Reconciling observations and models of thermonuclear bursts with nuclear experiments

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Thirty years of studying thermonuclear (type-I) bursts from accreting neutron stars have revealed a surprisingly rich spectrum of behaviour. A few sources which have been studied intensively offer confirmed examples of two of the three classes of ignition predicted theoretically, and these systems serve as crucial test-cases for numerical models. However, the behavior of the majority of systems cannot be fully reconciled with theoretical predictions, suggesting there is additional physics at work. Additionally, some new classes of bursts have emerged in recent years, including so-called "super" bursts, likely powered by unstable ignition of carbon, and intermediate-duration bursts which likely require a large accreted reservoir of pure helium.

In this talk I will briefly summarise the observed phenomenology of thermonuclear bursts, and discuss how well the available nuclear burning and ignition models can reproduce the behaviour of various sources. I will describe an ongoing observational project, the Multi-Instrument Burst ARchive (MINBAR), which aims to assemble a large sample of bursts observed by recent space missions, to enable comprehensive future studies of rare events and broad-scale behavior. Finally, I will present preliminary results from a new program to exploit this sample to provide constraints on key nuclear reactions that influence burst properties.