SETI survey focuses on Kepler's top Earth-like planets

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The Robert C. Byrd Green Bank Telescope in West Virginia, the largest steerable radio telescope in the world, is observing 86 planetary systems that may contain Earth-like planets in hopes of detecting signals from intelligent civilizations. (Courtesy NRAO)

(PhysOrg.com) -- UC Berkeley is searching for evidence of intelligent life on planets identified by the Kepler space telescope team as having Earth-like environments. This search for extraterrestrial intelligence (SETI) uses the Green Bank Telescope in West Virginia and targets 86 stars with possible planetary systems.

Now that NASA's Kepler space telescope has identified 1,235 possible planets around stars in our galaxy, astronomers at the University of

California, Berkeley, are aiming a radio telescope at the most Earth-like of these worlds to see if they can detect signals from an advanced civilization.

The search began on Saturday, May 8, when the Robert C. Byrd Green Bank Telescope – the largest steerable radio telescope in the world – dedicated an hour to eight stars with possible planets. Once UC Berkeley astronomers acquire 24 hours of data on a total of 86 Earth-like planets, they'll initiate a coarse analysis and then, in about two months, ask an estimated 1 million SETI@home users to conduct a more detailed analysis on their home computers.

"It's not absolutely certain that all of these stars have habitable planetary systems, but they're very good places to look for ET," said UC Berkeley graduate student Andrew Siemion.

The Green Bank telescope will stare for about five minutes at stars in the Kepler survey that have a candidate planet in the star's habitable zone – that is, the planet has a surface temperature at which liquid water could be maintained.

"We've picked out the planets with nice temperatures – between zero and 100 degrees Celsius – because they are a lot more likely to harbor life," said physicist Dan Werthimer, chief scientist for SETI@home and a veteran SETI researcher.

Werthimer leads a 30-year-old SETI project on the world's largest radio telescope, the Arecibo receiver in Puerto Rico, which feeds data to SETI@home for a detailed analysis that could only be done on the world's largest distributed computer.

"With Arecibo, we focus on stars like our sun, hoping that they have planets around them that emit intelligent signals," he said. "But we've

never had a list of planets like this before."

Werthimer also was involved with a SETI project that used the previous Green Bank telescope, which collapsed from structural failure in 1988.

"It's really amazing that SETI is able to come back home to Green Bank where project Ozma, the first SETI observations, took place 51 years ago," said Green Bank scientist Ronald Maddalena. "We now have a sensitivity that was undreamt of when Frank Drake ran his experiment in 1960."

Werthimer also conducted a brief SETI project using the Allen Telescope Array (ATA), which hosted a broader search for intelligent signals from space run by the SETI Institute of Mountain View, Calif. The SETI Institute's search ended last month when the ATA went into hibernation mode after the institute and UC Berkeley ran out of money to operate it.

Wealth of data from Green Bank telescope

The radio dish in rural West Virginia was needed for the new search because the Arecibo dish cannot view the area of the northern sky on which Kepler focuses. But the Green Bank telescope also offers advantages over Arecibo. UC Berkeley's SETI observations piggyback on other astronomical observations at Arecibo, and is limited in the wavelength range it can observe, which centers on the 21 centimeter (1420 MHz) line where hydrogen emits light. These wavelengths easily pass through the dust clouds that obscure much of the galaxy.

"Searching for ET around the 21 centimeter line works if civilizations are broadcasting intentionally, but what if planets are leaking signals like 'I Love Lucy'?" Werthimer said. "With a new data recorder on the Green Bank telescope, we can scan a 800 megaHertz range of frequencies

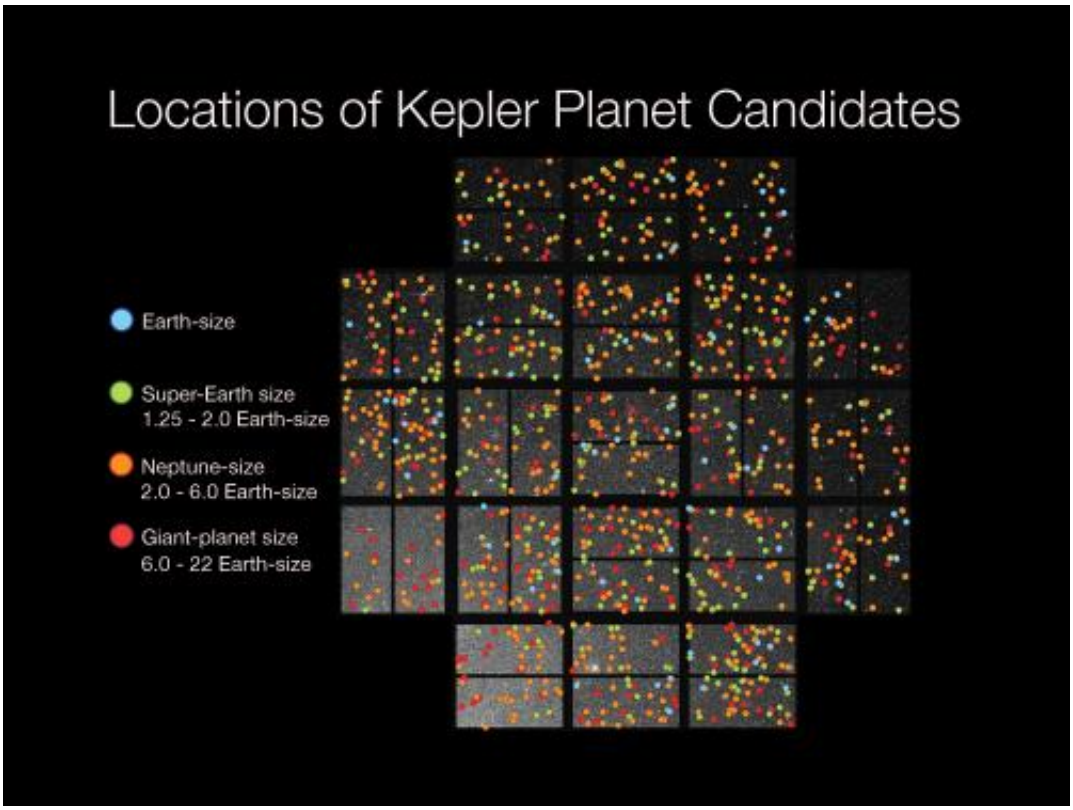
simultaneously, which is 300 times the range we can get at Arecibo."

Thus, one day on the Green Bank telescope provides as much data as one year's worth of observations at Arecibo: about 60 terabytes (60,000 gigabytes) in all, Siemion said. If they recorded a similar chunk of the radio spectrum from Arecibo, SETI@home would be overwhelmed with data, since the Arecibo sky survey observes nearly full time for years on end.

"It's also great that we will completely span the water hole, a canonical place to look for intentional signals from intelligent civilizations," Siemion said.

Gathering at the water hole

The water hole is a relatively quiet region of the radio spectrum in the universe and a range of wavelengths not significantly absorbed by material between the stars and galaxies. The water hole is bounded on one end by the 21 cm emissions from neutral hydrogen and on the other by the 18 cm emissions from the hydroxyl ion (OH). Because life is presumed to require the existence of liquid water, and water is composed of hydrogen and hydroxyl, this range was dubbed the water hole and seen as a natural window in which water-based life forms would signal their existence. That makes the water hole is a favorite of SETI projects.



UC Berkeley's SETI survey will target the most Earth-like of the 1,235 Kepler Objects of Interest. (Courtsy of NASA/Ames Research Center, W.Stenzel)

“This is an interesting place, perhaps a beacon frequency, to look for signals from extraterrestrial civilizations,” Siemion added.

The 86 stars were chosen from the 1,235 candidate planetary systems – called Kepler Objects of Interest, or KOIs with the help of Kepler team member Geoffrey Marcy, professor of astronomy at UC Berkeley. UC Berkeley’s targets include the 54 KOIs identified by the Kepler team as being in the habitable temperature range and with sizes ranging from Earth-size to larger than Jupiter; 10 KOIs not on the Kepler team’s habitable list but with orbits less than three times Earth’s orbit and orbital periods greater than 50 days; and all systems with four or more possible planets. After the Green Bank telescope has targeted each star,

it will scan the entire Kepler field for signals from planets other than the 86 targets.

A coarse analysis of the data by Werthimer and his team will be followed by a more thorough analysis by SETI@home users, who will be able to see whether they are analyzing Green Bank data as opposed to Arecibo data. The complete analysis for intelligent signals could take a year, Werthimer said.

“If you extrapolate from the Kepler data, there could be 50 billion planets in the galaxy,” he said. “It’s really exciting to be able to look at this first batch of Earth-like planets.”

The Green Bank telescope is operated by the National Radio Astronomy Observatory, with funds provided by the National Science Foundation (NSF). SETI@home is supported by NSF, NASA and private donations.

More information: setiathome.berkeley.edu/

Provided by University of California - Berkeley

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