THE NRO CO SURVEY OF NEARBY SPIRAL GALAXIES

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1. Introduction

Our survey observation is high spatial resolution (16") by NRO observatory 45 m antenna and have many galaxies of sample. This high resolution observations (16" = 1.6 kpc at 20 Mpc) could be to resolve the some characteristic structure, typical molecular gas disk, arm - interarm and optical bar.

2. Sample and Observations

We selected a sample of spiral galaxies based on the following criteria :
(1) Distance $\leq$ about 20 Mpc,
(2) far infrared flax at 100 mm $\geq$ about 20 Jy,
(3) declination $\geq$ -30 degree,
(4) inclination of the galactic disk $\leq$ 75 degree,
(5) isolated or weakly-interacting galaxies.
Of the selected galaxies, we were able to observe only 25 galaxies due to the limited observing time. The ^{12}CO ($J = 1 - 0$) observations were made between February 1995 and October 1992 with the 45-m telescope at Nobeyama Radio Observatory. The CO emission was usually observed along the major and minor axes of (non-barred) galaxies. If the inclination angle of a galaxy is large (i.e., near edge-on), CO was observed only along its major axis. In case of barred galaxies, CO was observed along the major and minor axes of the bar. The grid spacing was 10" or 11".

3. Distribution of Molecular Gas

The radial distributions of the surface density of H_2 molecules were obtained from the CO integrated intensity. The distribution of molecular gas show

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two characteristic properties which are related closely to the rotation curves and the bar structure.

3.1. OUTER DISK REGION

Most of the galaxies in our sample have a H_2 surface density of monotonously decreasing with the radius in the outer region of the flat rotation. Since the radial distribution in the region can be fitted possibly by a straight line in the semilogarithmic plots, the surface density of the H_2 molecules is presented by an exponential function of the distance R from the galactic center. The fittings were done in the region outside the transient point from the rigid-like to flat (differential) rotation. In barred galaxies, the region of the flat rotation is outside the bar-ends, so that the fitting were carried out in the outer region than the bar-ends.

3.2. INNER DISK REGION

Inner region means which is inside the transient point between the rigid and flat rotation and thus, in which the rotation velocity increases almost linearly with radius in non-barred galaxies. For barred galaxies, the inner region corresponds to the region from the center to the bar-end. Although the radial distribution of H_2 molecules in the inner region is not simple, we could classify it broadly into three (or probably two) types as follows:
(I)Lower central density than that extrapolated from the outer exponential distribution. More typically the molecular gas is depleted in the inner region and has a density peak density at the transient region between the rigid and flat rotation (e.g., NGC 6643, NGC 6503, NGC 7331).
(II)Higher central density than that extrapolated from the the outer exponential distribution (e.g., NGC 3504, NGC 4303). If the gas density is depleted at the middle place, the radial distribution of the molecular gas over the whole disk has two peaks at the center and the transient region between the rigid-like and flat rotation, like our Galaxy.
(III)Exponential distribution continuing from the outer disk in to the central positions (e.g., NGC 628, NGC 4102, NGC 4254).

All type I galaxies are non-barred and show the rigid (-like) rotation curve in the inner region resolved with the telescope beam of 16". All type II galaxies have an optical bar. Type III contains both barred and non barred galaxies. The transient point between the rigid and flat rotation is close to the galactic center, and the region of the rigid rotation and the H_2 radial distributions in this region cannot be resolved with our spatial resolution. Perhaps, the galaxies that belong to type III could be classified into type I or type II.