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Atomic Gravitational Wave Detectors

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Atom interferometry and atomic clocks continue to make impressive gains in sensitivity and time precision. With this in mind, I will discuss the potential science reach and technical feasibility of gravitational wave detectors based on precision atomic sensors. I will describe a new type of atom interferometry based on narrow-line optical transitions that combines inertial sensitivity with features from the best atomic clocks, allowing for increased immunity to technical noise and systematic errors. This technique is central to the Mid-band Atomic Gravitational wave Interferometric Sensor (MAGIS) proposal, which is targeted to detect gravitational waves in a frequency band complementary to existing detectors (0.03 Hz 10 Hz), the optimal frequency range to support multi-messenger astronomy. I will also discuss MAGIS-100, a 100-meter tall atomic sensor now being constructed at Fermilab that will serve as a prototype of such a gravitational wave detector, and that will be sensitive to proposed ultra-light dark matter (scalar and vector couplings) at unprecedented levels.