From Nuclear Structure and Dynamics to *rp*-Process Nucleosynthesis in X-Ray Bursts

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Proton-rich nuclei in the A = 70 mass region are of high interest both experimentally and theoretically due to their exotic structure and dynamics and also their role in nucleosynthesis via *rp*-process in type I X-ray bursts. Nucleosynthesis in explosive hydrogen burning at high temperatures and densities is mainly characterized by *rp*-process, a sequence of proton capture and weak interactions processes including β^+ and continuum electron capture. The competition between the proton capture rates and rates of the weak interaction processes at the waiting points determine the *rp*-process reaction flows and, consequently, the characteristic observables of the burst. Robust predictions on Gamow-Teller strength distributions for the β^+-decay of the ground state and thermally populated low-lying excited states in the stellar environment together with the temperature and density evolution of the continuum electron capture rates are needed to realistically evaluate the impact of weak interaction rates of the waiting point nuclei on nucleosynthesis. A comprehensive description of the structure and dynamics of ^{68}Se and ^{72}Kr waiting point nuclei dominated by shape coexistence and mixing requires beyond-mean-field models. ^{68}Se and ^{72}Kr stellar weak interaction rates have been realistically predicted within the beyond-mean-field *complex* Excited Vampir model. The impact of the stellar weak interaction rates of the two waiting points on *rp*-process nucleosynthesis and energetics has been studied using a post-processing approach based on a one-zone model [1] employing the temperature and density profile from Schatz *et al.* [2] and different initial H/He and metallicity compositions. The calculations reveal a significant impact on the reaction flow, burst duration, energy generation, hydrogen consumption and final composition of the burst ashes and point towards improved estimates on the X-ray burst nucleosynthesis.

[1] A. Petrovici, A. S. Mare, O. Andrei, and B. S. Meyer, *Phys.Rev. C* **100,** *015810* (2019)
[2] H. Schatz *et al.*, *Phys. Rev. Lett.* **86**, 3471 (2001)