Gravitational Wave Detection and Dark Matter Searches with Atom Interferometry

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Abstract  Atom interferometers exploit the quantum mechanical, wavelike nature of massive particles to make a broad range of highly precise measurements. Recent technological advances have opened a path for atom interferometers to contribute to two areas at the forefront of modern physics: gravitational wave astronomy and the search for dark matter. In this colloquium, I will describe a new experiment, MAGIS-100, that will use a 100-meter-tall atom interferometer to pursue these directions. MAGIS-100 will serve as a prototype gravitational wave detector in the mid-band frequency range 0.1 Hz to 10 Hz, which is complementary to the frequency bands addressed by laser interferometers such as LIGO and the planned LISA experiment. I will discuss the scientific motivation for gravitational wave detection in the mid-band. In addition, I will explain how MAGIS-100 can look for ultralight dark matter, a well-motivated class of dark matter candidates that behave as coherently oscillating fields.
**Biography** Tim Kovachy is an Assistant Professor at the Northwestern University Department of Physics and Astronomy and a member of the Northwestern University Center for Fundamental Physics at Low Energy. Dr. Kovachy’s research involves the use of precision atom interferometry for fundamental physics tests. He has played a leading role in pioneering the development of advanced techniques to enhance the sensitivity of atom interferometers. Dr. Kovachy and collaborators have used these methods to realize atomic gravitational sensors with unprecedented sensitivity, to probe quantum systems at macroscopic scales, and to study the interaction of macroscopic quantum systems with gravity. Additionally, he has contributed to analysis and technology development for gravitational wave detectors based on atom interferometry. Dr. Kovachy received his Ph.D. in Physics from Stanford University in 2016. Before moving to Northwestern in the Fall of 2018, he was a postdoctoral scholar at Stanford.