STRUCTURE OF THE MOLECULAR CLOUD AND STAR-FORMING ACTIVITY IN THE SAGITTARIUS B2 REGION

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1. Introduction and Observations

Sgr B2 is one of the most active star-forming complexes in our Galaxy located ~100 pc from the Galactic center. Whiteoak et al. (1987) found that groups of the OH and H_2CO masers and the compact HII regions are aligned in a north-south line, and suggested that star formation there is being triggered by a single large-scale event such as an interaction between molecular clouds. In order to investigate the total molecular cloud distribution and the triggering mechanism of the active massive-star formation in the Sgr B2 region, we mapped it in the ^{13}CO and $C^{18}O$ ($J = 1-0$) lines with the Nobeyama 45 m telescope in 1988 March and May. In the ^{13}CO line, an area was mapped of 345″ in right ascension and 495″ in declination covering the whole Sgr B2 molecular cloud at a grid spacing of 15″. In the $C^{18}O$ line, more restricted area was observed at 7.5″ or 15″ spacing. The HPBW of the 45 m telescope was 16″ at 110 GHz. Full description of the observations will be given elsewhere (Whiteoak et al. 1997).

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2. Results

The integrated intensity map shows that the ^{13}CO cloud consists of a compact core with a diameter of $\sim$3 pc centered on Sgr B2 (M) and an extended plateau with a size of $\sim$7.5 $\times$17 pc^2 containing most of the HII regions and the maser sources. Two C^{18}O cores with sizes of $\sim$1.2 $\times$1.9 pc^2 and $\sim$2.1 $\times$1.3 pc^2 are associated with Sgr B2 (M) and (N), respectively.

The ^{13}CO channel maps show that an extended 'hole' appears at $V_{\rm LSR} \sim 35 - 50$ km s^{-1}. There exists a large cloud at $V_{\rm LSR} \sim 65$ km s^{-1}. At $V_{\rm LSR} \sim 70 - 85$ km s^{-1}, an emission feature is elongated in a northeast-southwest direction with a maximum intensity towards Sgr B2 (N). This 'clump' has a distribution which coincides well with the hole at the lower velocities. With inceasing velocities, the emission concentration fades away and some filamentary structures emerge. At $V_{\rm LSR} \sim 110 - 120$ km s^{-1}, one of such filaments extends roughly north-south some 100$''$ west of Sgr B2 (M). Its size is $\sim$4.3$'$ $\times$ 1.0$'$, i.e., $\sim$11 pc $\times$ 2.5 pc. It is part of a long chain of clouds at least $\sim$17$'$, i.e., $\sim$42 pc long (Oka et al. 1997).

3. Discussion

A steep velocity gradient across the Sgr B2 molecular cloud has been interpreted in terms of rotation of the cloud or as due to multiple cloud components at different velocities. The present observations revealed that it has been caused by the two clouds with different sizes and velocities.

Hasegawa et al. (1994) have incorporated the hole and the clump of the ^{13}CO distributions into a cloud collision model in which the high-velocity clump ploughs into a more extended cloud with lower velocities, creating the hole. Star formation is being triggered at the collision interface between the two clouds, resulting in the extended distribution of maser sources and compact HII regions. The widely distributed gas at $\sim$65 km s^{-1} represents a cloud with motions already modified by the collision. Considerable star formation appears to have occurred in this cloud during the collision period, because it contains most of the continuum emission, including the more evolved HII regions — seven of the ten HII regions studied by Mehringer et al. (1993) have velocities between 59 and 72 km s^{-1}.

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