Measuring neutron star properties from thermonuclear bursts

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Thermonuclear (type-I) X-ray bursts arise from unstable ignition of accreted fuel on the surface of neutron stars in close binary systems. Many nuclear reactions contribute to the burning that follows ignition (e.g. Galloway & Keek, 2017), and the rates of several reactions help to shape the burst light curve. It has long been a goal of observers to deduce information about these reactions (and the properties of the host objects) from the observational data available.
In this presentation I will review recent progress reconciling numerical models with observations to meet this goal. Large samples of observational data, such as the Multi-INstrument Burst ARchive (MINBAR[1]) provide access to high quality, uniformly analysed observational data. Specific examples from this sample have been selected to serve as model test cases (Galloway et al., 2017). In parallel, a large sample of model predictions over a wide range of source conditions has been released (Lampe et al., 2016). Software tools are under development to comprehensively match observations to simulations, and hence determine the source parameters.
Numerical models are also being applied to more ambitious targets, including entire transient outbursts (e.g. Johnston et al., 2018). These efforts are beginning to produce robust constraints on neutron star properties including accreted fuel composition, as well as neutron star mass and radius, that take into account many of the astrophysical uncertainties normally affecting such measurements. I will discuss future plans and prospects including the connection to nuclear experimental physics.

References

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[1]http://burst.sci.monash.edu/minbar