X-ray Emission from G359.1-0.5

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Abstract. We report on the detection of X-ray emission from the supernova remnant (SNR) G359.1-0.5 in a deep ROSAT PSPC pointed observation. The diffuse emission is well confined within the radio shell of the SNR. Its spectrum can be represented by a thermal plasma model at T$\sim$ 1 keV and $F_x \sim 2\times10^{-11}$ erg cm^{-2} s^{-1} (0.1–2.0 keV) modified by the column absorption of $N_H \sim 3\times10^{22}$ cm^{-2}. This result supports the view that the source is at a large distance consistent with that from radio observation, and helps to resolve a puzzle about the SNR in previous observations.

1 Introduction

G359.1-0.5 has been of particular interest due to, among others, its possible association with *the Snake* or *the Mouse*, two members of a class of non-thermal radio filaments near the galactic centre (see Uchida et al. 1992). Estimates of the distance of G359.1-0.5 are important to support or eliminate the associations. However, there are contradictions between radio and X-ray observations. The radio result indicates a distance within the 3 kpc ring around the Galactic Center while a ROSAT All Sky Survey (RASS) study of the source would suggest its nearby location (Reich & Schlickeiser 1992, Uchida et al. 1992). We intend to study the SNR with a deep ROSAT PSPC pointed observation and present our results and discussion in the following sections.

2 Observations and Results

A search for serendipitous observation of SNR G359.1-0.5 reveiled that ROSAT sequence No. 400275 is the longest PSPC observation toward any direction where the object is within the Field of View (FOV). The SNR is about 20' off-axis where the sensitivity and spatial resolution of the telescope are modest which is enough for our proposed study although a support structure of the PSPC window just crosses the SNR. The total exposure time is 27,770 seconds from which about 27,255 seconds are left after rejecting the intervals

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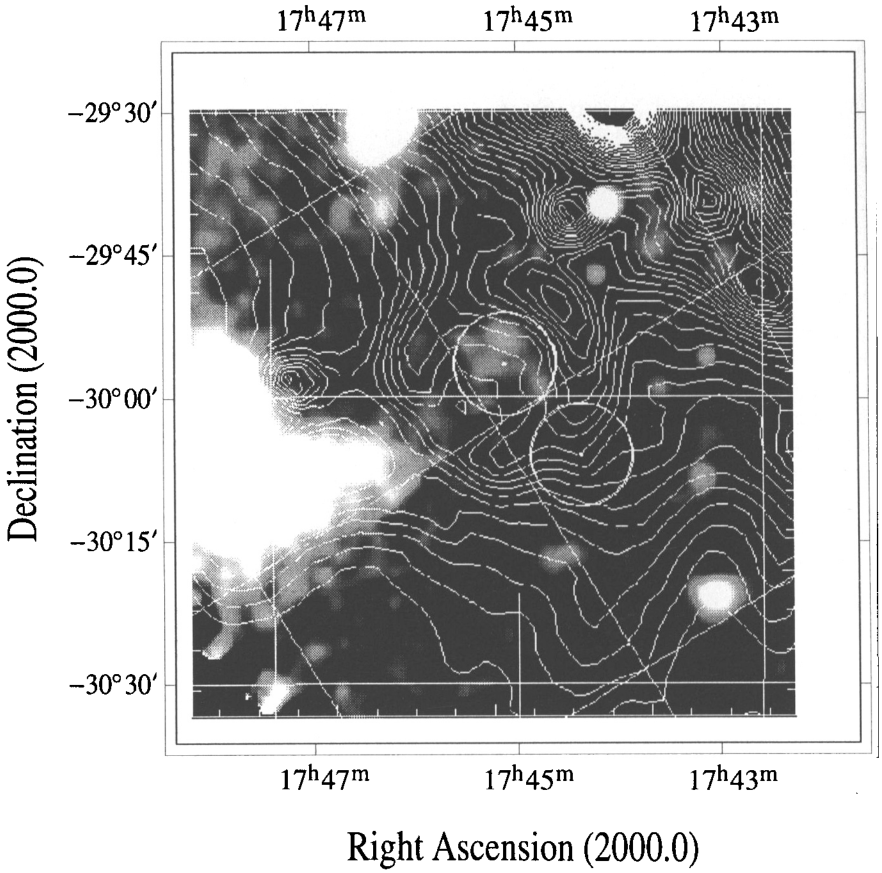

Fig. 1. X-ray intensity superimposed by 11 cm radio contours. The diffuse X-ray emission is enclosed by the radio shell of G359.1–0.5 at the figure center. Circles indicates the source and background region in spectral analysis. The diagonal coordinate lines crossing near the center are l=359^o (lower left to upper right) and b=–0.5^o (upper left to lower right).

with high background. The effective exposure at the object's detector position is between 11 and 19 kiloseconds taking into account obscuration by the wobbled window support structure.

The data analysis was carried out using the Extended Scientific Analysis System (EXSAS, Zimmermann et al. 1994). In the image of the soft energy band of 0.1–0.4 keV, there is neither evidence of point-like nor diffuse emission within the radio shell of G359.1–0.5. We therefore concentrate on the hard energy band. Fig. 1 shows the X-ray intensity map superimposed by the 11 cm radio contours. A highly significant diffuse emission feature is well

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confined within the shell structure of the SNR at the center of the figure. The circle enclosing the source region contains a total of 737 counts in the PSPC channel range 52–201, while the background region (lower right circle) contains 441 counts. Thus, the net source flux is 2.0×10^{-4}cts arcmin^{-2}s^{-1} which corresponds to a signal-to-noise-ratio of 14 sigma.

Fitting the X-ray spectrum with a thermal plasma model modified by neutral hydrogen absorption resulted in the reduced χ^2 of 1.2 (d.o.f. = 11, Fig. 2 (left)). This is not unacceptable considering the complexity of the background around the direction of the source and the influence of the detector support structure. The resultant parameters are T$\sim$ 1.0 keV for its temperature, $F_x \sim 2.0 \times 10^{-11}$ erg cm^{-2} s^{-1} for its flux in 0.1–2.0 keV and $N_H \sim 3.0 \times 10^{22}$ cm^{-2} for the absorption, respectively. It shall be noted that the temperature is not well determined due to the limited energy resolution and energy range of the instrument. Figure 2 (right) shows a χ^2 contour plot with 1, 2 and 3 σ confidence levels. It can be seen that the uncertainty is considerable. In particular, the temperature is not very well limited towards high values.

3 Discussion

The diffuse X-ray emission from G359.1–0.5 is slightly smaller in extent, than and seemingly well confined within, the radio shell. It was found that around the radio shell, there exists a dense molecular cloud and an HI ring. The interior of the radio shell, on the other hand, is relatively free of neutral material (Uchida et al. 1992). This is in accordance with the feature of the X-ray emission which is produced by hot plasma and is relatively easy to be detected within the SNR. The X-ray feature to the south-east which crosses the SNR shell near its south-eastern rim is most probably not associated with G359.1–0.5 at all. We suppose that it is an extended portion of the SNR G359.0–0.9.

Thus, the puzzle about the distance arisen from contradictory observations in the past can be resolved. The column density of G359.1–0.5 is large, 3×10^{22} cm^{-2}, which is not in conflict with the source distance near the Galactic center suggested by the radio observations. Its X-ray luminosity is then about $L_x \sim 2 \times 10^{35}$ erg s^{-1} in the 0.1–2.0 keV band assuming 8.5 kpc distance.

References

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Uchida, K., Morris, M., Yusef-Zadeh, F., (1992): AJ 104, 1533
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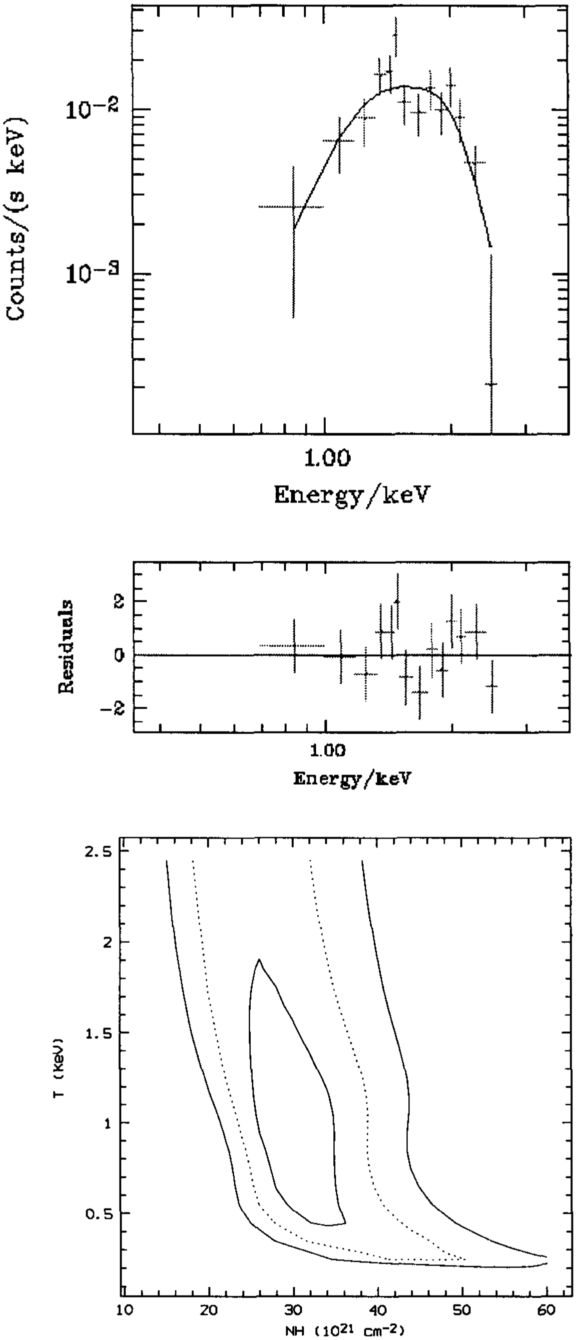

Fig. 2. ROSAT PSPC Spectrum of G359.1–0.5 with a thermal plasma fit and χ^2 contour a map of the fit parameters.

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