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Miniaturized Sources and Traps for Spectroscopy of Multicharged Ions JOSEPH N. TAN, NIST, NICHOLAS D. GUISE, NIST & University of Maryland — Penning traps made extremely compact (<150 cc) with rare-earth (NdFeB) magnets[1] have been used recently to isolate highly charged ions (HCI) for spectroscopy. For example, radiative lifetimes of metastable states are measured by observing the visible fluorescence emitted by isolated Ar XIV (441 nm, 2p $^2P_{3/2} \rightarrow$ 2p $^2P_{1/2}$) and Kr XVIII (637 nm, 3d $^2D_{3/2} \rightarrow$ 3d $^2D_{1/2}$). These measurements use HCIs extracted from an electron beam ion trap (EBIT) at NIST. For planned experiments, a new apparatus is being developed which will incorporate a "mini-EBIT" source using similar permanent-magnet structures. It combines a mini-EBIT and a compact Penning trap to facilitate production of multicharged ions including bare nuclei with nuclear charge in the range Z=1 to Z=10, in a cryogen-free setup with multiple ports for laser and atomic beam access to the isolated HCI. One goal is to produce one-electron ions in Rydberg states with transitions accessible to an optical frequency comb. Such engineered atomic systems are sought to enable tests of theory[2] that could illuminate the proton radius puzzle.[3]

[1]J.N. Tan, S.M. Brewer, and N.D. Guise, Rev. Sci. Instrum. **83**, 023103 (2012).
[2]U.D. Jentschura, et al., Phys. Rev. Lett. **100**, 160404 (2008).
[3]R. Pohl et al., arXiv:1301.0905 [physics.atom-ph].

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