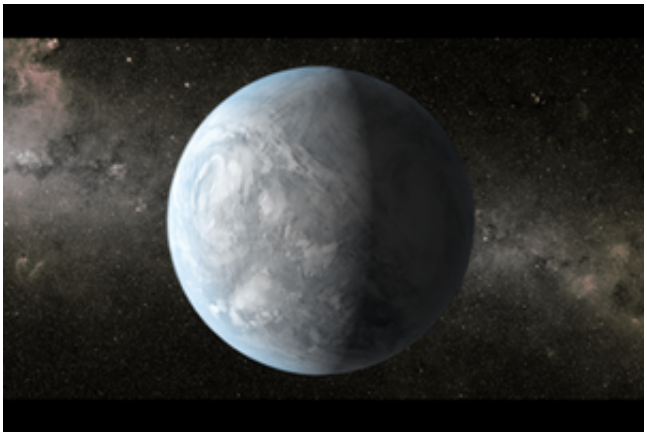
Precision measurements of exoplanet velocities

September 28 2016



An artist's conception of Kepler 62-e, a super-Earth exoplanet. Astronomers working to detect super-Earths around the most common kind of stars, M dwarfs, have successfully tested infrared techniques that overcome some of the limitations of optical measurements. Credit: NASA/Kepler mission

The search for exoplanets via the radial velocity technique has been underway for nearly thirty years, measuring the wobbles in a star's motion caused by the presence of orbiting bodies. The method has been very successful and has detected hundreds of exoplanets, but has been overtaken (at least in numbers of detections) by the transit method, which looks for dips in the star's light.

The radial velocity method has some powerful advantages, however, most notably that it can spot planets that do not pass across the face of

the star ("transit"). The majority of radial velocity targets (so far) have been stars similar roughly to our Sun, but this neglects the majority of stars, the less massive class M dwarfs, which make up 75% of the stars in the solar neighborhood. Surveys of some nearby M dwarfs have been able to reach astonishing velocity precisions - as tiny as a few meters per second (4.5 miles per hour)—adequate to detect a super-Earth orbiting in the star's habitable zone (where surface water remains liquid). In order to detect an Earth-mass planet around a solar-type star, however, precisions twenty times better are needed.

One of the technical challenges in measuring radial velocities for M-dwarfs is that they are relatively faint in the optical. Near infrared techniques can ameliorate this issue because the stars are brighter in the infrared, but naturally face some other problems. CfA astronomers John Johnson and Dave Latham were part of a team of scientists working to advance infrared techniques for radial velocity studies of M-dwarfs.

Using the current infrared instruments on NASA's Infrared Telescope Facility in Hawaii, the astronomers were able to achieve about three meters per second precision on some test M stars, demonstrating that the technique and the methods used to process and analyze the data are reliable. There are next generation infrared instruments are in the pipeline, and the new paper demonstrates that they should be able to spot super-Earths and mini-Neptunes in the habitable zones of M dwarfs.

More information: Peter Gao et al. Retrieval of Precise Radial Velocities from Near-infrared High-resolution Spectra of Low-mass Stars, *Publications of the Astronomical Society of the Pacific* (2016). DOI: 10.1088/1538-3873/128/968/104501

Provided by Harvard-Smithsonian Center for Astrophysics