Nuclear Processes in the Crusts of Accreting Neutron Stars

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Accreting neutron stars have crusts that differ in composition from regular neutron stars. The composition determines the thermal properties of the crust and thus observables during the accretion phase, such as X-ray bursts and superbursts in the shallow crust, as well as quiescent X-ray emission that probes the physics in the deeper regions of the crust. In addition accreted neutron stars have compositional boundaries where electron capture parent and daughter nuclei can coexist leading to a nuclear Urca process that further affect the thermal evolution. I will discuss results from recent calculations that determine for the first time the detailed composition of the outer crust, and the upper regions of the inner crust, and its implications for interpreting observables. It turns out that the shell structure of exotic neutron rich nuclei, as well as the interplay of X-ray burst physics and crust physics are of particular importance. I will also discuss recent experimental results from experiments at the National Superconducting Cyclotron Laboratory that determine location and strength of the most important Urca cooling nuclei through beta decay studies. I will conclude with an outlook for future work in theory as well as experiments at advanced rare isotope facilities such as FRIB.