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IS THE CEPHEID ZETA GEMINORUM A VISUAL BINARY ?

The  $10^d.15$  classical Cepheid  $\zeta$  Geminorum has three nearby companions which together form the system ADS 5742. The closest star to the Cepheid has remained relatively fixed over the years in position angle  $84^\circ$  at a separation of about 87 arcsec (Jeffers, van den Bos, and Greeby 1963), and one is naturally inclined to the possibility that it may be a physical companion to the Cepheid. For the purpose of investigating this possibility, Fernie (1969) obtained photoelectric UBV photometry for this star in February 1967. The results are retabulated below:

$$V = 11.46 \pm 0.02$$

$$B-V = 0.45 \pm 0.02$$

$$U-B = 0.06 \pm 0.02$$

If one makes the reasonable assumption that the star is a normal dwarf, the UBV data permit reddenings of  $E_{B-V} = 0.06 \pm 0.02$  for an F star and  $0.55 \pm 0.03$  for a B star. The former estimate agrees better with the field reddening found by Feltz and McNamara (1976) for stars near the Cepheid, and also with the fact that galaxies are easily detected on the POSS plates containing  $\zeta$  Gem. Unfortunately, at the time of the original investigation, neither value appeared to coincide with the expected reddening of  $E_{B-V} = 0.15$  for the Cepheid (Ferne 1967). In recent years, however, there has been a substantial revision of the colour excess scale for long period Cepheids, with the consequence that current estimates of  $E_{B-V}$  for  $\zeta$  Gem, as derived from its observed colours by Parsons and Bouw (1971), Parsons and Bell (1975), and Dean et al. (1978), range from 0.03 to 0.07. This leads us to conclude that ADS 5742 A and B may indeed form a physical system, if the fainter star is an F dwarf.

The consequences of this conclusion are of interest. According to the Cepheid period-age relation of Kippenhahn and Smith (1969), the expected age for  $\zeta$  Gem is about  $3 \times 10^7$  years. An F dwarf of the same age should lie on the zero-age main sequence (ZAMS). Thus, if we make a reasonable estimate of  $M_V = +3.46 \pm 0.10$  for ADS 5742 B based upon ZAMS fitting of the UBV data, we derive a corresponding intensity-mean value of  $\langle M_V \rangle = -4.11 \pm 0.10$  for  $\zeta$  Gem. This value is in excellent agreement with estimates derived from existing period-luminosity relations or from applications of the surface brightness technique (Barnes *et al.*, 1977). Also, the corresponding distance of  $366 \pm 17$  pc to the system results in a projected separation of about 0.15 pc for the two stars. If they are associated gravitationally, they must have an orbital period in excess of  $10^6$  years. Thus, the lack of any evident change in the location of B with respect to A over the period of past observations is a logical consequence of (although not evidence for) actual physical association.

The results are clearly encouraging and worthy of further investigation. We therefore urge observers with access to moderate-sized telescopes to make additional observational studies of the  $\zeta$  Gem system. All stars in the system could be profitably studied, both by photometric and spectroscopic techniques.

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