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Simulations of X-ray Bursts and Superbursts

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Neutron stars in low mass X-ray binary systems with an accretion flow of matter from the companion star have been observed to exhibit regular bursts. These so-called type I X-ray bursts are thermonuclear explosions occurring in the surface layers of neutron stars. After thousands of type I X-ray bursts, enough ashes have been accumulated and a rare superburst event may take place. Such an event is thought to be triggered by unstable burning of carbon. However, most theoretical models of superbursts are not able to reproduce the observed behaviour.
We present a one-dimensional model which simulates thousands of type I X-ray bursts in the surface layer of an accreting neutron star. To investigate this scenario, our code couples general relativistic hydrodynamic with a nuclear reaction network. Therefore, we are able to predict the evolution of the composition of the ashes, which has strong implications on the ignition of superbursts. Furthermore, we give an estimate for the heat source which is needed to trigger a superburst. We find that self-consistent simulations of superbursts are challenging and need further investigations.

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