Astronomers join forces to speed discovery of habitable worlds

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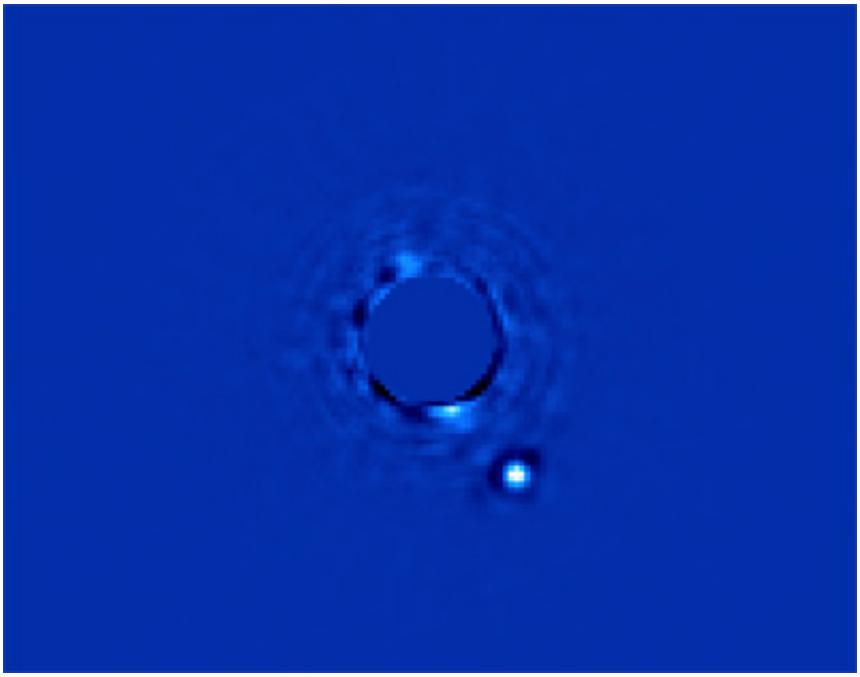

Gemini Planet Imager's first light image of Beta Pictoris b (to lower right of center), a planet orbiting the star Beta Pictoris. Light from the star is blocked in this image by a mask so it doesn't interfere with the light of the planet. Credit: Processing by Christian Marois, NRC Canada

UC Berkeley astronomers will lead one of 16 new projects funded by NASA to coordinate different exoplanet searches to more efficiently find habitable planets around other stars, and perhaps extraterrestrial life itself.

The project, led by James Graham, a UC Berkeley professor of astronomy, will bring together researchers at UC Berkeley and Stanford University and coordinate their efforts with other researchers across the United States. The budget for the four-year project is $3.25 million.

The Berkeley and Stanford teams are involved in two major exoplanet searches: a highly successful search for exoplanets based on the wobble they produce in a star's motion or the dimming they create when they transit in front of a star; and a newly launched survey by the Gemini Planet Imager to directly take pictures of planets by capturing the heat they give off.

"We're combining techniques to discover new information about how planets form, their range of properties and what sorts of planets are most common, with the eventual goal of finding terrestrial planets and venues for life in the universe," Graham said.

UC Berkeley's "Exoplanets Unveiled" project is part of the NExSS (Nexus for Exoplanet System Science) initiative announced April 21 by NASA to bring together the "best and brightest," according to a NASA press release. NExSS is conceived as a virtual institute marshalling the expertise of 10 universities, three NASA centers and two research institutes to better understand the various components of an exoplanet, as well as how the parent stars and neighboring planets interact to support life.

Planet snapshots

A unique aspect of the UC Berkeley-led project is the involvement of the Gemini Planet Imager (GPI), for which Graham is the project scientist. Bruce Macintosh, the principal investigator for GPI, is also part of the NASA team. GPI is a new instrument for the Gemini Observatory and began its exoplanet survey at the Gemini South Telescope in

November 2014. GPI has already imaged two previously known exoplanets and disks of planetary debris orbiting young stars where planets recently formed.

"With GPI, we've already shown that we can see planets as they move month to month around their stars," Macintosh said. "With this new collaboration, we will combine the strengths of imaging, Doppler and transits to characterize planets and their orbits."

Collaborator Geoff Marcy, a UC Berkeley professor of astronomy, perfected the Doppler technique, which detects stellar wobble, and went on to discover more than 100 of the first known exoplanets. He is also part of the Kepler Mission team that has discovered nearly 2,000 exoplanets by the transit method. Both these techniques find planets that orbit near their star, while direct imaging via GPI is most sensitive to planets orbiting far from their star. Habitable, Earth-like planets lurk in-between.

"A principal goal is to focus on the overlap region where we can use all three techniques we now have to study planets," Graham said.

"It is a wonderful confluence of multiple approaches to planet-hunting that allows us to detect planets that are both near and far from the host star," Marcy said.

Aside from the Gemini South Telescope, the team plans to harness the adaptive-optics capabilities of the Keck Observatories in Hawaii and eventually the Thirty Meter Telescope planned for construction next door to Keck on Mauna Kea.

Paul Kalas, an adjunct professor of astronomy and co-PI for the project, noted that the goal of imaging Earth-size planets is still decades away, since direct imaging instruments like GPI would have to be sensitive

enough to detect faint starlight reflected off the planet. Currently, GPI is able to see only hot, Jupiter-size planets that are bright because of their own infrared glow.

"The techniques and technologies developed for the Gemini Planet Imager will be used on future NASA planet-finding missions, such as the WFIRST telescope, which could see the reflected light from 'super-Earth' planets," Macintosh said. The Wide-Field Infrared Survey Telescope (WFIRST) is a NASA observatory designed to perform wide-field imaging and spectroscopic surveys of the near infrared sky to explore exoplanets and dark energy. It is expected to be launched in about 10 years.

"If you could see reflected light, you might be able to see the signature of life," Kalas said. "We are just now sowing the seeds to get to that point."

Provided by University of California - Berkeley

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