ON THE BINARY NATURE OF 89 HERCULIS

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ABSTRACT. The radial velocities of 89 Herculis (89 Her) between 1977 and 1981 show a clear periodicity of about 285 days. This periodic variation is interpreted as the orbital variation of 89 Her around an unseen companion. From the orbital elements no support is found for a low mass ($M \sim 2M_\odot$) for 89 Her, but rather a high mass ($13 < M/M_\odot < 24$) is preferred.

DISCUSSION

The high galactic latitude run-away yellow supergiant variable 89 Her, has attracted great interest in the past due mainly to its apparent peculiar position off the galactic plane and to its capricious variational behaviour (e.g., Fernie 1981). The star pulsates with a period of about 63.5 days (Arellano Ferro 1984) and has been observed to interrupt its rhythmic variation for several months (Fernie 1981). Its place of formation is controversial. It may have been formed out of the galactic plane [although it has solar composition (Searle, Sargent & Jugaku 1963)]. On the other hand, it may have traveled from the plane during its lifetime. It is of obvious importance then, to know its mass (age) and luminosity (distance to the plane).

A period analysis on the 1977-81 radial velocities revealed two clear periodicities; one of about 60 days, which is due to the pulsational variation, and the other of about 285 days which is interpreted as an orbital period.

Table 1. Several solutions for the 89 Her system.

Solution	$M_{89}/M_\odot$	$M_2/M_\odot$	$a(R_\odot)$	i
1	20	15	596	3.5°
2	20	2	510	19°
3	2*	15	413	2°
4	2*	2	144	6°

* $R_{89} \sim 130\ R_\odot$ (Fernie 1981)

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The orbital solution is:

γ = -27.8±0.2 km s^{-1} K = 2.8±0.2 km s^{-1}

e = 0.13±0.08 ω = 338°±11°

T = 244 3970.0±9.6   P = 285.8±41 days

and

$$f(M) = (M_2 \sin i)^3/(M_{89} + M_2)^2 = 6.063\times10^{-4} \pm 1.485\times10^{-4} M_\odot$$

$$a_{89} \sin i = 1.074\times10^7 \pm 0.089\times10^7 \text{ km.}$$

This solution fits the observations very well. If $-9 < M_V < -6$ then $13 < M/M_\odot < 24$ (see Arellano Ferro 1984) and $109 < R/R_\odot < 314$. In order to progress on the mass controversy (Fernie 1981; Bond et al. 1984) let us assume 20 $M_\odot$ and 2 $M_\odot$ for 89 Her. Given the above elements we find solutions 1 to 4 in Table 1. Solution 3 may be ruled out as it is difficult to understand how a 2 $M_\odot$ star can dominate over a 15 $M_\odot$ star and how such a system could have originated. In solution 4 the separation and the stellar radius are nearly equal and this solution may be rejected. Therefore the low mass case receives no support. Attention is called to the similarity of the 89 Her system to the 20 $M_\odot$ star BL Tel system which also has high galactic latitude and has been classified as a run-away star (Wing 1963, Feast 1967).

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