Precise calculations of charge radii of light nuclei

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Charge radii of light nuclei characterize distribution of electric charge inside corresponding nuclei and are a perfect tool to test modern high-precision nuclear forces. Experimentally these radii can be extracted from electron scattering and laser spectroscopy of normal and muonic atoms with sub-percent level of accuracy. Theoretical description with similar accuracy level requires very good understanding of two- and three-body forces, two-body electromagnetic currents, and various relativistic effects. We present a high-accuracy calculation of the nuclear structure for A=2,3,4 nuclei using the latest two- [1] and three-nucleon forces [2] and charge density operators derived up through the fifth order in the chiral effective field theory [3,4]. We predict the structure radii of the deuteron [3,4], the alpha-particle and the isoscalar combination of ^{3}H and ^{3}He, and perform a comprehensive analysis of various sources of uncertainties. Using the predicted values of ^{2}H and ^{4}He structure radii combined with spectroscopic measurements of the deuteron-proton charge radius difference and ^{4}He charge radius we extract the neutron and proton charge radii.

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