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X-ray Spectroscopy of the Supernova Remnant N103B

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Abstract. We report and interpret a new, 100 ks X-ray observation of the supernova remnant N103B obtained by the ASCA Observatory.

1. Introduction

The LMC supernova remnant N103B has provided some surprises. It is located in a star-forming environment, and is interacting with an HII region (Chu & Kennicutt 1988), but its X-ray spectrum shows that its element abundances have the classic signature of a Type Ia progenitor (Hughes et al. 1995). N103B's interaction with its environment has also left strong imprints. In the radio and in X-rays, its morphology is compressed toward the HII region, and its brightness enhanced (Dickel & Milne 1995; Tavarez et al. 1997).

2. Observations

We obtained a new, deep, 100 ks observation of N103B with the ASCA X-ray Observatory. The ASCA instruments provide good spectral resolution over the energy range 0.5–10 keV. The best ASCA spectrum, obtained by SIS0, is shown in Figure 1. The Fe K line blend near 6.5 keV was undetected in previous X-ray observations, including an earlier ASCA observation (Hughes et al. 1995; Hayashi 1997). The model shown is a Sedov model for shock temperature $kT =$ 0.70 keV and ionization parameter (electron density times remnant age) $nt =$ 1.4×10^{11} cm^{-3} s. This model provides a satisfactory qualitative fit to the ASCA spectrum, including the Fe K line, and is consistent with the average temperature and ionization age measured for the remnant from emission line ratio diagnostics. The interpretation of the Fe K emission, however, is subject to checking the accuracy of our models. With the Sedov models of Hamilton, Sarazin & Chevalier (1983), which uses older atomic physics, the Fe K blend is severely underpredicted by the models, although other spectral features are adequately modeled.

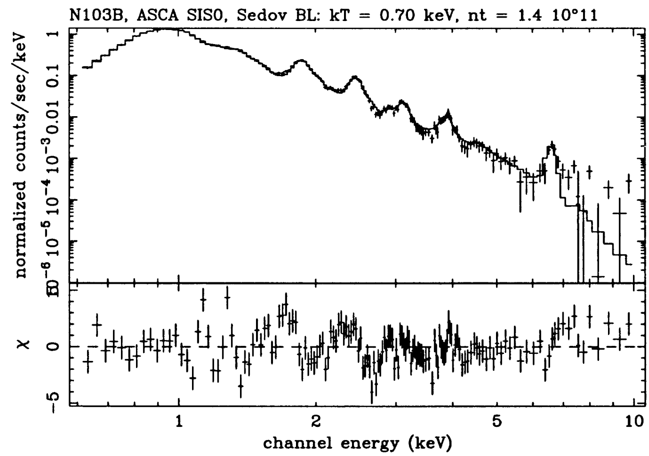

Figure 1. ASCA SIS0 observation of N103B, subtracted for background, and with the best-fit Sedov model folded through the instrument response and overlaid.

3. Discussion

The best-fit Sedov model provides reasonable consistency in the implied physical parameters. The dynamical Sedov age agrees with the ionization age to within a factor of two. A swept-up mass of $\sim 1\ M_\odot$ is comparable to the ejecta mass for a Type Ia remnant, and indicates that N103B is beginning its transition to the Sedov phase. The explosion energy is a factor of 15 lower than the canonical 10^{51} ergs, but this may be due to deceleration of the remnant by the HII region. Interaction with the HII region can also explain why this young, ejecta-dominated remnant is well-described by a Sedov model. The side of the remnant undergoing the interaction encounters higher densities and will thus both dominate the X-ray flux and evolve more quickly to the Sedov stage. This idea is supported by the observation that the optical filaments, located off-center toward the HII region, have characteristic ISM abundances (Danziger & Leibowitz 1985; Tavarez et al. 1997).

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