



The University of Texas at Austin
Department of Physics
College of Natural Sciences

Colloquium

Wednesday, March 22, 2023
John Archibald Wheeler Lecture Hall
PMA 4.102, 4:00pm

*Hunting for “fifth forces”,
dark matter, and gravitational waves
with optically levitated sensors*

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Abstract

Despite the tremendous success of the Standard Model of particle physics, many basic phenomena surrounding us remain without any satisfactory explanation, including the nature of Dark Matter and Dark Energy, which together make up 95 percent of the matter-energy content of our universe. Complementary to high-energy particle colliders or large-scale detectors, ultra-sensitive tabletop experiments are well suited to discover a wide range of new phenomena beyond the Standard Model, where feeble interactions require precision measurements rather than high energies. In high vacuum, optically levitated dielectric nanospheres can achieve excellent decoupling from their environment, making force sensing at the zeptonewton level (10^{-21} N) achievable. In this talk I will describe our experimental efforts using dielectric objects supported by radiation pressure as precision sensors to search for quantum effects related to gravity, high-frequency gravitational waves, and Dark Matter.

Andrew Geraci completed his undergraduate study in Physics and Mathematics at the University of Chicago. He completed a Ph.D. in physics at Stanford and then worked as a postdoctoral researcher at NIST in Boulder, CO where he was a National Research Council postdoctoral Research Associate. In 2011 Geraci started a research group as an assistant professor at the University of Nevada and moved to Northwestern University in 2018, where he is currently associate professor of physics and a member of the Center for Fundamental Physics and the Center for Interdisciplinary Exploration and Research in Astrophysics.

His research interests include tabletop tests for physics beyond the Standard Model, dark matter, experimental gravitation, gravitational wave detection, ultrasensitive force detection, hybrid quantum systems, and quantum optomechanics. Geraci also leads ARIADNE, an international collaboration using NMR-based techniques to search for the QCD axion. He is a Fellow of the American Physical Society and was recently selected as the recipient of the 2023 APS Francis Pipkin Award.