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Massive graviton dark matter searches with atom interferometers

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Atom interferometers offer exceptional sensitivity to ultra-light dark matter (ULDM) through their precise measurement of phenomena acting on atoms. Previous work has established their capability to detect scalar and vector ULDM, but their potential for detecting spin-2 ULDM has until recently remained unexplored. In this talk I will introduce the sensitivity of atom interferometers to spin-2 ULDM by considering several frameworks for massive gravity: a Lorentz-invariant Fierz-Pauli case and two Lorentz-violating scenarios. Coherent oscillations of the spin-2 ULDM field induce a measurable phase shift through three distinct channels: coupling of the scalar mode to atomic energy levels, and vector and tensor effects that modify the propagation of atoms and light. Atom interferometers uniquely probe all of these effects, while providing sensitivity to a different mass range from laser interferometers. These results demonstrate an exciting new theory target for atom interferometers and other quantum sensors to explore. Based on arXiv: 2412.14282; work in collaboration with Diego Blas and Christopher McCabe.

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