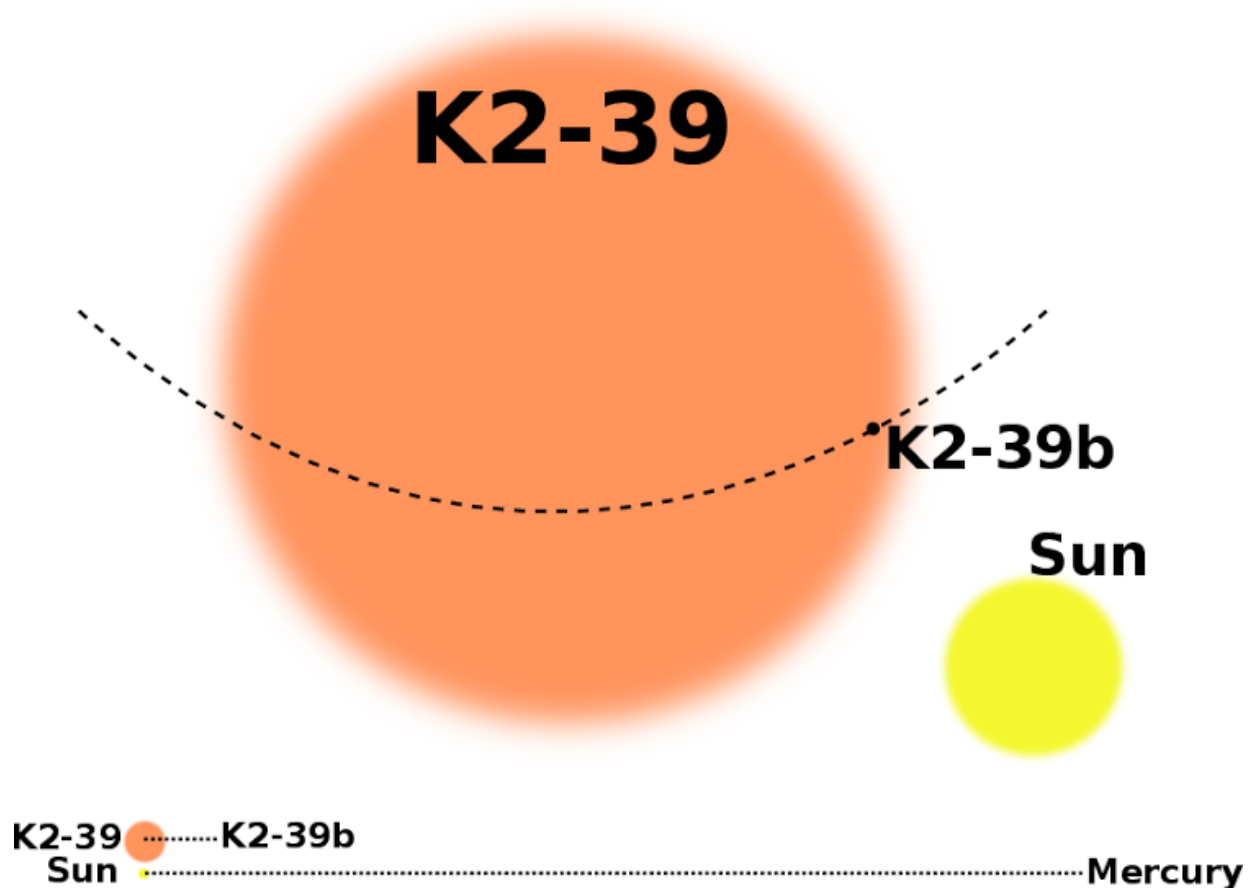


K2-39b: A planet that shouldn't be there at all

June 23 2016, by Tomasz Nowakowski



The size of subgiant K2-39 and its exoplanet, shown relative to the size of the sun. The distance between K2-39 and its planet is also indicated, relative to the distance of the sun to Mercury. The Earth is not shown on this figure, because it is more than two times further away than Mercury. Credit: Vincent Van Eylen/Aarhus University

(Phys.org)—An international team of astronomers has reported the discovery of a new giant extrasolar planet orbiting a subgiant star so closely that it should be destroyed due to tidal interactions. However, against all odds, the planet has survived and is the shortest-period alien world orbiting a subgiant star known to date. The findings were reported in a paper published on May 31 on arXiv.org.

The planet, designated K2-39b, was first spotted by NASA's prolonged Kepler mission, known as K2. To confirm the planetary status of K2-39b, the team of researchers, led by Vincent Van Eylen of the Aarhus University in Denmark, has employed the High Accuracy Radial velocity Planet Searcher (HARPS) spectrograph on the ESO 3.6m telescope in La Silla, Chile, the Nordic Optical Telescope in La Palma, Canary Islands, as well as the Magellan II telescope at the Las Campanas Observatory in Chile.

The ground-based follow-up measurements were crucial to confirm that the newly found object was, indeed, a genuine exoplanet. The scientists conducted the so-called radial velocity measurements to measure the movement of the star caused by the planet. They clearly confirmed that the planet was indeed real, and also allowed the team to determine its mass. According to the study, K2-39b is 50 times more massive than our planet and has a radius of about eight Earth radii.

However, what is most intriguing about the new findings is that the planet is orbiting its evolved subgiant host star every 4.6 days, and so closely that it should be tidally destroyed.

"K2-39b is a bit of a 'special beast,' because such short-period [planets](#) orbiting large, evolved stars, are quite rare. (...) This planet is special mostly because of the star it orbits: Its host star is an evolved star, a subgiant several times larger than the sun. Around such stars, very few short-period planets were known, and there is speculation this may be

because they cannot survive so close to such large stars. However, the fact that we have now found this planet, very close to a subgiant star, proves that at least some planets can survive there," Van Eylen told Phys.org.

Currently, there are two main theories attempting to explain the lack of close-in planets orbiting evolved subgiant stars. One of the hypotheses is that planets might be tidally destroyed as the star evolves and grows larger. The other scenario suggests that this is due to the systematically higher masses of the observed evolved stars compared to the observed main-sequence stars.

In the study, the scientists also attempt to estimate how long K2-39b can survive orbiting its sub-giant parent star. Taking into account the stellar mass of K2-39 and assuming that the planet remains in its current orbit, they suggest that the alien world will end its life probably in about 150 million years' time.

Furthermore, the team notes that it seems there may be a second planet in the system, at a much larger distance from the star. However, according to Van Eylen, the current data set has not been able to constrain this potential second planet. Further measurements may be able to do just that.

The researchers concluded that future studies of such planets like K2-39b orbiting evolved stars will help understand the fates of planets as their host [stars](#) grow older. Moreover, as K2 continues its observing campaign, it may discover other rare systems similar to K2-39, allowing scientists to further constrain stellar structure and planet formation and evolution.

More information: The K2-ESPRINT Project V: a short-period giant planet orbiting a subgiant star arXiv:1605.09180 [astro-ph.EP]

arxiv.org/abs/1605.09180

Abstract

We report on the discovery and characterization of the transiting planet K2-39b (EPIC 206247743b). With an orbital period of 4.6 days, it is the shortest-period planet orbiting a subgiant star known to date. Such planets are rare, with only a handful of known cases. The reason for this is poorly understood, but may reflect differences in planet occurrence around the relatively high-mass stars that have been surveyed, or may be the result of tidal destruction of such planets. K2-39 is an evolved star with a spectroscopically derived stellar radius and mass of $3.88^{+0.48}_{-0.42} R_{\odot}$ and $1.53^{+0.13}_{-0.12} M_{\odot}$, respectively, and a very close-in transiting planet, with $a/R_{\star}=3.4$. Radial velocity (RV) follow-up using the HARPS, FIES and PFS instruments leads to a planetary mass of $50.3^{+9.7}_{-9.4} M_{\oplus}$. In combination with a radius measurement of $8.3 \pm 1.1 R_{\oplus}$, this results in a mean planetary density of $0.50^{+0.29}_{-0.17} \text{ g cm}^{-3}$. We furthermore discover a long-term RV trend, which may be caused by a long-period planet or stellar companion. Because K2-39b has a short orbital period, its existence makes it seem unlikely that tidal destruction is wholly responsible for the differences in planet populations around subgiant and main-sequence stars. Future monitoring of the transits of this system may enable the detection of period decay and constrain the tidal dissipation rates of subgiant stars.

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