RELATION BETWEEN MATTER AND CHARGE RADII OF BORROMEAN HALO NUCLEI: THE 6HE NUCLEUS

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A semianalytic connection between matter and charge radii for Borromean halo nuclei is derived [1]. It is based on the three-body core + N + N cluster structure of such halo nuclei and knowledge of corresponding radii for the constituents from general properties of their ground states [2]. In stable nuclei the charge and matter sizes are close to each other, while in the neutron halo nuclei they are strikingly different. Traditionally, the charge radius is studied by electron scattering, isotope-shift measurements etc., involving the well-known electromagnetic interaction. Extracting the matter radius is more model-dependent, since in addition to ambiguities of the nuclear structure, supplementary assumptions on the reaction mechanism and effective nucleon-nucleon interactions are involved. Recently, a precise measurement of the charge radius of the 6He Borromean nucleus, 2.054 +- 0.014 fm, was performed [3] by the method of laser spectroscopy. Using the experimental value for the 6He point-proton charge radius 1.912 +- 0.0018 fm, and the point-proton charge/matter radius 1.45 fm of 4He (derived from the charge radius 1.672+-0.025 fm), we obtain with our semianalytic formula an r.m.s. matter radius of 6He equal to 2.59+-0.05 fm. Comparing this with r.m.s. radii extracted from nuclear reactions we may conclude, that Glauber type methods using core + valence neutron density [4] or granularity of the 6He structure with quantum interference [5], are gratifyingly consistent with our reconstructed value. The charge form factor of 6He which is subject of future experiments at GSI and RIKEN is also predicted.

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