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MAGIS-100 and Large Momentum Transfer Clock Atom Interferometry in Strontium

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I will discuss MAGIS-100, a new 100-meter tall atomic sensor being constructed at Fermilab. MAGIS-100 will serve as a prototype for proposed space-based atomic detectors that target gravitational waves in a frequency band complementary to existing detectors (0.03 Hz 3 Hz), the optimal frequency range to support multi-messenger astronomy. MAGIS-100 will also be sensitive to proposed ultra-light dark matter (scalar and vector couplings) at unprecedented levels, and is expected to allow new demonstrations of quantum mechanics over meter-scale wavepacket separation and long coherence times. In pursuit of these goals, I will also present recent efforts towards increasing the sensitivity of atom interferometers through the use of narrow-line clock transitions in alkaline earth atoms such as strontium. These narrow-line transitions hold promise to circumvent some constraints in conventional atom interferometers, enabling potentially increased sensitivity through large momentum transfer (LMT) atom optics and reduced susceptibility to laser phase noise in a gradiometer configuration. I will show recent results on LMT interferometry on the 689 nm intercombination line of strontium, which demonstrate for the first time an LMT interferometer based on sequential single-photon transitions, a critical requirement for MAGIS-100 and generally for gravitational wave detection using clock atoms.