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REFINEMENT OF THE FUNDAMENTAL FREQUENCY OF PULSATION OF DELTA SCUTI

Previously unpublished photoelectric magnitudes for δ Scuti (= HR 7020 = HD 172748) are presented in Figures 2, 3 and 4. These results were taken at Mt. Arapiles in Victoria on 1977 August 23 using a 20 cm telescope, an uncooled 1P21 photomultiplier tube and standard U,B,V filters. A number of standard stars were also observed; atmospheric extinction coefficients were derived (k_V=0.17 mag/air mass; k_B=0.32 mag/air mass; k_U=0.61 mag/air mass) and adequate transformations to the standard UBV system established.

ε Scuti (= HR 7032 = HD 173009) was used as a comparison star; observed magnitude differences were corrected for differences in air mass between the variable and comparison stars then transformed to the standard UBV system. Photoelectric V magnitude, B-V and U-B colour indices for ε Scuti are given by Cousins (1964); using these values and the corrected magnitude differences, the average magnitude and colour indices for δ Scuti were calculated to be V = 4.73, B-V = 0.36 and U-B = 0.10, in excellent agreement with average values given by Cousins and Stoy (1962). HR 7007 (= HD 172348) was used as a check star for V band measurements; the probable error in a single observation was determined to be ± 0.01 magnitude.

These data were not of sufficient precision or extent to justify analysis using Fourier techniques. However a maximum is clearly observed in all three bands at about HJD 2443379.05. Solutions for the light variation of δ Scuti are given by Fitch (1976). Using the frequencies determined by Fitch from analysis of b-magnitude measurements, we calculated the predicted light curve of δ Scuti at the time of our observations (see Figure 1). Dashed lines in Figures 2, 3 and 4 represent this predicted light curve shifted 0.02 day to the left (i.e. to earlier times). Despite the large scatter in our observations, this shifted curve is a good fit to results in all three bands.

Fitch (1976) compares the fundamental frequency of pulsation (f_0) for δ Scuti calculated from his b-magnitude measurements (f_0=5.16070 cycles/day)

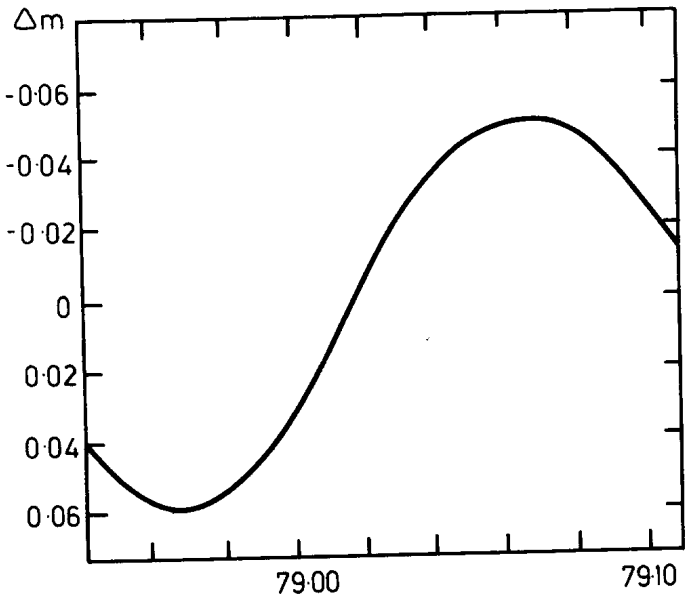

FIGURE 1

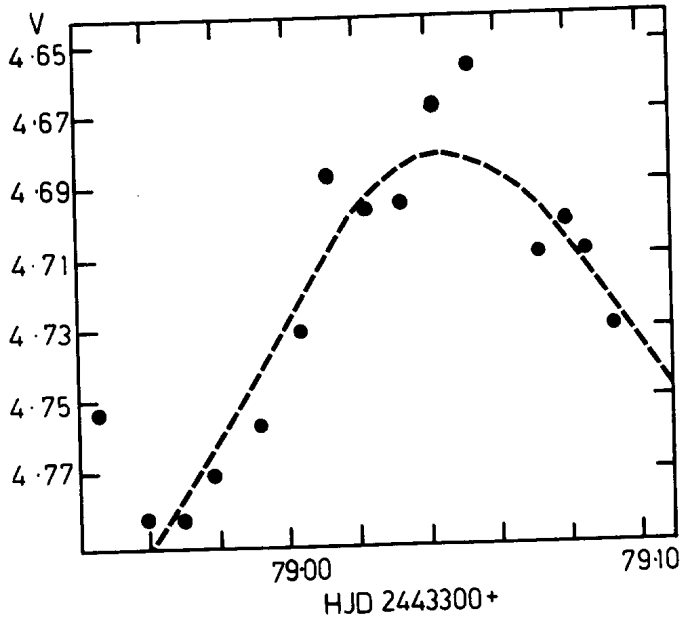

FIGURE 2

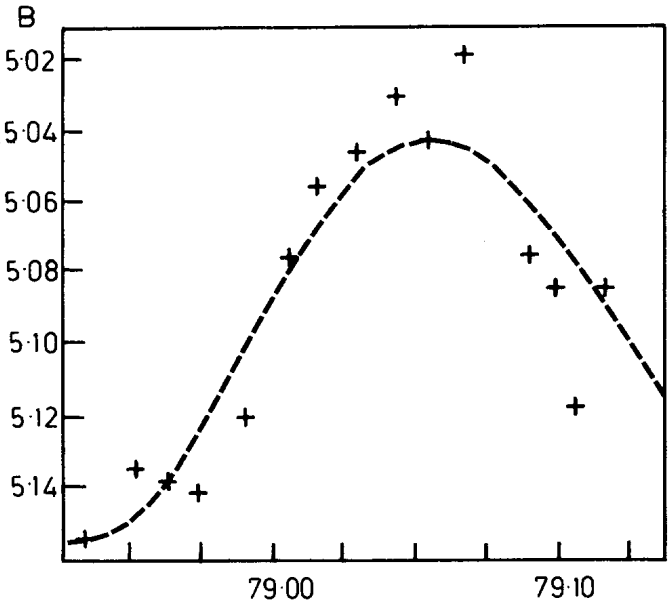

FIGURE 3

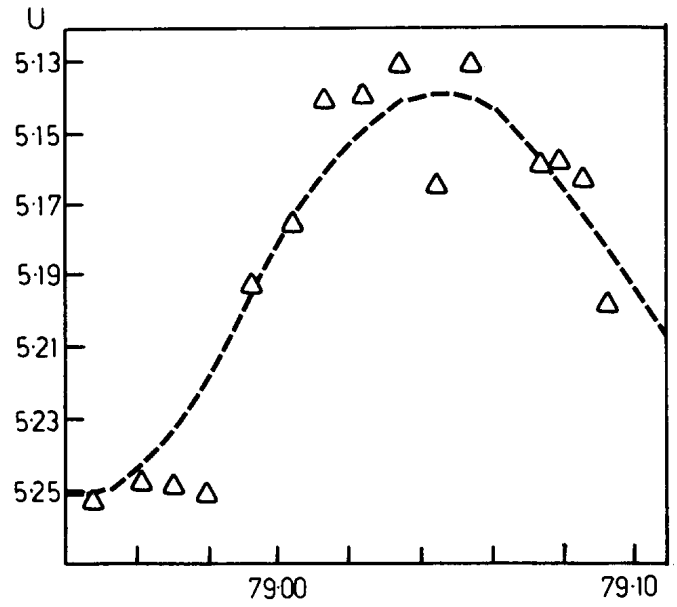

FIGURE 4

with that calculated using Fath's (1935, 1937, 1940) white light measurements (f_0=5.16078 cycles/day) and suggests that a secular change in f_0 of -0.000016 in 36 years may have occurred. He cautions that such a small difference can be explained in a number of ways including observational errors. Our observations of δ Scuti were taken 1542 days after Fitch's data for JD 2441837.

This corresponds to about 8000 cycles of the fundamental mode of pulsation of δ Scuti. Considering the extensive data collected by both Fath and Fitch and the excellent agreement in the fundamental frequency calculated from these separate sets of data, it is unlikely that our observed maximum could be shifted by one or more complete cycles from the predicted light curve. Hence agreement between the predicted light curve and Fitch's data for JD 2441837 (Fitch, 1976), and displacement of our observed maximum from the predicted maximum on JD 2443379 (0.02±0.004 day) would indicate a secular change in f_0 of +0.000013 in 4¼ years. It appears unlikely that these apparent changes in f_0 are primarily a result of secular changes in the fundamental frequency, but can be largely attributed to observational errors.

If this is the case then we can refine the fundamental frequency of pulsation of δ Scuti using the difference in time between our predicted and observed maxima. Such a procedure yields a fundamental frequency for δ Scuti of 5.160767±0.000013 cycles/day and provides a useful basis for further observations to measure secular changes in f_0.

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