Research Summary

In 2013 October I took up a postdoctoral research position at the University of Sydney. Since doing so, I have been largely working on two main topics: spectral classification of A stars and searching for binaries among pulsating A stars.

I have been classifying well over 100 stars a month, and am working on refining the MK standard stars in this age of digital spectra. With a denser grid of precisely characterised standards, spectral classification offers much more than a rough indication of temperature and luminosity. I have obtained a few hundred spectra for spectral classification from the ANU 2.3-m telescope at Siding Spring Observatory. The targets were chosen as high-likelihood lambda Bootis candidates, to match one of my research goals of extending the known number of these chemically peculiar stars.

In parallel to my work on spectral classification, I have been classifying the pulsational stability of delta Scuti stars. If a pulsating star is part of a binary or multiple system, its orbital motion introduces periodic modulation of its pulsation phase. This information, gathered entirely from existing *Kepler* photometry, allows construction of the radial-velocity curve of the binary system without need of ground-based spectroscopy (Murphy et al 2014).

In 2013 October I was awarded a PhD from the University of Central Lancashire. My PhD thesis, titled "Investigating the A-type stars with Kepler data", focussed on three overlapping topics: Fourier analysis techniques; case studies of pulsating A-type stars; and investigating the incidence of chemical peculiarity in A-type stars.

Data from the Kepler Space Telescope are capable of such exquisite precision, with noise levels below 2 μmag in some cases, that truly understanding instrumental artefacts is of paramount importance. To this end, investigations into *Kepler*'s short and long cadence data characteristics, and into the performance of the data processing pipeline, were conducted (Murphy 2012a,b). In addition, *Kepler's* unique configuration, being in a heliocentric orbit with a fixed field of view, allows one to conduct asteroseismology at frequencies beyond the conventional Nyquist frequency (Murphy et al. 2012b).

With the advent of space-based photometry, small-scale studies of classical pulsators from the ground are obsolete. Now, one must select the most promising targets and analyse those individual targets as deeply as possible. Case studies like these (e.g. Murphy et al. 2012a; 2013b) are fundamental to the progress of stellar astrophysics.

The A stars are host to a wide range of chemical peculiarities, and up to 50 per cent are peculiar at late A spectral types. Many types of peculiarity are expected to inhibit pulsation, but *Kepler* observations indicate pulsation in these stars. Understanding of the pulsation mechanisms and extent of the peculiarities hinges on not only case studies of individual chemically peculiar pulsators (Murphy et al. 2012a), but also surveys of chemical peculiarity and pulsation amplitudes (in prep.).

References

Complete articles of the following references can be found at simonmurphy.info/research

Finding binaries among Kepler pulsating stars from phase modulation of their pulsations: Murphy et al. (2014), (MNRAS), arXiv:1404.5649
Frequency analysis of the high-amplitude SX Phe star KIC 11754974: Murphy et al. (2013), MNRAS, 432, 2284
Super-Nyquist asteroseismology with the Kepler Space Telescope, Murphy et al. (2013a), MNRAS, 430, 2986
Kepler Fourier concepts: The performance of the Kepler data pipeline, Murphy (2012b), AN, 333, 1057
Pulsational amplitude growth of KIC 3420637 (HD 178875) in the context of Am and rho Puppis stars, Murphy et al. (2012a), MNRAS 427, 1418
Characteristics of Kepler short- and long-cadence data, Murphy (2012a), MNRAS 422, 665