TWO STRONG INFRARED SOURCES IDENTIFIED WITH DOUBLE REFLECTION NEBULAE

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Abstract Two objects from the U.S. Air Force Rocket survey (Price & Walker, private communication), numbers CRL 2688 and CRL 618, have each been identified with small double reflection nebulae illuminated by hidden stars. In one case the star is deduced to be type F, in the other, type O. The objects may be protostellar or, alternatively, precursors of planetary nebulae. These objects have been studied by various astronomers in different observatories at infrared, optical and radio wavelengths. Details of CRL 2688 are given by Ney et al. (1975) and Cramp ton et al. (1975), while CRL 618 is described by Westbrook et al. (1975).

References


DISCUSSION

Swings Does the central blob of CRL 618 have a low or high excitation spectrum? It appears that peculiar emission-line objects with infrared excess often show low excitation forbidden lines and/or lines indicative of high density \((10^6 - 10^7 \text{ electrons per cm}^3)\). D. Allen and I have suggested that some of these objects, e.g. He 2-446; the "butterfly" M 2-9, could be young dense planetary nebulae or objects between the Bp stage and the planetary nebula stage. Therefore knowing the spectrum of the core of the new CRL source would help in comparing all these peculiar objects.

Wynn-Williams The excitation appears to be fairly low.

van Bueren If your idea of a planetary nebula is correct, do you not find it strange that this object does not emit any radio radiation? If the estimated distance is correct, then the radius would be 0.03 pc, and a normal planetary nebula would be a fairly strong radio emitter.

Wynn-Williams I would not regard this as a "normal" planetary, but as a precursor of a "normal" planetary. The electron density would be much higher than normal.
Edmunds: Do you have any estimates of the dust mass in these objects? Would the masses involved be any problem from the point of view of production of the dust before the planetary stage?

Wynn-Williams: No, but I do not expect there to be a problem on this score.

Gilruth: For de-reddening the observations of CRL 618, the Whitford curve may not be a good approximation if most of the extinction is local to the source - the local dust may be different from the normal interstellar dust. The observations of CRL 2688 are very interesting, as this is the first object other than a late N star which shows $C_3$ absorption features. From the observations one notices that the excitation temperature for $C_3$ may be about 1000 K rather than several thousand, as for an F5I star. At the resolution of Crampton et al. one would not see so much structure in the $C_3$ spectrum if the temperature were several thousand degrees. That implies it is not a photospheric effect but is some kind of shell phenomenon. The emission features of $C_2$ (at 5165Å and 5635Å) also imply a low excitation temperature since the line at 4737Å is not seen and those at 5165 and 5635Å originate from the same upper state.

It is worth speculating whether this object is a post-IRC+10^0216 (post carbon star) object. I would suggest that the following observations should be attempted:

(i) Determining the C:O ratio in the stellar atmosphere from oxygen lines in the near infrared and carbon lines at about 4800Å.
(ii) Microwave observations may show the molecular composition of the nebulosity and one may be able to get the $^{12}C/^{13}C$ ratio. This may also help in distinguishing whether this is a post carbon star object or a protostellar object.