Contribution ID: **14** Type: **Oral presentation**

Impact of model variations for degenerate neutron capture rates within neutron star crusts

Tuesday 28 May 2024 10:20 (20 minutes)

Heavy element synthesis within stellar bodies typically manifests in explosive environments such as neutron star mergers. However, at the low temperature and high density conditions of a neutron star crust, degenerate neutrons provide alternate synthesis pathways compared to conventional systems. In this work, we study the effect of this degeneracy on neutron capture rates by several rp-process ashes and neutron-rich nuclei within accreting neutron stars. We investigate variations in the nuclear physics input which constructs the absorption cross section, and their effects on the reaction rate in the context of degenerate neutron capture. This includes variations in the level density model and the γ-strength function. Our results show that degeneracy can change the capture of neutrons by orders of magnitude compared to captures under explosive conditions. This may lead to changes in the abundance evolution of rp-process ashes, and the crust's cooling following X-ray bursts.

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