

Rapidly varying A-type stars in the SuperWASP archive

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Abstract. The searches for transiting exoplanets have produced a vast amount of time-resolved photometric data of many millions of stars. One of the leading ground-based surveys is the SuperWASP project. We present the initial results of a survey of over 1.5 million A-type stars in the search for high frequency pulsations using SuperWASP photometry. We are able to detect pulsations down to the 0.5 mmag level in the broad-band photometry. This has enabled the discovery of several rapidly oscillating Ap stars and over 200 δ Scuti stars with frequencies above 50 d^{-1} , and at least one pulsating sdB star. Such a large number of results allows us to statistically study the frequency overlap between roAp and δ Scuti stars and probe to higher frequency regimes with existing data.

Keywords. surveys, asteroseismology, techniques: photometric, stars: chemically peculiar, stars: variables: roAp, stars: variables: δ Scuti

1. SuperWASP

The Wide Angle Search for Planets (WASP) is a two site campaign in the search for transiting exoplanets (Pollacco *et al.* 2006). Each observatory consists of 8 telephoto lenses mounted in a 2×4 configuration. To date there are over 31 million objects in the WASP archive. Observations consist of two consecutive 30-s integrations followed by a 10 minute gap. The entire observable sky can be visited every 40 minutes. The short integrations, and non-uniform sampling, allow for a Nyquist frequency of up to 1440 d^{-1} .

Due to the observing strategy, observations of a single star can occur over many seasons, with the target sometimes appearing in more than one camera. This provides a long time-base of observations which can either be combined or split into individual data sets.

2. Methodology

We selected, using 2MASS colours, over 1.5 million A-type and earlier stars from the SuperWASP archive. We aimed to identify new pulsating systems with frequencies above 50 d^{-1} . Such a frequency range allows for the discovery of new δ Scuti stars, rapidly oscillating Ap (roAp) stars and compact pulsators. Thus, enabling a statistical study on potential frequency boundaries.

We calculated a periodogram for each WASP season for every individual object – over 9 million lightcurves. Periodograms for an object are cross-checked for peaks at the same frequency. An object is required to have two or more concurrent peaks to be thought of as genuine. Spectroscopic follow-up is sought for the most convincing candidates. For our northern targets we make use of the service mode on WHT/ISIS and UK SALT Consortium (UKSC) time on SALT/RSS for our southern targets.

Table 1. Current statistics from the WASP survey.

Pulsation Class	Candidates	Number with Spectra	Confirmed
roAp	21	21	10
δ Scuti (Am)	204	18*	29*(15)

*Some roAp candidates are found to be δ Scuti, hence the discrepancy.

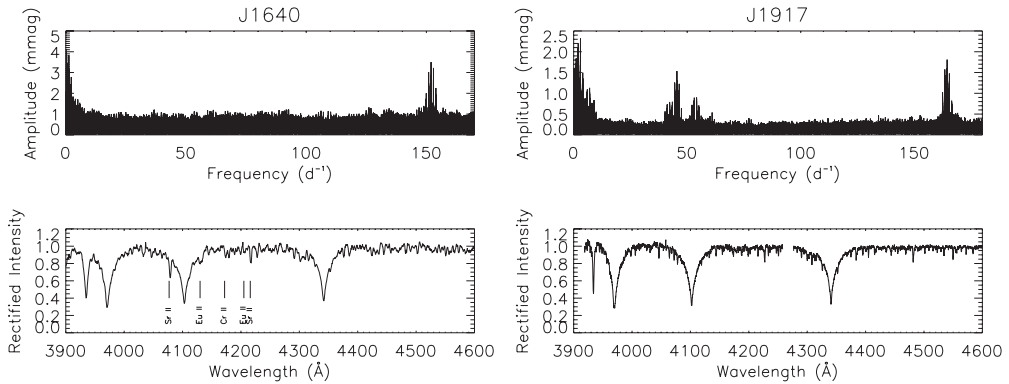


Figure 1. *Left:* An example of a WASP roAp periodogram and WHT/ISIS spectrum confirming the Ap nature of the star. *Right:* A hybrid target showing both roAp and δ Scuti pulsations. The SALT/RSS spectrum shows this is an Am star due to the weak Ca K line.

3. Results

3.1. roAp stars

To identify candidate roAp stars we require a target to show a single peak in the periodogram above 50 d^{-1} . This peak must appear in more than one season of WASP data to eliminate the possibility of spurious peaks due to noise. Using this criteria we identify 21 candidate stars. Classification spectra have been obtained for these targets, confirming at least 10 new roAp stars (e.g. Fig. 1, left).

3.2. δ Scuti stars

Candidate δ Scuti stars are identified as those objects with multiple frequencies higher than 50 d^{-1} and having their principle peak in multiple seasons. We have over 200 candidates up to a maximum frequency of 100 d^{-1} . Spectra have been secured for photometrically interesting targets such as J1917 (Fig. 1, right). 52% of the targets for which we currently have spectra are pulsating Am stars (also see Smalley *et al.* 2011).

4. Conclusions

The SuperWASP archive has provided a new approach in searching for stellar pulsations in the A-type stars. We have thus far identified 10 new roAp targets for further in depth study as well as highlighted over 200 potential new δ Scuti stars with periods shorter than ~ 30 minutes. The archive holds many more examples of pulsating systems which are yet to be exploited.

References

- Pollacco, D. L., Skillen, I., Collier Cameron, A., *et al.* 2006, *PASP*, 118, 140
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