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**UBV(RI)_c PHOTOMETRY OF THE RAPIDLY ROTATING
K-TYPE STAR HD 197890 = “SPEEDY MIC”¹**

HD 197890 (= SAO 212437 = CPD-37°8883 = RE J204745-363538) was found to be a very strong EUV and X-ray source during the ROSAT all-sky survey, with most of the emission due to a very intense flare event (Bromage et al. 1992; Matthews et al. 1994; Kürster 1995). Optical spectroscopy has revealed that the star is single and shows Ca II H&K emission, a very strong Li I 6708 Å line and a highly variable H α profile (Bromage et al. 1992; Jeffries 1993). From the $v \sin i$ value of 120 ± 20 km s⁻¹ and optical photometry it was immediately clear that HD 197890 was an extremely fast rotator and it was indeed nicknamed “*Speedy Mic*” (Bromage et al., 1992). So far HD 197890 is the most rapidly rotating nearby single late-type star known.

A V-band photometric study was presented by Anders et al. (1993) which, from a total of 62 observations over three nights in 1991 August/September, inferred photometric periods of 0.314 and 0.275 days. They present the whole data set by using the 0.314-day period that, however, produce a quite scattered light curve (see Figure 4 in Anders et al. 1993). They also computed a $v \sin i$ value of 170 ± 20 km s⁻¹ from the analysis of the Li 6707 Å and Ca 6717 Å lines and estimated a K5 spectral type.

In order to further investigate on the rotational period of HD 197890, multicolor photometric observations were carried out over the interval 7-13 October 1996 by using the 0.5m ESO telescope (La Silla, Chile) equipped with a single-channel photon-counting photometer, a thermoelectrically cooled R943-02 Hamamatzu photomultiplier and standard ESO filters matching the UBV(RI)_c system. Accurate differential photometry was obtained with respect to HD 198178 and SAO 212414, that were used as comparison and check stars, respectively. The observations were corrected for atmospheric extinction and transformed to the standard UBV(RI)_c system. Details on the observations and reduction procedures can be found in Cutispoto (1995). The typical error of our differential photometry is of the order of 0.005 magnitudes. We have also obtained the following V magnitude and colors for the comparison and check stars:

$$\begin{aligned} \text{HD 198178: } & V=7.96, B-V=1.04, U-B=0.89, V-R_c=0.53, V-I_c=1.01 \\ \text{SAO 212414: } & V=10.21, B-V=0.65, U-B=0.19, V-R_c=0.36, V-I_c=0.71 \end{aligned}$$

The errors on these values are of the order of 0.01 magnitudes. We have collected a total of 46 UBV(RI)_c photometric observations of HD 197890 that have been analyzed according to the method presented by Scargle (1982), which is essentially a Fast Fourier Transform adapted for unequally spaced data. The highest peak in the periodogram (F1) corresponds to a photometric period of 0.380 ± 0.004 days, i.e. 9.120 ± 0.096 hours (see Figure 1). There is a second significant frequency (F2) in the periodogram that corresponds to a period of 0.303 ± 0.004 days.

¹ based on data collected at the European Southern Observatory, La Silla, Chile

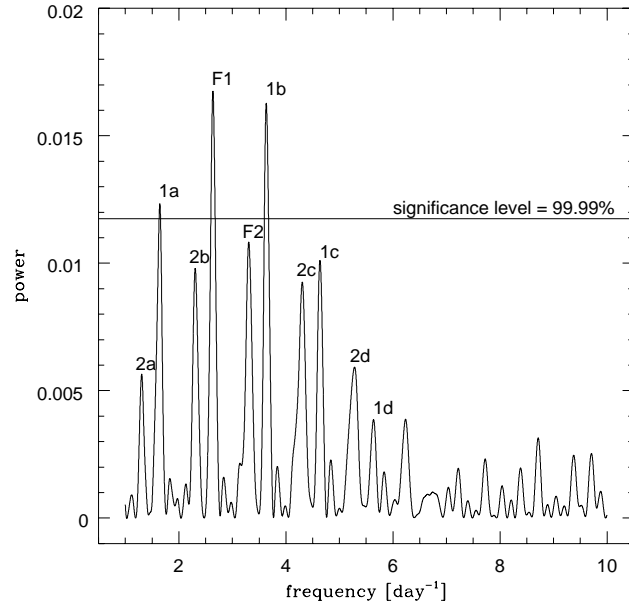


Figure 1. The periodogram obtained for HD 197890. The highest peak (F1) corresponds to a 0.380-day period; the 1a, 1b, 1c and 1d peaks are aliases of the F1 period. A second frequency (F2), corresponding to a 0.303-day period, and its aliases 2a, 2b, 2c and 2d are also visible

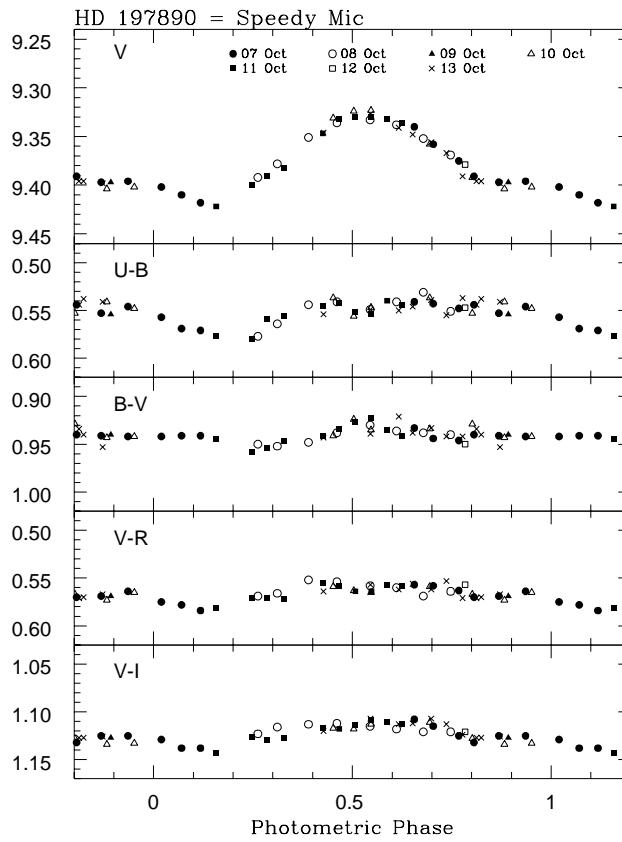


Figure 2. V-band light curve and colors of HD 197890 obtained over the time interval 1996, October 7-13. Phases are reckoned from the photometric ephemeris $HJD = 2450000.0 + 0.380 \times E$

The resulting V -band light curve with a peak-to-peak amplitude of about 0.1 magnitudes is shown in Figure 2, along with color variations that appear in phase with the V -band modulation. Phases are reckoned from the photometric ephemeris:

$$\text{HJD} = 2450000.0 + 0.380 \times E$$

The 0.303-day period produces a rather scattered light curve. Our light curve folded with the 0.380-day period has a smaller amplitude with respect to the Anders et al. (1993) data and presents a maximum and a minimum luminosity that are about 0.025 and 0.14 magnitudes brighter, respectively. We also note that folding the Anders et al. (1993) data with our 0.380-day period a light curve much less scattered than the original one is obtained.

The $B-V$ and $V-R_c$ colors of HD 197890 are consistent with those of a K3 V star, while the $U-B$ and the $V-I_c$ appears too blue and too red, respectively, for such a classification. These differences could be due to a very high activity level, to the fact that HD 197890 has not yet arrived on the main sequence or to both circumstances. However, from the $v \sin i$ value computed by Anders et al. (1993) and our new photometric period, the minimum stellar radius falls in the range 1.13-1.43 R_\odot , thus supporting the hypothesis that HD 197890 is a pre-main sequence star (Anders et al. 1993).

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