What can NuSTAR do for X-ray bursts?

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Unstable thermonuclear burning on the surface of accreting neutron stars is commonly observed as type I X-ray bursts. The flux released during these bursts, which is an important parameter to constrain the properties of the X-ray burst emission and thermonuclear burning.

Moreover, we expect that the high sensitivity of NuSTAR in hard X-rays will make it possible to study the behavior of the accretion emission associated with the ejected nuclear ashes, and identify the corresponding heavy elements. A positive identification of such edges would probe the nuclear burning processes, and provide a measure of the expansion wind velocity as well as the gravitational redshift from the neutron star.

In some rare burst conditions, the peak luminosity has been observed to exceed the Eddington limit as the neutron star photosphere undergoes a superexpansion up to a radius of the order of 1000 km. Such superexpansion bursts are consistent with pure He ignition, and are thus more likely to occur in Ultra-compact X-ray binaries (UCXBs), which accrete He-rich stellar material at low rates.

In this worst case, fitting the spectrum without the edge leads to \( \chi^2/\text{dof} = 92.9/147 \) vs. \( \chi^2/\text{dof}=91.1/145 \) with the edge included in the fit; this marginal detection can be used as an upper limit on the optical depth.

Conclusion: these simulations show that NuSTAR will be able to detect or constrain absorption edges in X-ray burst spectra.

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