PHYSICS AND ASTRONOMY

COLLOQUIUM

Dr. Adrian Lupascu

University of Waterloo

"Ultrastrong coupling of a single artificial atom to the electromagnetic field"

Abstract

I will present our results on the observation of ultrastrong interactions between an artificial atom and a one-dimensional quantum electromagnetic field. In this new regime the atom-field interaction strength is comparable to or larger than the atomic frequency. We design a tunable coupling circuit between the atom, a flux qubit, and the electromagnetic field in a superconducting transmission line, which allows us to explore the transition from weak to ultrastrong coupling. The experiments rely on coherent measurements of scattering of microwaves by the atom. We observe a linewidth comparable to the atomic frequency, a clear signature of ultra-strong coupling. We also find that the atomic frequency is systematically smaller than the bare atomic frequency, in agreement with renormalization by the field.

In the second part of the talk I will discuss experiments in which we apply strong driving to the atom. We show that the driving amplitude can be used to change the threshold for the coherent to incoherent transition for atom dynamics, as observed spectroscopically and in agreement with theory.

Finally, I will discuss prospects for the study of the atomic time dynamics in the ultra-strong coupling regime and its implications for investigations of open system physics, quantum optics, and relativistic quantum information.

Wednesday, January 16, 2019
3:30 p.m.
Elliott Building Room 167