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Production and Impact of Urca Nuclides[1]

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Observations of Quasi-persistent X-ray transients yield valuable constraints for neutron star physics and structure. The nuclear reactions which occur during the outburst phase determine the composition of the neutron star crust. During the cooling phase, observations probe the thermal structure of the curst. Nuclear reactions such as electron capture and beta decay cycling (Urca cycling) can cool the neutron star, impacting such observations, and may also affect the behavior of X-ray bursts. A thorough understanding of these reactions is therefore necessary for correct interpretation of X-ray observations of X-ray bursts, superbursts, and crustal cooling. The yet- unknown contribution of Urca cooling to the overall cooling of the neutron star depends both on the abundance of potential coolers (the ash composition) as well as the ground state to ground state transition strengths between the Urca pairs. This work will detail a new dedicated experimental program of measurements of ground state beta-decay strengths in potential crust Urca coolers at the National Superconducting Cyclotron Laboratory (NSCL), present first results, and discuss the impact on neutron star cooling.

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