Two super-Earth-sized planets discovered orbiting a nearby star

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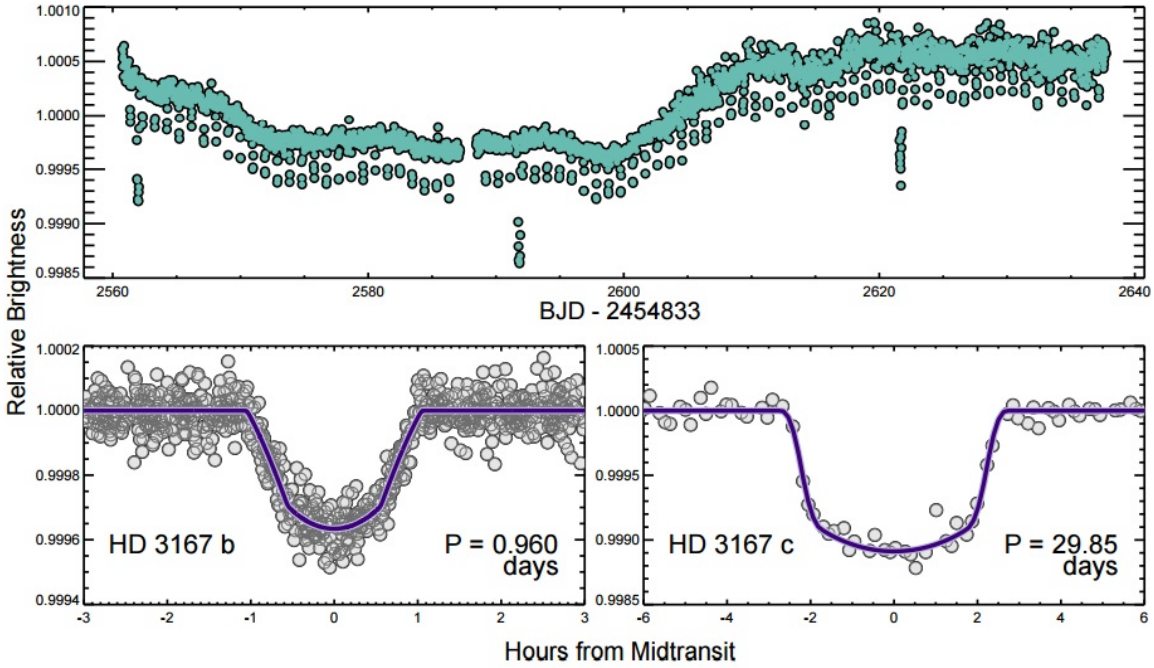

K2 light curve of HD 3167. Top: the full K2 light curve. Both the numerous, shallow transits of HD 3167 b and three deeper transits of HD 3167 c are evident in the light curve by eye. Bottom left: K2 light curve (grey dots) phase folded on the transits of HD 3167 b, and best-fit transit model (thick purple line). Bottom right: K2 light curve (grey dots) phase folded on the transits of HD 3167 c, and best-fit transit model (thick purple line). Credit: Vanderburg et al., 2016.

(Phys.org)—NASA's Kepler spacecraft continues its fruitful exoplanet

hunt with the newest discovery of two super-Earth-sized alien worlds. The newly detected planets are orbiting a nearby sun-sized star known as HD 3167, located some 150 light years away. The results are presented in a paper published July 18 on the arXiv pre-print server.

Although Kepler has lost two of its four reaction wheels and therefore cannot be precisely pointed toward stars, it is still capable of detecting new exoworlds. The spacecraft is now in its extended mission, known as K2, during which it has already found over 100 new planets. The HD 3167 system is just the latest addition to the vast collection of extrasolar worlds detected by K2.

HD 3167 was observed by Kepler between January 3 and March 23, 2016 during Campaign 8 of its K2 mission. This observation campaign allowed a team of astronomers, led by Andrew Vanderburg of the Harvard–Smithsonian Center for Astrophysics (CfA), to detect two transit signals that could be planets circling around this nearby star.

"We identified two planet candidates transiting HD 3167 after processing pixel-level data to produce a light curve, removing systematic effects due to Kepler's unstable pointing, and searching for planets using a Box Least Squares periodogram search," the researchers wrote in the paper.

To confirm the planetary status of these candidates, the team conducted follow-up observations employing the Tillinghast Reflector Echelle Spectrograph (TRES) on the 1.5 m telescope at the Fred L. Whipple Observatory on Mt. Hopkins, Arizona and the Robo-AO adaptive optics system installed at the 2.1 m telescope at the Kitt Peak National Observatory, also in Arizona. They also used statistical techniques to validate the planetary nature of the transiting signals.

The confirmed exoplanets received designation HD 3167 b and HD

3167 c. With a radius of about 1.6 Earth radii, HD 3167 b is the inner planet, orbiting the host star in just slightly less than one day. The outer planet is nearly three times bigger in size than Earth and has an orbital period of approximately 30 days.

HD 3167 could be an excellent target for further follow-up observations as it is one of the closest and brightest stars hosting multiple transiting planets. The scientists noted that this system is highly suitable for precise radial velocity observations to measure the planets' masses.

"If HD 3167 b is rocky with a mass of about four Earth masses, it should induce radial velocity variations with a semiamplitude of about 3 ms^{-1}. Depending on its composition, HD 3167 c could induce radial velocity variations with a semiamplitude of anywhere between 1 ms^{-1} and 3 ms^{-1}. These signals should be readily detectable with modern spectrographs," the paper reads.

The team also emphasized that the outer planet is one of the best currently known small planets for atmospheric characterization with transit transmission spectroscopy. However, they also noted that the short period of HD 3167 b makes it likely that spectroscopic observations of HD 3167 c's atmosphere might overlap with a transit of the inner planet.

"This could be an efficient way to rule out a hydrogen-dominated atmosphere for HD 3167 b. Observers should be cautious, however, to ensure that a transit of HD 3167 b not interfere with out-of-transit observations necessary for calibration," the researchers concluded.

More information: Two Small Planets Transiting HD 3167, arXiv:1607.05248 [astro-ph.EP] arxiv.org/abs/1607.05248

Abstract

We report the discovery of two super-Earth-sized planets transiting the bright (V = 8.94, K = 7.07) nearby late G-dwarf HD 3167, using data collected by the K2 mission. The inner planet, HD 3167 b, has a radius of 1.6 R_e and an ultra-short orbital period of only 0.96 days. The outer planet, HD 3167 c, has a radius of 2.9 R_e and orbits its host star every 29.85 days. At a distance of just 45.8 +/- 2.2 pc, HD 3167 is one of the closest and brightest stars hosting multiple transiting planets, making HD 3167 b and c well suited for follow-up observations. The star is chromospherically inactive and slowly rotating, ideal for radial velocity observations to measure the planets' masses. The outer planet is large enough that it likely has a thick gaseous envelope which could be studied via transmission spectroscopy. Planets transiting bright, nearby stars like HD 3167 are valuable objects to study leading up to the launch of the James Webb Space Telescope.