Bull. Astr. Soc. India (2001) **29**, 305–307

HD 12098 a new far-northern roAp star

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Abstract. The *rapidly oscillating Ap* (roAp) stars are cool, magnetic, chemically peculiar stars which pulsate in non-radial p-modes in the period range 4-16 min and have Johnson B amplitudes less than 8 mmag. "The NainiTal-Cape survey" to search for and study new roAp stars in the northern hemisphere was initiated in 1998 in collaboration between ISAC & UPSO from India and SAAO & UCT from South Africa. HD12098 is the first roAp star discovered in this survey and also the first far northern hemisphere roAp star. During the initial observations the star showed modulation in the pulsation amplitude indicating the multi-periodicity of pulsations. The multi-periodicity may be either due to the excitation of different modes or due to the rotation of the star. In order to resolve these frequencies HD12098 was observed extensively in October 2000. The preliminary results of these observations are presented here.

Keywords : chemically peculiar, roAp, star:Ap, star : HD12098.

1. Observations

HD 12098 has an apparent magnitude $m_V = 7.97$. It has the color indices $(b - y) = 0.191$, $m_1 = 0.328$, $c_1 = 0.517$, $\beta = 2.796$ (Hauck & Mermilliod 1998), $\delta m_1 = -0.122$, $\delta c_1 = -0.279$. Based on the metallicity, HD 12098 is classified as an Ap star (Olsen). Recently Wade et al. (2001), have detected a longitudinal magnetic field of $\approx 2kG$ in HD 12098.

HD 12098 was discovered as a variable star in 1999 during "Naini Tal - Cape survey" (Peter et al., 1999). New high-speed photometric observations of HD12098 are obtained in Oct 2000 on six nights using the ISRO high-speed three channel photometer (Ashoka et al., 2001) attached to the 1.2 m telescope at

Gurushikhar, Mt. Abu, belonging to Physical Research Laboratory, Ahmedabad. The data are acquired as continuous 10-s intergration through Johnson B-light. The observations were occasionally interrupted briefly for the measurements of the sky background. Such interruptions were usually of the order of 40-s. Since these were follow-up observations, all the three channels of the photometer were used, monitoring a comparison star in the second channel and the sky in the third channel. A diaphragm of 30″ was used to minimize the errors due to tracking and seeing.

2. Data reduction and analysis

The data were corrected for the dead-time losses, sky background and atmospheric extinction. After corrections the light-curves were merged together onto a common time base. The combined data were rebinned to 40-s to reduce the computational time.

A typical light-curve of the HD12098, which clearly illustrates the *strong modulation* of the signal is shown in Figure 1. The top panel is part of the light-curve obtained on 21 October 2000 and the bottom panel is part of data obtained on 22 October 2000. The dashed line is the sinusoid of frequency 2.173 mHz fitted to the data. The corrected data are subject to the Discrete Fourier Transform (DFT) to check for the periodicity. The DFT yielded a peak around 2.174 mHz. The data were then subjected to a non-linear least square fit (nlsq) which refined the value to 2.17385 ± 0.0001 mHz. A sinusoid corresponding to this frequency is subtracted from the time domain (prewhitening) and the procedure is repeated to search for further frequencies, if any are present. This yielded a second peak at 2.18069 ± 0.00016 mHz. The Fourier transform of the original light-curve and that after subtracting the sinusoids are shown in Figure 2. No other significant peak above the noise level is seen in the residual spectrum up to the Nyquist frequency corresponding to the integration time of 40-s. A detailed discussion of the results are published elswhere (Girish et al., 2001).

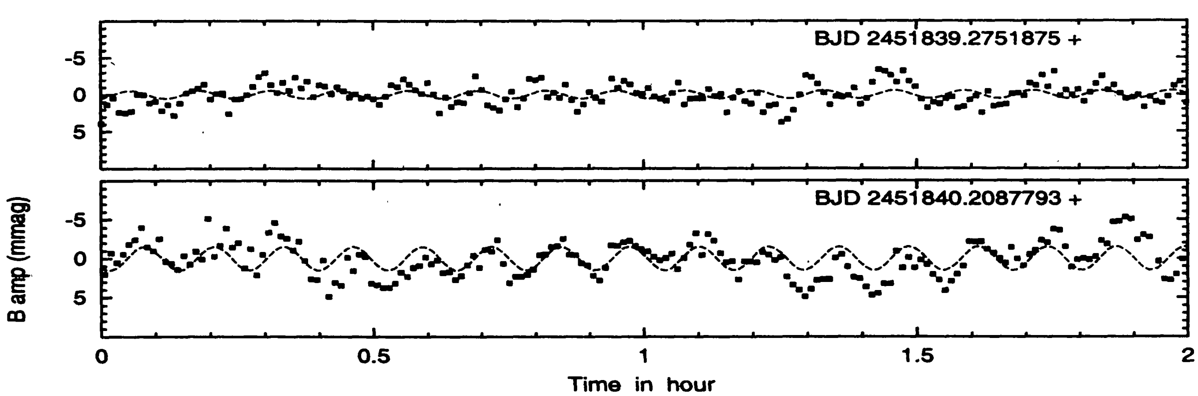

Figure 1. Typical light-curves of HD 12098 obtained on 21 October 2000 and 22 October 2000. The dashed line is the sinusoid corresponding to the frequency 2.17385 mHz. The starting time (in BJD) is indicated in the figure.

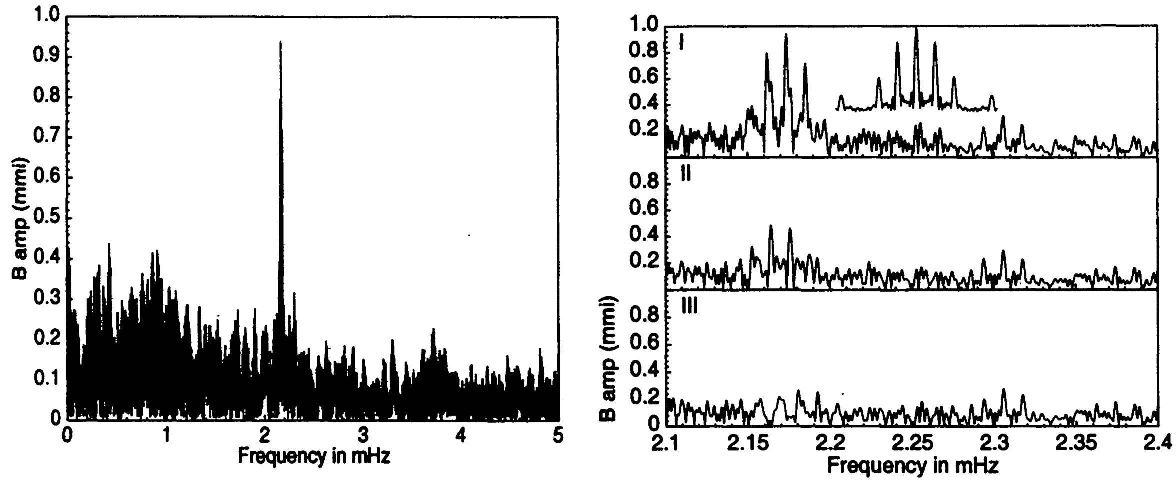

Figure 2. Fourier transform of all the six nights data combined together. The right hand side panel is the expanded view of the amplitude spectrum. The window pattern is shown in the inset. The FT after subtracting the frequency ν_1 = 2.17385 mHz is shown in the panel II. The third panel is the residual spectrum after subtracting ν_1 = 2.17385 mHz and ν_2 = 2.18069 mHz from the time domain.

3. Conclusions

The initial analysis of the data shows the presence of two frequencies 2.17385 and 2.18069 mHz. The difference between these two frequencies corresponds to a beating period of 1.22 day. Combining the present data with the data obtained in 1999, it is found that the modulation in the pulsation amplitude on different nights vary with a period near 1.22 day. Hence, we presume that the second frequency is due to the rotational modulation of the main frequency. More data and multi-site observations are needed to substantiate this claim and to break the one day aliases.

References

Ashoka B.N., Kumar., Babu V.C., et al., 2001, JAA 22, # 1

Girish V., Seetha S., Joshi S., et al., 2001, (under preparation) Hauck B., & Mermilliod M., 1998, A&AS, 129, 431

Martinez P., Girish V., Joshi S et al., 2000, IBVS No. 4853

Olsen E.H., 1980, A&AS, 39, 205

Wade G.A., Bagnulo S., Donati J.F., et al., 2001 Ap news letter #35