

Radial Pulsation of the roAp Star HD 122970?

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Abstract. We acquired multisite observations of the newly discovered rapidly oscillating Ap star HD 122970. A frequency analysis shows the presence of two independent modes, one singlet and one equally spaced triplet. By applying the oblique pulsator model and asymptotic theory we infer that the triplet originates from a distorted dipole mode and that the singlet most probably corresponds to a radial mode.

1. Introduction

HD 122970 is an equatorial 8th magnitude F0 star whose Strömgren indices indicate enhanced metallicity and line blocking. It was tested for photometric variability during a Northern Hemisphere survey for rapidly oscillating Ap stars (Handler & Paunzen 1999) and it was discovered to be variable with a period of about 11 min. Since this result was obtained at the beginning of a large multisite campaign on the δ Scuti star XX Pyx (see Arentoft et al. 2000), it was decided to include HD 122970 as a second-priority target in that campaign.

2. Observations and Frequency Analysis

We acquired 119 hr of high-speed time-series photometry with seven telescopes at six observatories. The total time base of the measurements is five months, but 92% of the data was gathered during a six-week period.

The frequency analysis of the reduced *B*-filter light curves yielded four statistically significant periodicities (Table 1). Three of them ($f_2 - f_4$) form an equally spaced triplet within the accuracy of frequency determination.

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Table 1. Multifrequency solution for the roAp star HD 122970. Phases are relative to pulsation amplitude maximum.

	Frequency (μHz)	B Amplitude (mmag)	Phase (radians)	S/N
f_1	1502.476 ± 0.001	1.68 ± 0.03	3.43 ± 0.05	29.8
f_2	1477.823 ± 0.002	0.85 ± 0.03	1.87 ± 0.10	14.4
f_3	1476.799 ± 0.006	0.43 ± 0.03	1.26 ± 0.21	7.3
f_4	1478.929 ± 0.010	0.25 ± 0.03	1.07 ± 0.36	4.2

3. Interpretation

By applying the oblique pulsator model (Kurtz 1982) and simple asymptotic theory to the observed pulsations, we can immediately rule out nine of the twelve initially possible mode identifications (assuming $\ell \leq 2$) for the two independent modes.

When imposing the measured $v \sin i$ and the rotation period from the triplet spacing as further constraints, one can again use the oblique pulsator model to infer limits on the “permitted” inclination angle of the rotational axis to the line of sight. This eliminates one further identification. Among the remaining two ℓ pairs the triplet is always a (distorted) $\ell = 1$ mode and the singlet f_1 is either $\ell = 0$ or $\ell = 2$. However, the interpretation involving an $\ell = 2$ identification for f_1 is only possible within a very small range of i , hence unlikely.

More observations of HD 122970 are needed to obtain a unique mode identification (an upper limit on possible rotational sidelobe amplitudes of f_1 lower than 0.1 mmag is required), and to determine the degree of distortion of the conjectured radial mode compared to that of the dipole mode. This could help to understand the influence of the magnetic field on the pulsations.

See Handler et al. (2000) for further details.

References

- Arentoft, T., Handler, G., Shobbrook, R. R., et al. 2000, in these proceedings, p. 469
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