Field guide for confirming new earth-like planets described

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Astronomers looking for earth-like planets in other solar systems — exoplanets — now have a new field guide thanks to earth and planetary scientists at Washington University in St. Louis.

Bruce Fegley, Ph.D., Washington University professor of earth and planetary sciences in Arts & Sciences, and Laura Schaefer, laboratory assistant, have used thermochemical equilibrium calculations to model the chemistry of silicate vapor and steam-rich atmospheres formed when earth-like planets are undergoing accretion . During the accretion process, with surface temperatures of several thousands degrees Kelvin (K), a magma ocean forms and vaporizes.

"What you have are elements that are typically found in rocks in a vapor atmosphere," said Schaefer. "At temperatures above 3,080 K, silicon monoxide gas is the major species in the atmosphere. At temperatures under 3,080 K, sodium gas is the major species. These are the indicators of an earth-like planet forming."

At such red-hot temperatures during the latter stages of the exoplanets' formation, the signal should be distinct, said Fegley.

"It should be easily detectable because this silicon monoxide gas is easily observable," with different types of telescopes at infrared and radio wavelengths, Fegley said.

Schaefer presented the results at the annual meeting of the Division of Planetary Sciences of the American Astronomical Society, held Sept. 4-9 in Cambridge, England. The NASA Astrobiology Institute and Origins Program supported the work.

Forming a maser

Steve Charnley, a colleague at NASA AMES, suggested that some of the light emitted by SiO gas during the accretion process could form a maser — Microwave Amplification by Stimulation Emission of Radiation. Whereas a laser is comprised of photons in the ultraviolet or visible light spectrum, masers are energy packets in the microwave image.

Schaefer explains: "What you basically have is a clump of silicon monoxide gas, and some of it is excited into a state higher than ground level. You have some radiation coming in and it knocks against these silicon monoxide molecules and they drop down to a lower state.

"By doing that, it also emits another photon, so then you essentially have a propagating light. You end up with this really very high intensity

illumination coming out of this gas."

According to Schaefer, the light from newly forming exoplanets should be possible to see.

"There are natural lasers in the solar system," she said. "We see them in the atmospheres of Mars and Venus, and also in some cometary atmospheres."

In recent months, astronomers have reported earth-like planets with six to seven times the mass of our earth. While they resemble a terrestrial planet like earth, there has not yet been a foolproof method of detection. The spectra of silicon monoxide and sodium gas would be the indication of a magma ocean on the astronomical object, and thus an indication a planet is forming, said Fegley.

The calculations that Fegley and Schaefer used also apply to our own earth. The researchers found that during later, cooler stages of accretion (below 1,500 K), the major gases in the steam-rich atmosphere are water, hydrogen, carbon dioxide, carbon and nitrogen, with the carbon converting to methane as the steam atmosphere cools.

Source: Washington University in St. Louis