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Experiment at NIST to produce one-electron ions in circular Rydberg states

JOSEPH TAN, NIST, SAMUEL BREWER, University of Maryland, NICHOLAS GUISE, NIST — Highly charged ions, including bare nuclei, produced in the NIST EBIT (electron beam ion trap) are extracted and captured in the simplest Penning trap that can be configured with a single neodymium (NdFeB) magnet. Slowing and capture of bare nuclei is a step towards formation and study of one-electron ions within the well-controlled environment of a Penning or Paul trap. Detailed laser spectroscopy of hydrogen-like ions in circular Rydberg states would potentially provide a test of theory in a regime with completely negligible nuclear-size corrections. Such a test is of particular interest in the wake of the large discrepancy in proton radius determinations that resulted from the muonic hydrogen Lamb-shift measurements. We discuss some experiments with captured ions planned in a more elaborate apparatus configured with a two-neomagnet (Nd-FeB) Penning trap for better magnetic field homogeneity, an electron gun for intrap loading of low-Z ions, and optical access for spectroscopy experiments with low-energy, highly-charged ions.

1N. Guise, S.M. Brewer and J.N. Tan, oral presentation at this meeting

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