THE CORE OF A QUIESCENT CLOUD, L183

C.M. Walmsley, H. Ungerechts, G. Winnewisser
Max-Planck-Institut für Radioastronomie, Bonn, Germany

Simultaneous observation of the J,K=1,1 and 2,2 inversion transitions of ammonia (NH_3) with high spatial resolution ($\lesssim$1 arc min) offers a powerful method of probing the core region of interstellar clouds for evidence of molecular clumping and of prevailing physical conditions which could lead to star formation. We have therefore used the Effelsberg 100-m radiotelescope to make an extensive study of the central region of the nearby dark dust cloud L183 (also known as L134N) in the NH_3 (1,1) transition; the spatial resolution was 40 arcsec. The core region as mapped in the NH_3 (1,1) transition with a velocity resolution of 0.08 km s^{-1} consists of two elongated condensations separated by about 2 arcmin in north-south direction (see Fig. 1). The central part of the NH_3 cloud has an approximate dimension of 6' (N-S) by 2' (E-W) corresponding to a linear extent of 0.17 x 0.06 pc at an assumed distance of 100 pc. The measured velocity structure of the NH_3 cloud seems to reflect the double peaked nature of the cloud in that it increases from 2.30 km s^{-1} in the south to about 2.5 km s^{-1} at the northern end of the southern NH_3 peak, and then decreases again to 2.3 km s^{-1} towards the north. The intrinsic linewidths of NH_3 (corrected for hyperfine blending) do not vary significantly with position and are between 0.2 and 0.3 km s^{-1}. The two ammonia peaks are part of a central molecular ridge from which we have observed NH_3 (2,2) emission at 9 positions (see Fig. 1). The rotation temperature T_{21} as determined from the optical depths of the (1,1) and (2,2) transitions is $\sim$9K for all positions, and hence the kinetic temperature T_{kin} seems close to this value as well, i.e. $\sim$10K throughout the central part of L183. A more detailed account is being publsihed elsewhere (Ungerechts, Walmsley and Winnewisser).

In addition HC_3N ($J=1\rightarrow0$; $F=2\rightarrow1$) emission has been detected from the ridge; the emission has a single peak at the northern ammonia condensation (see Fig. 1). The HC_3N velocities ($\sim$2.4 km s^{-1}) agree within the experimental uncertainties with those of NH_3, suggesting that both molecular species occupy the same volume of space. The linewidths of both molecules ($\sim$0.2 km s^{-1} for HC_3N) are consistent with a kinetic temperature of $\sim$10K. Thus the observations of NH_3 and the detection of

B. H. Andrew (ed.), Interstellar Molecules, 91–92.

https://doi.org/10.1017/S0074180900072247 Published online by Cambridge University Press

HC_3N indicate that the core region of L183 is a small (L < 0.2 pc), dense ($n(H_2) \sim 5 \times 10^4 cm^{-3}$), and low mass ($\sim 1 M_\odot$) fragment with two NH_3 condensations. They exhibit throughout the core region a velocity dispersion (~ 0.2 km s^{-1}) which is close to the thermal limit and smaller than typical free-fall velocities. Thus the cloud is presently in a quiescent "pre-protostellar" stage which is marked by gravitational equilibrium; there is no evidence of the presence of a protostellar object embedded within the cloud. Slowly accreting material or external influences such as shock-waves are likely causes of eventual collapse.

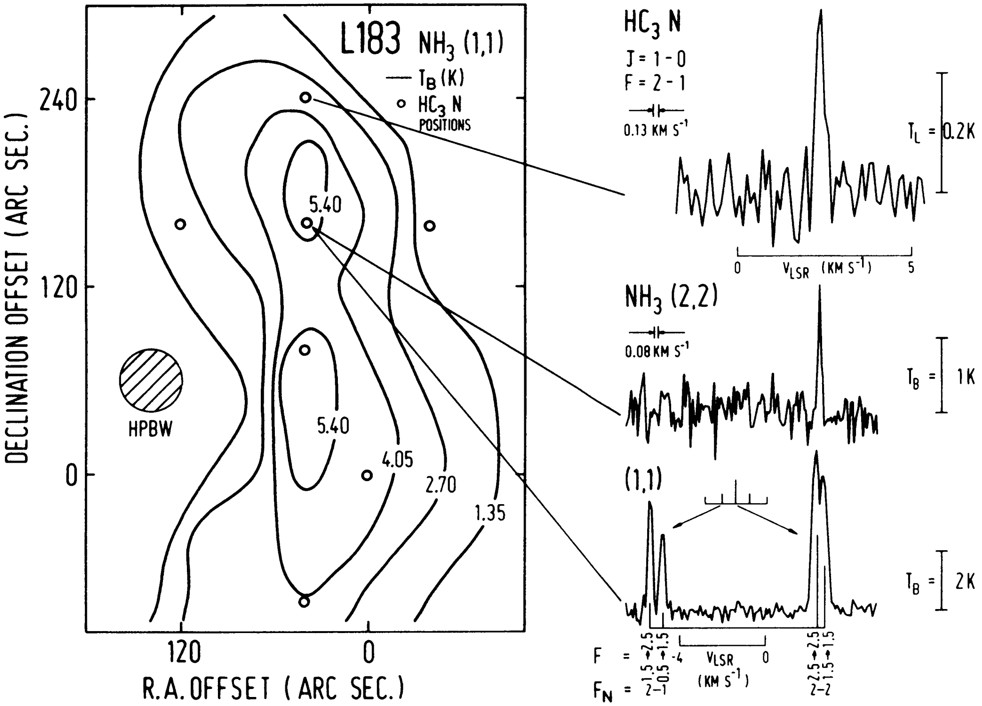

Figure 1. NH_3 map of the core region of L183, and sample spectra of HC_3N and NH_3 at selected positions. The (0,0) position is $\alpha(1950) = 15^h51^m30^s$, $\delta(1950) = -02°43'31''$.