CIRCUMNUCLEAR MOLECULAR GAS IN STARBURST AND SEYFERT GALAXIES

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In order to investigate circumnuclear molecular gaseous contents and its relation to the nuclear activity, we made a search for circumnuclear ^{12}CO (J=1-0) emission from 28 starburst-nucleus galaxies (SBNs) and 12 Seyfert galaxies with the recession velocities less than 5000 km s^{-1}, using the Nobeyama Radio Observatory 45-m telescope. The full half-power beam width of 17 arcsec covers a region of less than about 5 kpc in diameter for the sample galaxies. The circumnuclear CO emission has been detected from twelve SBNs (one is marginal) and four Seyfert galaxies. Our main results and conclusions are summarized as follows.

I. Starburst-Nucleus Galaxies

(1) We study a relation between M_{H_2}/M_{HI} and [OIII]/Hβ, where the latter ratio provides a measure of excitation condition of the ionized gas. It is indicated that the galaxies in which the circumnuclear gas is less abundant have higher-excitation emitting regions in general. This implies that molecular gas clouds are dissociated by strong radiation and/or supernova wind activity in such galaxies. Alternatively, we simply interpret that more intense starburst activity tends to have consumed more molecular gas.

(2) Comparing our results with previous CO studies made at radio observatories with larger beam sizes, we investigated the radial distribution of molecular gas in seven SBNs. We found that most of the SBNs show a tendency of central concentration of molecular gas in comparison to Seyfert galaxies.

(3) We found that two of the SBNs (Mrk 52 and Mrk 708) have very narrow CO line widths although they look like significantly inclined galaxies. This strongly suggests that the circumnuclear molecular gas clouds in these galaxies are kinematically independent from the host galaxies. Since these galaxies have prominent bar structure, it is considered that the bar shock cause forcing gas infall toward the nuclear regions, triggering the nuclear starburst activities.

II. Seyfert Galaxies

(1) We derived the circumnuclear surface density of molecular gas which is corrected for inclination of the galaxies. This analysis shows that the surface density span a wide range over two orders of magnitude. Further, there is no significant difference in the surface densities between types 1 and 2 Seyfert galaxies. Thus, we may conclude that the circumnuclear molecular content is not a key parameter producing the dichotomy of the Seyfert galaxies.

(2) It is also shown that there is no significant difference in the circumnuclear surface densities of molecular gas among the Seyfert, starburst, and normal galaxies. This implies that the circumnuclear gaseous content is not a key parameter determining which activity occurs in nuclei. We may conclude that more centrally condensed (*i. e.*, less than 10 - 100 pc in diameter) gas components play an essential role on the occurrence of nuclear activities.

(3) Comparing our results with the previous ones, we deduced radial distribution of surface density of molecular gases. We cannot obtain evidence for strong central concentration of molecular gas in our sample Seyfert galaxies except for NGC 3227. This is consistent with the previous result by Blitz, Mathieu, and Bally (1986).

(4) Comparing our CO emission line profiles with the previous ones taken with the larger beams, we discussed circumnuclear components of molecular gases. In particular, we found that molecular gas clouds may be absent in the SE of the nucleus of NGC 7469 where the high-excitation emitting region is discovered by Heckman *et al.* (1986). It is suggested that the nuclear activity (strong radiation and/or wind) may destruct the molecular clouds in that region.

REFERENCES

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Heckman, T. M., Beckwith, S., Blitz, L., Skrutskie, M., and Wilson, A. S. 1986, *Ap. J.*, **305**, 157.

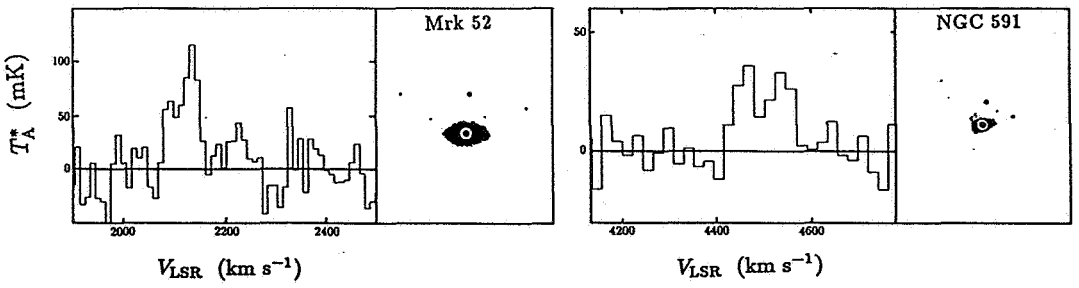

Fig. 1 . Examples of the observed ^{12}CO ($J = 1 - 0$) spectra of the starburst nuclei (Mrk 52) and Seyfert galaxies (NGC 591).

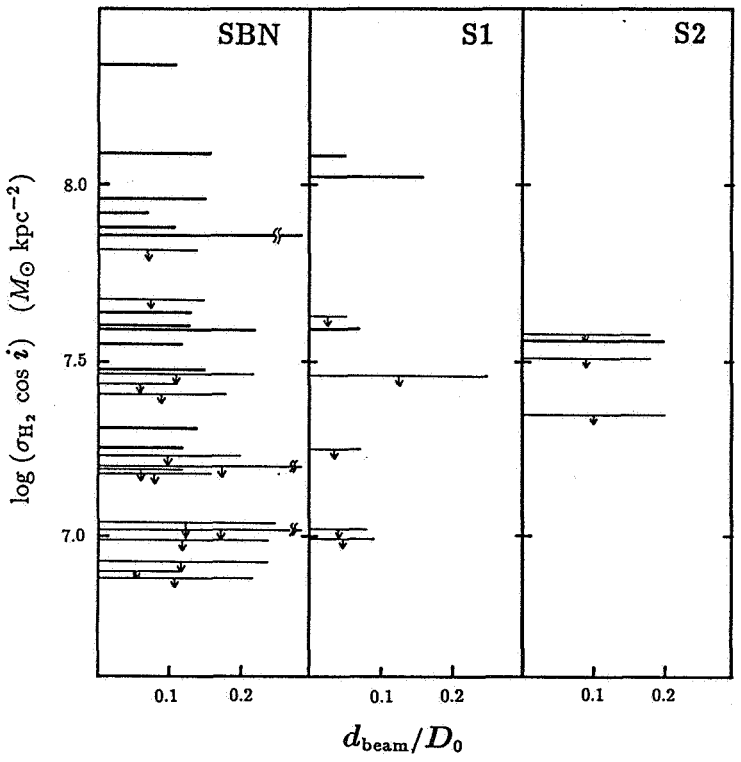

Fig. 2 . Circumnuclear surface densities of molecular gas corrected for the inclination of galaxies. The panels (a), (b), and (c) show the results of SBNs, Seyfert 1 (S1), and Seyfert 2 (S2), respectively.

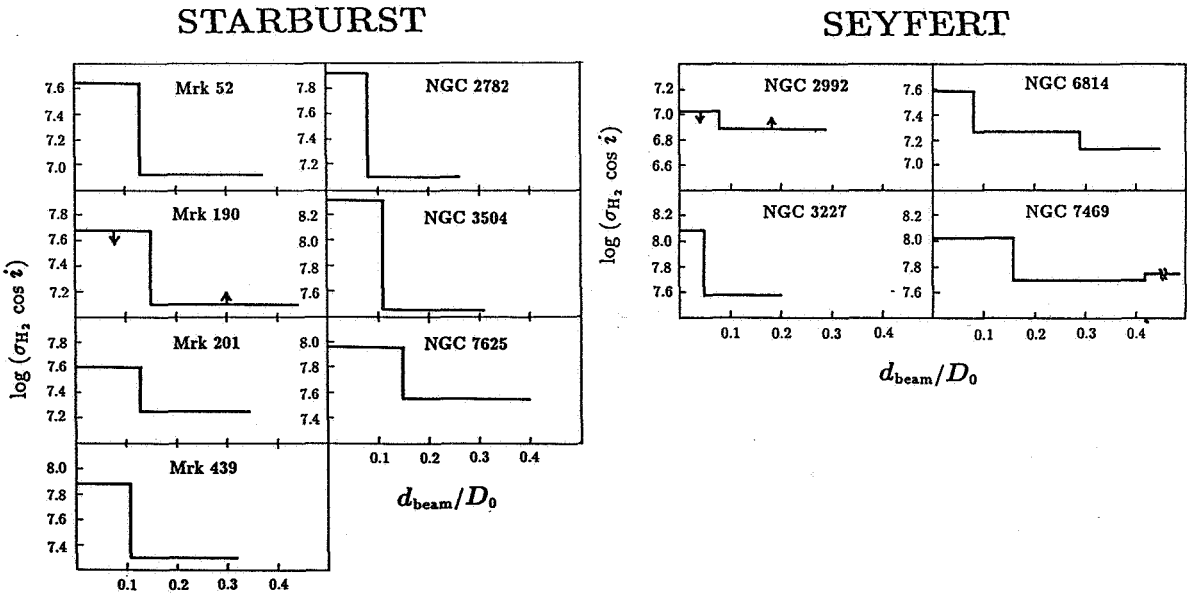

Fig. 3 . The radial distribution of surface molecular densities for seven SBNs and 4 Seyfert galaxies.