The Equation of State of Dense Matter: Connecting Nuclear Experiment and Astrophysical Observations

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The equation of state (EOS) of matter near and above the nuclear saturation density can be probed in neutron stars, nuclear structure, and heavy-ion collisions. However, experimental and observational uncertainties make constraining the EOS a challenge. In the first part of this talk, it is demonstrated that the composition of the neutron star crust depends on both the EOS of low-density neutron matter and the nuclear symmetry energy. This dependence is observable in the quasi-periodic oscillations which are exhibited by magnetars during giant flares. This is a promising way of obtaining the EOS, as these oscillation frequencies are less sensitive to observational uncertainties.

An increasing number of neutron star mass and radius measurements are becoming available, from both accreted and isolated neutron stars. In the second part of this talk, it is shown that these observations now allow a statistical approach for determining the EOS. A Bayesian formalism for constraining the EOS is presented, which appropriately reflect the experimental and astrophysical uncertainties. In order to match currently available observations, the pressure of the EOS must be relatively small near the saturation density.