PROTON DISTRIBUTION RADII OF $^{12-19}$C ILLUMINATE FEATURES OF NEUTRON HALOS AND EQUATION OF STATE

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Neutron-rich nuclei offer a wealth of new features that surface only at extremes of neutron-proton asymmetry. In such nuclei, the nuclear halo and skin have unfolded new features with a nuclear surface that is dominantly composed of neutrons. These nuclei therefore also provide good grounds to investigate the equation of state of asymmetric nuclear matter. In order to determine the extent of the neutron surface and to characterize the nuclear halos, one needs knowledge on the proton and matter radii.

We will report first accurate determination of the point proton root-mean-square radii of neutron-rich carbon isotopes $^{15-19}$C as well as $^{12-14}$C from new measurements of charge-changing cross sections performed at the fragment separator FRS, GSI, Germany. The results that will be presented show rapidly growing thick neutron surface (skin). New predictions from the *ab initio* coupled cluster computations will be compared to the data. The good agreement with the data illustrates the importance of the accurate description of the chiral nucleon-nucleon and three-nucleon forces. It will be shown that the observed radii define a large halo radius for ^{19}C, comparable to that of ^{11}Li while that of ^{15}C is relatively smaller.

The presentation will show how the symmetry energy and its density derivative are constrained from their correlation with the radii and the neutron skin thickness. These parameters of the equation-of-state of asymmetric nuclear matter are important to understand the properties of neutron stars, specifically the radius of the neutron star.