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Determination of point proton radii of neutron-rich nitrogen isotopes

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Exploring neutron-rich nuclei near the drip line with significant neutron/proton asymmetry exposes exotic phenomena like the existence of a neutron halo or skin and (dis)appearance of existing magic numbers. Nuclear halos result from the spatial distribution of outermost neutrons, causing a low-density extende. A systematic study of the point proton radii (root mean square radii of the density distribution of protons treated as point particles, referred to as point proton radii) along an isotopic chain reveals insights into the impact of the extended neutron wavefunction on the protons. This work presents the first determination of the point-proton radius for ^{23}N, as well as the radius of ^{21}N. The systematic study of $^{21-23}$N radii will be performed.

The RI beams of $^{21-23}$N are produced via projectile fragmentation reaction after the primary beam of ^{48}Ca (345A MeV) interacts with the rotating ^{9}Be target at the BigRIPS facility at RIKEN Nishina Center in Japan. The charge-changing cross section (σ_{cc}) was measured with a carbon target placed at the final focal plane using the transmission technique. The ratio of the number of particles transmitted through the target without any loss of protons to the number of incoming particles provides the desired cross-section. The proton radii are extracted from the measured σ_{cc} using the finite-range Glauber model framework.

The proton radii derived from this study, combined with the previously reported significantly large matter radius of ^{23}N, as well as the proton radii measurements of $^{17-22}$N, offer valuable insights into the structural features of the neutron-rich isotope ^{23}N. Furthermore, a σ_{cc} measurement of ^{21}N at two different energies (i.e., at approximately 230A MeV and 900A MeV) further provides the groundwork for the necessity of a scaling factor.

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