Investigating α Time Variation with Cold Highly Charged Ions

VERSOLATO OSCAR[1], SCHWARZ MARIA[1], WINDBERGER ALEXANDER[1], ULLRICH JOACHIM[1,2], SCHMIDT PIET[2,3], DREWSEN MICHAEL[4], CRESPO LOPEZ-URRUTIA JOSE[1]

[1] *Max-Planck-Institut für Kernphysik. D-69116 Heidelberg, Germany*
[2] *Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116, Braunschweig, Germany*
[2] *Institut für Quantenoptik, Leibniz Universität Hannover, D-30167 Hannover, Germany*
[2] *Department of Physics and Astronomy, University of Aarhus, DK-8000 Aarhus C, Denmark*

Narrow optical transitions in highly charged ions (HCIs) are of special interest for metrology as well as for studying fundamental physics. Atomic clocks could exploit the low sensitivity of HCIs to external electric fields. Measurements will benefit from advantageous scaling laws governing the contributions of nuclear size effects and QED in HCIs. For example, the highest sensitivity for a changing fine structure constant ever calculated for a stable atomic system is found in Ir^{17+}. An even better candidate for this purpose is the radioactive Cf^{16+}. However, spectroscopy of HCIs is hindered by the large (10^6 K) temperatures at which they are usually produced and trapped. A tremendous improvement will be obtained when HCIs are cooled down to mK temperatures. In collaboration with the Ion Trap group at Aarhus University we have developed a cryogenic linear Paul trap [1] in which HCIs will be sympathetically cooled by laser-cooled Be^+ ions. Optical access for laser light is maximized while maintaining excellent UHV conditions that are indispensible for long HCI storage times. The Paul trap will soon be attached to an electron beam ion trap (EBIT) which is able to produce a wide range of HCIs. A separate EBIT measurement will also soon provide the first input needed for a necessary experimental determination of the transition energies of Ir^{17+} at a level required for laser experiments. Measurements towards this end are now underway.

[1] M. Schwarz *et al.*, Rev. Sci. Instr. 83, 083115 (2012)