College of Natural Sciences & Mathematics
UNIVERSITY OF DENVER

Physics & Astronomy Colloquium

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Towards optical clocks based on highly charged ions for tests of fundamental physics

Optical atomic clocks based on highly charged ions (HCIs) offer several promising avenues for the study of physics beyond the standard model of particle physics. Among these are searches for time variation of the fine structure constant, $\dot{\alpha}/\alpha$, ultralight scalar dark matter, and tests of quantum electrodynamics (QED). Due to level crossings occurring in high charge states, narrow linewidth, optically accessible transitions with a high sensitivity to $\dot{\alpha}/\alpha$ are predicted in systems such as Pr^{10+}. We plan to create HCIs in a compact electron beam ion trap (EBIT) and then transfer them to a cryogenic radiofrequency (rf) Paul trap where quantum-logic spectroscopy (QLS) will be performed. I will present an update on HCI production in a newly developed EBIT as well as recent results on precision laser spectroscopy using a single $^{9}Be^{+}$ in our first-generation rf trap. In addition, I will present an update on the development of a Ca^{+}/Ba^{4+} quantum-logic clock for use as an improved optical frequency standard and a recently established optical fiber link between CSU and the NIST-WWV clock ensemble located in Fort Collins, CO.