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NEW OBSERVATIONS OF THE POSSIBLE HIGH AMPLITUDE δ SCUTI VARIABLE V854 SCORPII

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The variability of V854 Sco (= CSV 2614 = HV 10535 = GSC 5617-00730) was discovered by E. Hughes Boyce (1942) who classified the star as an eclipsing variable of type W UMa, varying between magnitudes 13.9 and 14.5, but gave no elements. Robinson (1967) estimated the magnitude of V854 Sco on 200 plates of the Harvard Observatory collection, taken between JD 2427900 and JD 2430133, with exposure times of 45 minutes. A period of 0.1024012 ± 0.0000001 day was found, with a mean variation between photographic magnitudes 13.05 and 13.41. He also noted a larger dispersion of the data at maximum, compared to the minimum, and attributed this to a cycle-to-cycle variation of the amplitude. Due to the long exposure times, the mean amplitude could be underestimated. The characteristics of V854 Sco compiled by Rodríguez et al. (1994) are based on these data. Kinman (1998) refers to V854 Sco as a possible high amplitude δ Scuti star (HADS) located high above the galactic plane. To our knowledge there exists no colour information for this object.

We observed V854 Sco in the spring of 2000 with the 0.35-m telescope of CBA Belgium and the 0.4-m telescope of Beersel Hills Observatory (see Vanmunster et al. (2000) for a complete description of the CBA Belgium Observatory equipment and software). Both telescopes are equipped with an ST7 CCD-camera. We used a 2×2 binning mode. Due to the faintness of the star and the low altitude above the horizon, no filter was used. Exposure times varied between 120 and 200 seconds. Observations were made on five nights from JD 2451673 to 2451704, spanning a total time base of 31 days (see Table 1). Respectively 288 (CBA) and 47 (BHO) data points were obtained, with a total observing time amounting to 14 hours. The CBA frames were calibrated and reduced using the profile fitting algorithm of the software package MIPS (Buil et al. 1993). The frames taken at BHO were reduced with the aperture photometry procedure of the Mira AP software package[†]. The comparison star was GSC 5617-00683 ($14\overset{m}{.}0$). The standard deviation of the measurements check minus comparison star was $0\overset{m}{.}02$ on JD 2451679 ($n = 47$). An offset in mean magnitude for the latter data with respect to the rest of the data was applied on a telescope-to-telescope basis. All differential magnitudes were computed with respect to the same comparison star. They are available on request.

[†]MIRA AP is distributed by Axiom Research, Inc.

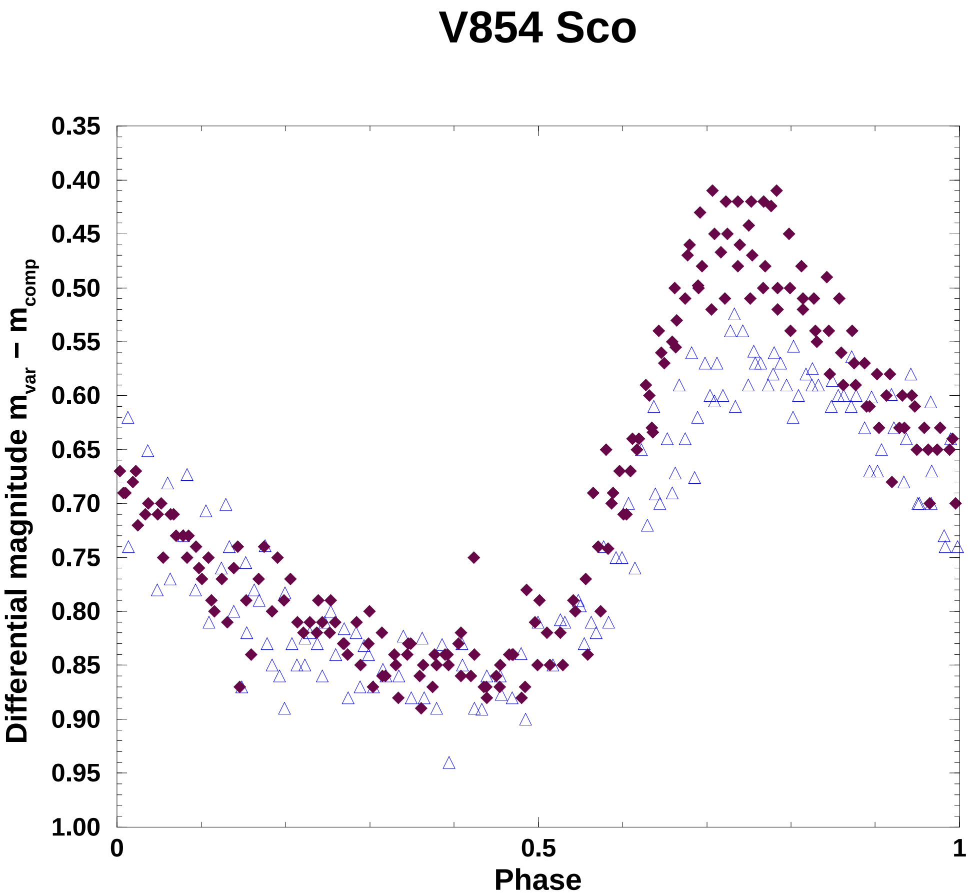

Figure 1. The V854 Sco data phased against the frequency of 9.7644123 c/d: filled diamonds represent the data on JD 2451679.428–2451679.521 ($n = 39$), 2451693, 2451704 while open triangles are used for JD 2451673, 2451679.525–2451679.544 ($n = 8$), 2451690

Table 1: Log of observations

Date	JD+	No. data	Telescope
May 8/9, 2000	673	29	CBA
May 14/15	679	47	BHO
May 25/26	690	74	CBA
May 28/29	693	104	CBA
June 8/9	704	81	CBA

'JD+' stands for 'JD 2451000+'

The data were frequency-analysed with Period98 (Sperl, 1998). We obtained the same period as reported by Robinson (1967): 0.102413 ± 0.000002 days, corresponding to the frequency of 9.7644 ± 0.0002 cycles per day (c/d). Fig. 1 shows the mean light curve phased against the best fitting frequency of 9.7644123 c/d. The mean peak-to-peak amplitude in white light is $0\overset{m}{.}34$ in good agreement with the range in photographic magnitude (Robinson, 1967). The error in frequency means that we believe that a shift in phase of 0.07 or larger between the first and the last timing of maximum light can be detected in the data string ($\Delta\phi = \Delta f \times$ number of cycles). With a full amplitude of $0\overset{m}{.}34$, such a phase shift corresponds to a deviation of $0\overset{m}{.}023$, which is of order of the estimated noise level. This error in frequency is thus an upper limit. However the peak-to-peak amplitude varies by as much as $0\overset{m}{.}15$. The shape of the light curve varies strongly within two subsequent cycles, as can been seen in Fig. 1 (see different symbols for different sets of data). The skewness of the light curve is strongest at maximum amplitude. We have applied a fit to all the data taking the first harmonic into consideration, giving:

$$\begin{array}{lll} f = 9.7644 \text{ c/d}; & a_1 = 0\overset{m}{.}162; & \phi_1 = 0.969; \\ 2f = 19.5288 \text{ c/d}; & a_2 = 0\overset{m}{.}049; & \phi_2 = 0.338; \\ t_0 = \text{JD } 2451673.4793; & \text{mean difference} = 0\overset{m}{.}703 & \end{array}$$

and a residual standard deviation equal to $0\overset{m}{.}045$ ($0\overset{m}{.}057$ without the harmonic term). The residual dispersion in amplitude is concentrated mainly around the phase of maximum light. The parameters characterizing the shape of the light curve in a Fourier decomposition give $R_{21} = 0.33$ and $\Phi_{21} = 2.51$. The latter value is a bit low compared to other δ Scuti stars (Poretti et al., 1990).

In conclusion we report the constancy of the period for this high amplitude δ Scuti star over a time range of almost 60 years. In addition we confirm that the mean peak-to-peak amplitude fluctuates by as much as $0\overset{m}{.}15$. From the re-occurrence of a similar light curve shape on a time scale of several days, one can expect beating between two closely spaced frequencies. We searched but found no indication for a second frequency in our data. However this does not argue against the existence of a second frequency, as it could well be that coverage with respect to the corresponding beat period is insufficient.

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