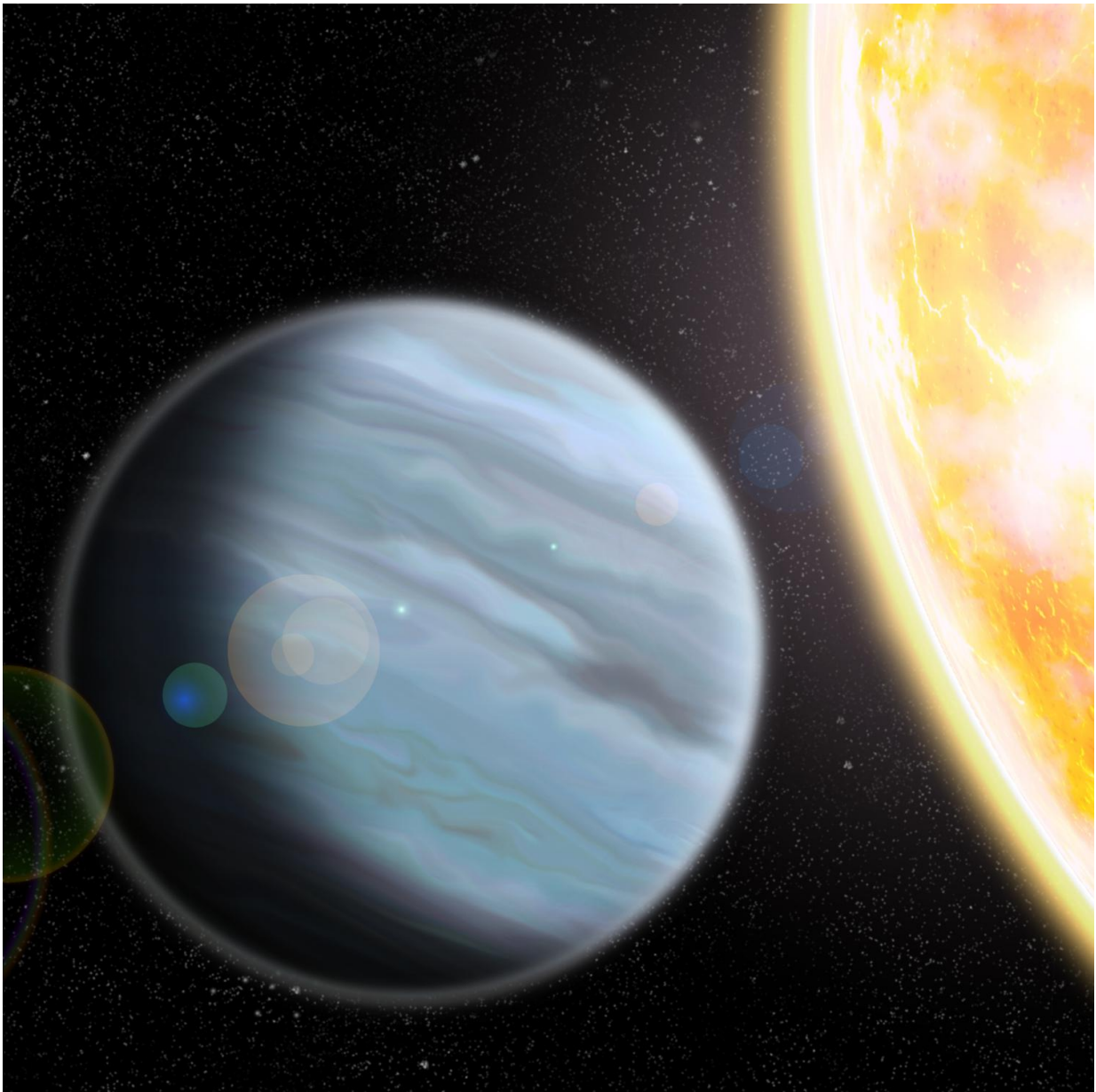


New 'styrofoam' planet provides tools in search for habitable planets

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Artist's rendering of KELT-11b, a 'styrofoam'-density exoplanet orbiting a bright star in the southern hemisphere. Credit: Walter Robinson/Lehigh University

Fifth-graders making styrofoam solar system models may have the right idea. Researchers at Lehigh University have discovered a new planet orbiting a star 320 light years from Earth that has the density of styrofoam. This "puffy planet" outside our solar system may hold opportunities for testing atmospheres that will be useful when assessing future planets for signs of life.

"It is highly inflated, so that while it's only a fifth as massive as Jupiter, it is nearly 40 percent larger, making it about as dense as styrofoam, with an extraordinarily large atmosphere," said Joshua Pepper, astronomer and assistant professor of physics at Lehigh University, who led the study in collaboration with researchers from Vanderbilt University and Ohio State University, along with researchers at universities and observatories and amateur astronomers around the world.

The research, "KELT-11b: A Highly Inflated Sub-Saturn Exoplanet Transiting the V+8 Subgiant HD 93396," is published online in *The Astronomical Journal*.

The planet's host star is extremely bright, allowing precise measurement of the planet's atmosphere properties and making it "an excellent testbed for measuring the atmospheres of other [planets](#)," Pepper said. Such observations help astronomers develop tools to see the types of gases in atmospheres, which will be necessary in the next 10 years when they apply similar techniques to Earthlike exoplanets with next-generation telescopes now under construction.

The planet, called KELT-11b, is an extreme version of a gas planet, like

Jupiter or Saturn, but is orbiting very close to its host star in an orbit that lasts less than five days. The star, KELT-11, has started using up its nuclear fuel and is evolving into a red giant, so the planet will be engulfed by its star and not survive the next hundred million years.

The KELT (Kilodegree Extremely Little Telescope) survey uses two small robotic telescopes, one in Arizona and the other in South Africa. The telescopes scan the sky night after night, measuring the brightness of about five million [stars](#). Researchers search for stars that seem to dim slightly at regular intervals, which can indicate a planet is orbiting that star and eclipsing it. Researchers then use other telescopes to measure the gravitational "wobble" of the star - the slight tug a planet exerts on the star as it orbits - to verify that the dimming, called a "transit," is due to a planet and to measure the planet's mass.



The KELT-South robotic telescope in South Africa that made the discovery of KELT-11b. Credit: Joshua Pepper

Scientists and Citizens Search Sky

Pepper built the two telescopes used in the KELT survey, which he runs with researchers at Vanderbilt University, Ohio State University, Fisk University and the South African Astronomical Observatory. Among the more than 30 contributors to the research are partners at NASA, Harvard University, University of Pennsylvania, Princeton University and University of California at Berkeley. Lehigh University physics graduate student Jonathan Labadie-Bartz is a member of the KELT team and a co-

author on the paper. Some 40 "citizen scientists" in 10 countries across four continents have also contributed to the KELT project and several contributed directly to the discovery of KELT-11b and are co-authors on the paper.

While several projects using small robotic telescopes have found hundreds of planets orbiting other stars - and space telescopes like the NASA Kepler mission have discovered thousands - most of those planets orbit faint stars, making it difficult to measure the planets' properties precisely.

"The KELT project is specifically designed to discover a few scientifically valuable planets orbiting very bright stars, and KELT-11b is a prime example of that," Pepper said. The star, KELT-11, is the brightest in the southern hemisphere known to host a transiting planet by more than a magnitude and the sixth brightest transit host discovered to date. Planets discovered by the KELT survey will be observed in detail by large space telescopes such as Hubble and Spitzer and the James Webb Space Telescope, scheduled to launch in 2018, to understand how planets form and evolve and how their atmospheres behave, Pepper said.

The KELT researchers set out to discover [gas giant planets](#) orbiting bright stars, but did not expect to find planets with such low mass and large sizes. Located in the southern sky, the "extraordinarily inflated" KELT-11b is the third-lowest density planet with a precisely measured mass and radius that has been discovered. "We were very surprised by the amazingly low density of this planet," Pepper said. "It's extremely big for its mass. It's got a fifth of the mass of Jupiter but is puffed up into this really underdense planet."

Though researchers are debating the cause of KELT-11b's inflation, further study of the planet could provide additional information about the mechanism that causes inflated planets, Pepper said. The planet's

large [atmosphere](#) also provides good opportunities for developing techniques needed to identify chemicals in planets' atmospheres to assess habitability or products of life in the atmospheres of other planets.

"We don't know of any real Earthlike planets or stars for which we can measure their atmospheres, though we expect to discover more in future years," Pepper said. "These (giant gas) planets are the gold standards or testbeds for learning how to measure the atmospheres of planets."

The research was supported by the National Science Foundation, NASA and a variety of universities and foundations.

More information: Joshua Pepper et al, KELT-11b: A Highly Inflated Sub-Saturn Exoplanet Transiting the= 8 Subgiant HD 93396, *The Astronomical Journal* (2017). [DOI: 10.3847/1538-3881/aa6572](https://doi.org/10.3847/1538-3881/aa6572)

Provided by Lehigh University

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