

Plenary Talk

PV IV Tue 9:45 Paulussaal

Highly Charged Ion Optical Clocks to Test Fundamental Physics — ●PIET O. SCHMIDT — Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — Leibniz Universität Hannover, Hannover, Germany

The extreme electronic properties of highly charged ions (HCI) make them highly sensitive probes for testing fundamental physical theories while reducing systematic frequency shifts, making HCI excellent optical clock candidates. The technical challenges that hindered the development of such clocks have now all been overcome, starting with their extraction from a hot plasma and sympathetic cooling in a linear Paul trap, readout of their internal state via quantum logic spectroscopy,

and finally the preparation of the HCI in the ground state of motion of the trap. Here, we present the first operation of an atomic clock based on an HCI (Ar^{13+} in our case) and a full evaluation of systematic frequency shifts. The achieved uncertainty is almost eight orders of magnitude lower than any previous frequency measurements using HCI and comparable to other optical clocks. By comparing the isotope shift between $^{36}\text{Ar}^{13+}$ and $^{40}\text{Ar}^{13+}$ the theoretically predicted QED nuclear recoil effect could be confirmed. Finally, first results on the search for a 5^{th} force based on isotope shift spectroscopy of $\text{Ca}^+/\text{Ca}^{14+}$ isotopes will be presented. This demonstrates the suitability of HCI as references for high-accuracy optical clocks and to probe for physics beyond the standard model.