Constraining Nuclear Models from PREX and CREX Data on Pb-208 and Ca-48 Neutron Skin Thicknesses

Tianqi Zhao
Ohio University

Parity-violating electron scattering on Pb-208 and Ca-48 from JLab experiments (termed PREX and CREX, respectively) have reported neutron skin thicknesses of 0.121(+0.35) (-0.35) fm and 0.283 (+0.071) (-0.071) fm, respectively. This data can shed light on the isospin dependence of nuclear interactions in nuclei without the uncertainties associated with strong interaction probes.

To account for the reported data, we have generated a few hundred thousand energy density functionals and calculated properties of finite nuclei, infinite nuclear matter, as well as of neutron stars. Our joint analyses of PREX and CREX data favor energy density funtionals with a large bulk symmetry energy S_v=33(+6)(-7) MeV and a small symmetry energy slope parameter L at the nuclear equilibrium density, which is in 2-sigma (95\%) tension with nuclear masses and charge radii. This tension leads to a strong constraint on the L=42(+15)(-17) MeV. The posterior distribution is dominated by CREX data since it rules out large L, whereas the PREX likelihood function has a long tail which is compatible with small L. Joint analyses with neutron star constraints including the maximum mass, tidal deformability, and radius observations slightly tighten the lower bound L to be 43(+15)(-11) MeV. Furthermore, we find that our results agree nicely with previous neutron skin experiments, dipole probabilities as well as with recent ab-initio calculations.

Tuesday, October 25th, 2022

4:00 pm

Lindley Hall room 321