Explosive hydrogen burning during type I X-ray bursts on neutrons stars

Friedrich-Karl Thielemann[1], Jacob Lund Fisker[2], Hendrik Schatz[3]

[1]University of Basel, Dept. of Physics (Basel, Switzerland)

[2]University of Notre Dame (Notre Dame, USA)

[3]Michigan State University (East Lansing, USA)

Hydrogen accretion in close binary stellar systems from a companion star onto a neutron star results in the accumulation of unburned matter up to a critical mass of the order $5 \times 10^{-13}\, M_{\odot}$. The ignition under pycnonuclear conditions leads to a thermonuclear runaway and causes an X-ray burst. Explosive hydrogen burning in type I X-ray bursts (XRBs) is driven by charged particle reactions, creating isotopes with masses up to $A = 100$ via proton captures. Since charged particle reactions in a stellar environment are very temperature sensitive, we use a realistic time-dependent general relativistic and self-consistent model of type I X-ray bursts to provide accurate values of the burst temperatures and densities. This allows a detailed and accurate time-dependent identification of the reaction flow from the surface layers through the convective region and the ignition region to the neutron star ocean. Using this, we determine the relative importance of specific nuclear reactions in the X-ray burst.