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Chandra discovery of luminous supersoft X-ray sources in M81

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Abstract

A Chandra ACIS-S imaging observation of the nearby galaxy M81 (NGC 3031) reveals nine luminous soft X-ray sources. The local environments, X-ray spectral properties, and X-ray light curves of the sources are presented and discussed in the context of prevailing physical models for supersoft sources. It is shown that the sample falls within expectations based on population synthesis models taken from the literature, although the high observed luminosities (Lobs ~ 2 × 1036-3 × 10 38 ergs s-1 in the 0.2-2.0 keV band) and equivalent blackbody temperatures (Teff ~ 40-80 eV) place the brightest detected M81 objects at the high-luminosity end of the class of supersoft sources defined by previous ROSAT and Einstein studies of nearby galaxies. This is interpreted as a natural consequence of the higher sensitivity of Chandra to hotter and more luminous systems. Most of the sources can be explained as canonical supersoft sources: accreting white dwarfs powered by steady surface nuclear burning with X-ray spectra well fitted by hot white dwarf local thermodynamic equilibrium atmosphere models. An exceptionally bright source is scrutinized in greater detail since its estimated bolometric luminosity, L bol ~ 1.5 × 1039 ergs s-1, greatly exceeds theoretical estimates for supersoft sources. This source may be beyond the stability limit and undergoing a phase of mass outflow under extreme conditions. Alternatively, a model in which the observed X-ray spectrum arises from an accretion disk around a black hole of mass ~1200/(cos i) 1/2 M⊙ (viewed at an inclination angle i) cannot be excluded.

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Keywords

Binaries: symbiotic, Stars: atmospheres, Stars: evolution, White dwarfs, X-rays: stars