Metrology with Cold Highly Charged Ions in the cryogenic linear Paul trap CryPTEx

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Narrow optical transitions in highly charged ions (HCIs) are of particular interest for metrology as well as for studying fundamental physics. Atomic clocks would exploit an extremely low sensitivity of HCIs to external electric fields. Furthermore, measurements benefit from advantageous scaling laws that govern the contributions from QED as well as from weak interactions. As an example, the highest sensitivity for a changing fine structure constant ever calculated for a stable atomic system is found in Ir^{17+}. 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 when trapped and sympathetically cooled by laser-cooled Be^+ ions. In collaboration with the Ion Trap group at Aarhus University we have developed a cryogenic linear Paul trap [1] suited for this purpose. Optical access for laser light is provided while excellent UHV conditions, that are indispensible for long HCI storage times, are maintained. The Paul trap is now attached to an MPIK electron beam ion trap (EBIT) which is able to produce a wide range of HCIs that are now able to fly through the trapping area of CryPTEx. A separate ongoing 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.

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