FILTERED CCD IMAGES OF SOUTHERN HERBIG-HARO OBJECTS

B. Whitmore & D.H.M. Cameron
Dept. of Physics & Astronomy
University College London
Gower Street
London WC1E 6BT

R.F. Warren-Smith
Physics Department,
University of Durham,
South Road
Durham DH1 3LE

1. Introduction

It is currently believed that Herbig-Haro (HH) objects are a consequence of a high-velocity (up to at least 200 km s^{-1}) outflow of material from a young embedded star. These flows can often be detected by deep observations of optical emission lines using CCD cameras.

We obtained deep filtered CCD images of six southern star forming regions containing HH objects with the aim of detecting any ionised outflow which may be present. The filters used were centered on the H α emission line (λ6563Å) and the combined [O I] lines at $\lambda\lambda$6300 and 6363Å, since they are amongst the strongest observed from HH objects. Infrared observations from the IRAS point source catalogue were used to search for evidence of an embedded protostar powering these HH objects.

2. Discussion

HH 46/47 lie within the Bok Globule ESO 210-6A and are associated with a well collimated optical outflow showing evidence of bipolarity (Dopita, Schwartz & Evans 1982). Our [O I] image shows the jet structure well, since H_{alpha} emisson from the globule edge is not present. The exciting star of this outflow has a bolometric luminosity of 20 L_{solar}, based on a distance of 450 pc.

The H_{alpha} image of HH 52, 53, 54A-E and 54X (Chamaeleon T2 association) shows that HH 54 has an extended complex morphology and a faint filament extending towards HH 54X. As can be seen from Figure 1 HH 52/53 are extended in the direction of HH 54, suggesting a possible association. A weak IRAS point source is situated near to the eastern edge of HH 54. This source is confirmed by IRAS AO data and another source is found to the east of HH 52 (see Figure 1).

HH 56 and 57 are associated with the small dark cloud Sandquist 178 in the Norma T1 association. A recently brighten star, identifed as a FU Orionis object, has appeared 20" W of HH 57 (Graham & Frogel 1985). Our H_{alpha} image clearly shows that this new object is associated with HH 57, and has no connection with HH 56.

I. Appenzeller and C. Jordan (eds.), Circumstellar Matter, 189–190.

Two IRAS point sources lie within the bounds of this image: the FU Ori objects lies at the edge of the error box for one of these, the second lies to the S of HH 57. Their luminosities are 125 and 35 L_{solar} respectively, based on a distance of 700 pc (Graham & Frogel 1985). IRAS additional observations show that this first source is indeed the FU Ori object, the likely driving source for HH 57.

The H_{alpha} image of HH 100 shows the extended nature of this object and also shows a faint filamentary structure directed towards HH 101. The H_{alpha} image of HH 101 shows a spiral structure to its emission knots, enveloped within a faint cone-like emission feature pointing towards HH 100. The morphological picture indicates that these two sources are linked, a view also supported by the proper motion studies which indicate that HH 100 and 101 are moving away from the likely exciting star HH 100/IR.

The three images containing HH 48, 49/50 and 51 (Chamaeleon T1 association) all suffer some spurious reflections caused by the telescope, making it difficult to detect any faint jet-like structure. HH 48 appears star-like and is detected as a point source by IRAS. There are no near-by IR sources in the vicinity of HH 49/50 and 51. HH 55 (Lupus 2 dark cloud) appears star-like and shows no evidence for any jet activity. A T-Tauri star RU Lup lies 2 arcmin to the SW and is the only IRAS source in the vicinity, thus suggesting it is the likely exciting star for HH 55.

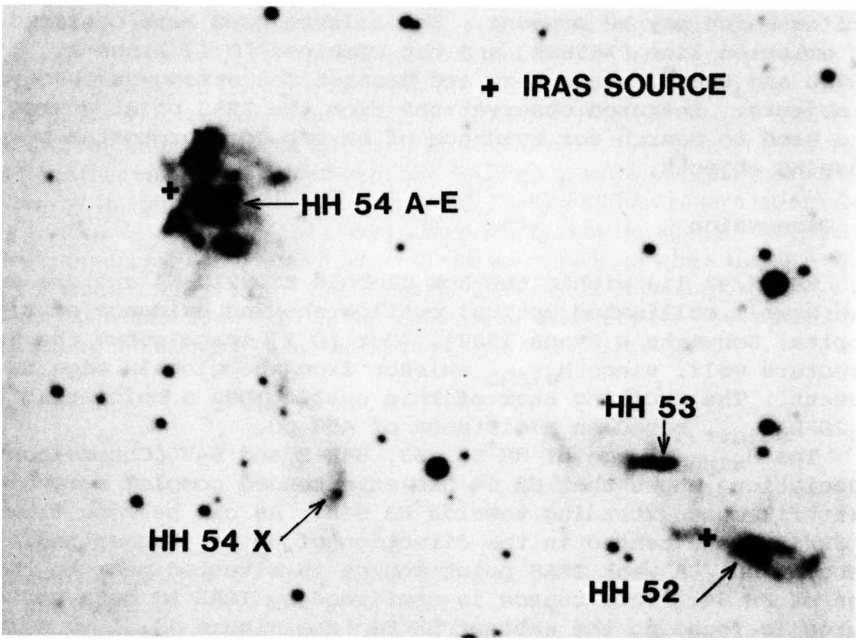

FIGURE 1. H_{α} image of HH 52/53/54: crosses denote IRAS sources.

3. References

Doptia, M.A., Schwartz, R.D. & Evans, I, 1982, Ap.J.Letts., 263, L77.
Graham, J.A. & Frogel, J.A., 1985, Ap.J., 289, 331.

https://doi.org/10.1017/S0074180900156384 Published online by Cambridge University Press