New system discovered with five planets

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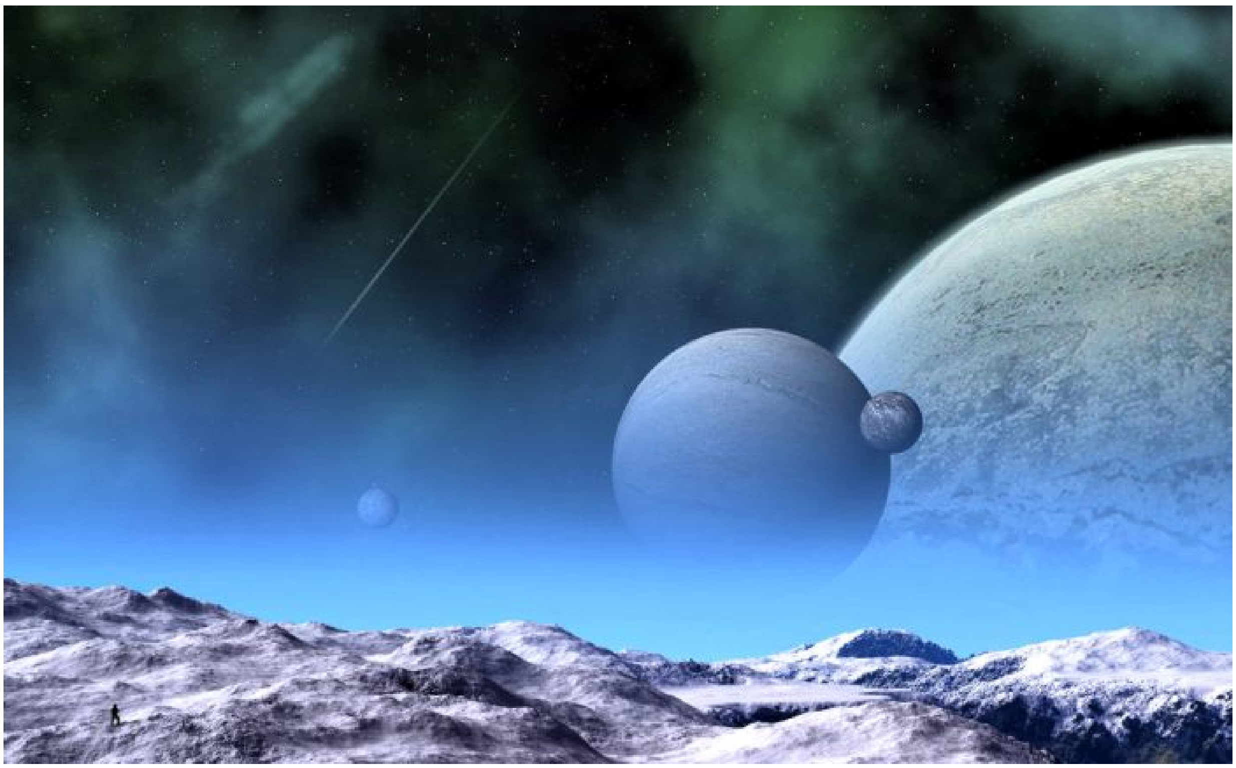


A new study announced the discovery of a system hosting five transiting planets. Credit: jhmart1/deviantart

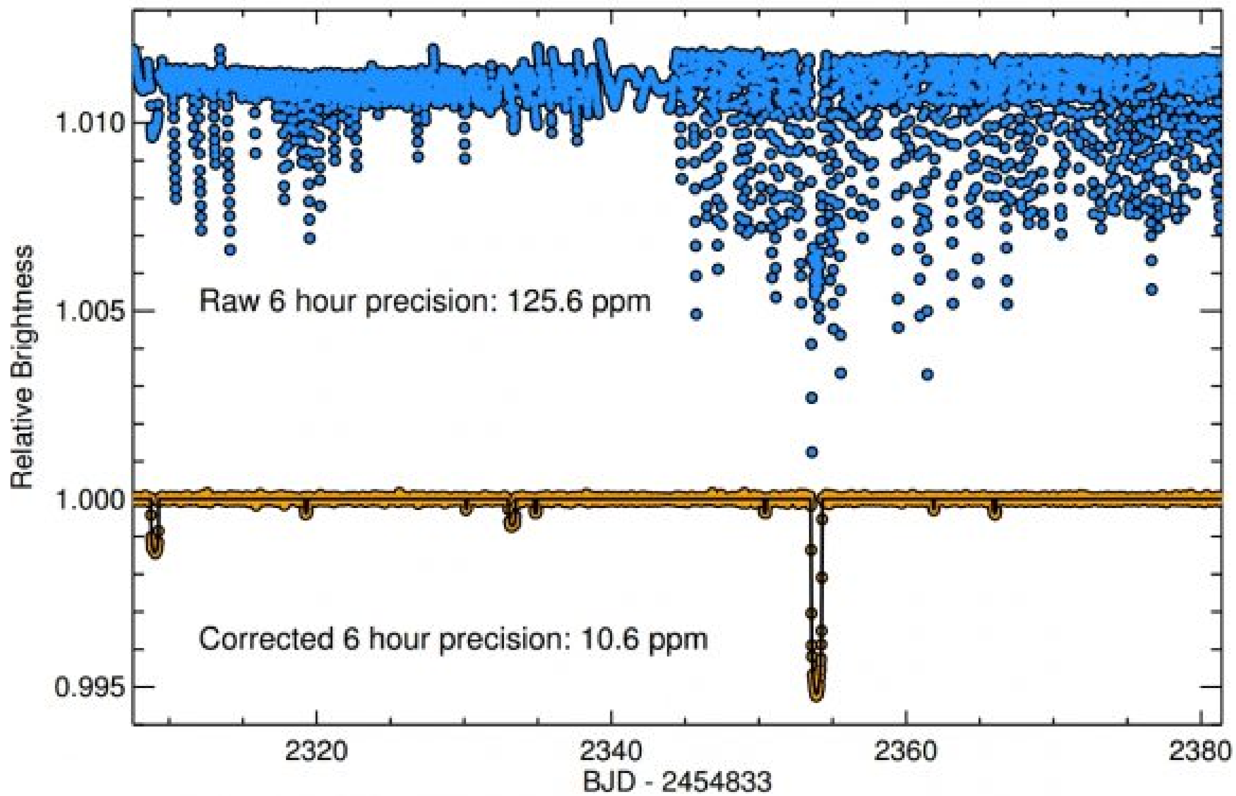
NASA's planet-discovering Kepler mission suffered a major mechanical failure in May 2013, but thanks to innovative techniques subsequently implemented by astronomers the satellite continues to uncover worlds beyond our solar system (i.e., exoplanets). Indeed, Andrew Vanderburg (CfA) and colleagues just published results highlighting a new system found to host five transiting planets, which include: two sub-Neptune sized planets, a Neptune sized planet, a sub-Saturn sized planet, and a Jupiter sized planet.

The team was able to identify the rare suite of five planets in Kepler's extended mission data by developing algorithms that attempt to compensate for the satellite's instability, which resulted from the mechanical failure that occurred in 2013. A member on the team, Martti H. Kristiansen, identified the five transits in diagrams subsequently produced by their pipeline. The image below conveys the raw and corrected data, whereupon bona fide transits are readily discernible in the latter.

Vanderburg and colleagues obtained spectra that implies the star hosting the planets (designated HIP 41378) is relatively similar to the Sun, featuring a radius and mass of 1.4 and 1.15 times that of the Sun, respectively. However, the planets in the newly discovered system were found to complete their orbits in a comparatively short time (typically less than 1 year). The shorter orbital periods are often a result of a selection bias that stems from efforts aimed at detecting planetary systems using the transit method, which uncovers planets by identifying the drop in brightness that occurs as an exoplanet passes in front of its host star along our sight-line. Such transits are rare because of the impracticality of monitoring a target host star unceasingly, and because of orientation effects (i.e., a near edge-on perspective is required). The Kepler satellite monitored HIP 41378 for 75 days.

The original Kepler mission observed a 110 square degree field for four years, and Vanderburg noted Kepler's extended (K2) mission could survey an area up to 20 times larger, thus significantly increasing the number of objects observed. In particular, it is hoped that a suite of new exoplanets could be discovered orbiting brighter host stars, as those identified during the original Kepler mission were typically faint. Precise velocity measurements are difficult to achieve for fainter stars, and the data are needed to complement brightness measurements and further characterize the exoplanets discovered. Specifically, results inferred from the transit search method are often paired with those determined from velocity (Doppler) analyses to yield the density of the planetary systems (e.g., is it a water world?). Vanderburg noted that the system they discovered possesses amongst the brightest planet host stars from either the Kepler or K2 missions, and is an ideal target for future velocity observations, "it could therefore be detectable with spectrographs like HARPS-N and HIRES in the northern hemisphere, and HARPS and PFS in the south."

The Kepler satellite provides an advantageously large field of view, to enable the simultaneous monitoring of numerous targets, yet a disadvantage is that its resolution is rather coarse. Indeed, the comparatively poor resolution can result in spurious transit signals ("planet impostors"), which are actually binary star systems in disguise. "There are many things in the sky that can produce transit-like signals that are not planets, and thus we must be sure to identify what really is a planet detected by Kepler," Stephen Bryson told Universe Today in 2013. A pseudo planetary transit could occur owing to a chance superposition of a bright star and a fainter eclipsing binary system, whereby the objects lie at different distances along the sight-line. The bright foreground star dilutes the typically large eclipses produced by the binary system, hence mimicking the smaller eclipses displayed by transiting planets. Vanderburg and colleagues evaluated that possibility by obtaining higher-resolution images using the Robo-AO adaptive optics system on the 2.1-m telescope at the Kitt Peak National Observatory. The adaptive optics system helps correct distortions imposed by Earth's atmosphere, thus yielding an admirably high-resolution image that did not appear to feature contaminating stars.



Kepler brightness measurements for the star HIP 41378 indicate it hosts five transiting planets. On the x-axis is time, and on the y-axis is the relative brightness. Attenuations in brightness may occur when planets traverse their host star along our sight-line, and block the emerging stellar light. The blue data convey the raw brightness measurements, while the data displayed below are corrected for effects such as those endemic to the Kepler's satellite's mechanical failure (instability). Credit: Vanderburg et al. 2016, arXiv

Vanderburg noted optimistically that, "Discoveries such as the HIP 41378 system show the value of wide-field space-based transit surveys. The Kepler spacecraft had to search almost 800 square degrees of sky (or seven fields of view) before finding such a bright multi-planet system suitable for follow-up observations. HIP 41378 is a preview of the type of discoveries the TESS satellite (2017 launch date) will make routine."

Higher-resolution images were obtained to ensure the transits were tied to exoplanets. The observations were acquired using the Robo-AO adaptive optics system on the 2.1-m telescope at the Kitt Peak National Observatory. Credit: ifA

More information: Five Planets Transiting a Ninth Magnitude Star. arxiv.org/abs/1606.08441

Source: Universe Today