MAGIS-100: A New Experiment for Gravitational Wave Detection and Dark Matter Searches with Atom Interferometry

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Atom interferometers exploit the quantum mechanical properties of matter to make a variety of highly precise measurements [1]. By leveraging recent advances in atom interferometry technology [2, 3, 4], the MAGIS collaboration is planning to build a 100-meter-tall strontium atom interferometry apparatus (MAGIS-100) to search for ultralight, wavelike dark matter in the mass range 10^{-22} eV to 10^{-11} eV and to serve as a prototype gravitational wave detector in the 'mid-band' frequency range of 0.1 Hz to 10 Hz, which is complementary to the frequency ranges probed by LIGO and by the planned LISA interferometer [5]. In this talk, I will discuss the motivation and plans for the MAGIS-100 experiment.

Several research and development directions will be pursued to enhance the sensitivity of MAGIS-100 to gravitational waves and dark matter. Technologies to be developed include atomic beam splitters with increased momentum transfer, ultracold strontium sources with increased atom flux, and spin-squeezed [6] strontium sources for entanglement-enhanced quantum metrology [5]. It is anticipated that MAGIS-100, in combination with these research and development efforts, will pave the way for a kilometer-scale apparatus (MAGIS-1000) that will be capable of detecting known sources of gravitational waves. In combination with other instruments such as MIGA [7], the MAGIS collaboration plans to contribute to a global network of atomic gravitational wave detectors.

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