Atomic parity violation in ytterbium

Dionysios Antypas[a], Anne Fabricant[b], Jason Stalnaker[c], Konstantin Tsigutkin[d], and Dmitry Budker[a,b,e]

[a]*Helmholtz-Institut Mainz, Mainz, Germany*
[b]*Johannes Gutenberg-Universität Mainz, Mainz, Germany*
[c]*Oberlin College, Department of Physics & Astronomy, Oberlin, Ohio, USA*
[d]*ASML, Veldhoven, The Netherlands*
[e]*Department of Physics, University of California at Berkeley, Berkeley, California, USA*

In the study of electroweak interactions, atomic parity violation (APV) experiments form a powerful tool, providing valuable information about the Standard Model and low-energy nuclear physics. Ytterbium is an excellent system for such studies, due to its strong APV effect (largest effect observed in any atomic system to date) and the availability of many stable isotopes. This brings within reach the possibility to perform high-precision measurements of the isotopic dependence of the effect, which would serve as a probe of the neutron skin variation among these different isotopes of the ytterbium nuclei. In addition, a determination of the nuclear spin-dependent contributions to the APV effect would be an observation of the nuclear anapole moment, and would yield information about nucleon-nucleon weak meson couplings.

Our programme in ytterbium parity violation in Mainz has reached in early 2018 its first milestone, namely the observation for the first time, of the isotopic variation of the APV effect, as predicted by the electroweak theory. We will present the result of these measurements, and discuss future prospects for determining nuclear spin-dependent APV effects as well as neutron distributions in ytterbium.