

X-ray bursting neutron star atmosphere models: Spectra and color corrections

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Abstract

Aims. X-ray bursting neutron stars in low-mass X-ray binaries constitute an appropriate source class for constraining the masses and radii of neutron stars, but a sufficiently extended set of corresponding model atmospheres is necessary for these investigations. **Methods.** We computed such a set of model atmospheres and emergent spectra in a plane-parallel, hydrostatic, and LTE approximation with Compton scattering taken into account. **Results.** The models were calculated for six different chemical compositions: pure hydrogen, pure helium, and a solar mix of hydrogen and helium with various heavy element abundances $Z = 1, 0.3, 0.1$, and $0.01 Z$. For each chemical composition the models are computed for three values of surface gravity, $\log g = 14.0, 14.3$, and 14.6 , and for 20 values of the luminosity in units of the Eddington luminosity, L/L_{Edd} , in the range $0.001-0.98$. The emergent spectra of all models are redshifted and fitted by a diluted blackbody in the RXTE/PCA 3-20 keV energy band, and corresponding values of the color correction (hardness factors) f_c are presented. **Conclusions.** Theoretical dependences f_c-L/L_{Edd} can be fitted to the observed dependence $K^{-1/4}-F$ of the blackbody normalization K on flux during cooling stages of X-ray bursts to determine the Eddington flux and the ratio of the apparent neutron star radius to the source distance. If the distance is known, these parameters can be transformed to the constraints on neutron star mass and radius. Theoretical atmosphere spectra can also be used for direct comparison with the observed X-ray burst spectra. © 2011 ESO.

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Keywords

methods: numerical, radiative transfer, scattering, stars: atmospheres, stars: neutron, X-rays: stars