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H AND K MAPS OF TWO STAR-FORMING REGIONS: S 140 AND CEP A OB3

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The molecular clouds near S 140 and Cep A OB3 both contain regions that emit strongly in the infrared but which have relatively little or no emission in radio wavelengths. The lack of radio emission is usually interpreted to mean that little ionization has taken place, and that the IR emission comes from dust heated by a central pre-main sequence object (Blair et al, 1978, Beichman et al, 1979, Hughes and Wouterloot, 1984, among others). We have made high resolution maps of these two areas with H and K broadband filters with the 2.3m telescope of the Wyoming Infrared Observatory (WIRO). Our observations were made with an InSb detector using the standard WIRO mapping technique of multiple scanning to construct a series of 64"x64" pictures. Our scanning was made in one arcsec steps with a 7" aperture to produce a resolution of about 6" FWHM.

S 140

Observations of S 140 by Blair et al (1978) with moderate resolution (32" aperture) in J, H, and K, revealed a prominent IR source that they called S 140IR. We have scanned a 64"x124" box surrounding their S 140IR region and have obtained total IR fluxes which are in close agreement with Blair et al (see Table 1). Figure 1 shows that we

TABLE 1: OBSERVATIONS

	H(Jy)	K(Jy)	H(mag)	K(mag)	(H-K)
S 140					
Blair et al (1978)	.82	4.26			
Present work:					
all of S 140IR	.78	4.13	7.76	5.46	2.30
Region A	.038	.242	11.05	8.54	2.51
Region B	.056	.266	10.64	8.44	2.20
Region C (central)	.38	2.09	8.54	6.19	2.35
Cep A OB3					
Present work:					
Region A	.078	.032	12.77	10.73	2.04
Region B	-	.035	-	10.63	>3
Region C	.069	.068	10.40	9.91	.49
Main Region (central)	.237	2.17	9.09	6.46	2.63

have been able to resolve additional detail in S 140IR. Our detail corresponds to that seen by Dinerstein et al (1979) at 0.9μm and Campbell (1986) at 1.0μm. The large (H-K) values for all components of S 140IR indicates that they are probably embedded in the parent molecular cloud with A_V = 25 mag and A_K = 2.2 mag (cf Elias, 1978). The separation of about 10" between components corresponds to approximately 9000 AU for a distance of 910 parsecs. FIR measurements by Harvey et al (1978) show a luminosity of 2 x 10^4 L_O, most of which is from the central object, but the two smaller sources must have about 1000 L_O each if the FIR luminosity is apportioned in proportion to the K luminosities.

CEP A OB3

Recent radio studies of Cep A by Hughes and Wouterloot (1984) and FIR studies by Evans et al (1981) have shown the similarity of Cep A to S

140. There is, however, some emission detected from ionized regions by the radio observations, indicating a slightly more advanced stage of evolution for Cep A. We observed a 124"x124" area around the strongest source in Cep A in both H and K, and the K map is displayed in Figure 1. We have identified three sources (A,B, and C) separate from the main source, and information about these sources is shown in Table 1. The low value of (H-K) for source C indicates that it is probably a foreground star, but the remaining regions seem to be equally embedded in the molecular cloud. The main source also seems to show a definite bifurcation into two separate sources, although we have treated it as a single object in our measurements. All the objects can be enclosed in a circle of diameter 30" arc, which corresponds to 20,000 AU (or .1 pc) at a distance of 730 pc. This is small for a star cluster, but large for a binary system, and the fate of this system as it evolves is uncertain. The radio study by Hughes and Wouterloot (1984) is of very high resolution (1") and it shows 14 regions strung in a linear array across almost 60". The FIR luminosity is 2 x 10^4 $L_\odot$ for Cep A. The main source must be a single star or perhaps two stars of about this total luminosity. The fainter members A and B must have luminosities of the order of 150 $L_\odot$ if we can apportion the luminosity according to the K luminosity.

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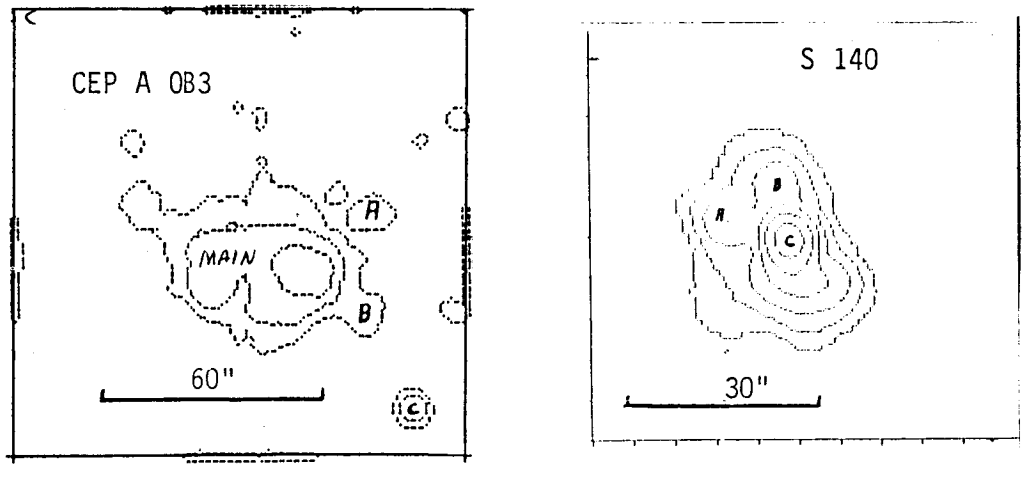

FIGURE 1. Contour plots of the K observations of S 140 and Cep A OB3. The Cep A levels are 200, 800, and 3200 μJy, and the S 140 levels are 100, 200, 400, 800, 1600, and 3200 x10^{-5}Jy.