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# A PHOTOMETRIC NULL RESULT IN THE SEARCH FOR PULSATIONS OF THE LUMINOUS RAPIDLY OSCILLATING Ap STAR HD 116114

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The rapidly oscillating Ap (roAp) stars are cool, magnetic, chemically peculiar A-type stars that pulsate with periods in the range of $5.6 - -21$ min and Johnson $B$ semi-amplitudes $< 0.008$ mag. These oscillations are caused by global p-mode pulsations of low spherical degree ($\ell < 3$) and high radial overtones ($n \gg \ell$). Because they show multiperiodic oscillations, the roAp stars are good targets for the application of the techniques of asteroseismology. For instance, by comparing the observed frequency spectrum to asymptotic pulsation theory it is possible to determine their absolute magnitudes.

Most of the roAp stars have so far been discovered with high-speed photometry. However, it has recently become clear that spectroscopy is even more sensitive for the detection of rapid pulsations because it provides information over a larger depth range of the chemically stratified atmospheres (see, e.g., Ryabchikova et al. 2002; Kurtz et al. 2003). Therefore, some spectral lines may show quite large radial velocity amplitudes (e.g., Elkin et al. 2005a) due to the rapid oscillations. In some cases, even photometrically undetected pulsation modes may be discovered spectroscopically (Kurtz et al. 2005).

Rapid oscillations of the luminous Ap star HD 116114 were recently discovered by Elkin et al. (2005b). The radial velocity variability has a period of 21 min, making HD 116114 the longest-period pulsator among the roAp stars. The star had already been checked for photometric variability by Martinez & Kurtz (1994) who found no rapid oscillations. However, as some roAp stars are known to show intrinsic amplitude variability (on top of their rotational amplitude modulations) and as the measurements by Martinez & Kurtz (1994) were taken some 15 yr before the spectroscopy by Elkin et al. (2005b), we decided to carry out a new photometric study.

Our observations were acquired at the Sutherland site of the South African Astronomical Observatory (SAAO) using a computer-controlled pulse-counting photometer on the 0.5-m telescope. To minimize the noise introduced into the light curves by telescope tracking errors we used a large aperture ($45''$). We observed the star for one to two hours with continuous integrations through a Johnson $B$ filter during seven nights. The nearby G2V star HD 115642 was additionally observed every $\sim$15 min to verify the stability of the photometric conditions; only the six best nights were chosen for further analysis. Our final data set comprises 6.2 hr of observation and spans a total of 12 d, corresponding to about 45 per cent of the rotation period of HD 116114 as derived by Mathys et al. (2005, in preparation). This means that the known amplitude modulation of roAp stars over the rotation cycle should not be able to mislead us into believing the star to be constant, if it has detectable variability.

Amplitude spectra of our measurements are shown in Fig. 1. The periodogram in the upper panel was computed from the relative (HD 116114 – HD 115642) magnitudes. It shows some low-frequency noise increase which can be due to one (or both) of the two stars. Setting all the nightly mean magnitudes to zero results in the periodogram in the lower panel of Fig. 1. Again, we find no statistically significant rapid variability of HD 116114 in our photometry, although it is interesting to note that the highest peak in this plot occurs at a period of 21.3 min, within the errors the same as the period detected by Elkin et al. (2005b). We conclude that spectroscopy is indeed a very sensitive tool to discover the pulsations of roAp stars: whereas a 2-hr spectroscopic run was sufficient to detect the variability of the star with certainty (Elkin et al. 2005b), our photometric measurements, being three times as extensive, were not.

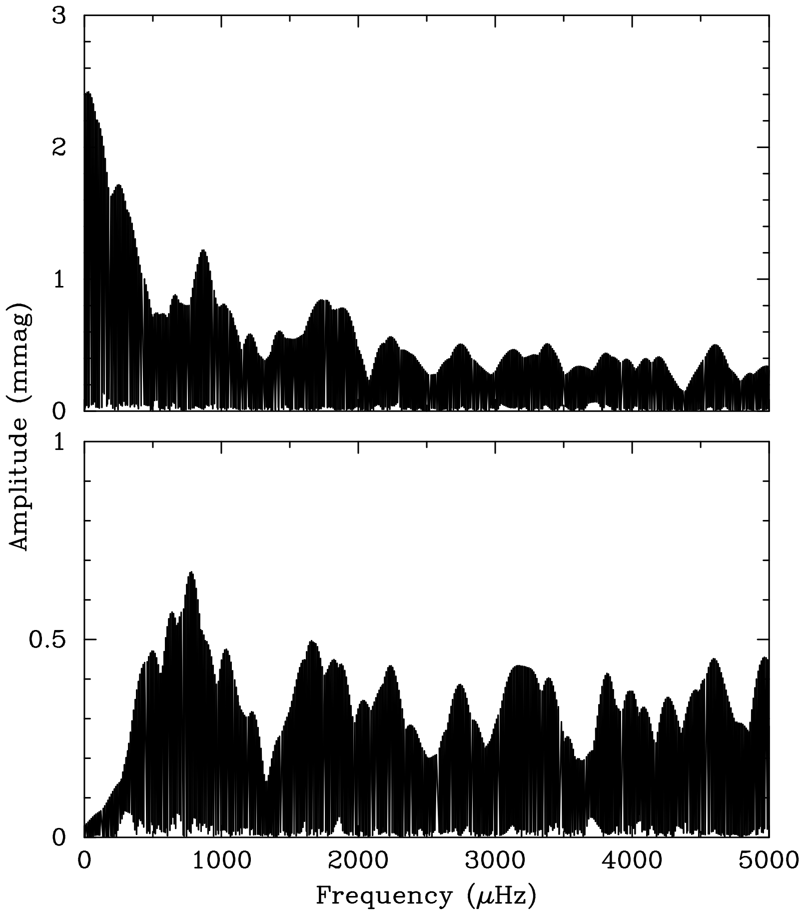


**Figure 1.** Upper panel: amplitude spectrum of our observations of HD 116114 relative to the comparison star HD 115642. Lower panel: amplitude spectrum of our data after nightly zeropoint adjustments. Note the magnified scale of the lower panel.

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