



Ph.D. DISSERTATION DEFENSE

Candidate: Thomas Beitel
Degree: Doctor of Philosophy
School/Department: Charles V. Schaefer, Jr. School of Engineering and Science / Physics
Date: Tuesday, December 16, 2025
Time/Location: 10:30AM / Babbio 203
Title: Graviton Detection and Its Quantum Aspects

Chairperson: Dr. Igor Pikovski, Department of Physics, School of Engineering & Sciences

Committee Members: Dr. Ting Yu, Department of Physics, School of Engineering & Sciences
Dr. Xiaofeng Qian, Department of Physics, School of Engineering & Sciences
Dr. Adam Overwig, Department of Physics, School of Engineering & Sciences
Dr. Miles Blencowe, Department of Physics and Astronomy, School of Arts & Sciences, Dartmouth College

ABSTRACT

There has been a great amount of speculation on how gravity works on a quantum level, but very little experimental input. Recently, we have shown that single gravitons, the expected quantum particle of gravity, can be detected. Here I will summarize how single gravitons can be detected and discuss how this result facilitates the study of gravitational waves and the exploration of quantum gravity, inspired by historical tests probing the quantization of light. Specifically, we discuss how the proposed detector differs from previous graviton detection attempts, how different gravitational wave states can be deduced through detection probabilities and other tomography, and how fundamental quantum properties of gravitons, such as the frequency-energy relationship of the graviton and the quadrupole interaction of gravity, can be tested. Our results demonstrate the near future realization of graviton detection and resulting tests that can provide a more concrete and empirical outlook on the quantum nature of gravity.