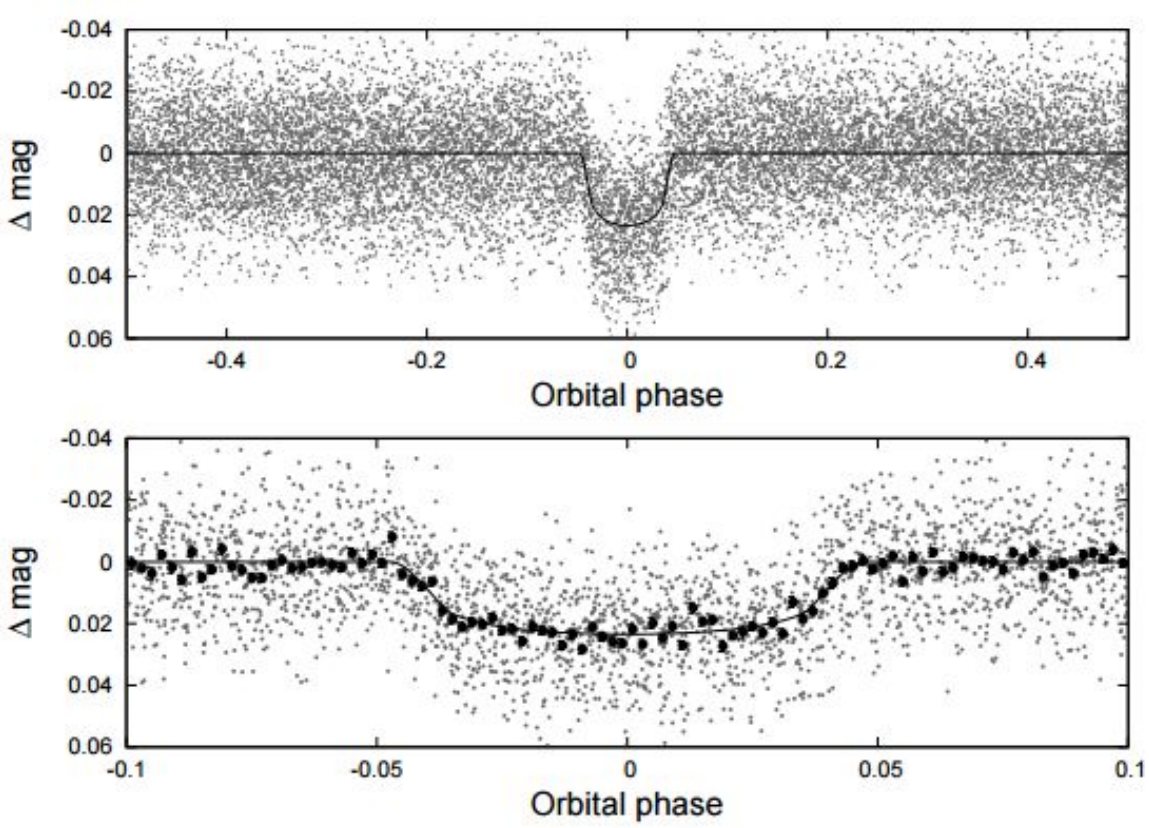
Astronomers discover a giant planet spinning up its star

June 7 2016, by Tomasz Nowakowski



Unbinned instrumental r band light curve of HATS-18 folded with the period P = 0.8378434 days resulting from the global fit. The solid line shows the best-fit transit model. In the lower panel we zoom–in on the transit; the dark filled points here show the light curve binned in phase using a bin-size of 0.002. Credit: arXiv:1606.00848 [astro-ph.EP]

(Phys.org)—A giant "hot Jupiter" exoplanet has recently been detected by an international team of astronomers led by Kaloyan Penev of Princeton University. The newly found alien world, designated HATS-18b, is an interesting case of a planet tidally spinning up its parent star. Moreover, this planetary system could be a great laboratory for researchers when it comes to testing theories of planet–star interactions. The new findings were presented in a paper published online on June 2 on arXiv.org.

In order to find exoplanets orbiting HATS-18, the team used the Hungarian-made Automated Telescope Network-South (HATSouth) to obtain over 10,000 images of this sun-like star. This observation campaign was carried out between April 2011 and July 2013. The astronomers also conducted a series of follow-up spectroscopic observations in 2015, utilizing the 2.3 m telescope at the Siding Spring Observatory in Australia and the 2.2 m MPG/ESO telescope at the European Southern Observatory (ESO) in Chile.

The radial velocity signals collected by the researchers allowed them to distinguish a sinusoidal variation in phase with the transit ephemeris, confirming the presence of a massive planet around HATS-18. According to the study, the newly detected exoplanet has a radius of about 1.34 Jupiter radii and is two times more massive than our solar system's biggest planet. The orbital period of HATS-18b equals 0.84 days. This exoworld is a typical example of a "hot Jupiter"—a gas giant planet with characteristics similar to the solar system's biggest planet. Hot Jupiters have high surface temperature as they orbit their host stars very closely.

What intrigues the scientists about the newly found planetary system is that the planet appears to be tidally spinning up the star.

"The high planet mass, combined with its short orbital period, implies

strong tidal coupling between the planetary orbit and the star. In fact, given its inferred age, HATS-18 shows evidence of significant tidal spin up," the researchers wrote in the paper.

Penev and his colleagues believe that this system could be one of the best laboratories for testing theories of star–planet interactions and planet formation. They noted that modeling this "spin-up" effect for this system alone would bring promising results regarding the tidal dissipation efficiency.

"Such modeling may begin to disentangle some of the very poorly understood physics behind tidal dissipation by measuring its dependence on various system properties. (…) Extremely short-period planets like HATS-18b provide a fantastic laboratory to test a range of interactions between the planet and the star, and hence, expanding this sample is extremely valuable for the study of extrasolar planets," the paper reads.

The researchers propose performing similar studies on a larger number of exoplanet systems, especially on all planets with extremely short orbital periods like HATS-18b. These future analyses could provide new insights on the dependence of tidal dissipation on planetary system parameters. In conclusion, the team endorses more systematic studies of other giant exoworlds similar to HATS-18b.

"Clearly, a more systematic effort to analyze all suitable exoplanet systems and properly account for the stellar angular momentum loss uncertainties is bound to yield very meaningful constraints on the stellar tidal dissipation, as well how it changes with various system properties," the team wrote.

More information: HATS-18 b: An Extreme Short—Period Massive Transiting Planet Spinning Up Its Star, arXiv:1606.00848 [astro-ph.EP] arxiv.org/abs/1606.00848

Abstract

We report the discovery by the HATSouth network of HATS-18 b: a 1.980 +/- 0.077 Mj, 1.337 +0.102 -0.049 Rj planet in a 0.8378 day orbit, around a solar analog star (mass 1.037 +/- 0.047 Msun, and radius 1.020 +0.057 -0.031 Rsun) with V=14.067 +/- 0.040 mag. The high planet mass, combined with its short orbital period, implies strong tidal coupling between the planetary orbit and the star. In fact, given its inferred age, HATS-18 shows evidence of significant tidal spin up, which together with WASP-19 (a very similar system) allows us to constrain the tidal quality factor for Sun-like stars to be in the range 6.5