Electro-Optics & Physics Joint Seminar
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Shaping single photons:
Engineering spectro-temporal properties of quantum states of light

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Abstract

"Light is both a wave and a particle" is the consensus that the modern quantum optics community has come to in reconciling Newton's vision with that of Hyugens, while passing through Planck experiments and Einstein's theory of the photoelectric effect.

Single photons are the most basic element of the modern quantum theory of light, and play a key role as information carriers in quantum networks, often referred to as "flying qubits," because of the low level of interaction between them and their environment. In this talk, I start by discussing techniques of generating single photons on-chip via the excitation of an Indium Arsenide quantum dot (QD) in a cavity resonator. Unfortunately, due to limitations on the emission wavelength, the single photon emission is often at a different wavelength than that of interest. Moreover,due imperfect growth and unavoidable dephasing mechanisms, the emission wavelength is different for each QD in the system and the generated photons suffer from poor interference visibility, hence limiting their usefulness in linear optical quantum computing applications. I will present results that show noiseless wavelength translation of single photons, and how to employ this technique to erase the spectral distinguishibility of two QD states. Temporal filtering via synchronized amplitude modulation will then be employed to enhance the temporal properties of the QD emission. As an outlook, I will show first results on a new method for arbitrary and waveform shaping of single photons through the modulation of temporal and spectral phase of a photonic wavepacket, that goes beyond simple translation or intensity modulation of light.

Biographical sketch

Dr. Imad Agha is currently assistant professor at UD, where his research focuses on the development of photonic integrated circuits. Dr. Agha received a B.E. in ECE from the American University of Beirut, Lebanon, and a Ph.D. in Applied Physics from Cornell University. His doctoral research focused on characterizing parametric nonlinear optical interactions in high-Q microresonators. Prior to UD, he was at NIST, USA and at CNRS, France, working in the field of quantum optics and squeezed states of light.