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HD 34409 - A DELTA SCUTI VARIABLE

The star HD 34409 (=BD+69°315) was reported to be a variable of small amplitude by Hilditch (1971). He also reported the spectral type of HD 34409 as F2 and indicated that the light variations of the star closely resembled δ Scuti type variability in appearance and duration.

This star was chosen as a secondary comparison during the observations of the programme star AS Cam and was observed on the 38-cm reflector of the Uttar Pradesh State Observatory employing 1P21 photomultiplier, conventional UBV filters of Johnson and Morgan (1953) and d.c. techniques.

A total of eight nights of observations obtained between JD 2440544 and JD 2442783, using HD 34463 (=BD+69°317) as a comparison star, have been discussed in this communication.

Although the observations during all the eight nights have been secured through U, B and V filters, but the light curves of B filter have only been presented in this paper as the light curves in U and V filters show a large scatter.

Moreover, we were mainly interested in finding out the nature of variability of the star HD 34409 and in obtaining the times of maxima. The scatter present in the observations may be attributed primarily to the faintness (9^m.1) of the star, the magnitudes of both the variable and the comparison stars being close to the limiting magnitude (10^m.0) of the reflector.

The details of the variable and the comparison stars are given as follows:

Star	α_{1855}	δ_{1855}	m_V	Sp.Type (BD)
Variable star = HD 34409 = BD+69°315	05 ^h 07 ^m 10 ^s	+69°14'5"	9 ^m .1	A
Comparison star = HD 34463 = BD+69°317	05 ^h 07 ^m 35 ^s	+69°25'3"	9 ^m .5	A

The average standard deviations of the comparison star in U, B and V filters are $\pm 0^m.020$, $\pm 0^m.010$ and $\pm 0^m.012$ respectively. The instrumental magnitudes have been converted into standard magnitudes with the help of several stand-

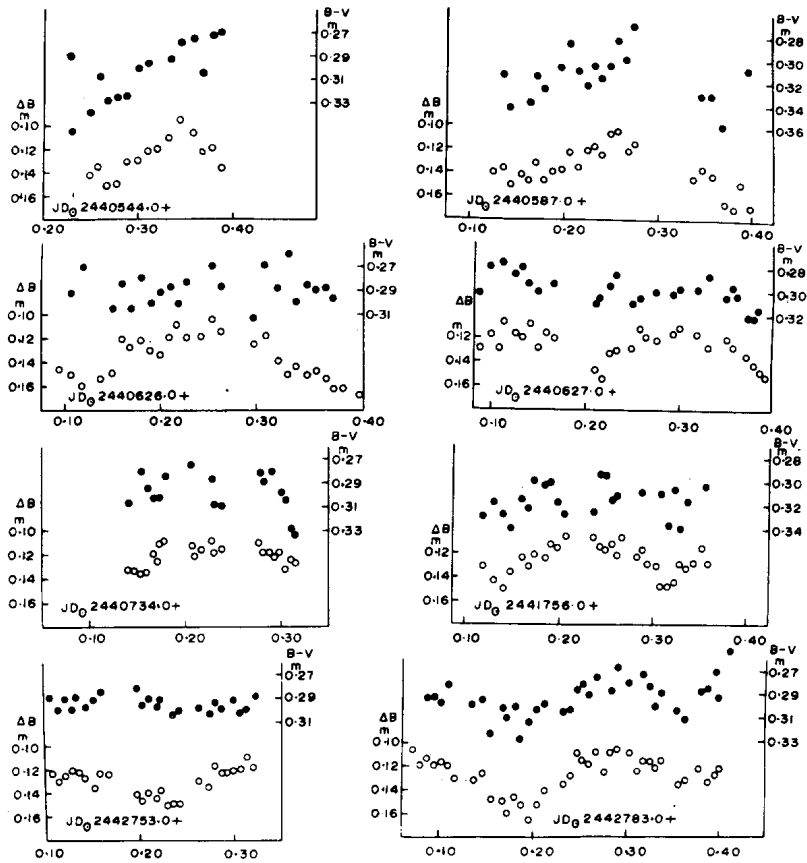


Figure 1 Light and colour curves of HD 34409

ard stars, chosen from the list of Johnson and Morgan (1953). The differential B magnitudes (ΔB), in the sense variable minus comparison, have been plotted against heliocentric Julian day. The light curves, thus obtained are plotted in Fig. 1, wherein the observed points are shown as open circles.

The times of maxima, determined with a graphical accuracy of $\pm 0.001^d$, are given below:

JD(He1)	JD(He1)
2440544.345	2441734.250
2440587.265	2441756.233
2440626.243	2442753.135
2440627.290	2442783.290

The colour indices (B-V and U-B) of the variable and the comparison star have been determined and are given as under:

Star	B-V	U-B	Sp.Type
HD 34409	+0. ^m 30	+0. ^m 21	F 2
HD 34463	+0.15	+0.09	A 5

The average colour of the comparison star comes out to be B-V = +0.^m147 and U-B = +0.^m093, which places the star into A5V spectral-luminosity class (vide Golay, 1974), while the colour of the variable star comes out to be B-V = +0.^m304 and U-B = +0.^m205. These colour indices indicate that the variable is close to spectral-luminosity class F2 II, showing a moderate ultraviolet excess of 0.^m05, when compared with the colour-colour sequences given by Golay (1974). The luminosity class may be off than this because of the ultraviolet observations being not so reliable due to smallness of the deflections through U filter. The standard deviations of the colour indices for B-V and U-B are $\pm 0.^m009$ and $\pm 0.^m014$, respectively. This finding, with regard to the spectral class, is in agreement with the results obtained by Hilditch (1971), who also confirmed the spectral type of the variable with the spectroscopic observations. However, there is a disagreement in the value of U-B excess. Accordingly, only difference between our and Hilditch's (1971) findings is that the U-B value of HD 34409 showed an ultraviolet depression (vide Hilditch, 1971), while we find that the U-B value shows a moderate ultraviolet excess. Since Hilditch (1971) did not give any indication about the colour-colour sequence, which he used for assessing the spectral classes, hence it is difficult to point out the cause of this difference. Moreover, he did not mention the luminosity class of the variable star either. The luminosity of the star has been assessed to be +1.^m4. The colour and luminosity diagram suggests that the star belongs to luminosity class IV, showing an ultraviolet excess of the order of 0.^m15.

The B-V and U-B colour indices of all the observations have been obtained, and the B-V colour of every observation has been plotted on the top of Fig.1 as filled circles.

The light curves presented in Fig. 1 show that the average amplitude of maxima comes out to be $0.^m05 \pm 0.^m01$. Hilditch also points out that the variable is of small amplitude.

From the above detailed maxima (and employing the method of least squares) we have computed the fundamental (mode) period to be $0.^d1803695$. The varying amplitudes present in the light curves show the presence of beat phenomenon.

In addition, HD 34409 falls in the δ Sct region in the colour-colour dia-

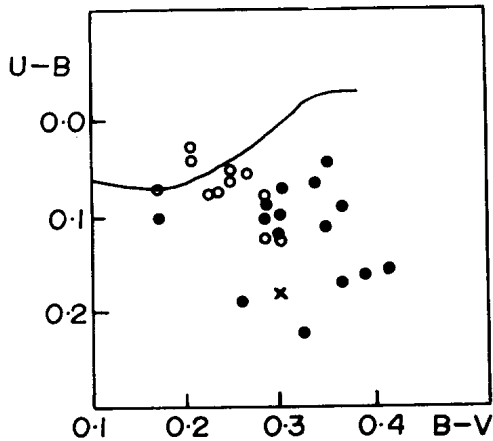


Figure 2. Position of HD 34409 (cross) plotted in the diagram showing δ Sct stars (filled circles) and dwarf cepheids (open circles). The solid line represents the main sequence.

gram (Frolov, 1975) as shown in Fig. 2. The approximate luminosity of the star has been assessed from the data given by Frolov (1975) in Tables 28 and 29. The M_V of HD 34409 has been estimated to be $+1.4^m$. When the values are plotted on the colour (B-V) and luminosity (M_V) diagram given by Frolov (1975), the variable falls in the δ Sct region. Likewise when the luminosity and the period of the star are plotted on the diagram given by Frolov (1975), it follows the P-L relation valid for δ Sct stars. H-R diagram (M_V vs B-V) reveals that the star may belong to luminosity class IV (subgiant) (vide Burbidge and Burbidge, 1958).

All the above facts confirm that the star HD 34409 is a δ Scuti variable of small amplitude (0.05^m), spectral type F2 IV, and has a fundamental (mode) period of 0.1803695^d .

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