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Hyper-EBIT: A source for heavy highly charged ions

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ALPHATRAP is a Penning trap experiment located at the Max-Planck-Institut für Kernphysik, Heidelberg with the goal to perform tests of quantum electrodynamics (QED) in strong fields by measuring the bound electron magnetic moment or g factor [1]. These tests are performed using highly charged ions, where the few remaining electrons experience the strong fields emanating from the nucleus. Recently, the g factor of $^{118}Sn^{49+}$ was measured at ALPHATRAP with sub parts-per-billion precision, one of the most stringent tests of bound-state quantum electrodynamics, up to two-loop contributions, in very strong fields [2]. In order to push such tests even further, into the most extreme field strengths, similar measurements should be performed with the heaviest highly charged ions such as $^{208}Pb^{81+}$, where the electric fields reach up to 10^{16} V/cm.

The production of $^{208}Pb^{81+}$ involves overcoming the ionization energy of 100 keV. To produce and inject $^{208}Pb^{81+}$ into the cryogenic Penning trap of ALPHATRAP, we are currently constructing the "Hyper-EBIT", an electron beam ion trap designed for electron beam energies of 300 keV and currents of about 500 mA. I will be presenting the current status of Hyper-EBIT development.
[1]S. Sturm et al., Eur. Phys. J. Spec. Top. 227, 1425–1491 (2019)
[2]J. Morgner, et al., Nature 622, 53–57 (2023)

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