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EPSILON CEPHEI: A COMPLEX DELTA SCUTI STAR

Epsilon Cephei (HR 8494) was found to be variable by Breger (1966). He observed the star on two nights and derived a period of about 0.042 days by inspecting the times of maximum. He was, however, unable to combine the two nights to improve the period. His light curve shows a variable amplitude (from 0.02 to 0.026 magnitudes). Fesen (1973) observed the star for seven hours on one night using a y filter and found dramatic evidence of variable amplitudes (from 0.007 to 0.025 magnitudes). By inspecting times of maximum, Fesen derived a period of 0.043 days, though he suggests that the period was variable and nearly doubled after three cycles.

Epsilon Cephei has been observed on seven nights ranging from September 1974 to August 1982. The data taken during 1977 were obtained with the 152 cm telescope at Black Moshannon Observatory (Pennsylvania State University) using V and U filters in a dual channel DC photometer. The other observations were taken at the Joseph R. Grundy Observatory of Franklin and Marshall College with a V filter and DC electronics. The light curves are shown in Figure 1, where each point is the difference in magnitude between the variable and the average of the preceding and following comparison star observations. The comparison star was HR 8472, the same as that used by Fesen.

Out of seven nights, only three or four are useful. The combination of low amplitude and short period makes the effect of noise difficult to remove. From an inspection of the times of maximum in these light curves, we estimate the period to be 0.04 $\pm$0.003 days. This is consistent with the periods estimated by Breger and Fesen.

To compensate for the high noise level and to try to improve the period, we calculated 3-bin variance spectra as described by Jurkevich (1971). Three bins are expected to be best for limited data sets (DuPuy, 1982). Spectra were calculated using the original, unsmoothed data. Of the seven, only the four longest and least noisy produced usable spectra (Figure 2). They yield periods of 0.039, 0.041, 0.037 and 0.035 days. The average of these is 0.038 days. An identical spectrum computed from Fesen's data (Figure 3) yields a period of 0.037 days.

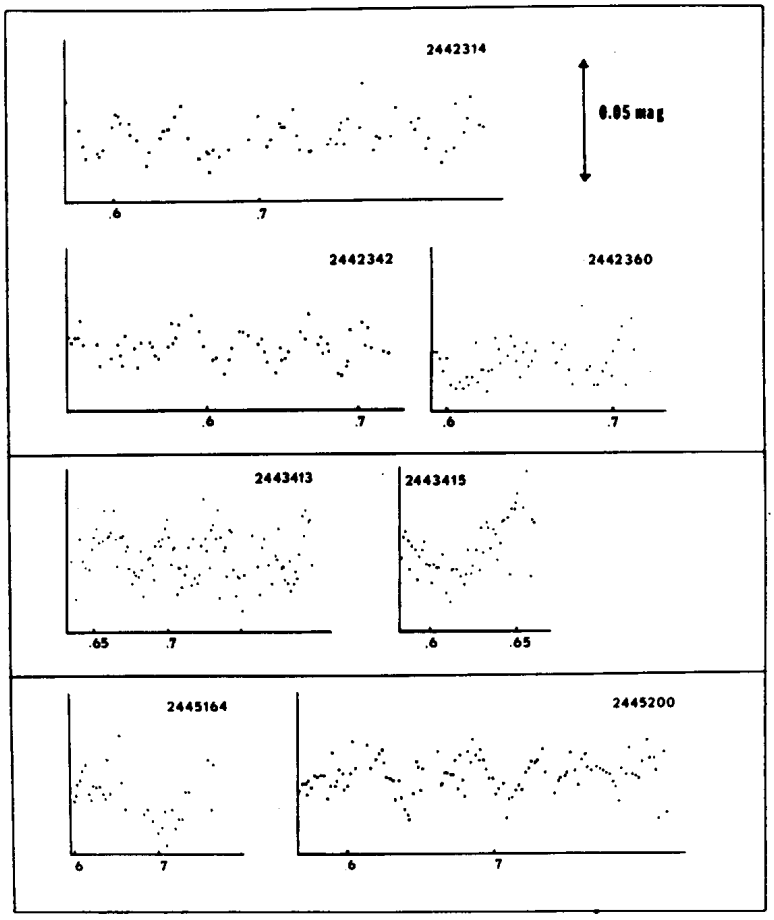

Figure 1
Light curves of Epsilon Cephei in V magnitude from 1974, 1977 and 1982

We suggest, on the basis of these spectra, that the true period is about 0.038 days and not the 0.042 days commonly quoted in the literature. Due to the uncertainty in the period and the spacing of the data sets, we cannot combine data from different nights to improve the resolution in the spectrum.

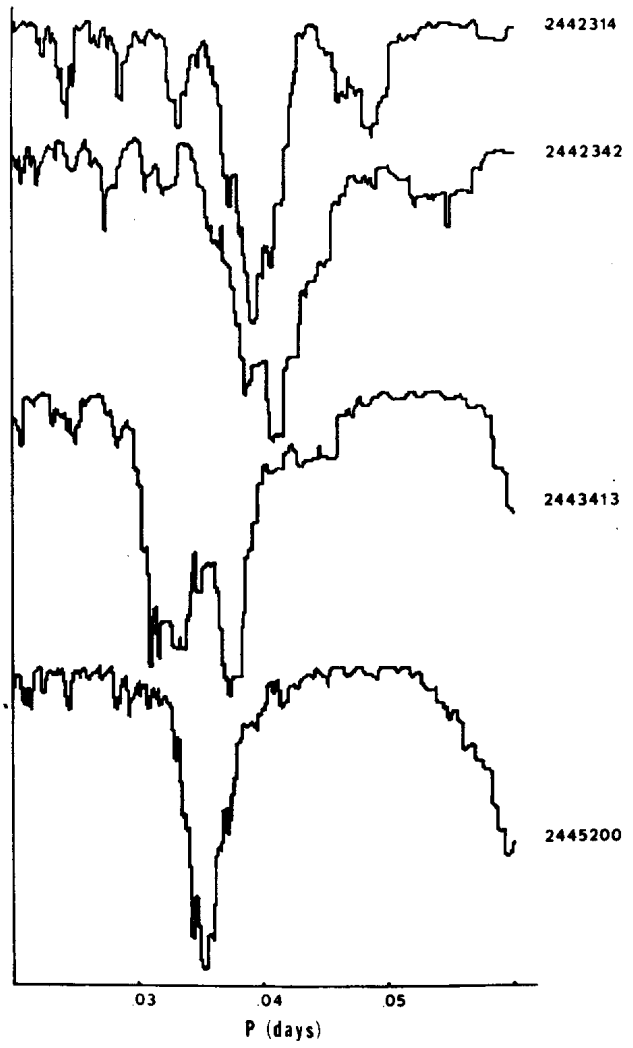

Figure 2

Three bin variance spectra of the four best nights shown in Figure 1

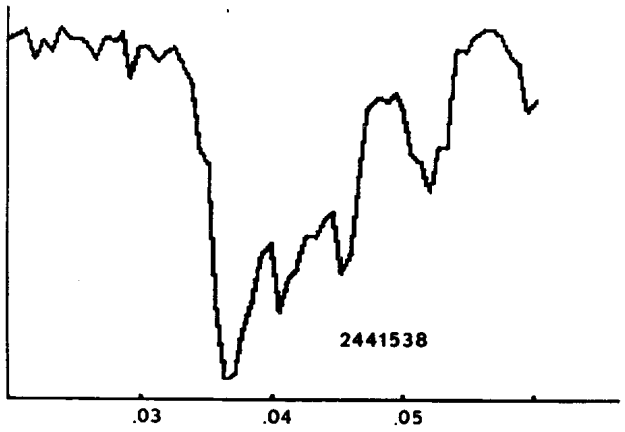

Figure 3
A three bin variance spectrum of the observations published by Fesen (1973)

The data published here suggest that the amplitude varies about an average of roughly 0.02 magnitudes. We suspect that these variations in amplitude are caused by the beating of multiple periods, but our data does not justify searching for a second period. Although the variance spectra might suggest that the period was different on different nights, we prefer to believe that the stars's complex behaviour is due to the beating of at least two periods and not due to abrupt period changes as suggested by Fesen.

Epsilon Cephei is a complex Delta Scuti star of very short period. Careful analysis will probably reveal beating though such a study will require high quality observations made on successive nights.

We would like to thank the Astronomy Department of Pennsylvania State University for providing observing time for one of us (MAS) in 1977.

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