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Determination of the neutron-deficient ^{54}Ni charge radius and symmetry energy constraints using the difference in mirror pair charge radii

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Different parameterizations of Skyrme energy density functionals show large variations in the stiffness of the neutron equation of state (EOS), making extrapolations to higher densities uncertain [bro00]. It has been shown that the difference in mirror pair charge radii is correlated with the L parameter, which is the slope of the symmetry energy in the nuclear EOS [bro17]. By placing constraints on L, the neutron equation of state can thereby be constrained. In the present study, the charge radius of neutron-deficient ^{54}Ni was determined for the first time using collinear laser spectroscopy at the BEam COoling and LAser spectroscopy (BECOLA) facility [min13, ros14] at NSCL/MSU. Using the difference in mirror pair charge radii between ^{54}Ni and ^{54}Fe , a constraint of $20 \leq L \leq 70$ MeV has been placed [pin21], consistent with results from the gravitational wave event of the GW170817 neutron star merger [rai19] and barely consistent with those from PREX-II [ree21]. Constraints on the neutron skin for ^{48}Ca from this experiment are in agreement with the preliminary CREX results released at DNP 2021, implying a “soft” EOS and contradictory to the PREX results. In addition to the experimental results, a new trend analysis will be discussed, which evaluates the reliability of the difference in mirror charge radii as a good isovector indicator [rei22].

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