Old Dominion University
Department of Physics

Virtual Colloquium

Thursday, March 18, 2021
3:00 pm

"Light-matter interaction for photonic quantum technologies"

Dr. Alisa Javadi
University of Basel

Abstract: Photonic quantum technologies are matchless for applications such as large-scale quantum networks and quantum-enhanced sensing. Furthermore, photons provide new paradigms for quantum simulations and a testbed for benchmarking the advantage of quantum simulators over classical ones. These applications demand novel resources such as efficient single-photon sources, large clusters of entangled photons, and nonlinear optical gates. A 1D-atom, a quantum emitter coupled to a single optical mode with high efficiency, can deliver most of these functionalities.

In this talk, I will present two realizations of an artificial 1D-atom: single quantum dots coupled to nanophotonic waveguides, or to a tunable Fabry-Perot microcavity. These realizations open the door to a myriad of tools such as single-photon sources, giant optical nonlinearities, and non-reciprocal optical elements.

In the first part of the talk, I will present our progress towards realizing an efficient source of single photons. I will demonstrate both an on-chip, and a fiber-coupled single-photon source, and outline the prospects for converting these sources to a source of entangled photons suitable for photonic quantum computing and communications. In the second part of the talk, I will show that the transmission through a 1D-atom is a highly nonlinear process, and the on-set of the nonlinearity occurs at only two nanowatts. I will discuss the nonlinearity's quantum nature and show that it takes place at the single-photon level.

Finally, I will present an overview of my feature research direction and my vision for quantum computing and quantum networking using photons.

BIO: Alisa Javadi is a postdoctoral fellow at the University of Basel. His research lies at the interface between solid-state physics and quantum optics. He works on harnessing the interaction between photons and artificial atoms as a resource for quantum information processing.
He received his Ph.D. degree from the Niels Bohr Institute at the University of Copenhagen in 2015. During his Ph.D., he demonstrated optical nonlinearities at the single-photon level. Recently, his research on single-photon sources led to a record-breaking single-photon source based on a quantum dot in an optical microcavity. Some of the other outcomes of his research include demonstrating chiral coupling between photons and quantum emitters, and demonstrating optical switching with long memory in a waveguide. He is a recipient of Marie Skłodowska-Curie postdoctoral fellowship from the European Commission.

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Eastern Time (US and Canada)
Dr. Alisa Javadi, University of Basel

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