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Clues to Stellar Evolution Revealed in Red Giants' Core

Posted on Thursday 31st March 2011

University of Birmingham asteroseimologists are part of a team of scientists who have studied approximately 600 red giant stars and have been able to distinguish between those that burn hydrogen and those that are burning helium in their cores, according to research published in the journal Nature today (30 March 11).

Red giants are stars that are nearing the end of their life. They have expanded to many times their original size, are cooler in temperature and redder in appearance.

As their evolution continues they exhaust their supply of hydrogen at their cores and instead, burn hydrogen in the surrounding shell. They then start to burn helium in their core.

Scientists, up until now, have not been able to distinguish between red giants that have started burning helium and those that are still on their way to that state and are having to rely on burning hydrogen in a shell around the core as their source of energy. Using data from the NASA Kepler mission the scientists are seeing, for the first time, the vibrations in red giants – the signature tune of the interior of the stars – which tell them whether the star is still burning hydrogen or whether it is more advanced in its evolution and is burning helium at its core.

New discoveries in the spacing of the gravity modes (g-modes) has led to these discoveries about the internal state of the red giants. P- and g- modes are the oscillations or natural resonances of solar-type stars. Previously p-modes had been observed in the Sun – these are seen as sound waves which come to the surface and can be easily detected. However there is another sort of natural resonance which is normally hidden – g-modes. These are deep seated waves of sound which are constrained deep inside the star and do not come to the surface. The asteroseismologists have discovered that in red giants some of the p-modes have almost the same frequencies as the hidden g-modes and can be coupled with them. The p-modes act as a window on the g-modes allowing the scientists to observe them, gaining information about the very deep interior of these stars. The g-modes are very sensitive to the conditions in the core - much more so than for the pure p-modes and so make a wonderful probe for the conditions there.

Professor Yvonne Elsworth, asteroseismologist from the University of Birmingham's School of Physics and Astronomy, said, *'We are getting a real observational handle on the interior of red giants due to the detection of G mode patterns. We are gleaning new information on the internal state of these stars. We can now test the theorists' models of the stars' internal structures. This has the potential to change what we think we know about stellar evolution.'*

Dr Andrea Miglio, asteroseismologist from the University of Birmingham's School of Physics and Astronomy, said, *'We can start to use the new data from Kepler to test stellar physics in conditions very different from those encountered in the Sun. Moreover it is possible to determine the age of those stars with unprecedented precision, allowing the characterisation of populations of stars in our galaxy.'*

Notes to Editors

1. This research is published in the journal Nature, entitled 'Gravity modes as a way to distinguish between hydrogen- and helium-burning red giant stars'.

2. The Kepler Mission was launched in March 2009 and is monitoring the brightness of more than 150,000 stars in our own galaxy, to search for planets orbiting those stars, and to monitor their oscillations (asteroseismology).

For further information

Kate Chapple, Press Officer, University of Birmingham, tel 0121 414 2772 or 07789 921164, email: **k.h.chapple@bham.ac.uk (mailto:k.h.chapple@bham.ac.uk)**

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