

First high-resolution *Chandra* LETGS spectrum of the transient supersoft X-ray source RX J0513.9-6951

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Abstract

The transient luminous soft X-ray source RX J0513.9-6951 in the large magellanic cloud is a key object within the class of accreting binary supersoft X-ray sources. In this system, mass-transfer is thought to occur close to the Eddington limit of a solar mass white dwarf. The source switches quasi-periodically between two physically distinct states with anti-correlated X-ray and optical luminosities. We have obtained the first high-resolution X-ray spectrum of RX J0513.9-6951 on December 24, 2003 during an X-ray bright state as a 48 ks target of opportunity observation with the low energy transmission grating spectrograph (LETGS) on board *Chandra*. The X-ray observations were triggered using optical monitoring data obtained with ANDICAM on the 1.3-m telescope at Cerro Tololo, Chile of the SMARTS consortium. The X-ray spectrum deviates strongly from a smooth continuum and reveals complex structures which are probably a mixture of absorption and emission line patterns. Such features can be understood as a superposition of X-ray emission from a hot high-gravity stellar atmosphere and from an optically thin corona-like plasma enshrouding the system. Here, we present first results of our spectral analysis of the LETGS data using white dwarf atmosphere codes.

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1. Introduction

Luminous supersoft stellar X-ray sources (SSS), first recognized by the *Einstein* observatory (Long et al., 1981), have been firmly established as a distinct class of objects by *ROSAT* (Trümper et al., 1991). They are observationally distinguished by their very soft X-ray spectra with blackbody temperatures from 10 to 80 eV and luminosities of 10^{36} – 10^{38} erg/s (Kahabka and van den Heuvel, 1997). Currently, about 100 SSS are known, most of them

in the Magellanic Clouds and other nearby galaxies (Greiner, 2000; see also Kahabka, 2006).

Several SSS have been identified as accreting close binaries with orbital periods of ~ 1 day or less. They are interpreted as white dwarfs which accrete matter from a more massive main-sequence secondary at a rate \dot{M}_{acc} just sufficient to permit (quasi-)stable nuclear burning near its surface (van den Heuvel et al., 1992). This implies that the luminosity must be close to the Eddington limit of a solar mass object. Stable burning stops below $\sim 10^{-7} M_{\odot}/\text{yr}$, where shell flashes begin. The conventional model predicts that at $\dot{M}_{\text{acc}} > 4 \times 10^{-7} M_{\odot}/\text{yr}$, a red-giant envelope develops and X-ray emission is temporarily quenched (van den Heuvel et al., 1992). Hachisu et al. (1996), however, have

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