The ALPHATRAP g-Factor Experiment

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The ALPHATRAP experiment, located at the Max-Planck-Institute for Nuclear Physics in Heidelberg, Germany, aims to measure the g-factor of electrons in highly-charged ions with fractional uncertainties of 10^{-11} or below. This allows tests of bound-state quantum electrodynamics (BS-QED) in the extreme field region, for example by measuring the g-factor of the bound-electron of $^{208}Pb^{81+}$ in the 10^{16} V/cm field of the nucleus, and comparing it to theoretical predictions. It is a follow-up experiment to the Mainz electron g-factor experiment, which provided the most stringent of BS-QED [1] and the most accurate measurement of the electron mass [2].

The highly charged ions are bred in external electron-beam ion traps and transported through a room-temperature-to-4K beamline into a double-Penning-trap system. The trap system allows microwave and laser access for manipulating the motion and spin-state of trapped ions. An additional external ion source delivers $^{9}Be^{+}$ ions, which can be trapped simultaneously, laser-cooled with a 313 nm laser, and used for sympathetic cooling of the highly-charged ions. Trap characterization measurements using externally loaded ions demonstrated single-ion detection, sufficient stability of the trapping fields, and excellent vacuum conditions of better than 10^{-17} mbar. Further tests of laser- and microwave-manipulation of trapped ions are currently under way. An overview of the experiment will be given and progress towards a first measurement on the bound-electron g-factor of $^{40}Ar^{13+}$ will be discussed.

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[1] S. Sturm *et al*., Physical Review Letters **107** (2011) 023002.

[2] S. Sturm *et al*., Nature **506** (2014) 467–470.