Chandra Spectra of the Cassiopeia A Point Source

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[Contributed talk, 15min.]

Abstract

We present the first Chandra High Energy Transmission Grating (HETG) spectra of the X-ray point source (XPS) at the center of the Cassiopeia A supernova remnant, using our recent HETGS observation of Cas A (Obsid 1046), as well as spectra extracted from the long duration archival 50 ksec ACIS-S3 observation (Obsid 114). Discovered in the Chandra first light image, the flux and spectrum of XPS strongly indicate that it is associated with the remnant, but it has been difficult to classify the point source unambiguously. The assertion that the XPS is a weakly magnetized neutron star ($B \leq 10^{10}$ G) radiating primarily via thermal emission is supported by the recent discovery of weak X-ray pulsations with a 13 ms period (H. Tananbaum, talk presented at 198th Mtg. AAS). Such a source is an ideal candidate to fit with our new theoretical atmosphere models (Joss, Madej, and Stage, these proceedings). Early data fit well to a variety of spectral forms, including power laws, model neutron star atmospheres, pure blackbody, and thermal bremsstrahlung (Chakrabarty et al., ApJ 548: 800; Pavlov et al., ApJ 531: L53). With our longer duration and higher resolution observations, we have greater ability to discriminate among the possible spectral models. We have previously carried out model atmosphere fits to a spectrum extracted from the archival 50 ksec observation. Our results yielded effective temperatures ($kT_{eff} \simeq 0.2$ keV) and radii ($R_{eff} \simeq$ 2 km) that are comparable to those obtained in earlier fits to neutron-star model atmospheres (Chakrabarty et. al.). The lack of detection of radio pulsations or of a synchrotron nebula from the location of the XPS (McLaughlin et al., ApJ 547: L41) suggests that the XPS is not a classical young pulsar, a result with which we agree. The quality of our model atmosphere fits is superior to those we obtained using simple power law or blackbody models. Furthermore, recent upper limits on the emission from the XPS at near infrared and optical wavelengths are inconsistent with single power law models (Kaplan et al., astroph/0102054), and also favor the blackbody or atmosphere model interpretation. Here we present the results of fitting our hydrogen/helium and iron model atmospheres to the new high resolution grating spectrum of the XPS, and interpret the inferred temperatures and radii. We also discuss the effect on the XPS spectrum of infall of nearby supernova ejecta onto the NS, and the effects of variations in the density of the photo-electric absorption column along the line of sight, including effects from the remnant shell.

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