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(G*) Model constraints for degenerate neutron capture rates in neutron star crusts

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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 consider strongly interacting asymmetric nuclear matter and its effect on the neutron chemical potential and therefore on the capture rates. We then 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. Finally, we propose an analytic approximation for highly degenerate neutron capture rates. Our results may help interpret the abundance evolution of rp-process ashes.

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