Asteroseismology – a key to reveal stars and their planets

Charles Kuehn, University of Sydney, 2015

Asteroseismology is the study of pulsating stars with a specific focus on learning about the internal structure of these stars. While stars are often thought of as constant, many stars in the sky actually vary in brightness. These brightness variations are caused by the outer layers of the stars pulsating, causing the star to get slightly bigger and smaller and slightly changing the temperature of the outer layers of the star. These pulsations are essentially starquakes and they can be used to study the interior structure of stars in a similar way to how earthquakes are used to study the internal structure of the Earth.

The *Kepler Space Telescope* was launched by NASA in 2009 with a primary mission to find exoplanets, planets orbiting other stars. Kepler utilized what is known as the transit method, detecting small decreases in the brightness of a distant star that occur when a planet orbiting that star passes between us and the star. To do this, Kepler precisely measured the brightness of stars in one spot on the sky for four years. These observations not only allowed for the identification of exoplanets but also the study of stars that vary in brightness for any reason. The quality of the Kepler dataset was unprecedented, allowing for pulsating stars to be studied in a way never before possible. Following the failure of two reaction wheels which help control the direction that the telescope is pointed in, Kepler is now in what is known as the *K2* where it is looking at different regions on the sky for three months at a time, providing a new sample of pulsating stars to study.

One of the most exciting aspects of asteroseismology is that it provides a way for us to learn about stars evolve over the course of their life. During both its original mission and it's a *K2* mission, Kepler observed several star clusters. Star clusters are a collection of between a few hundred and a million stars that all form together out of one very large cloud of gas and dust. The stars in a cluster are all formed at the same time, from the same material and the primary difference between them is their mass which determines how they will evolve. Thus, by observing a star cluster, we get a snapshot of stars at various stages of evolution. Observations of star clusters by Kepler have given us a chance to study different types of pulsating stars that are at different evolutionary stages, helping to provide valuable information about stellar evolution. One of the most interesting questions that we are currently using this data to attempt to answer concerns how much mass stars lose during their life as stellar winds blow off portions of their outer layers.