Beitrag ID: **46** Typ: **Talk**

Atomic Physics –from Metrology to BSM Searches

Donnerstag, 18. September 2025 09:30 (25 Minuten)

Atomic physics has long been at the forefront of precision measurement, providing both the tools to define fundamental standards and the sensitivity to probe physics beyond the Standard Model (BSM). Recent advances have allowed us to address open questions in neutrino physics, test the limits of bound-state quantum electrodynamics (QED), and provide benchmark data for astrophysics and plasma modeling. In this talk, I will present a broad overview of these efforts, drawing from my work, co-workers and collaborations.
On the BSM frontier, I will discuss the BeEST experiment, which uses superconducting tunnel junction detectors to measure the recoil spectrum of ^{7}Li nuclei from electron-capture decay of ^{7}Be [1,2]. This approach enables direct searches for heavy sterile neutrinos and has recently provided the first constraints on the spatial extent of neutrino wavepackets [3]. I will also highlight the theoretical challenges in accurately modeling atomic relaxation processes, particularly shake-up and shake-off, using multiconfiguration Dirac–Fock methods [4], which are essential to disentangle potential new-physics signatures from standard atomic effects.
In parallel, high-precision x-ray spectroscopy of highly charged ions provides stringent tests of QED in multi-electron systems. Reference-free measurements of He-like transition energies [5-7] combined with Bayesian statistical analyses [8] allow us to benchmark theory at the ppm level and to evaluate possible deviations as potential signs of new interactions.
Finally, I will show how these precision tools feed into applications well beyond the laboratory, from accurate fluorescence yields and line-shape parameters [9–10] relevant for plasma modeling to laboratory measurements of astrophysically abundant ions [11-12], which are essential for interpreting modern x-ray observations of hot cosmic environments.
Together, these examples illustrate how atomic physics continues to connect precision metrology with fundamental physics searches, playing a key role in both testing the Standard Model and enabling discoveries in astrophysics.

Autor: MACHADO, Jorge (LIBPhys-UNL)

Vortragende(r): MACHADO, Jorge (LIBPhys-UNL)

Sitzung Einordnung: Session 9