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Vertical structure of the outer accretion disk in persistent low-mass X-ray binaries

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Abstract

We have investigated the influence of X-ray irradiation on the vertical structure of the outer accretion disk in low-mass X-ray binaries by performing a self-consistent calculation of the vertical structure and X-ray radiation transfer in the disk. Penetrating deep into the disk, the field of scattered X-ray photons with energy E ≳ 10 keV exerts a significant influence on the vertical structure of the accretion disk at a distance R ≳ 1010 cm from the neutron star. At a distance R ~ 1011 cm, where the total surface density in the disk reaches Σ0 ~ 20 g cm-2, X-ray heating affects all layers of an optically thick disk. The X-ray heating effect is enhanced significantly in the presence of an extended atmospheric layer with a temperature Tatm ≈ (2-3) × 106 K above the accretion disk. We have derived simple analytic formulas for the disk heating by scattered X-ray photons using an approximate solution of the transfer equation by the Sobolev method. This approximation has a ≲10% accuracy in the range of X-ray photon energies E < 20 keV. © 2011 Pleiades Publishing, Ltd.

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Keywords

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