Astronomy with Millimeter and Submillimeter Wave Interferometry
ASP Conference Series, Vol. 59, 1994
M. Ishiguro and Wm. J. Welch (eds.)

Distribution of HC_5N in IRC+10216

Shuro Takano and Shuji Saito
Institute for Molecular Science, Myodaiji, Okazaki, Japan 444.

ABSTRACT The distribution of HC_5N was observed in the envelope of the carbon star IRC+10216 with the Nobeyama Millimeter Array. A shell like distribution with its diameter of about 29" was found. The diameter is larger than that of HC_3N.

Introduction

IRC+10216 is a red-giant with the carbon-rich circumstellar envelope. Many molecular spectral lines have been detected toward IRC+10216, and this object is a prototypical for the study of physics and chemistry of late-type stars. In the envelope, temperature and pressure change in wide ranges depending on the distance from the central star. The type of chemical reactions is, therefore, known to change as the distance from the central star; themodynamic equilibrium reactions, neutral-neutral reactions, and ion-molecule reactions and photochemical reactions. The effective method to study the formation reaction of a molecule is to observe its distribution in the envelope. The millimeter-wave interferometer is a powerful instrument for such purpose. We have already observed the shell distribution of SiC_2 in IRC+10216 (Takano et al. 1992); SiC_2 is most probably produced by ion-molecule reactions.

In the present paper, we report the result of the interferometric observation of HC_5N in IRC+10216. The interferometric observation of HC_3N is reported by Bieging and Rieu (1988) and Bieging and Tafalla (1992). One of the interesting points is a difference in the shell diameter and the shape between HC_3N and HC_5N.

Observation

The observations were carried out in 1991 Jan. to May (4 days) with the Nobeyama Millimeter Array. The relatively compact C and D configurations (baseline lengths are 10 to 119 m) were employed. The synthesized beam was about 9"x6" (HPFW). The observed transition was J=35-34 of HC_5N at 93.188 GHz. The velocity resolution was 1 km/s.

Results and Discussion

(1) The obtained maps show that HC_5N has a shell like distribution

https://doi.org/10.1017/S0252921100019333 Published online by Cambridge University Press

with its diameter of about 29" (9×10^{16} cm; 200 pc is assumed as the distance) (Fig. 1). If no rapid neutral-neutral reactions exist for the formation of HC_5N in the outer envelope, HC_5N is considered to be mainly produced by ion-molecule reactions. (2) The diameter of the HC_5N shell (29.3" in average) is found to be about 6" larger than that of HC_3N (23.4" in average; Fig. 2 of Bieging and Rieu 1988) in several position angles. If the difference in the diameters indicates the difference in the speed of the formation between HC_3N and HC_5N, this observational result means that it takes about 200 years for the carbon-chain growth of 2 carbons. (3) The clear non-spherical structure is found in the distribution of HC_5N. In particular, the southwest and the northeast parts of the shell show the strong emission. The analogous nonspherical structures are also observed in the distributions of HC_3N and SiC_2. One of the probable reasons is that mass from the central star is ejected nonspherically. Late-type stars are considered to evolve into planetary nebulae, and more than half of the planetary nebulae show nonspherical structure (e.g., Zuckerman and Aller 1986). Therefore, the nonspherical structure found in IRC+10216 may indicate the late stage of the stellar evolution.

References

Bieging, J.H. and Nguyen-Q-Rieu 1988, *ApJ*, **329**, L107.
Bieging, J.H. and Tafalla, M. 1992, to appear in *AJ*.
Takano, S., Saito, S., and Tsuji, T. 1992, *PASJ*, **44**, 469.
Zuckerman, B. and Aller, L.H. 1986, *ApJ*, **301**, 772.

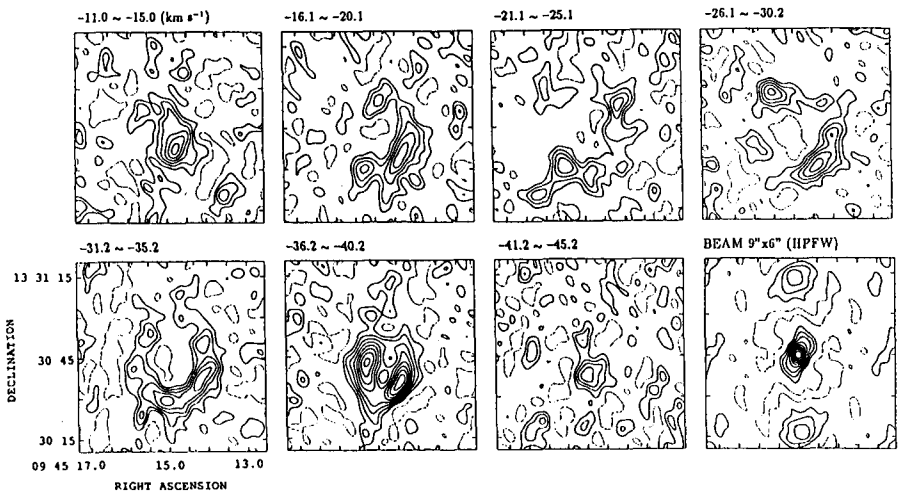

Fig. 1: Velocity channel maps of HC_5N in the envelope of IRC+10216. The contour intervals for the maps are 0.05 Jy/Beam, zero omitted.

https://doi.org/10.1017/S0252921100019333 Published online by Cambridge University Press