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Probing Fundamental Physics with Long-baseline Atom Interferometry

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Atom interferometers exploit spatially delocalized quantum states to make a wide variety of highly precise measurements. Recent technological advances have opened a path for atom interferometers to contribute to multiple areas at the forefront of modern physics, including searches for wave-like dark matter, gravitational wave detection, and fundamental quantum science. In this talk, I will describe MAGIS-100, a 100-meter-tall atom interferometer being built at Fermilab to pursue these directions. MAGIS-100 will serve as a prototype gravitational wave detector in a new frequency range, between the peak sensitivities of the LIGO and LISA, that is promising for pursuing cosmological signals from the early universe and for studying a broad range of astrophysical sources. In addition, MAGIS-100 will search for wave-like dark matter, probe quantum mechanics in a new regime in which massive particles are delocalized over macroscopic scales in distance and time, and act as a testbed for advanced quantum sensing techniques. Finally, I will discuss the potential and motivation for follow-on atomic detectors with even longer baselines.

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