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The influence of accretion geometry on the spectral evolution during thermonuclear (type I) X-ray bursts

Kajava J., Nättilä J., Latvala O., Pursiainen M., Poutanen J., Suleimanov V., Revnivtsev M., Kuulkers E., Galloway D.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2014 The Authors Published by Oxford University Press on behalf of the Royal Astronomical Society. Neutron star (NS)masses and radii can be estimated from observations of photospheric radiusexpansion X-ray bursts, provided the chemical composition of the photosphere, the spectral colour-correction factors in the observed luminosity range, and the emission area during the bursts are known. By analysing 246 X-ray bursts observed by the Rossi X-ray Timing Explorer from 11 low-mass X-ray binaries, we find a dependence between the persistent spectral properties and the time evolution of the blackbody normalization during the bursts. All NS atmosphere models predict that the colour-correction factor decreases in the early cooling phase when the luminosity first drops below the limiting Eddington value, leading to a characteristic pattern of variability in the measured blackbody normalization. However, the model predictions agree with the observations for most bursts occurring in hard, lowluminosity, island spectral states, but rarely during soft, high-luminosity, banana states. The observed behaviour may be attributed to the accretion flow, which influences cooling of the NS preferentially during the soft state bursts. This result implies that only the bursts occurring in the hard, low-luminosity spectral states can be reliably used for NS mass and radius determination.

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Keywords

Accretion, accretion discs, Stars: neutron, X-rays: binaries, X-rays: bursts