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Coordinated observational campaigns for non-radially pulsating objects

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Abstract

In recent years we have initiated and contributed to a number of campaigns to study non-radially pulsating objects. Our observing facility is the Mt John University Observatory 1.0 m telescope equipped with a high-efficiency and extremely stable echelle spectrograph, ideal for spectroscopic mode identification. Our current interests include δ Scuti star campaigns and a programme to study the non-radial pulsations in γ Dor stars. We are investigating several different methods of line profile analysis and spectroscopic mode identification of these targets. An overview of the programme, with specific examples, is presented.

Spectroscopy at the Mt John University Observatory

The instrumentation for asteroseismology at the University of Canterbury's Mt John University Observatory (MJUO) is the 1.0 m telescope with the fibre-fed High Efficiency and Resolution Canterbury University Large Echelle Spectrograph, HERCULES ($R \approx 40\,000$ or 80 000; Hearnshaw et al. 2002;). The major elements of HERCULES are fixed to an optical bench located inside a cylindrical vacuum tank (4.3×1.2 m) in which the pressure is maintained at 1 to 5 torr. The tank is situated in a thermally isolated and insulated room. RMS stability of 15 m s^{-1} over time spans of 4 to 5 years is being achieved. This is ideal for high-resolution, time-series asteroseismological studies of reasonably bright stars ($V < 9$). The longitude of MJUO, coupled with our ability to acquire long sequences of observing time using this facility, allow us to coordinate and contribute to both single-site and multi-site asteroseismology campaigns.

Target stars, analysis techniques and results

We have completed the observational aspect of one multi-site campaign on QW Pup and HD 139095 (Wright et al. 2006) and are undertaking single-site observations from MJUO of a larger list of targets (Table 1). We have measured projected rotational velocities, identified binary or multiple systems and are investigating line-profile variations (LPV). A number of our targets have turned out to be in multiple stellar systems and orbital periods are still being determined.

Line profiles are tested for variation by visual inspection of stacked plots and by plotting the residuals after subtraction of the average line profile. To increase our sensitivity to small-scale line profile variations, a high S/N representative line profile is obtained through cross correlating selected lines in each spectrum. Techniques used to analyse the line profile variations include the moment method (Briquet & Aerts 2003) and the phase change across the profile method (Telting & Schrijvers 1997). Our intention is to carry out spectroscopic mode identification by comparing the observed line profile variations with those predicted from models of the various non-radially pulsation modes.

Table 1: Targets observed using the MJUO 1.0 m and HERCULES.

Star	Comments	# obs	$V\sin i$ (km s^{-1})
HD 10167	F0V, V=6.676, SB2	2	6±2, 6±2
HD 14940	F0IV, V=6.673, γ Dor	2	44±2
HD 17310	F0, V=7.79	2	7±3
HD 27377	F0V, V=7.4	1	8±2
HD 40745	F2IV, V=6.207, γ Dor	2	40±2
HD 41448	A9V, V=7.6	2	106±5
HD 75747	A7V, V=6.07, RS Cha, SB2	351	69±2, 72±2
HD 166114	F2V, V=5.858, Triple system?	19	8±2, 7±2
HD 172416	F5V, V=6.632, SB1	10	54±3
HD 187028	F0V, V=7.5, γ Dor	1	95±7
HD 189631	F0V, V=7.54, LPV	7	51±5
HD 214291	F7V, V=6.581, SB2	78	69±3, 69±3
HD 216910	F2IV, V=6.699, γ Dor, LPV	11	100±6

References

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