The nuclear chart and equation of state from nuclear forces

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This talk will discuss ab initio calculations of the nuclear chart and predictions for the drip lines from light through medium-mass nuclei. Starting from a chiral two- and three-nucleon interaction with good saturation properties, we have calculated ground-state and separation energies for all nuclei from helium to iron, nearly 700 in total. From a systematic comparison, we find that the deviation of separation energies from experiment yields an approximately Gaussian distribution. We use this to provide theoretical uncertainties for our ab initio calculations towards the drip lines. Where the drip lines are known experimentally, our predictions are consistent within the estimated uncertainty. For the neutron-rich fluorine to titanium isotopes, we provide predictions to be tested at rare-isotope beam facilities. This work demonstrates that ab initio calculations are advancing to global theories. In the second part of this talk, we will discuss ab initio calculations of the nuclear equation of state based on the same chiral effective field theory interactions, with a focus on constraints for neutron star properties, thermal effects on the equation of state, and comparisons to astrophysical observations.

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