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RECENT INFRARED PHOTOMETRY OF V1057 CYGNI

V1057 Cygni is a member of the select group of FU Orionis variable stars (Herbig 1977). Beginning in late 1969, the visual brightness of V1057 Cyg rose by nearly 5^m (Welin 1971). Maximum light was reached in late 1970, after which the brightness has declined very slowly. Infrared photometry from 1.25 μm to 22 μm was obtained shortly after maximum light by Cohen and Woolf (1971) and Rieke et al. (1972). Simon et al. (1972), Simon (1975), and Simon and Dyck (1977) extended these light curves from 1971 March through 1975 September. During this time, the infrared fluxes at 10 μm and 20 μm decreased along with the visual brightness of the star, while the 5 μm brightness remained virtually unchanged. Following the most recent report of JHK photometry (Mould et al. 1978), no other IR data have been published, although optical photographs show a continued fading of V1057 Cyg and its surrounding reflection nebula (Duncan et al. 1981). In order to learn whether the IR brightness has undergone any recent changes, we have obtained new 1.25-20 μm photometry of this star.

The observations were made on the 3.8-m UKIRT telescope on Mauna Kea, Hawaii, on the nights of 1981 September 7-10, and on the 1.3-m telescope of the Kitt Peak National Observatory on 1981 November 14. These magnitudes are summarized in Table I below:

TABLE I

Infrared Magnitudes

		J.D. = 2444855		
K (2.2)	L' (3.8)	M (4.7)	N (10.2)	Q (20)
5.42	3.85	3.33	1.35	-1.0
		J.D. = 2444922		
J (1.23)	H (1.66)	K (2.22)	L (3.45)	M' (4.63)
7.10	6.14	5.45	4.30	3.65

The effective wavelengths (in μm) of the filters are listed in parentheses. Photometric uncertainties are of the order of $0^{m}.05$ except at Q where the uncertainty is $0^{m}.1$. Since 1971 March (Rieke et al. 1972), J and H have faded by $1^{m}.0$, there has been a $0^{m}.7$ drop in brightness at K, while the flux at both L and M has remained unchanged to within the observational uncertainties. The 10-20 μm emission continues to

drop, falling by a factor of 2 since 1975 (Simon and Dyck 1977) and by nearly a factor of 10 since 1971 March. The average rate of decline decreased from $0^{m}.4$ yr^{-1} during the first five years after maximum to $0^{m}.1$ yr^{-1} in the second half of the decade.

No completely satisfactory explanation exists for the IR emission of V1057 Cyg (Simon et al. 1972, Rieke et al. 1972, Simon 1975), although thermal emission from circumstellar dust very likely contributes to the 10-20 μm emission. The origin of the near-IR flux may be circumstellar (Simon et al. 1972) or photospheric (Mould et al. 1978). Speckle interferometry of V1057 Cyg, obtained by one of us (H.M.D.) in the fall of 1981, places an upper limit of 0.1 seconds of arc on resolvable angular structure at 2.2 μm and 3.8 μm. At a distance of 600 pc, this angular size corresponds to a linear diameter of 1×10^{15} cm. If the 5 μm flux is circumstellar, possibly from material ejected during the 1969-70 flare-up, then the speed of expansion can be no greater than 13 km/s. A high velocity shell spectrum is observed (Herbig 1977; Mundt 1981), with absorption components blueshifted in radial velocity 90-180 km/s. For shell expansion velocities of this size, material thrown off from the star a decade ago would produce resolvable structure on the scale of 0.7-1.4 seconds of arc.

The alternative is that most of the 5 μm flux is photospheric and unresolved by the interferometric observations. A very large change in the photospheric temperature ($\Delta T = 1000$ K) would be required to account for the observed $\Delta V \simeq 2^m$ and $\Delta K \simeq 0\overset{m}{.}7$ if these changes are solely the result of a decline in photospheric surface brightness; a large drop at 5 μm should then have been observed. The relative changes in visual and near-IR light curves cannot be reconciled with a time-dependent increase in extinction due to the formation of circumstellar grains unless these grains are significantly grayer than normal interstellar dust.

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