A HIGH VELOCITY MOLECULAR CLOUD NEAR THE CENTER OF THE GALAXY

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1. Introduction

Molecular clouds in the Galactic center region are characterised by their large velocity widths and physical conditions which differ from clouds in the Galactic disk (e.g., Morris 1996). These clouds may not be gravitationally bound, but in equilibrium with the high external pressure in the Galactic bulge (Spergel & Blitz 1992, Oka et al. 1997a).

We have discovered, in large-scale ^{12}CO J=1–0 and ^{13}CO J=1–0 images taken with the NRO 45 m telescope (Oka et al. 1997b, Hasegawa et al. 1997)[1], a number of compact clouds with large velocity widths and bright CO emission, as well as a number of molecular shells and/or arcs.

[1]This work is based on the Nobeyama Radio Observatory (NRO) 45m telescope key program: 'A Large-Scale CO Imaging of the Galactic Center'.

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 193-194.

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2. CO 0.02–0.02: A Compact Cloud with Extremely Large Velocity Width

CO 0.02–0.02 is such a compact cloud with a very large velocity width ($\Delta V \geq 100$ km s^{-1}, see Fig.1 - and $\sim$ 400 km s^{-1} in the J=3–2 line), located $\sim 5'$ Galactic-east from Sgr A*. CO J=3–2 line observations with the JCMT (Fig.2), HCN and HCO$^+$ J=1–0 line observations with the NRO 45m show that the cloud is bright in all these lines, suggesting CO 0.02–0.02 has a relatively high density and temperature of $n(H_2) \geq 3 \times 10^4$ cm^{-3} and $T_k \geq 60$ K (Oka et al. 1997c).

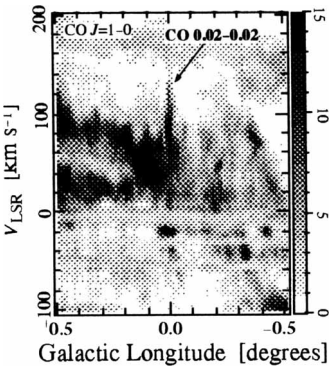

Figure 1. A CO J=1–0 longitude-velocity map at $b = -1'08''$.

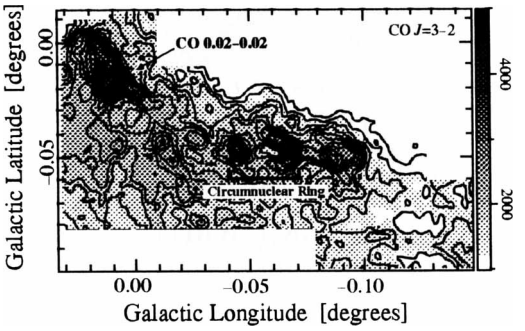

Figure 2. A map of CO (J=3–2) emission integrated over the velocity range V_{LSR} = –100 to 200 km s^{-1}. Contour intervals are 200 K km s^{-1}.

3. Energetics

The size and the velocity width of CO 0.02–0.02 suggest that the cloud may have been accelerated within the last $\sim 4 \times 10^4$ years. The kinetic energy of the cloud: $\sim 4 \times 10^{50}$ erg, corresponds to an amount of energy equivalent to several tens of supernovae, and the CO J=3–2 maps show that it is associated with some expanding shells (see Fig.2) - although the observed thermal radio flux at 20 cm toward the cloud precludes acceleration by Wolf-Rayet stellar winds.

This result implies that compact clouds with large velocity widths in this region may have been accelerated by supernovae, and that the boisterous molecular gas kinematics may be a result of the violent release of kinetic energy by a number of supernova explosions.

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