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INFRARED EXCESS OF CEPHEID BINARIES

Two recent papers (Deasy and Butler, 1986; McAlary and Welch, 1986) have drawn attention to the fact that the IRAS observations (see Beichman et al., 1985) indicated considerable mass loss from classical Cepheids. The mass loss would be the most natural way to put an end to some of the existing Cepheid mass discrepancies (see e.g. Burki, 1984).

If the infrared flux is due to the thermal radiation of the Cepheid, then the observed flux ratio F(25μm)/F(12μm) would be about 0.25 for the effective temperature range of the Cepheids (see Deasy and Butler, 1986). Presence of circumstellar matter and/or a near-by companion star would, however, alter the value of the flux ratio.

The aim of this note is to show that Cepheids belonging to binary systems have, on average, a larger flux ratio than the single ones.

Because the rate of binaries among them is 25-35 % (Burki, 1984), one might expect a number of Cepheids belonging to binary systems to appear in the IRAS Point Source Catalog. This catalog contains about 60 classical Cepheids (McAlary and Welch, 1986). For eight definitely binary stars from this sample, and for seven stars for which duplicity can be excluded, the catalog contains accurate fluxes both at 12 and 25 μm. The duplicity of the former eight stars is established beyond doubt using spectroscopic and photometric evidence (see Table I). The most significant reference (not necessarily the discovery) about the presence of the companion is also given in Table I. "Probable" and "possible" binaries are excluded from this study. In the case of the seven single Cepheids "single" means that extensive spectroscopic and photometric investigations have failed to detect any companion. A list of references relating to the negative results on their duplicity would be too long so it is omitted from Table II, which table lists these latter stars as well as their log P and flux ratio. Unfortunately the infrared fluxes for other known Cepheid binaries are not accurate enough to be included.

Table I

Binary Cepheids

	log P	F_{25}/F_{12}		Reference
SU Cas	0.29	0.31 ±	0.06	Evans (1985)
α UMi	0.60	0.23	0.02	Roemer (1965)
AH Vel	0.63	0.29	0.05	Gieren (1980)
FF Aql	0.65	0.26	0.04	Lloyd Evans (1968)
AX Cir	0.72	0.43	0.12	Lloyd Evans (1982)
η Aql	0.86	0.24	0.04	Mariska et al. (1980)
S Sge	0.92	0.27	0.05	Lloyd Evans (1968)
S Mus	0.99	0.30	0.06	Lloyd Evans (1982)

Table II

Single Cepheids

	log P	F_{25}/F_{12}	
δ Cep	0.73	0.28 ±	0.06
β Dor	0.99	0.23	0.02
ζ Gem	1.01	0.23	0.03
X Cyg	1.21	0.29	0.06
Y Oph	1.23	0.24	0.04
l Car	1.55	0.24	0.03
RS Pup	1.62	0.35	0.04

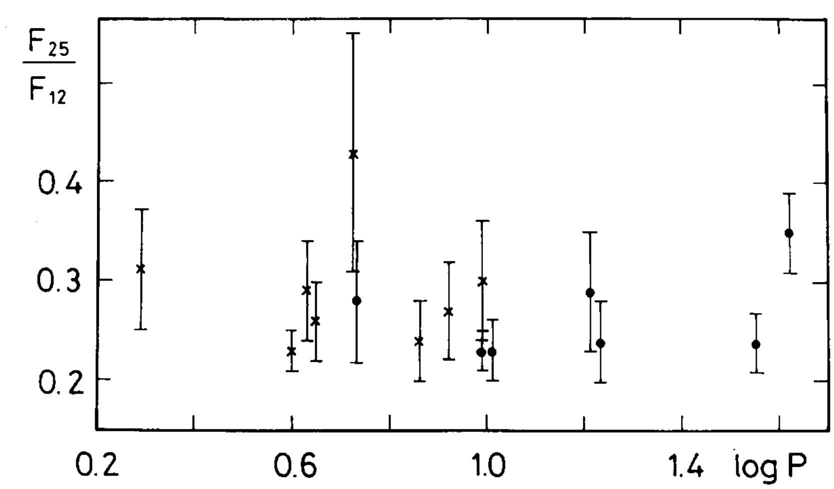

Figure 1

Figure 1 shows the ratio of the 25 μm and 12 μm fluxes as a function of the logarithm of the pulsation period. Cepheids belonging to binary systems are marked by × , dots denote single Cepheids. The error bar for each ratio is also shown. It is clear from the figure that most of the binary Cepheids have a larger infrared excess than do their single counterparts. The longest period single Cepheids evolve more rapidly, therefore a higher mass loss rate is expected. The case of RS Pup is a good illustration of this. Since the companion stars of the binary Cepheids are mostly blue stars (e.g. η Aql, AX Cir, S Mus), infrared excess cannot be explained by thermal radiation of the companion. Mass loss triggered by the pulsation (see Willson and Bowen, 1984) — enhanced due to the presence of the companion and/or free-free transition radiation in the circumstellar matter around the blue component — might be the possible cause of this infrared behaviour. Obviously, the binary Cepheids in the infrared band deserve increased attention, too.

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