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Neutral atom traps of rare isotopes at the precision frontier

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Laser cooling and trapping techniques offer unprecedented control of an atom's external and internal degrees of freedom. The species of interest can be selectively captured, precisely positioned, cooled close to absolute zero temperatures, and observed with high signal-to-noise ratio even down to the single-atom level. Likewise, the atom's internal electronic and magnetic state can be accurately manipulated and interrogated. Applied in nuclear physics, these techniques are ideally suited for precision measurements in the fields of testing fundamental interactions and symmetries, nuclear structure studies, and detection of rare isotopes. In particular, they offer unique opportunities in the quest for physics beyond the Standard Model when applied to specific rare isotopes that exhibit enhanced sensitivity to signals of new physics. In my talk, I will review new and ongoing developments and will cover world-wide efforts to apply laser cooling and trapping of rare isotopes to experiments such as measurement of atomic parity-non-conservation, searches for permanent electric dipole moments, studies of nuclear beta decays, and ultra-trace isotope analysis.

Primary author: Dr MUELLER, Peter (Argonne National Laboratory)

Presenter: Dr MUELLER, Peter (Argonne National Laboratory)

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