Astronomers reveal a rapidly spinning core inside ageing stars

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An international team of astronomers, including scientists from the University of Birmingham, has looked deep inside some old stars and discovered that their cores spin at least ten times as fast as their surfaces. The research, led by Leuven University in Belgium, is published today (7 December 2011) in the journal Nature.

It has been known for a long time that the surfaces of these stars spin slowly, taking about a whole year to complete one rotation. The team has now discovered that the cores at the heart of the stars spin much faster at about one rotation per month. The discovery was made possible because of the ultra high precision of the data from NASA's Kepler space telescope.

The astronomers analysed waves travelling through the stars, which appear at the surface as rhythmic variations in the stars' brightness. The study of such waves is called asteroseismology, and is able to reveal the conditions deep inside a star which would otherwise remain hidden from view. Different waves probe different parts of the star and by a detailed comparison of the depth to which these waves travel inside the star, the team found evidence of the rotation rate and its dramatic increase towards the stellar core.

The stars studied for this research are so-called red giants. Our Sun will become a red giant in about 5 billion years. Their outer layers have expanded to more than 5 times their original size, and cooled down significantly so that they appear red. Meanwhile, their cores have done exactly the opposite, and have contracted to an extremely hot and dense environment. To understand what has happened to a star's spin consider what happens to an ice skater performing a pirouette. A spinning ice skater will slow down if the arms are stretched far out, and will spin faster if the arms are pulled tightly to the body. Similarly, the rotation of the expanding outer layers of the giant has slowed down, while the shrinking core has spun up.

Professor Yvonne Elsworth, from the University of Birmingham's School of Physics and Astronomy, said, *'Understanding how stars age is a key problem in modern astronomy. It is a great step forward that we are now able to measure the rotation rate at the centre of old stars. It will also help us to predict how our own Sun will evolve.'*

The Kepler space telescope is one of NASA's most successful current space missions. Designed to search for Earth-size planets in the habitable zone of distant stars, the mission has detected numerous planetary candidates, and has confirmed many bona fide planets outside our solar system. Kepler is capable of detecting variations in a star's brightness of only a few parts in a million, and its measurements are therefore ideally suited to detect the tiny waves mentioned above. The effect of rotation on these waves is so small that its discovery needed two years of almost continuous data gathering by the Kepler satellite.

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The NASA Kepler Mission
More background information and image material can be found under the following links.

- Kepler webpage at NASA: **http://kepler.nasa.gov/ (http://kepler.nasa.gov/)**
- The Kepler Asteroseismic Science Consortium: **http://astro.phys.au.dk/KASC/ (http://astro.phys.au.dk/KASC/)**
- Pictures and illustrative Material of Kepler: **Kepler Image 1 (http://kepler.nasa.gov/images/LithoArtKepler2-full.jpg)** , **Kepler Image 2 (http://kepler.nasa.gov/images/Kepler2008Dec-cmykOnWht-full.jpg)** , **Kepler's field of view on the sky (http://kepler.nasa.gov/multimedia/photos/?ImageID=9)**

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