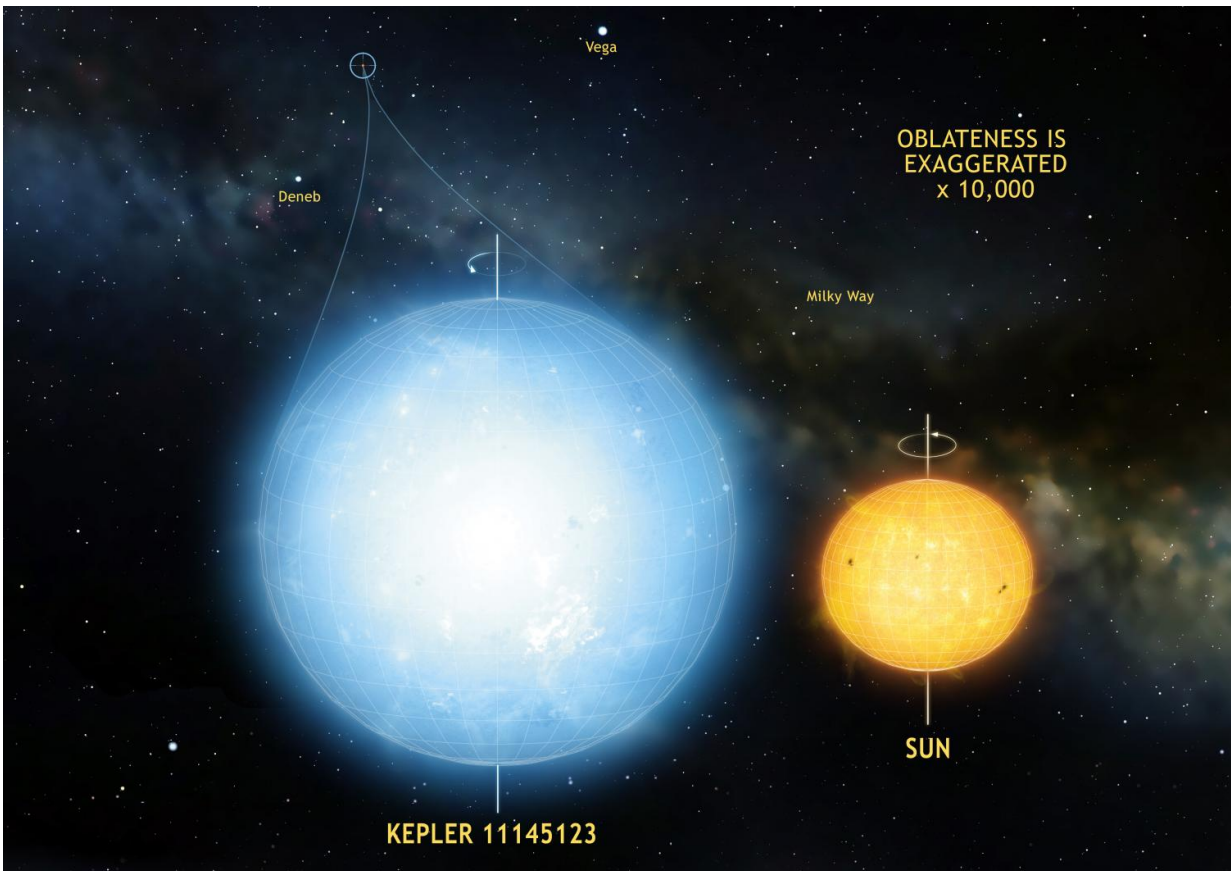


Distant star is roundest object ever observed in nature

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The star Kepler 11145123 is the roundest natural object ever measured in the universe. Stellar oscillations imply a difference in radius between the equator and the poles of only 3 km. This star is significantly more round than the sun. Credit: Mark A. Garlick

Stars are not perfect spheres. While they rotate, they become flat due to the centrifugal force. A team of researchers around Laurent Gizon from the Max Planck Institute for Solar System Research and the University of Göttingen has now succeeded in measuring the oblateness of a slowly rotating star with unprecedented precision. The researchers have determined stellar oblateness using asteroseismology - the study of the oscillations of stars. The technique is applied to a star 5000 light years away from Earth and revealed that the difference between the equatorial and polar radii of the star is only 3 kilometers - a number that is astonishingly small compared to the star's mean radius of 1.5 million kilometers; which means that the gas sphere is astonishingly round.

All stars rotate and are therefore flattened by the [centrifugal force](#). The faster the rotation, the more oblate the star becomes. Our Sun rotates with a period of 27 days and has a radius at the equator that is 10 km larger than at the poles; for the Earth this difference is 21 km. Gizon and his colleagues selected a slowly rotating star named Kepler 11145123. This hot and luminous star is more than twice the size of the Sun and rotates three times more slowly than the Sun.

Gizon and his colleagues selected this star to study because it supports purely sinusoidal oscillations. The periodic expansions and contractions of the star can be detected in the fluctuations in brightness of the star. NASA's Kepler mission observed the star's oscillations continuously for more than four years. Different modes of oscillation are sensitive to different stellar latitudes. For their study, the authors compare the frequencies of the modes of oscillation that are more sensitive to the low-latitude regions and the frequencies of the modes that are more sensitive to higher latitudes. This comparison shows that the difference in radius between the equator and the poles is only 3 km with a precision of 1 km. "This makes Kepler 11145123 the roundest natural object ever measured, even more round than the Sun," explains Gizon.



The star Kepler 11145123 is the roundest natural object ever measured in the universe. Stellar oscillations imply a difference in radius between the equator and the poles of only 3 km. This star is significantly more round than the Sun. Credit: Laurent Gizon et al. and the Max Planck Institute for Solar System Research, Germany. Illustration by Mark A. Garlick.

Surprisingly, the star is even less oblate than implied by its rotation rate. The authors propose that the presence of a magnetic field at low latitudes could make the star look more spherical to the [stellar oscillations](#). Just like helioseismology can be used to study the Sun's magnetic field, asteroseismology can be used to study magnetism on [distant stars](#). Stellar magnetic fields, especially weak magnetic fields, are

notoriously difficult to directly observe on distant stars.

Kepler 11145123 is not the only star with suitable oscillations and precise brightness measurements. "We intend to apply this method to other [stars](#) observed by Kepler and the upcoming space missions TESS and PLATO. It will be particularly interesting to see how faster rotation and a stronger [magnetic field](#) can change a star's shape," Gizon adds, "An important theoretical field in astrophysics has now become observational."

More information: Shape of a slowly rotating star measured by asteroseismology, *Science Advances*, 16 November 2016.
advances.sciencemag.org/content/2/11/e1601777

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