The region of $358° \leqq \ell \leqq 55°$, $-1\overset{\circ}{.}5 \leqq b \leqq +1\overset{\circ}{.}5$ was observed. Scans were taken in the direction almost perpendicular to the galactic plane at a rate of $3\overset{'}{.}8$/sec. The scan length was 3° and the interval between scan passages was $1\overset{'}{.}2$.

The data reduction was made using "CONDUCT", the radio astronomical reduction system at NRO, a part of which uses the NOD2 reduction package (Haslam 1974). Scanning effects, which are mainly caused by weather conditions, were removed by using the "pressing" method (Sofue and Reich 1979).

The survey revealed a large number of new interesting features associated with the galactic structure and star forming regions; many discrete compact and extended sources, complex regions composed of small thermal and nonthermal sources, several new supernova remnants, and a prominent off-plane Ω-shaped radio lobe near the galactic center (Sofue and Handa 1984). A complex region at $\ell = 21° - 26°$ in the survey was reported by Sofue *et al.* (1985) and Sofue *et al.* (1985).

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DYNAMICS OF GIANT MOLECULAR CLOUDS IN THE DENSITY WAVE POTENTIAL

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We performed an N-body simulation of a system of gravitating particles modeling the system of stable Giant Molecular Clouds (GMCs) in the background density wave potential. The system of gravitating GMCs forms shocks in the spiral potential well, and shows a prominent spiral structure.

Since most of the interstellar mass is contained in GMCs, the dynamical behavior of the interstellar gas is governed by that of GMCs. We refer to the aggregation of GMCs as the GMC gas hereafter. In the

https://doi.org/10.1017/S0074180900096340 Published online by Cambridge University Press

GMC gas the mutual gravitational encounters ensure rapid relaxation (Fukunaga 1983,1984, Tosa and Fukunaga 1985). In what follows we show by the N-body simulation that the gravitating GMC gas also forms the large scale galactic shocks.

The model of the gravitating GMC gas is defined as follows: (1) All the GMCs have the same mass, (2) GMCs are long lived, and (3) GMCs are not influenced by other interstellar components. The force acting on a GMCs is the sum of:

i) The gravitational force from the other GMCs.

ii) The axisymmetric gravitational force of the stellar system.

iii) The gravitational force of the two arm spiral density wave of the stellar system, and iv) the frictional force, which acts if two GMCs come closer than a certain radius.

For the axisymmetric force field we use the one described by the rotation curve of Burton and Gordon (1978), while for the density wave potential we use the model of Roberts (1969). The distribution of GMCs is similar to that of the "5-kpc molecular ring" of our Galaxy.

Figure 1 shows the evolution of the GMC system. Prominent two arm spiral patterns can be seen. The spiral density maxima are due to shock

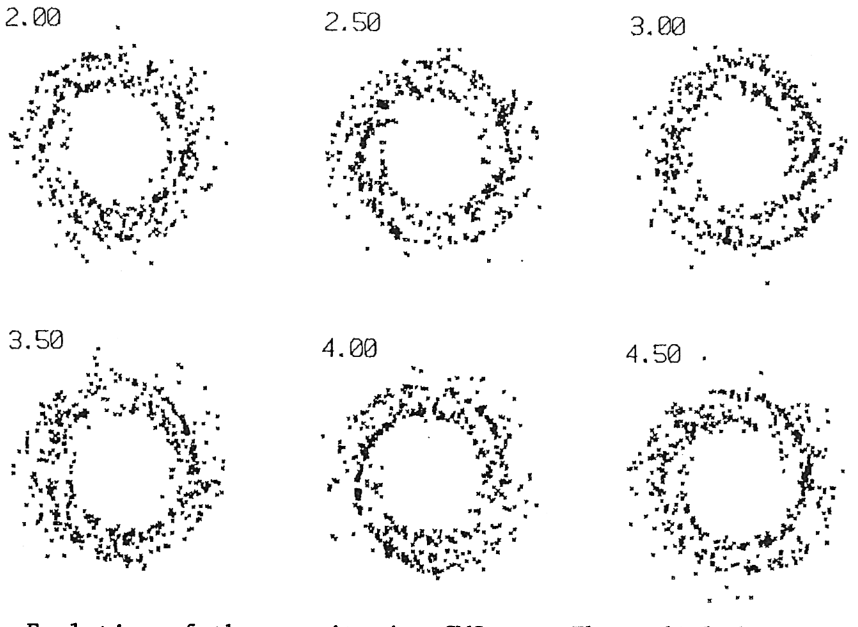

Fig. 1. Evolution of the gravitating GMC gas. The radial distribution is similar to that of the "5-kpc molecular ring" of our galaxy. The radii of the inner and the outer edges of the ring are 4 kpc and 8 kpc, respectively. The mass and number of GMCs are 2×10^6 $M_\odot$ and 500, respectively. The parameters for the density wave are: $\Omega_p = 13.5$ km $s^{-1}kpc^{-1}$, $i = 6^\circ.86$, and $F = 0.05$, where Ω_p, i, and F mean the pattern speed, the inclination, and the amplitude of the density wave, respectively. The time is in units of the rotation period, 1.57×10^8 years, at 6 kpc from the galactic center.

https://doi.org/10.1017/S0074180900096340 Published online by Cambridge University Press

formation at the spiral potential wells. Though the spiral pattern is sometimes distorted due to small-scale and short-lived fluctuations, the grand design is stable for a long run.

As many observations show, GMCs are the active star forming sites. If star formation in a GMC is a spontaneous phenomenon, the global pattern of star forming regions is similar to that of GMC gas given in Figure 1. If the star forming activity on the other hand is influenced by the neighboring clouds (e.g. cloud-cloud collisions), the spiral patterns of active star forming regions are more prominent than those given in Figure 1.

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FORMATION OF GIANT MOLECULAR CLOUDS BY COAGULATION OF SMALL MOLECULAR CLOUDS IN A SPIRAL GRAVITATIONAL POTENTIAL

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ABSTRACT. The formation process of giant molecular clouds (GMCs) is investigated from the standpoint of the coagulation theory of molecular clouds. Small clouds collide with each other and grow to become massive ones. Ultimately they form GMCs with a finite lifetime. The occurrence of star formation in a GMC destroys it and consequently small clouds are formed again. We study the time evolution of the clouds which move through a spiral gravitational potential by an N-body simulation. Then the ensemble of clouds responds to the spiral potential and forms a spiral structure similar to that produced by hydrodynamical galactic shock. It is shown that GMCs are formed in the spiral arm region by collisions between clouds. The distribution of GMCs indicates their short lifetime, of the order of a few times 10^7 years.

1. INTRODUCTION. Many molecular clouds consist of giant molecular

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