The Astronews

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FIRST POTENTIALLY HABITABLE EARTH-SIZED PLANET CONFIRMED BY GEMINI AND KECK OBSERVATORIES

The first Earth-sized exoplanet orbiting within the habitable zone of another star has been confirmed by observations with both the W. M. Keck Observatory and the Gemini Observatory. The initial discovery, made by NASA's Kepler Space Telescope, is one of a handful of smaller planets found by Kepler and verified using large ground-based telescopes. It also confirms that Earth-sized planets do exist in the habitable zone of other stars.

"What makes this finding particularly compelling is that this Earth-sized planet, one of five orbiting this star, which is cooler than the Sun, resides in a temperate region where water could exist in liquid form," says Elisa Quintana of the SETI Institute and NASA Ames Research Center who led the paper published in the current issue of the journal Science. The region in which this planet orbits its star is called the habitable zone, as it is thought that life would most likely form on planets with liquid water.

Steve Howell, Kepler's Project Scientist and a co-author on the paper, adds that neither Kepler (nor any telescope) is currently able to directly spot an exoplanet of this size and proximity to its host star. "However, what we can do is eliminate essentially all other possibilities so that the validity of these planets is really the only viable option."

With such a small host star, the team employed a technique that eliminated the possibility that either a background star or a stellar companion could be mimicking what Kepler detected. To do this, the team obtained extremely high spatial resolution

(Continued on page 2)

Inside this issue:

Upcoming Events:

- ☆The next meeting is 7:30PM on **Tues., May 6** 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., **May 4** at 3:30 p.m. at the POST building at UH.

Up To The Minute:

DISCOVERED: A COLD, CLOSE NEIGHBOR OF THE SUN

NASA's Wide-field Infrared Survey Explorer (WISE) and Spitzer Space Telescope have discovered what appears to be the coldest "brown dwarf" known -- a dim, star-like body that surprisingly is as frosty as Earth's North Pole. Named "WISE J085510.83-071442.5," the brown dwarf appears to be 7.2 light-years away, earning it the title for fourth closest system to our sun.

Brown dwarfs start their lives like stars, as collapsing balls of gas, but they lack the mass to burn nuclear fuel and radiate starlight. The newfound coldest brown dwarf is named WISE J085510.83-071442.5. It has a chilly temperature between -54 and -9 deg. Fahrenheit (-48 to -13 deg. Celsius). Previous record holders for coldest brown dwarfs, also found by WISE and Spitzer, were about room temperature.

WISE was able to spot the rare object because it surveyed the entire sky twice in infrared light, observing some areas up to three times. Cool objects like brown dwarfs can be invisible when viewed by visible-light telescopes, but their thermal glow, even if feeble, stands out in infrared light. In addition, the closer a body, the more it appears to move in images taken months apart. Airplanes are a good example of this effect: a closer, low-flying plane will appear to fly overhead more rapidly than a high-flying one.

After noticing the fast motion of WISE J085510.83-071442.5, Luhman spent time analyzing additional images taken with Spitzer and the Gemini South telescope on Cerro Pachon in Chile. Spitzer's infrared observations helped determine the frosty temperature of the brown dwarf. Combined detections from WISE and Spitzer, taken from different positions around the sun, revealed the object's parallax, and thus its distance. The closest system to Earth, a trio of stars, is Alpha Centauri, at about 4 light-years away. WISE J085510.83-071442.5 is only a few light years farther than that.

☆ *--story courtesy NASA*

The Astronews is a monthly newsletter of the Hawaiian Astronomical Society. Some of the contents may be copyrighted. We request that authors and artists be given credit for their work. Contributions are welcome. Send them to the Editor via email. The deadline is the 16th of each month. We are not responsible for unsolicited artwork.

President's Message

by Chris Peterson

The total lunar eclipse we experienced on April 14th in Hawaii was the first since 2010, but we will get two more at about six month intervals, in October of this year and April of next. Most of the U.S. will see another one in September of next year, but we won't be well placed for that one.

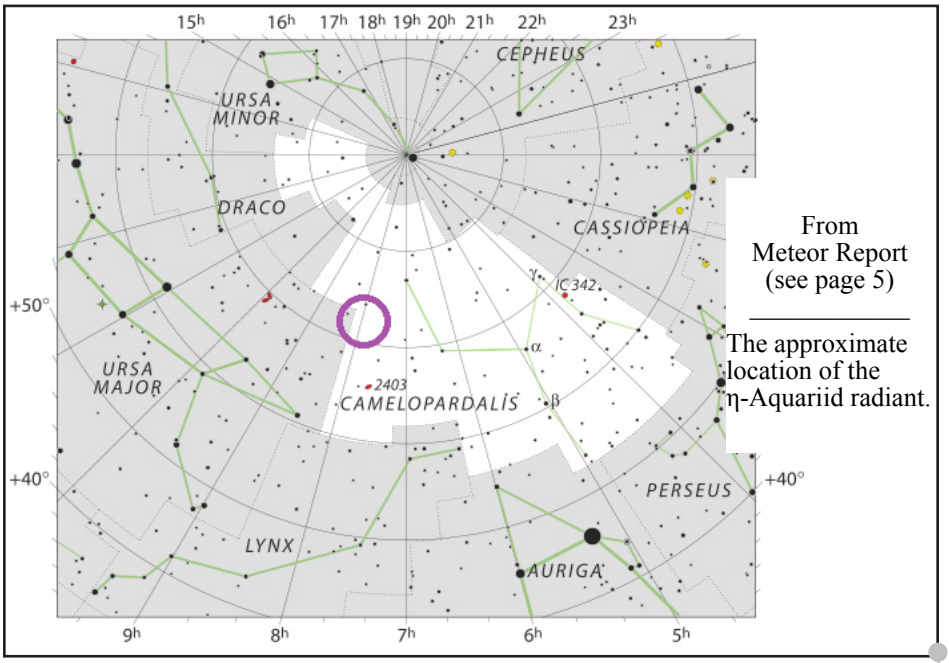
Eclipses happen when the Moon occupies the part of its orbit that crosses the ecliptic, but only if nearly exactly along the Earth-Sun line. The Moon's orbit lies at an angle to the plane of the ecliptic, so most full Moons pass above or below Earth's shadow, and most new Moons pass above or below the Sun in our sky. Twice a year, as the Earth and Moon orbit the Sun, the ascending and descending nodes of the Moon's orbit (the places where it crosses the ecliptic going north or south) line up with the Earth and Sun. If the Moon is full then, there is a total lunar eclipse. If it's new, there's a solar eclipse.

If the Moon is at a different phase, there may be a partial or penumbral lunar eclipse when it becomes full. A solar eclipse often precedes or follows a lunar eclipse by half a lunar cycle. Because the Earth's shadow is so much bigger than the Moon, there is usually some sort of lunar eclipse every six months. The footprint of totality for a solar eclipse is much smaller, so solar eclipses are rarer.

Even though lunar eclipses are common, it is uncommon to get several total eclipses in a row. We just experienced the first of four.

If the Moon's orbit were fixed in space, eclipses would happen on a more regular schedule, but it's not. The Moon's orbital plane precesses, so the nodes also precess around the ecliptic. Succeeding eclipse opportunities are slightly less than six months apart. You may remember that our total solar eclipse in Hawaii in 1991 fell in July. A full precession cycle takes about 18½ years.

Chris



From Meteor Report (see page 5)

The approximate location of the η-Aquariid radiant.

NASA's Space Place

The Power of the Sun's Engines

By Dr. Ethan Siegel

Here on Earth, the sun provides us with the vast majority of our energy, striking the top of the atmosphere with up to 1,000 Watts of power per square meter, albeit highly dependent on the sunlight's angle-of-incidence. But remember that the sun is a whopping 150 million kilometers away, and sends an equal amount of radiation in all directions; the Earth-facing direction is nothing special. Even considering sunspots, solar flares, and long-and-short term variations in solar irradiance, the sun's energy output is always constant to about one-part-in-1,000. All told, our parent star consistently outputs an estimated 4 × 1026 Watts of power; one second of the sun's emissions could power all the world's energy needs for over 700,000 years.

That's a literally astronomical amount of energy, and it comes about thanks to the hugeness of the sun. With a radius of 700,000 kilometers, it would take 109 Earths, lined up from end-to-end, just to go across the diameter of the sun once. Unlike our Earth, however, the sun is made up of around 70% hydrogen by mass, and it's the

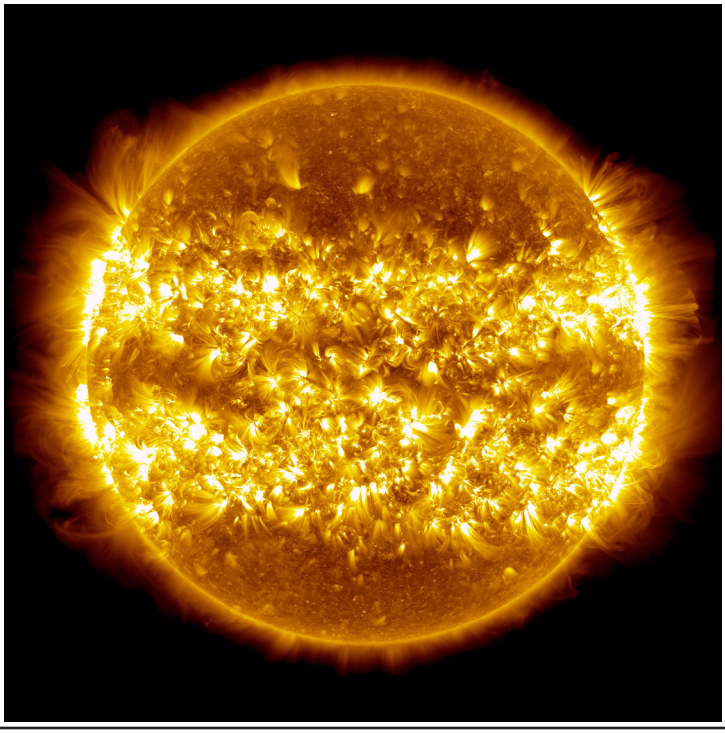


Image credit: composite of 25 images of the sun, showing solar outburst/activity over a 365 day period; NASA / Solar Dynamics Observatory / Atmospheric Imaging Assembly / S. Wiessinger; post-processing by E. Siegel.

The η-Aquariids (ETA) peak this year on May 6th, and unlike most major showers, they do not have a sharp peak. Instead they have a plateau of strong activity centered on the maximum. Thus, you can observe a few days before or after this date. It is best to observe before dawn, which helps to to avoid the first quarter Moon. An avid observer can begin to observe this shower around 3am, then the maximum hourly rate will decrease as the dawn light increases. The lower the latitude, the more meteors you should see – this is good for observers in Hawaii.

A news item from the American Meteor Society (AMS) caught my eye this year. Sky and Telescope (Kelly Beatty) also provided a report. The AMS predicts the possibility on May 23-24 of a major meteor display in the northern hemisphere. The shower peaks at 7-8 UT (9-10pm HST on 5/23), when the Earth is expected to encounter numerous particles that were produced by comet LINEAR P/209. The particles were released starting in 1798 and the most recent in 1979. The particle orbit will pass at it's closest about 0.0002 AU (18,500 miles) from the Earth. This is quite close to the Earth. This comet was very small, thus a storm is not expected, but rather a display on par with a typical major shower. However, some dynamicists (Vaubaillon, Maslov) are making claims that a "storm" is posssible. The particles shed by this comet are ecpected to be larger than normal, therefore bright meteors are possible. The waning crescent Moon should not interfere much with viewing. The radiant is in norther Camelopardalis, about 10 degrees from Polaris. Northerly latitudes are preferred, but Hawaii should be reasonable if you have a dark, northern sky (like the north shore).

See chart on page 3-- Let's all make an effort to observe this eclectic shower. Any data on this display is extremely important to the AMS and observations on meteors (time, magnitude, color, observing conditions) would be most welcome. Please forward you information to Mike and I.

MOON PHASES

First Quarter	*Full Moon*	*Last Quarter*	*New Moon*
May 07	**May 14**	**May 21**	**May 28**

Shower	Activity	Max Date	λ 2000	Radiant α	Radiant δ	V∞ km/s	*r*	ZHR
η-Aquariids (ETA)	04/19 - 05/28	May 06	45.5°	338°	-01°	66	2.4	55
η-Lyrids (ELY)	05/03 - 05/14	May 08	48.0°	287°	+44°	43	3.0	3

If you see an η-Aquariids or LINEAR 209P's, please report it, we want to know!

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

May 3, 03h, M 5.4° S of Jupiter
(63° from sun in evening sky)

May 11, 02h, M 2.8° SSW of Mars
(139° from sun in evening sky)

May 14, 02h, M 0.56° S of Saturn
(175° from sun in midnight sky)

May 21, 16h, M 4.7° NNW of Neptune
(83° from sun in morning sky)

May 24, 11h, M 2.0° NNW of Uranus
(47° from sun in morning sky)

May 25, 05h, M 2.2° NNW of Venus
(38° from sun in morning sky)

May 25, 06h, M 5.9° S of Mercury
(22° from sun in morning sky)

May 31, 22h, M 5.4° S of Jupiter
(40° from sun in evening sky)

Other Events of Interest

Times are Hawaii Standard Time

May 10 Astronomy Day

May 10, 08h, Saturn at Opposition

May 14, 09:18h, Full Moon

May 15, 13h, Venus 1.2° SSE of Uranus
(40° from sun in morning sky)

May 24, 21h,
Mercury at greatest elongation
(22.7° East of the sun in evening sky)

May 28, 08.42h New Moon

☿ Mercury

Mercury has its best evening appearance of the year, reaching greatest elongation of May 24.

♀ Venus

Shines brightly in the morning sky, rising about two hours before the sun.

♂ Mars

Mars is still high and bright in the evening sky, setting long after midnight.

♃ Jupiter

Jupiter shines brightly in the SW evening sky, setting 3-4 hours after sunset.

♄ Saturn

At opposition on May 10. This is the best month to observe the ringed planet. Best viewed near midnight.

♅ Uranus

Uranus is visible low in the southeast before sunrise, but will be much better placed for viewing later in the year.

♆ Neptune

Neptune is above Uranus in the eastern sky before sunrise. It will also be better placed for viewing later in the year.

⚳ Dwarf Planet 1Ceres

Reached opposition last month at magnitude of about +7.0 and is still well placed for viewing in the evening sky.

⚶ Asteroid 4 Vesta

Reached opposition in April at a magnitude of about +5.8 and can be viewed near Ceres.

Meeting Minutes

by Gretchen West

President Chris Peterson called the April 1, 2014 meeting of the Hawaiian Astronomical Society to order at 7:33p.m. The meeting was held in the Planetarium, on the grounds of the Bishop Museum, Honolulu, Hawaii. There were 22 members and two visitors in attendance.

Hawaii Space Lecture Series: This month's lecture is scheduled for 7:30 p.m., April 22, 2014. Dr. Lionel Wilson, will be speaking on "Volcanic Activity on Early Mercury." Dr. Wilson is an Emeritus Professor of Earth & Planetary Sciences, Lancaster University, England. Regular lectures usually take place at the NASA Pacific Regional Planetary Data Center, room 544 in the Pacific Ocean Science and Technology Building at UH Manoa. Call 808-956-3132 go to http://www.higp.hawaii.edu/prpdc for more information.

June Pot Luck: We hope that members will mark their calendars. Our June 3rd general membership meeting will be preceded by a **club pot luck** at the Bishop Museum. We look forward to having members join us on that evening to share good food and great conversation. We will have a sign-up sheet at the May meeting. Please be sure to contact us if you are thinking of coming. More information to follow in the May minutes.

Hawaii State Science and Engineering: ***Chris Peterson*** reminded members that the 57th Hawaii State Science and Engineering Fair takes place this year on April 1 and 2, at the Hawaii Convention Center. This year's HAS judges will be ***Peter Besenbruch and Susan Girard.*** We will give out awards in both the Junior Research and Senior Research divisions.

School & Special Event Star Parties: ***John Gallagher*** reports that we have three upcoming school star parties in April and one upcoming in May.

April 14 - Punahou School & Bishop Museum - Total lunar eclipse.

April 17 - Pohakea Elementary (Ewa) - STEM night.

May 7 - Ala Wai Elementary - Sign-up sheet at the May meeting.

FYI: ***Paul Lawler*** shared a new gadget called "Snapzoom." This universal smartphone scope adapter by HI Resolution Enterprises will allow you to shoot great shots using binoculars as well as through the focuser of your telescope. The item connects and aligns a smartSergiephone camera with the eyepiece of your binoculars or your scope. Nifty little item. Look for it.

Visitors: We had two visitors with us for the April meeting. ***Bob Carson***, a former member, joined us for the evening and ***Ted Pierson*** found us on-line.

Reports: ***Chris Peterson*** spoke briefly about the recent Lunar Planetary Science Conference 2014 that took place March 18 - 22 in Woodlands, Texas. Chris shared information about Apollo astronaut Jack Schmidt who spoke at the conference. Jack Schmidt is the only geologist ever to perform fieldwork on another world (the Moon).

Discussion: There were some questions regarding the current turmoil in the Ukraine and with Vladimir Putin. Questions were asked about the cooperation between the U.S. and Russia in space at the International Space Station.

Monday, April 14th is a total Lunar eclipse. The H.A.S. and member astronmers will help out at the Bishop Museum starting at 6:30 pm, through totality around 8:40 p.m., and continue until the eclipse ends, around 11:30 p.m.

Astronomy Day: H.A.S. will celebrate International Astronomy Day on Saturday, May 10, 2014, at Kahala Mall. We will have a table display set up in front of Whole Foods. In addition, we will have solar viewing on the 2nd floor parking deck above Whole Foods.

(Continued on page 9)

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

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	1	2	3 7:13 PM Public Star Party(G) 7:12 PM Public Star Party(K) Sunset: 6:59 PM
4	5	6 7:30 PM Club Meeting	7 7:15 PM Lunar Night 2014	8	9	10 Sunset: 7:02 PM
11	12	13	14	15	16	17 6:00 PM Public Star Party(D) Sunset: 7:05 PM
18	19 8:00 PM Globe at Night	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 6:45 PM Club Star Party (D) Sunset: 7:08 PM
25 8:00 PM Globe at Night	26 Memorial Day 8:00 PM Globe at Night	27 8:00 PM Globe at Night	28 8:00 PM Globe at Night	29	30	31 7:27 PM Public Star Party(G) 7:26 PM Public Star Party(K) Sunset: 7:11 PM

<<Upcoming Star Parties>>

Public Party-Dillingham	**May 17 (Besenbruch)**
Kahala/Ewa Public	**May 3 & 31**
Club Only-Dillingham	**May 24 (Rykken)**

☆ ☆ Upcoming School Star Parties ☆ ☆

Wed.	**05/07**	Ala Wai Elementary (McCully)

Volunteers needed for public and school star parties!

Please contact John Gallagher: gallaghej002@hawaii.rr.com

(Space Place continued from page 4)

individual protons -- or the nuclei of hydrogen atoms -- that fuse together, eventually becoming helium-4 and releasing a tremendous amount of energy. All told, for every four protons that wind up becoming helium-4, a tiny bit of mass -- just 0.7% of the original amount -- gets converted into energy by E=mc2, and that's where the sun's power originates.

You'd be correct in thinking that fusing ~4 × 1038 protons-per-second gives off a tremendous amount of energy, but remember that nuclear fusion occurs in a huge region of the sun: about the innermost quarter (in radius) is where 99% of it is actively taking place. So there might be 4 × 1026 Watts of power put out, but that's spread out over 2.2 × 1025 cubic meters, meaning the sun's energy output per-unit-volume is just 18 W / m3. Compare this to the average human being, whose basal metabolic rate is equivalent to around 100 Watts, yet takes up just 0.06 cubic meters of space. In other words, you emit 100 times as much energy-per-unit-volume as the sun! It's only because the sun is so large and massive that its power is so great.

It's this slow process, releasing huge amounts of energy per reaction over an incredibly large volume, that has powered life on our world throughout its entire history. It may not appear so impressive if you look at just a tiny region, but -- at least for our sun -- that huge size really adds up!

Check out these "10 Need-to-Know Things About the Sun": http://solarsystem.nasa.gov/planets/profile.cfm?Object=Sun.

Kids can learn more about an intriguing solar mystery at NASA's Space Place: http://spaceplace.nasa.gov/sun-corona.

☆

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration

(Minutes continued from page 7)

Guest Speaker: Our speaker this month was Dr. Nadir Haghighipour, a fellow of the Institute for Astronomy and NASA Astrobiology Institute, University of Hawaii-Manoa. He obtained a PhD at the University of Missouri-Columbia in Planetary Dynamics and Extra-solar Planets. Dr. Haghighipour spoke to the assembled membership regarding Exo-Planetary Systems and Binary Star Systems. His lecture and Power Point presentation covered dueling theories regarding extrasolar planetary formation around binary stars. His discussion touched on the possibility of habitability of such planets. Dr. Haghighipour left us with two websites that can be accessed to allow members to play with the possibilities of planetary formation: http://astro.twam.info/hz-ptype/multistar and http://astro.twam.info/hz.

Planetarium: ***Joanne Bogan*** guided us through the universe. She again showed us the differences between the digistar system and the GOTO planetarium mechanism. We traveled from Earth to Alberio and back, and showed us the ISS. She is a master at utilizing the power of the Bishop Museum's Planetarium. It is always wonderful to sit back and have a guided tour of the universe.

Mahalo: As there was no further business, the meeting was adjourned at 9:34 p.m. Members enjoyed tasty refreshments supplied by ***Otis Wikman.***

Respectfully Submitted,
Gretchen West
HAS Secretary

Treasurer's Report

by April Lew

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

Initial Balance:	**$3,617.31**
Income:	
Magazine Payments	32.95
Donations	61.00
Dues Received	212.00
Total Income:	**$305.95**
Expenses:	
Astronews	159.18
Awards	50.00
Magazine Subscriptions	68.00
Refreshments	27.00
Total Expenses:	**$304.18**
Final Balance	**$3,619.08**

Welcome to new members *Mary Jean Solywoda, and Ellery, Anielyn & Nova Galanto*. A special thanks to ***the Galantos, Sapaviths and Grzegorz Glaz*** for their donations.

Thanks to all members who ***renewed*** their membership this 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.

(Planet continued from page 1)
observations from the eight-meter Gemini North telescope on Mauna Kea in Hawai`i using a technique called speckle imaging, as well as adaptive optics (AO) observations from the ten-meter Keck II telescope, Gemini's neighbor on Mauna Kea. Together, these data allowed the team to rule out sources close enough to the star's line-of-sight to confound the Kepler evidence, and conclude that Kepler's detected signal has to be from a small planet transiting its host star.

"The Keck and Gemini data are two key pieces of this puzzle," says Quintana. "Without these complementary observations we wouldn't have been able to confirm this Earth-sized planet."

The Gemini "speckle" data directly imaged the system to within about 400 million miles (about 4 AU, approximately equal to the orbit of Jupiter in our solar system) of the host star and confirmed that there were no other stellar size objects orbiting within this radius from the star. Augmenting this, the Keck AO observations probed a larger region around the star but to fainter limits. According to Quintana, "These Earth-sized planets are extremely hard to detect and confirm, and now that we've found one, we want to search for more. Gemini and Keck will no doubt play a large role in these endeavors."

The host star, Kepler-186, is an M1-type dwarf star relatively close to our solar system, at about 500 light years and is in the constellation of Cygnus. The star is very dim, being over half a million times fainter than the faintest stars we can see with the naked eye. Five small planets have been found orbiting this star, four of which are in very short-period orbits and are very hot. The planet designated Kepler-186f, however, is earth-sized and orbits within the star's habitable zone. The Kepler evidence for this planetary system comes from the detection of planetary transits. These transits can be thought of as tiny eclipses of the host star by a planet (or planets) as seen from the Earth. When such planets block part of the star's light, its total brightness diminishes. Kepler detects that as a variation in the star's total light output and evidence for planets. So far more than 3,800 possible planets have been detected by this technique with Kepler.

The Gemini data utilized the Differential Speckle Survey Instrument (DSSI) on the Gemini North telescope. DSSI is a visiting instrument developed by a team led by Howell who adds, "DSSI on Gemini Rocks! With this combination, we can probe down into this star system to a distance of about 4 times that between the Earth and the Sun. It's simply remarkable that we can look inside other solar systems." DSSI works on a principle that utilizes multiple short exposures of an object to capture and remove the noise introduced by atmospheric turbulence producing images with extreme detail.

Observations with the W.M. Keck Observatory used the Natural Guide Star Adaptive Optics system with the NIRC2 camera on the Keck II telescope. NIRC2 (the Near-Infrared Camera, second generation) works in combination with the Keck II adaptive optics system to obtain very sharp images at near-infrared wavelengths, achieving spatial resolutions comparable to or better than those achieved by the Hubble Space Telescope at optical wavelengths. NIRC2 is probably best known for helping to provide definitive proof of a central massive black hole at the center of our galaxy. Astronomers also use NIRC2 to map surface features of solar system bodies, detect planets orbiting other stars, and study detailed morphology of distant galaxies.

"The observations from Keck and Gemini, combined with other data and numerical calculations, allowed us to be 99.98% confident that Kepler-186f is real," says Thomas Barclay, a Kepler scientist and also a co-author on the paper. "Kepler started this story, and Gemini and Keck helped close it," adds Barclay.

See back cover for image. For more images and information, see www.gemini.edu.

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Hawaiian Astronomical Society
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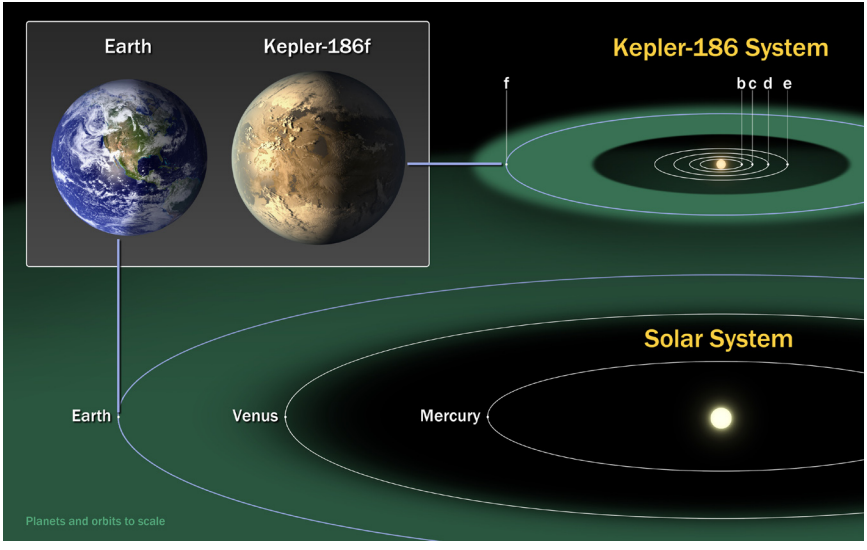

Kepler-186 and the Solar System: This diagram compares our inner solar system to Kepler-186, a five-planet system about 500 light-years from Earth in the constellation Cygnus. The Kepler-186 system is home to Kepler-186f, the first validated Earth-size planet orbiting a distant star in the habitable zone—a range of distances from a star where liquid water might pool on the surface of an orbiting planet. The discovery of Kepler-186f confirms that Earth-size planets exist in the habitable zone of other stars and signals a significant step closer to finding a world similar to Earth. See front cover for story.
Courtesy: GeminiObservatory/NASA Ames/SETI Institute/JPL-CalTech