Plan to identify watery Earth-like planets develops

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Astronomers are looking to identify Earth-like watery worlds circling distant stars from a glint of light seen through an optical space telescope and a mathematical method developed by researchers at Penn State and the University of Hawaii.

"We are looking for Earth-like planets in the habitable zone of their star, a band not too hot nor too cold for life to exist," says Darren M. Williams, associate professor of physics and astronomy, Penn State Erie, the Behrend College. "We also want to know if there is water on these planets."

For life to exist, planets must have habitable temperatures throughout a period long enough for life to evolve. For life as we know it, the planet must have a significant amount of water. Scientists already know how to determine the distance a planet orbits from its star, and analysis of light interacting with molecules in the atmosphere can indicate if water exists. However, Williams and Eric Gaidos, associate professor of geobiology, University of Hawaii, want to identify planets with water on their surfaces.

The researchers' method, reported in an upcoming issue of *Icarus* and currently available online, relies on the reflective properties of water.

"A planet like Venus, with a dense atmosphere, will scatter the sunlight in all directions," Williams says. "If you look at Venus in phases, when it is full, it is brightest and when it is crescent, it is faintest."

When a planet is full in respect to its sun with the whole disk illuminated, water would actually be darker than dirt. However, when a planet is in crescent, with the sun glancing off the watery surface, the reflection will be brightest.

The image of the Blue Marble, taken by Apollo 17 in December 1972, is striking because the Earth is 70 percent covered in water. The researchers believe that large enough amounts of water will provide a glint of light visible in the infrared and visible spectrum if they watch the planet for long enough.

"We are going to look at the planets for a long time," says Williams. "They reflect one billionth or one ten billionth of their sun. To gain enough light to see a dot requires observation over two weeks with the kinds of telescopes we are imagining. If we stare that long, unless the planet is rotating very slowly, different sides of the planet will come through our field of view. If the planet is a mix of water, we are going to see the mix travel around the planet."

The researchers want to monitor the light curve of a distant planet as the planet spins on its axis and moves around its star. By looking at the changes in brightness, correlated to the planet's phase, they should be able to tell if the planet has liquid oceans. If the temperatures are correct, the liquid is probably water.

While there are currently no telescopes capable of identifying watery planets, astronomers hope that a terrestrial planet finder telescope will orbit the earth in the next 10 to 20 years. In the meantime, the Penn State researcher has arranged for the current Mars Express and Venus Express missions of the European Space Agency, to look back at the Earth occasionally from a great distance and observe what our watery planet looks like in various phases.

"Any time that the Earth is in a crescent phase as viewed by a distant space vehicle, we should take advantage of the situation and look back at the Earth," says Williams.

Source: Penn State