Shocked molecular gas in the foot point of the molecular loop near the Galactic Center

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The Central Molecular Zone (CMZ) of the Galaxy is characterized by high gas kinetic temperature (~30-60K) and by high gas density (~10^4 cm^{-3}). We found the loop like molecular features 300 pc away from the Galactic Center, which have the same properties of CMZ at the giant molecular cloud (GMC) in their foot point, and suggested that the loops and the GMC are formed by magnetically buoyancy driven by Parker instability [1, 2]. It is expected that there are shock fronts made by the slipping gases along the loop in the foot point. We report the results of molecular line observations by using ASTE, Mopra, NANTEN2 telescopes toward the GMC in the foot point of the loops in order to search for evidence of the shock.

We found more than ten clumps sizes of which 2-3 pc and masses of which ~1000 solar masses in the GMC in CO(J=3-2,1-0) [Figure 1]. They show high excited emission in CO (R_3-2/1-0 ~ 1.0-1.5). The shapes of the spectra in these clumps have very broad velocity dispersion (30-40 km/s) and wing like components [Figure 2]. These properties suggest the existence of the shock. High excited CO emissions also support it. On the other hand, the emissions of ^{13}CO and CI ($^3P_1$-$^3P_0$) are very weak and almost the same. The emission of CO (J=7-6) was not detected. We have estimated physical parameters in these clumps by using LVG analysis. The results indicate that these regions have low-density (10^2-10^3 cm^{-3}) and high-temperature (>100 K). Additionally, the model of shocked gas shows the consistent results on temperature and density and indicates the shock velocity of 40-50 km/s [3].

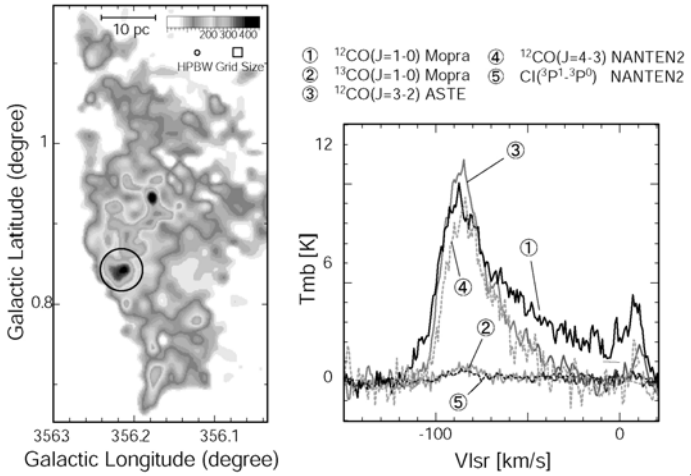

Figure 1(left): The integrated intensity map of the foot point of the Galactic Loop in ^{12}CO(J=3-2).
Fgiure 2(right): The spectra in each line toward the region inditated by circle in Figure 1.

References

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