HERBIG-HARO EMISSION IN TWO BIPOLAR REFLECTION NEBULAE

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ABSTRACT. CCD images show that the reflection nebula associated with PV Cep is bipolar. From spectroscopy of this object as well as of the bipolar Boomerang Nebula we find low excited Herbig-Haro emission and indications for collimated high velocity flows along the polar axes of both nebulae. The central star of the Boomerang Nebula is probably double.

1. BOOMERANG NEBULA

This bipolar nebula ($\alpha=12^h42^m$, $\delta=-54^o15'$) was discovered by Wegner and Glass (1979). At the 2.2 m telescope on La Silla we obtained CCD images and a red longslit CCD spectrum along its polar axis. The CCD rows corresponding to positions A and B in Figure 1 contain stellar spectra which are markedly different. We classify spectrum B as K0III-K2III, while spectrum A is definitely earlier. This is consistent with the UBVJ photometry by Wegner and Glass (1979) and the 12-100 μm fluxes of the coincident IRAS point source: these data can be fitted assuming a double star K0III+A0III, $A_V=2.9$ mag and d=900 pc. The components of the double star are oriented roughly NS, their angular separation is of the order of 1-2 arc sec. The spectra C and D contain a weak scattered continuum and the strong emission lines [OI] 6300, 6364 (also present in B), Hα, [NII] 6548, 6583 and [SII] 6716, 6731. These lines are absent north of D and south of B. They strongly recall the spectrum of the jet in L 1551 (Sarcander et al., 1985). We suggest that the K giant induces this HH emission by a collimated high velocity flow.

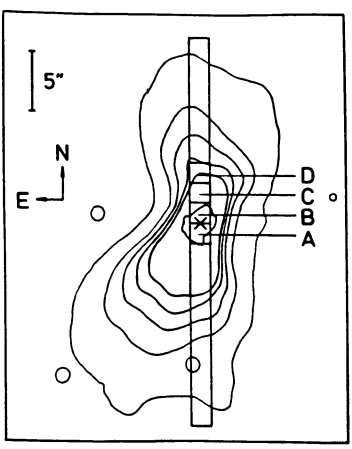

Fig. 1: The inner part of the Boomerang Nebula: red CCD contours with the position of our longslit spectrogram. Cross = central star.

I. Appenzeller and C. Jordan (eds.), Circumstellar Matter, 181–182.

2. THE PV CEP NEBULA

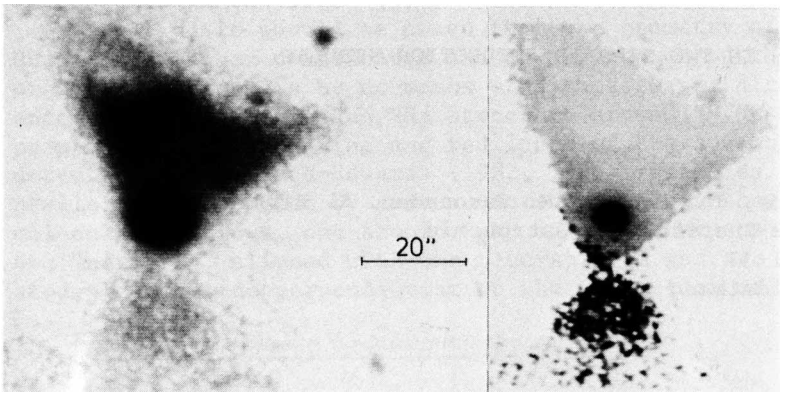

Fig. 2: CCD image of PV Cep in I (left) and the R-I colour index derived from the I and an R image. The reddening strongly increases from north to south.

The bipolar structure of the highly variable nebula associated with PV Cep (Cohen et al., 1981) became evident in R and I CCD pictures taken with the 3.5 m telescope on Calar Alto (Figure 2). Bipolar CO outflow is also present (Levreault, 1984). The southern lobe is deeply embedded in the associated dark cloud. Longslit spectroscopy in the red of PV Cep and the northern lobe revealed:

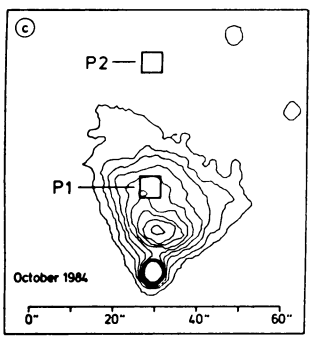

Fig. 3

The star shows chromospheric emission lines, broad Hα emission characteristic of a rotating or expanding shell, and blue-shifted HH emission typical for T Tauri stars with circumstellar disks (Appenzeller et al., 1984). The northern lobe is a pure reflection nebula, with exception of positions P1 and P2 (Figure 3): here a blue-shifted HH spectrum is emitted (v=-225km s^{-1}), again suggesting the presence of a highly collimated flow from the star along the polar axis of the bipolar nebula.

3. REFERENCES

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