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Searching for Ultra-Low-Mass Dark Matter with Precision Atomic Experiments

Wednesday 10 September 2025 09:30 (30 minutes)

Ultra-low-mass bosonic particles produced non-thermally in the early Universe may form a coherently oscillating classical field that can comprise the observed cold dark matter. The very high number density of such particles can give rise to characteristic wave-like signatures that are distinct from the particle-like signatures considered in more traditional searches for WIMP dark matter. In particular, ultra-low-mass scalar dark matter may induce apparent variations of the fundamental "constants"of Nature, while ultra-low-mass pseudoscalar (axionlike) dark matter may induce time-varying spin-precession effects (including oscillating electric dipole moments). I discuss the basic principles, recent results and future possibilities in searches for ultra-low-mass dark matter using a variety of precision low-energy experiments, including atomic spectroscopy, optical cavities and interferometers, torsion pendula, magnetometry, neutron experiments and g-factor measurements.

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