

H I Study of Southern Galactic Supernova Remnants

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Abstract. We briefly summarize the survey of H I 21 cm emission lines to search for shocked atomic gas associated with Galactic supernova remnants (SNRs) in the southern sky. For G347.3–0.5, we discuss the distance to the SNR and the implications of the H I results.

1. The Survey

We carried out a H I 21-cm line survey to search for shocked atomic gas associated with Galactic SNRs in the southern sky. We have studied 97 SNRs at $253^\circ < \ell < 358^\circ$ in the Green's catalog using the Southern Galactic Plane Survey (SGPS) data. We compare the average H I spectra of SNRs to those of the surrounding regions, and look for excessive emission wider than 10 km s^{-1} and localized at the position of the SNRs. We divide the SNRs into 3 ranks, where the increasing number implies increasing reliability of a detected H I feature. The ranks correspond to those of Koo & Heiles (1991), who did a similar survey toward the northern SNRs. Of the 97 SNRs, 10 SNRs are ranked as 3, 22 SNRs are ranked as 2, and others are ranked as 1. Rank 3 SNRs have very high-velocity H I gas confined to the SNR, and the association is quite plausible.

2. G347.3–0.5

G347.3–0.5 (RX J1713.7–3946) is one of the rank 3 SNRs. It is a shell-type SNR with X-rays dominated by non-thermal synchrotron radiation like SN 1006. TeV gamma-ray emission has been detected toward the X-ray bright western shell (Muraishi et al. 2000). There are two different interpretations for G347.3–0.5: (1) it is a young SNR at a distance of 1 kpc, possibly the remnant of the SN AD 393 (Koyama et al. 1997), and (2) it is an old SNR at a distance of 6 kpc, possibly interacting with molecular clouds (Slane et al. 1999).

Figure 1 (left) shows average H I and CO profiles toward the direction of the SNR. The H I profile is obtained from the SGPS data while the CO profile is from the CfA CO survey (Dame, Hartmann & Thaddeus 2001). The total H I column density along the line of sight is $(1.8\text{--}2.3) \times 10^{22} \text{ cm}^{-2}$ assuming a constant spin temperature of 130–200 K. The total column density of H_2 molecules, using $N(\text{H}_2)/I(\text{CO}) = 1.9 \times 10^{20} \text{ cm}^{-2} (\text{K km s}^{-1})^{-1}$, is $\simeq 0.4 \times 10^{22} \text{ cm}^{-2}$. Hence, the

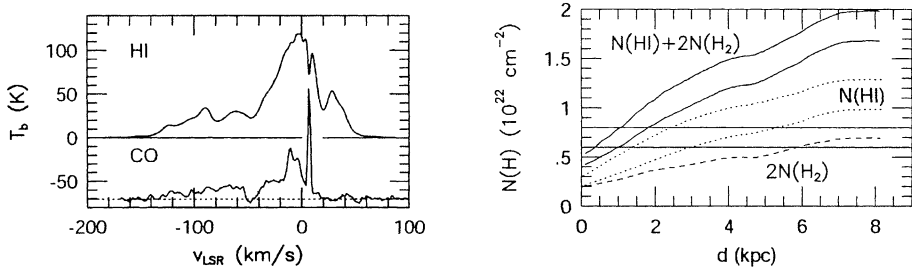


Figure 1. *Left panel:* HI and CO ($J=1-0$) profiles toward the SNR. The peak intensity of the CO emission is 1.3 K. *Right panel:* Hydrogen column density as a function of distance toward G347.3–0.5. For $N(\text{HI})$ (and $N(\text{HI}) + 2N(\text{H}_2)$), the upper and lower graphs correspond to spin temperatures of 130 K and 200 K, respectively.

total column density of H nuclei is $(2.6 - 3.1) \times 10^{22} \text{ cm}^{-2}$, which is considerably greater than the X-ray absorbing columns ($\simeq 0.6-0.8 \times 10^{22} \text{ cm}^{-2}$; Slane et al. 1999). Figure 1 (right) shows how the column densities vary as a function of distance, which was obtained by converting the LSR velocity to distance assuming a flat Galactic rotation model. There is a distance ambiguity, and we arbitrarily assumed that 2/3 (1/3) of the column density at a given velocity is from the gas on the near (far) side. We also assumed that 2/3 of the HI emission between $v_{\text{LSR}} = 0$ and $+10 \text{ km s}^{-1}$ is from the local gas, while all the H_2 emission in this velocity range is assumed to be from the local gas because there is a self-absorption HI feature associated with the molecular gas. According to Figure 1 (right), the distance at which the accumulative column density equals the X-ray absorbing columns is $\sim 1 \text{ kpc}$.

The excess HI emission toward G347.3–0.5 is detected between $v_{\text{LSR}} = 68$ and 81 km s^{-1} at the western rim where the X-rays are enhanced. At a distance of 1 kpc, the radius ($30'$) of the SNR is 9 pc and the detection of shock-accelerated HI gas implies an interaction with a dense medium. Previous studies showed that the fast-moving HI gas is often produced by SNR shocks propagating through molecular clouds, and G347.3–0.5 may interact with molecular clouds too.

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