34.5°	110°	-45°	18	2.0	Var

You never know when or where meteors are going to turn up!

Tom Giguere, 808-782-1408, ***Thomas.giguere@yahoo.com***
Mike Morrow, PO Box 6692, Ocean View, HI 96737

Planets Close To the Moon

Times are Hawaii Standard Time

Apr 6, 11h, M 5.3° S of Jupiter
(85° from sun in evening sky)

Apr 14, 08h, M 3.4° S of Mars
(172° from sun in midnight sky)

Apr 16, 21h, M 1.2° W of Saturn
(155° from sun in morning sky)

Apr 24, 09h, M 4.8° NNW of Neptune
(57° from sun in morning sky)

Apr 25, 11h, M 4.1° NNW of Venus
(43° from sun in morning sky)

Apr 27, 00h, M 2.0° NNW of Uranus
(23° from sun in morning sky)

Mercury is closer than 15° from the sun when near the moon in April

Other Events of Interest

Times are Hawaii Standard Time

Apr 1, 21h, Uranus at conjunction with the sun (Passes into morning sky)

Apr 8, 11h, Mars at Opposition

Apr 11, 17h, Venus 0.66° NNW of Neptune (45° from sun in morning sky)

Apr 12, 19h, 4-Vesta at Opposition

Apr 14, 03h, Mars closest to earth - (0.618 a.u.)

Apr 14, 11h, 1-Ceres at Opposition

Apr 14, 21:44h, Moon Full
(Total eclipse of Moon)

Apr 20, Easter Sunday (First Sunday after the first full moon after the Vernal equinox)

Apr 22, Lyrid Meteors

Apr 25, 17h, Mercury at superior conj. with sun (passes into evening sky)

Apr 28, 20:17h New Moon

☿ **Mercury** Mercury finishes a rather poor apparition in the morning early in the month. Reaches superior conj. on April 25	♀ **Venus** Shines brightly in the morning sky, rising about two hours before the sun.	♂ **Mars** Reaches oppositiion on April 8. This opposition is a little below average with Mars having a magnitude of -1.5 and a disk diameter of 15”.
♃ **Jupiter** Jupiter is near the meridian at sunset and shines brightly in the SW evening sky.	♄ **Saturn** Saturn rises in the mid-evening. It is best observed after midnight when it is high in the sky.	♅ **Uranus** Uranus is lost in the glare of the sun in April.
♆ **Neptune** Neptune is above Venus in the eastern sky before sunrise. It will be better placed for viewing later in the year.	Asteroid **4 Vesta** Reaches opposition on April 12 at a magnitude of about +5.8	Dwarf Planet **1 Ceres** Reaches opposition on April 14 at magnitude of about +7.0

(Sedna continued from pg. 2)

(4-meter) telescope in Chile to discover 2012 VP113. The telescope is operated by the Foundation of Universities for Research in Astronomy, under contract with the National Science Foundation. The Magellan 21-foot (6.5-meter) telescope at Carnegie's Las Campanas Observatory in Chile was used to determine the orbit of 2012 VP113 and obtain detailed information about its surface properties.

"The discovery of 2012 VP113 shows us that the outer reaches of our solar system are not an empty wasteland as once was thought," said Trujillo, lead author and astronomer." "Instead, this is just the tip of the iceberg telling us that there are many inner Oort Cloud bodies awaiting discovery. It also illustrates how little we know about the most distant parts of our solar system and how much there is left to explore."

Our known solar system consists of the rocky planets like Earth, which are close to the sun; the gas giant planets, which are further out; and the frozen objects of the Kuiper belt, which lie just beyond Neptune's orbit. Beyond this, there appears to be an edge to the solar system where only one object somewhat smaller than Pluto, Sedna, was previously known to inhabit for its entire orbit. But the newly found 2012 VP113 has an orbit that stays even beyond Sedna, making it the furthest known in the solar system.

Sedna was discovered beyond the Kuiper Belt edge in 2003, and it was not known if Sedna was unique, as Pluto once was thought to be before the Kuiper Belt was discovered in 1992. With the discovery of 2012 VP113, Sedna is not unique and is likely the second known member of the hypothesized inner Oort cloud. The outer Oort cloud is the likely origin of some comets.

"The search for these distant inner Oort cloud objects beyond Sedna and 2012 VP113 should continue, as they could tell us a lot about how our solar system formed and evolved," says Sheppard.

Sheppard and Trujillo determine that about 900 objects with orbits like Sedna and 2012 VP113 with sizes larger than 621 miles (1000 km) may exist. The dwarf planet is likely one of hundreds of thousands of distant objects that inhabit the region in our solar system scientists refer to as the inner Oort cloud. The total population of the inner Oort cloud is likely bigger than that of the Kuiper Belt and main asteroid belt.

"Some of these inner Oort cloud objects could rival the size of Mars or even Earth," said Sheppard. This is because many of the inner Oort cloud objects are so distant that even very large ones would be too faint to detect with current technology."

A dwarf planet is an object in orbit around the sun that is large enough to have its own gravity pull itself into a spherical, or nearly round, shape. 2012 VP113's closest orbit point to the sun brings it to about 80 times the distance of the Earth from the sun, a measurement referred to as an astronomical unit or AU.

The rocky planets and asteroids exist at distances ranging between .39 and 4.2 AU. Gas giants are found between 5 and 30 AU, and the Kuiper belt (composed of hundreds of thousands of icy objects, including Pluto) ranges from 30 to 50 AU. In our solar system there is a distinct edge at 50 AU. Until 2012 VP113 was discovered, only Sedna, with a closest approach to the Sun of 76 AU, was known to stay significantly beyond this outer boundary for its entire orbit.

Both Sedna and 2012 VP113 were found near their closest approach to the sun, but they both have orbits that go out to hundreds of AU, at which point they would be too faint to discover. The similarity in the orbits found for Sedna, 2012 VP113 and a few other objects near the edge of the Kuiper Belt suggests the dwarf planet's orbit might be influenced by the potential presence of a yet unseen planet perhaps up to 10 times the size of Earth. Further studies of this deep space arena will continue.

For more details on the new dwarf planet, visit: *http://home.dtm.ciw.edu/users/sheppard/inner_oort_cloud/* ☆

Hawaiian Astronomical Society
Event Calendar

List View Past Events < April 2014 > Upcoming Events Add/Log Event

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1 7:30 PM Club Meeting	2	3	4	5 7:02 PM Public Star Party(G) 7:01 PM Public Star Party(K) Sunset: 6:49 PM
6	7	8	9	10	11	12 Sunset: 6:51 PM
13	14 7:00 PM Punahou Astronomy Class	15	16	17 7:15 PM Family Discovery Day	18	19 6:00 PM Public Star Party(D) Sunset: 6:54 PM
20 8:00 PM Globe at Night	21 8:00 PM Globe at Night	22 8:00 PM Globe at Night	23 8:00 PM Globe at Night	24 8:00 PM Globe at Night	25 8:00 PM Globe at Night	26 8:00 PM Globe at Night 6:45 PM Club Star Party (D) Sunset: 6:56 PM
27 8:00 PM Globe at Night	28 8:00 PM Globe at Night	29 8:00 PM Globe at Night	30	1	2	3

<<Upcoming Star Parties>>

Kahala/Ewa Public	**Apr 05**
Public Party-Dillingham	**Apr 19 (West)**
Club Only-Dillingham	**Apr 26 (Wikman)**

☆ ☆ Upcoming School Star Parties ☆ ☆

Thurs.	**03/20**	Papahana Kuaola (Kaneohe)
Mon.	**04/14**	Punahou Astronomy Club (Honolulu)
Thurs.	**04/17**	Pohakea Elementary (Ewa Beach)
Tues.	**05/07**	Ala Wai Elementary (Honolulu)

(Space Place continued from page 4)

To create a terrestrial reference frame, you need to know the distance between as many points as possible. Two methods help achieve that goal. Very-long baseline interferometry uses multiple radio antennas to monitor the signal from something very far away in space, like a quasar. The distance between the antennas can be calculated based on tiny changes in the time it takes the signal to reach them. Satellite laser ranging, the second method, bounces lasers off of satellites and measures the two-way travel time to calculate distance between ground stations.

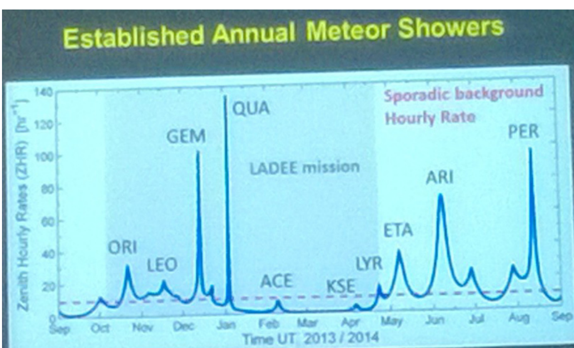
Weiss and his colleagues would like to add a third method into the mix—GPS. At the moment, GPS measurements are used only to tie together the points created by very long baseline interferometry and satellite laser ranging together, not to directly calculate a terrestrial reference frame.

“There hasn’t been a whole lot of serious effort to include GPS directly,” says Weiss. His goal is to show that GPS can be used to create a terrestrial reference frame on its own. “The thing about GPS that’s different from very-long baseline interferometry and satellite laser ranging is that you don’t need complex and expensive infrastructure and can deploy many stations all around the world.”

Feeding GPS data directly into the calculation of a terrestrial reference frame could lead to an even more accurate and cost effective way to reference points geospatially. This could be good news for missions like Jason 2. Slight errors in the terrestrial reference frame can create significant errors where precise measurements are required. GPS stations could prove to be a vital and untapped resource in the quest to create the most accurate terrestrial reference frame possible. “The thing about GPS,” says Weiss, “is that you are just so data rich when compared to these other techniques.”

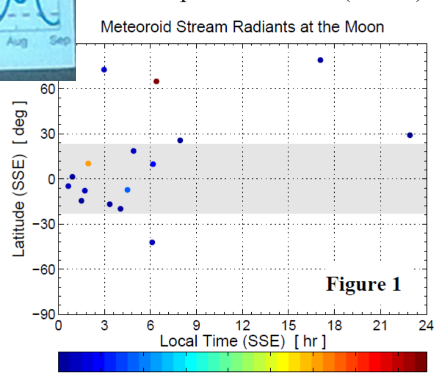
You can learn more about NASA’s efforts to create an accurate terrestrial reference frame here: *http://space-geodesy.nasa.gov/*.

Kids can learn all about GPS by visiting *http://spaceplace.nasa.gov/gps* and watching a fun animation about finding pizza here: *http://spaceplace.nasa.gov/gps-pizza*. ☆



(Meteor Report continued from page 5)

It was nice to see some real science down with regards to meteor showers. I think this shows experiments may or may not find what they are looking for, but often something new and unexpected is seen. (below)



Other results for this mission can be found on line. This figure above was published in an abstract entitled: *The Impact of Meteoroid Streams on the Lunar Atmosphere and Dust Environment during the LADEE mission.* It compares the orbit of LADEE with the radiants of the various showers, this explains why some major showers, like the Perseids are not recorded.

HAS Financial Report for the month ending as of Mar. 15, 2014

Initial Balance:	**$3,585.12**
Income:	
Astronomy Payment	34.00
Dues Received	193.00
Total Income:	**$227.00**
Expenses:	
Astronews	67.86
Equipment	60.00
S&T Subscription	22.00
Total Expenses:	**$194.81**
Final Balance	**$3,617.31**

HAS welcomes new members ***Ted, Deborah, & Andrew Pierson, and Leighton Hasegawa, and thanks all members who renewed their membership this year.*** Also big mahalo to members ***Noel Villamil and Kayoko Calef*** for their donations last month.

A reminder to those whose membership expired at the end of last year. **Check your mailing label for your anniversary date.**

NOTICE:

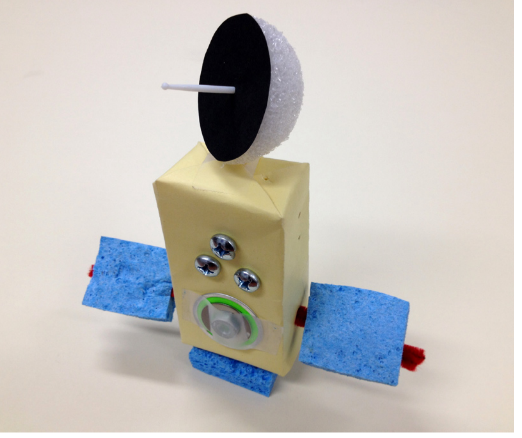
HAS will publish a complete listing of Club members in the **June 2014** issue of the Astronews. This publication is required by Club by-laws, Article III, Section 2 Para C(e) and Article VIII, Section 1B. Unless notified otherwise, this list will include all member's names, mailing addresses, and phone numbers. If you wish to have some or all of your data excluded, please notify the Club Treasurer, ***April Lew*** before **May 15, 2014**.

Please be advised that this listing is intended for Club members' personal use only in contacting one another. *It is not to be used for any commercial or solicitation purposes.* With the exception of our membership in the Astronomical League, HAS does make this list available to, nor do we sell its contents to anyone for any purpose. Please respect our member's right to privacy.

Member information is not to be republished, redistributed, or used for any commercial or solicitation purposes.

NASA Kids: Build Your Own Satellite

- Container: small juice box.
- Power source: battery made from a yellow sponge.
- Instruments: small plastic dish attached with a pick-up stick.
- Communication: Radio dish made with half a styrofoam ball, black construction paper, and a part of a pick-up stick.
- Orientation finder: star tracker made from a screw.
- Held together with: Scotch tape.



BALLOON BOON IN FRONT OF A BLUE MOON: Although not technically a "blue moon" in astronomical terms, the BRRISON misson carried an 0.8 m telescope and optical and infrared sensors to study the comet ISON from above nearly all of Earth's atmosphere. In addition to observing Comet ISON, scientists plan to have BRRISON observe many other targets during its flight. These include Comet Encke; moons and other satellites of Jupiter; the hydrated (water-bearing) asteroids 24 Themis and 130 Elektra; the star systems Castor and Mizar; and Earth's moon. See more on BRRISON on page 3 and image on back cover.

Image credit: Rob Landis

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Place stamp here. Post Office will not deliver mail without proper postage

BRRISON (Balloon Rapid Response [for Comet] ISON) launch sequence, Fall 2013. From bottom of the gondola on up to the apex of the balloon measures over 1000 feet — just longer than a Nimitz-class aircraft carrier. At altitude, the balloon expands to nearly the size of the Rose Bowl stadium. See more on BRRISON on page 3. *Courtesy: NASA/JHU/APL*