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Heating and Cooling in Accreting Neutron Stars

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Neutron stars in low mass X-ray binaries accrete enough mass over their lifetimes to replace their entire crust. The accreted matter undergoes a series of nuclear reactions in the crust as it is compressed by continued accretion to higher density. These reactions, which include electron captures, neutron emissions, and pycnonuclear reactions, heat the crust and core of the neutron star. In this talk I will discuss what we can learn from observations of transiently accreting neutron stars in quiescence, when accretion has turned off and we can see emission from the neutron star directly. The quiescent luminosity of these neutron stars constrains the neutrino emissivity in the neutron star core. In systems with long accretion outbursts, observations of thermal relaxation of the crust in quiescence enable, for the first time, constraints on the thermal conductivity and heat capacity of the crust. In this way, low mass X-ray binary neutron stars offer a remarkable chance to constrain the properties of dense neutron-rich matter, such as neutron superfluidity and pasta phases in the inner crust of neutron stars.