

Possible CO clouds interacting with the SNRs G21.8-0.6 and G32.8-0.1

Jianjun Zhou¹, Jarken Esimbek¹, Xizheng Zhang² and Hongbo Zhang²

¹National Astronomical Observatories/Ururmqi Observatory, CAS, China, 40-5 South Beijing Road, Ururmqi Xinjiang 830011, China; ² National Astronomical Observatories, CAS, China, 20A, Datun Road, Chaoyang Dis, Beijing 100012.

Abstract. We have obtained the first CO(1-0) maps towards the SNRs G21.8-0.6 and G32.8-0.1, which are associated with OH 1720 MHz masers. Based on the morphological correspondence between the radio remnant and the CO cloud, and the velocity and position agreement between the OH maser and CO clouds, we tentatively suggest the clouds may be interacting with G21.8-0.6 and G32.8-0.1. However, the shock-excited line broadening was not obvious for these two SNRs. We discuss the possible reasons for this.

Keywords. ISM:clouds — ISM: individual (G21.8-0.6, G32.8-0.1) — ISM:molecules — masers — supernova remnants

OH 1720 MHz masers are a known signature of SNR-molecular cloud interactions. The excitation of OH 1720 MHz maser emission requires very dense gas ($\sim 10^5 \text{ cm}^{-3}$) with a temperature of 50–125K. A C-type shock caused by expanding supernova remnant will create such conditions (Elitzur 1976; Lockett *et al.* 1999). This has been confirmed by many molecular line observations (Koralesky *et al.* 1998; Reach & Rho 1998; Frail & Mitchell 1998; Reynoso *et al.* 2000). We took CO(1-0) observations towards the SNRs G21.8-0.6 and G32.8-0.1, both of which are associated with 1720 MHz OH masers. The sensitivity of the observation is 0.26 K (rms) for an integration time of 60 seconds. The results indicate that $^{13}\text{CO}(1-0)$ emission of these two SNRs is very weak, while no $\text{C}^{18}\text{O}(1-0)$ was detected. The CO clouds around these two SNRs are displayed in Figure 1 and Figure 2.

Based on the morphological signature of CO clouds, and position and velocity agreement between the OH maser and CO clouds, we tentatively suggest that cloud C of G21.8-0.6 and cloud F of G32.8-0.1 may be physically related to the SNR. However, we did not detect line broadening in cloud F, and line broadening is not very strong in cloud C. A possible reason for this is that the shocked molecular gas may be highly excited, so the emission from the low-lying CO(1-0) transition is weak (Wilner *et al.* 1998). Moreover, the background cloud emission could mask such weak features. Taking into consideration the complex CO spectra, we think that confusion due to different velocity components along the line of sight plays an important role here.

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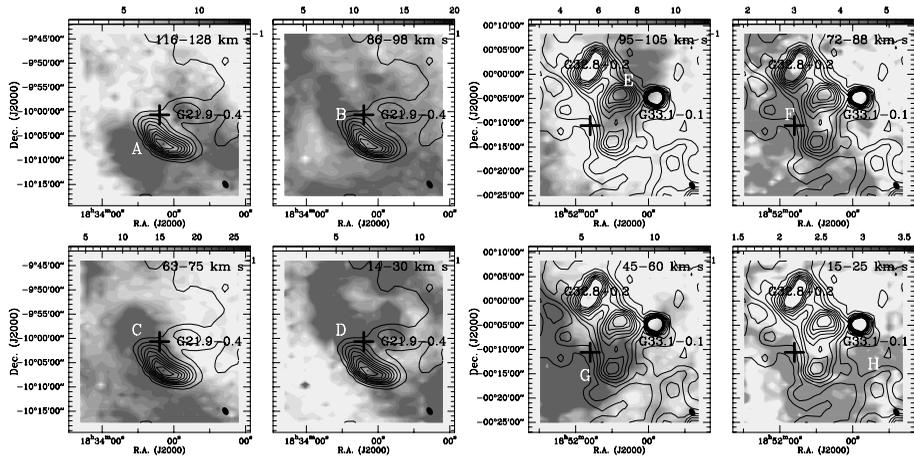


Figure 1. Left: Set of four channel maps of $^{12}\text{CO}(1-0)$ emission integrated over velocity ranges 116-128, 86-98, 63-75 and 14-30 km s^{-1} toward G21.8-0.6. The grey scale is in K km s^{-1} and is shown on top of the image. The 2σ noise level of these maps are 1.25, 1.65, 2.18, and 1.29 K km s^{-1} respectively. The beam, $106'' \times 70''$, is indicated by black filled ellipse in the bottom right corner. The contour map was obtained from the radio continuum survey of the Galactic plane at 11 cm wavelength (Reich *et al.* 1984). G21.9-0.4 is a HII region. The plus sign shows the position of OH 1720 MHz maser.

Right: Set of four channel maps of $^{12}\text{CO}(1-0)$ emission integrated over the velocity ranges 95-105, 72-88, 45-60 and 15-25 km s^{-1} toward G32.8-0.1. The grey scale is in K km s^{-1} and is shown on top of the images. The 2σ noise level of these maps are 1.46, 1.11, 1.53 and 0.99 K km s^{-1} respectively. The beam, $106'' \times 70''$, is indicated by black filled ellipse in the bottom right corner. the continuum contour of G32.8-0.1 was also obtained from the radio continuum survey of the Galactic plane at 11 cm wavelength (Reich *et al.* 1984), which including two HII regions, G32.8+0.2 and G33.1-0.1. The plus sign indicates the position of OH maser.

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