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High-speed IR photometry of the roAp star HD134214

Rapidly oscillating Ap stars (roAps) are mostly cool, magnetic ApSrCrEu stars which suffer oscillations with periods of a few minutes and amplitudes of a few mmag in the blue band. The class was first described by Kurtz (1982) and, over the last decade, several searches for new members have been conducted with variable degrees of success (see e.g. Martinez *et al*, 1991). So far, the roAp class is formed by roughly twenty objects with quite significant properties (Kurtz, 1990).

HD134214 is one of the few roAp stars which can be observed from the northern hemisphere, during a substantial period of time (m_v=7.48, α=15.1 h, δ=-13.°78). When it was discovered as a new member of the group, using two-site rapid B band photometry (Kreidl and Kurtz, 1986), HD134214 oscillated with a frequency of 2949.6 μHz and an amplitude of 3.21 mmag. Since then, critical frequency changes of around 0.5 μHz have been detected, as well as large phase shifts (Kreidl, 1992). However, the amplitude has remained almost constant during the last 7 years, with values ranging from 3.2 to 3.5 mmag. These kinds of phenomena had never been observed in any other member of the class.

In recent years, a controversy has been raised concerning the possibility of detecting the oscillations at infrared (IR) wavelengths. In principle, the amplitude should decrease with increasing wavelength by a certain amount (ratios $\Delta B/\Delta J \sim 4$ and $\Delta B/\Delta K \sim 6$ have been proposed: Matthews *et al*, (1990). However, opposite results have been obtained so far. Weiss *et al* (1991), in αCir, and Belmonte *et al* (1991), in 10Aql, have found marginal evidence of amplitude excesses at IR wavelengths, when trying to establish upper limits. On the contrary, Matthews *et al* (1992) always find amplitudes lower than expected in the H, J and K bands. They show that this discrepancy could be explained by the wavelength dependence of limb darkening and its weighting effect on the integrated photometric amplitude of a non-radial mode. To further complicate the situation, new, recent observations on 10Aql do not seem to repeat previous findings (Belmonte *et al*, 1992).

In this paper we report on an effort in the same direction, presenting the results obtained in the roAp HD134214 after nearly 45 hours of rapid IR photometry (J and K bands) performed in April and May 1991, at a good photometric site for the IR. The observations were conducted at the 1.54*m* Carlos Sánchez Telescope (TCS) of the

Teide Observatory (OT) in the canary island of Tenerife (Spain). The instrument was the standard CVF infrared system with a cooled solid state detector. This configuration allowed to measure automatically cycles of 20s integrations on several filters, performing simultaneous sky background corrections. In this particular case, we chose to observe in the J (1240 nm) and K (2200 nm) bands, completing a whole cycle every 53 seconds, adequate for the periods we wanted to investigate (order of 5 min). Weather conditions were excellent during most of the run, as can be seen in Table 1 which gives the journal of the observations. Globally, nearly 45 hours of useful data were obtained, which represents 80% of possible coverage and 26% of the whole duty cycle. Figure 1 shows the light curves, in both filters, obtained for one of the good nights. Direct evidence of oscillations was not found on any night.

Date (1991)	$\int$	t (hours)	K_J	K_K	σ_J (mmag)	σ_K (mmag)
29/4	431	6.82	0.114	0.083	4.4	3.7
30/4	244	3.57	0.090	0.062	2.8	3.7
01/5	421	6.67	0.089	0.079	4.7	4.5
03/5	207	3.28	0.064	0.071	3.5	5.4
04/5	421	6.67	0.104	0.064	6.1	6.8
05/5	466	7.38	0.062	0.048	6.6	9.3
06/5	427	6.76	0.079	0.061	4.6	6.1

Table 1: *Journal of observations. For each date, the table lists: the number of 20 s integrations, the length in hours from the beginning to the end of the run, the extinction coefficient derived for the J and K filters, and the standard deviation of the airmass fit reduction procedure.*

The J and K photometric data series were reduced with a standard astronomical fit to airmass. This procedure yields the residual series, together with the standard deviation of the fit (an indication of the data quality) and the extinction coefficients in the IR bands. On this ocassion, values of K_J=0.086±0.002 *mag per airmass* and K_K=0.067±0.002 *mag per airmass* have been obtained for these coefficients; these are amongst the most accurate ever obtained for OT.

Residual series were analyzed via an iterative sine wave fitting procedure. Little information could be gained from the individual nightly spectra, so that an analysis of a 45 hour long global series was made, with an intrinsic resolution of 1.45 μHz (not enough to study possible frequency shifting). The amplitude spectra obtained are presented in Figure 2.

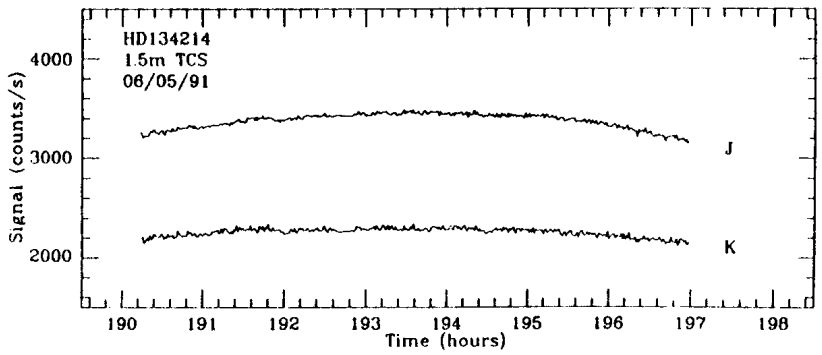

Figure 1: High-speed IR photometry light curves of HD134214 in the J and K bands, for the night of May 6 1991.

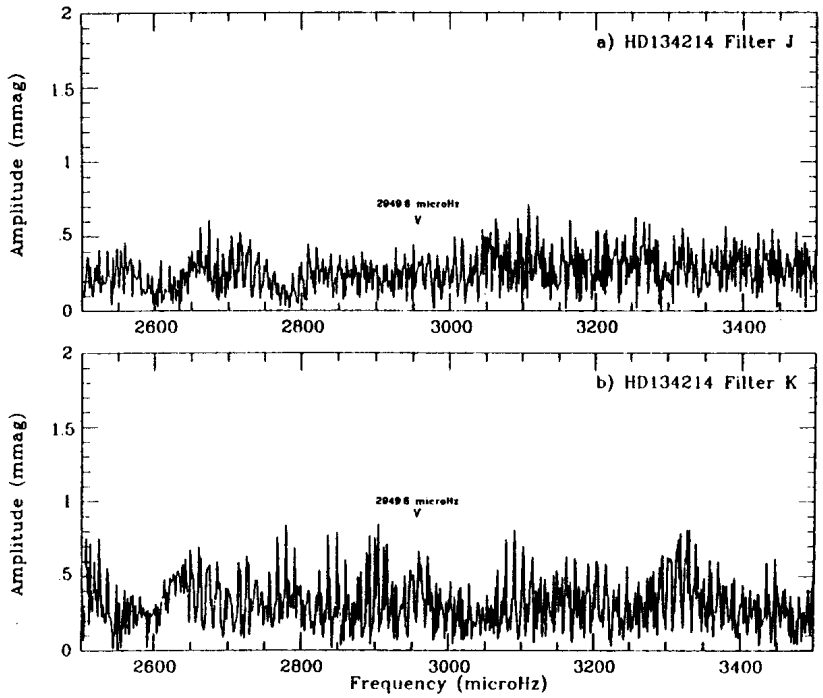

Figure 2: Amplitude spectra of the global 45 hour residual series in the J (a) and K (b) filters. The location of the frequency where oscillations are evident in the blue band is also signaled in the plot.

Despite the low noise level attained at both wavelengths (well below 0.8 mmag), we cannot claim detection of oscillations at the frequency interval (2949-2950 μHz) where peaks are found in other wavelengths. Having in mind a constant amplitude, as suggested by recent observations, for a ΔB$\sim$3.2 mmag, we should have found ΔJ$\sim$0.8 mmag and ΔK$\sim$0.6 mmag. However, as clearly shown in Fig. 2a, an uppermost limit of order 0.5 mmag can be fixed for the amplitude of any possible oscillation in the J band. The evidence is not so clear for the K band, where a peak of 0.65 mmag is located nearby the known oscillation frequency.

In principle, with these results in hand, we feel inclined to support the latest results given by Matthews *et al* on other roAps. However, our previous experience with this kind of observation compels us to be very cautious before supporting the existence of the deep decline in the wavelength dependence of amplitude, at IR bands, on the basis of so little evidence. Besides, the strange behaviour displayed by HD134214 over the last few years still deserves a deep explanation. A multi-site, multi-band, rapid photometry campaign is highly desirable, and would put us in an ideal position to face all the problems stated above.

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