DYNAMIC STRUCTURE OF THE HORSEHEAD NEBULA

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We have made a preliminary map of the Horsehead nebula in CO (J=1-0) using the NRO 45-m telescope. The HPBW is 15", the grid spacing 10", and the velocity resolution is ~0.1km/s. Figure 1 shows the integrated intensity with a velocity interval 10-11.5 km/s, which we found represents well the shape of the dark globule of the Horsehead. The coincidence of the CO feature and the dark nebulocity is strikingly well, especially at the sharp edges in the south and in the west (from the neck to the ears). The quality of the data are not satisfactory, though. The typical noise level is 1 K rms in T_A^*, and the accuracies of the pointing and the intensity calibration is rather low due to the bad weather during the observation. Some scanning effects in the intensities can be recognized in Figure 1. One of the reason why the gap obtically seen beneath the jaw is not clear in the CO map may be attributed to the pointing errors.

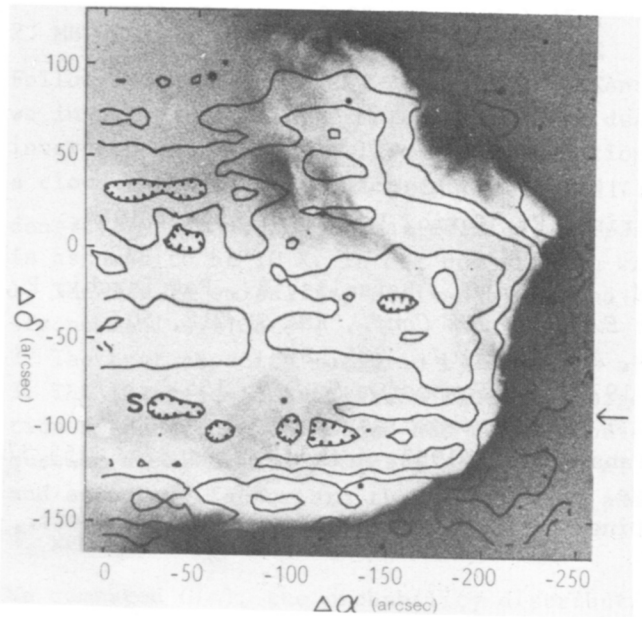

Figure 1

Contour of the integrated intensity with a velocity interval 10-11.5 km/s superposed on a photograph obtained by the ESO 3.6m telescope (courtesy of B. Reipurth). The lowest contour is 2 K•km/s and the contour is spaced 2 K•km/s. The arrow shows the axis of the spacial-velociy map shown in figure 2.

https://doi.org/10.1017/S0074180900095073 Published online by Cambridge University Press

There was an argument on the formation process of the Horsehead, whether an instability like Rayleigh-Taylor instability made it or it has just survived destruction by star-forming activities because of its high densities (Stark and Bally 1982). The area of our mapping is rather small to answer it, but we feel the scale height is too low and the structure is too complicated both in space and in velocity to understand that it was caused by a simple instability. The only global structure is a velocity gradient of about 3 km/s/pc (we found its direction is NE-SW, not N-S), which was understood by Stark and Bally (1982) as a part of the periodic structure along the ionization front (N-S).

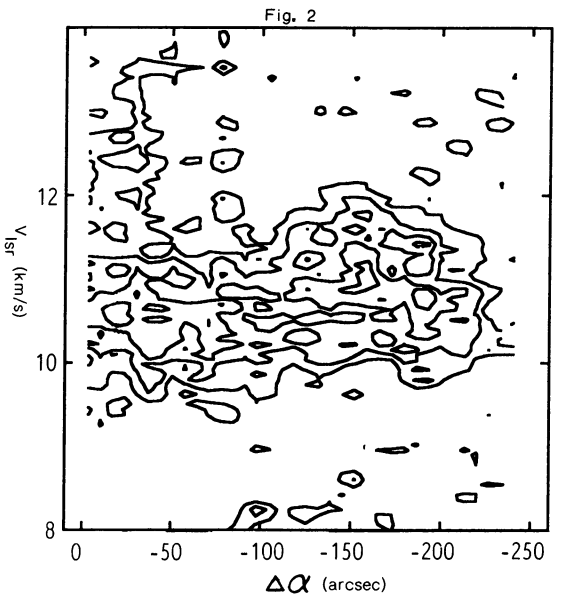

Figure 2

Spacial-velocity map of CO J=1-0 emission from spectra taken at grid positions along the axis of constant declination offset $\Delta\delta$ = -90 arcsec, which is shown by an arrow in Fig. 1. Contour levels represent the corrected antenna temperature T_A^* (K), 2 K at the lowest and 2 K spacing.

The optical and near infrared study (Reipurth and Bouchet 1984) has shown us that the Horsehead is an active site of low mass star formation. We have examined if there are any evidences of internal motion due to the activities of newly formed stars. Within the limited quality of our data, we have found regions where red-shifted wings are seen at positions of $\Delta\alpha$ = 0-30 arcsec and $\Delta\delta$ = -90 arcsec, which are shown in Figure 2. The positions of these features seem surrounding a small cavity marked with S in Figure 1, which lies to the east of the filamental structure near the faint stars B33-13 and B33-14 (Reipurth and Bouchet 1984). It is not certain at present whether these red-shifted wing features are due to some star-forming activities or not. We are planning to observe deeper toward the same region in the near future.

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https://doi.org/10.1017/S0074180900095073 Published online by Cambridge University Press