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Search for synchrotron X-ray dominated SNRs in the *ASCA* Galactic plane survey

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1. Introduction

Since the discovery of cosmic rays, the origin and acceleration mechanism have been long-standing problems. A breakthrough was the discovery of synchrotron X-rays from SN 1006, which supports the idea that SNRs are the presence of high energy electrons (Koyama et al. 1995). The origin of the high energy electrons is considered to be diffusive shock acceleration in the expanding shell. In order to explore the SNR origin of the cosmic rays, we have to know how many SNRs are cosmic ray accelerators. In this paper, we report on the result of our search for them in the *ASCA* Galactic plane survey.

2. Observation and results

The *ASCA* Galactic plane survey covered region $|l| < 45°$ and $|b| < 0.4°$ with exposure time of $\sim$ 10 ksec. In the entire mosaic map shown by Sugizaki et al. (2001), we searched for SN 1006-like SNRs, excluding about 10% of the surveyed area which was suffered from stray light of bright X-ray sources. We selected the 4 brightest diffuse hard X-ray sources and performed follow-up deep exposure observations with 50 ks exposures. The GIS images in the 0.7–7.0 keV band around the SNR candidates are shown in Figure 1. Diffuse enhancements can be seen centering on (l, b) = (11.°0, 0.°0), (25.°5, 0.°0), (26.°6, −0.°1), and (28.°6, −0.°1); hence they are referred to as G11.0+0.0, G25.5+0.0, G26.6−0.1, and G28.6−0.1. Since their background-subtracted spectra are hard and have no emission lines, we fitted them with a power-law model. This model fits all spectra well as shown in Table 1. The detailed analysis for G28.6−0.1 is described in Bamba et al. (2001).

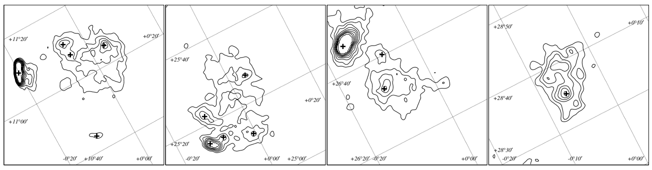

Fig. 1. The images around the emissions in the 0.7–7.0 keV band.

Table 1. The best-fit parameters for a power-law model.

	G11.0+0.0	G25.5+0.0	G26.6−0.1	G28.6−0.1
Γ	$1.6^{+0.3}_{-0.2}$	$1.8^{+0.4}_{-0.2}$	$1.3^{+0.2}_{-0.1}$	$2.1^{+0.3}_{-0.4}$
$N_{\rm H}^{\dagger}$	$0.8^{+0.3}_{-0.3}$	$2.4^{+0.8}_{-0.6}$	$0.4^{+0.2}_{-0.2}$	$2.7^{+0.8}_{-0.7}$
Flux‡ ..	3.8	2.0	3.5	3.7

†: $\times 10^{22}$ cm^{-2}. ‡: $\times 10^{-12}$ ergs s cm^{-2} in the 0.7–10 keV band.

3. Discussion

The diffuse morphologies and hard spectra of the 4 sources imply that they are all Crab-like or SN 1006-like SNRs, both of which are characterized with non-thermal X-rays. On the other hand, in the radio band, Crab-like SNRs are bright, while SN 1006-like ones are dim. Since they have no catalogued radio counterpart, we concluded that they are all SN 1006-like SNRs.

We, as follows, estimated the total number of such diffuse hard sources that escaped detection in the previous radio surveys. In the survey region, 5 hard diffuse sources have been found, the 4 sources presented in this paper and G347.3−0.5 (Koyama et al. 1997). On the other hand, there are 73 of 231 radio catalogued SNRs in the surveyed region (Green 2001). Assuming that the catalogued radio SNRs and the undiscovered SNRs have the same distributions, we can estimate the total number of the undiscovered SNRs $N_{SNR} = \frac{231}{73} \cdot 5 = 16$. Therefore, there may be $\sim$ 10 SNRs still undiscovered on the Galactic plane. To confirm it, search for them with deeper exposure and better spatial resolution is needed.

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