Feeding Compact Objects: Accretion on All Scales
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Accretion process powering the supersoft X-ray sources: A test with the multiwavelength modeling the SED

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Abstract. Radiation of supersoft X-ray sources (SSS) dominates both the supersof X-ray and the far-UV domain, and can be detected also within the optical/near-IR wavelengths. To determine fundamental parameters of SSSs, a multiwavelength approach in modeling their spectra is essential. By this way, the basic physical parameters of a SSS (the temperature, radius, luminosity and column density of the neutral hydrogen) can be determined unambiguously. Here I demonstrate this case for the symbiotic X-ray binary RXJ0059.1-7505 (LIN 358) in the Small Magellanic Cloud (SMC).

Keywords. Stars: fundamental parameters, X-rays: binaries, X-rays: individuals: LIN 358

1. Introduction

SSSs were first detected in the Magellanic Clouds with the *EINSTEIN* and *EXOSAT* satellites. Later observations with *ROSAT* verified their supersoft nature. Typical blackbody parameters of SSSs are a temperature of $3-5\times10^5$ K and an effective radius of $1-3\times10^9$ cm, which suggests luminosities to be as high as $\sim10^{38}\,\mathrm{erg\,s^{-1}}$ (e.g., Greiner *et al.* 1991). SSSs are understood as interacting binary systems consisting of an accreting compact object and a low-mass ($\leqslant 1M_\odot$) main-sequence or slightly evolved late-type star. In special cases, the donor star can also be an M-type giant. These sources are often called as symbiotic X-ray binaries (SyXBs). Currently, it is thought that the high energy output produced by SSSs is the result of steady nuclear burning of hydrogen accreted onto a massive white dwarf (Van den Heuvel *et al.* 1992)

As the spectrum of SSSs consists of more components of radiation, a multiwavelength approach in modeling their global (supersoft X-ray to near-IR) continuum is required. In this contribution I present example of the SyXB RXJ0059.1-7505 (LIN 358).

2. Multiwavelength model SED of LIN 358

LIN 358 is a SyXB in the SMC (e.g., Mürset *et al.* 1996). Multiwavelength (~30 Å to $\sim2.2\,\mu$m) modeling the SED of the LIN 358 spectrum suggests a high luminosity of its SSS, $L\sim1.1\times10^{38}\,(d/60\,\mathrm{kpc})^2$ ergs^{-1}, the blackbody temperature $T\sim250\,000$ K and the column density of the neutral hydrogen $N_{\mathrm{H}}\sim6.1\times10^{20}\,\mathrm{cm^{-2}}$, which corresponds to the effective radius $R^{\mathrm{eff}}\sim0.09\,(d/60\,\mathrm{kpc})R_\odot$. In addition, the modeling revealed strong contribution from a nebula characterized with emission measure of $\sim2.4\times10^{60}\,(d/60\,\mathrm{kpc})^2$, and radiating at $T_{\mathrm{e}}\sim18\,000$ K. The nebula represents probably the ionized fraction of the giant's wind as in the classical symbiotic binaries during quiescent phases. Finally, the photometric $BVJHK$ flux-points allowed to determine the contribution from the giant ($T_{\mathrm{eff}}\sim4\,000$ K, $L_{\mathrm{giant}}\sim7\,300\,(d/60\,\mathrm{kpc})^2\,L_\odot$ and $R_{\mathrm{giant}}\sim178\,(d/60\,\mathrm{kpc})R_\odot$). The

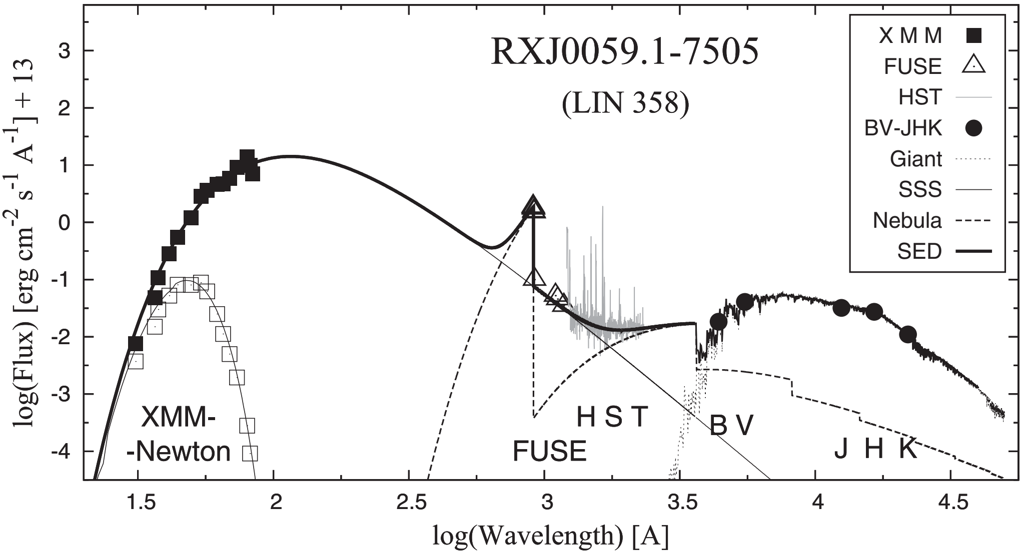

Figure 1. A comparison of the observed and modeled SED of LIN 358 (see keys). The composite spectrum was disentangled into its individual components by the method of Skopal *et al.* 2009.

best model SED fitting the observed continuum fluxes from the supersoft X-ray to the near-IR is shown in Fig. 1. According to Van den Heuvel *et al.* (1992), the source of the radiative energy of 'classical' SSSs is a steady nuclear burning of the hydrogen rich material on the WD surface. Accordingly, the high luminosity of LIN 358 requires a high mass (0.9–1.2 $M_{\odot}$) WD accreting at $\sim 2.7 \times 10^{-7}\,\mathrm{M}_{\odot}\,\mathrm{yr}^{-1}$ from the giant's wind (see e.g. Fig. 1 of Van den Heuvel 2011).

3. Conclusion

Multiwavelength ($\sim$ 30 Å to $\sim 2.2\,\mu$m) modeling the global SED of SSSs allows to determine their L, T and $N_{\rm H}$ parameters unambiguously. The modeling identified a strong nebuar radiation dominating the near-UV. In this way derived parameters for the SyXB LIN 358 suggest a high mass (0.9–1.2 $M_{\odot}$) WD accreting from the wind of the red giant at $\sim 2.7 \times 10^{-7}\,\mathrm{M}_{\odot}\,\mathrm{yr}^{-1}$.

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