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THE PHOTOMETRIC VARIABILITY OF EPSILON PERSEI

Epsilon Persei (HR 1220, HD 24760, B0.7III (or B0.5V), $V = 2.88$) has a long history of suspected light, radial velocity, and line profile variations (reviewed by Smith 1984) going back to the beginning of this century. Our own interest in this star arose from the photographic spectroscopic studies of Bolton, Lane and Thomson at this Observatory; they showed that this star exhibits striking line profile variations, with as many as four components moving through the line profile on a time scale of a few hours. More recently, Smith (1984), Penrod and others have recorded the line profile variations of this star with modern high-dispersion, high signal-to-noise spectroscopic detector systems. They have found that it is possible to model these variations with a combination of prograde sectorial non-radial pulsation modes. Our previously-unpublished 1979 and 1980 photometric observations give some indication of the nature of the photometric variability of this star, and place some constraints on the pulsation modes which may be present.

Photometric observations were made by one of us (JRP) on five nights in November 1979 and on seven nights in November 1980 using the #4 0.4 m telescope at the Kitt Peak National Observatory in Arizona. A 1P21 photomultiplier and pulse-counting electronics were used, along with a three-magnitude neutral density filter to reduce the coincidence counting effects. Measurements were made through a standard Strömgren b filter, differentially with respect to the stars HR 1229 ($A1$, $V = 6.2$) and HR 1234 ($B9.5$, $V = 6.3$). Magnitude differences were corrected for differential extinction effects, and times were reduced to the sun. The magnitude differences, on the instrumental system, are shown in Figure 1. A table of these data may be obtained from author JRP if necessary. The standard deviation of the magnitude differences between the comparison stars was 0.004 .

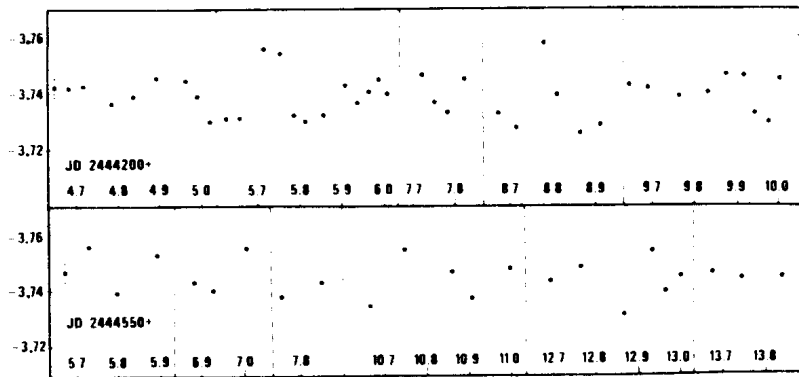


Figure 1 - Photometric (b) observations of ϵ Persei relative to HR 1229. The constancy of HR 1229 was established relative to HR 1234. The error bars indicate the standard error of a single observation. The program star exhibits small but significant variability from hour to hour, but not from night to night or season to season.

The main results of our photometric observations are as follows:

1. The scatter in the magnitude differences between ϵ Persei and HR 1229 is considerably greater ($\sigma = 0.^m0074$) than that between HR 1229 and HR 1234 ($\sigma = 0.^m004$) whereas the reverse might be expected since the former two stars are brighter and closer together in the sky. This suggests that ϵ Persei is variable with a σ of about $0.^m006$, which corresponds to a peak-to-peak amplitude of about $0.^m02$ on the average.
2. The variations appear to take place on a time scale of hours. The variations from night to night, and between the 1979 and 1980 runs, do not exceed $0.^m01$ in b.
3. Period analysis of the 1979 observations, using the methods of Scargle (1982) and Stellingwerf (1978), show a peak at a period of about 0.216 day. The statistical significance of this peak is 0.87 (the probability that it is not due to chance), which is suggestive but not convincing. The power spectrum of the less numerous 1980 observations also shows a peak at this period, but with an even lower significance.

4. Even after the removal of these peaks, there is a residual variance of about 0.01^m . This suggests that two or more modes may be present (or that the variability may be irregular).

It is not possible to draw any firm conclusions from our observations, because of their limited number, and because of the lack of simultaneous spectroscopic observations. In November of this year, we plan to obtain many more observations, and Myron A. Smith plans to obtain simultaneous spectroscopic observations. We encourage other observers to obtain careful photometric observations of this interesting star.

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