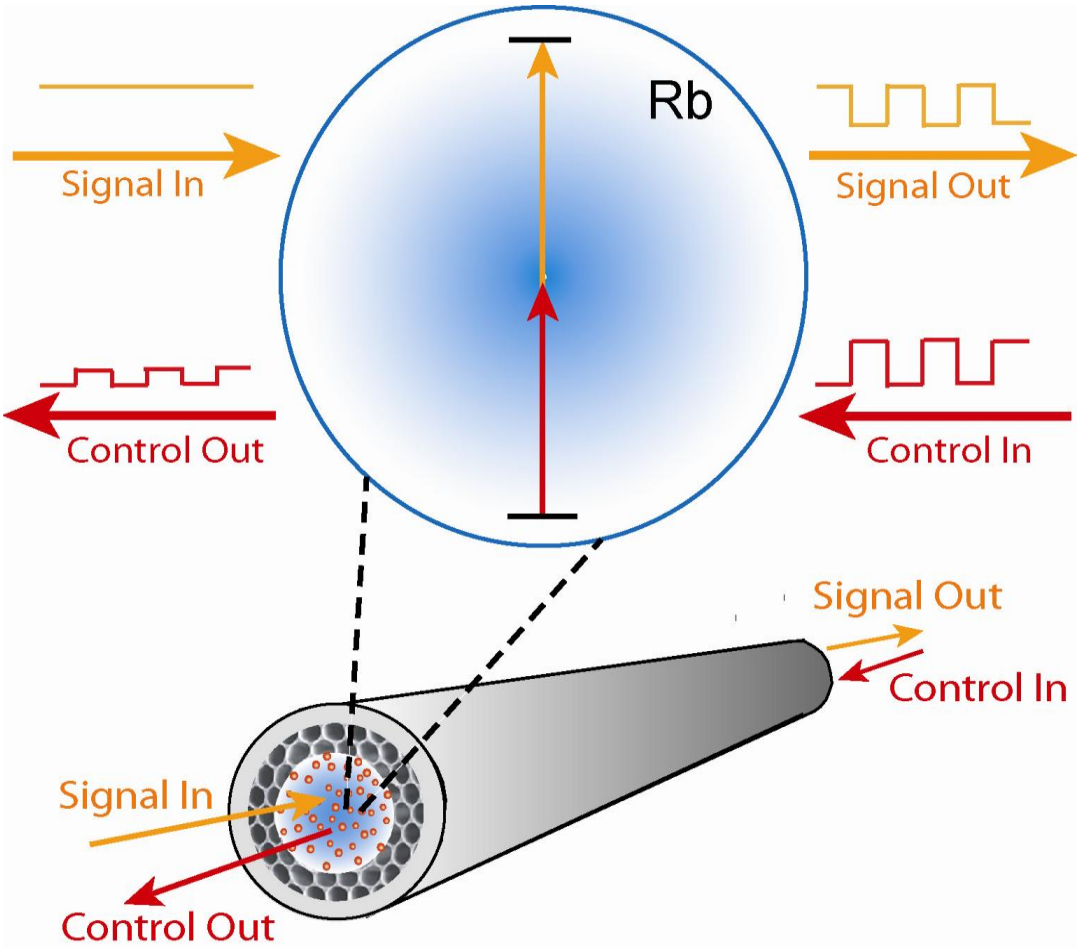
Title – Few-photon nonlinear optics in photonic bandgap fibers

Speaker - Vivek Venkataraman

Affiliation - School of Applied and Engineering Physics, Cornell University, Ithaca, NY, USA

Abstract - The ability to control light with light (all-optical control) at ultralow powers has been a major avenue of research in photonics, and it is critical to demonstrate such effects near the single-photon level for quantum information applications. Alkali-metal vapors such as rubidium (Rb) have been used extensively for light-matter interactions due to the large cross section per atom and well-defined energy level structure. Optical waveguides such as photonic band-gap fibers (PBGFs) with a hollow core allow various gases to be injected into the core and interact with single-mode optical fields. We have demonstrated the ability to load hollow-core optical fibers with rubidium vapor, and this system exhibits exceptionally strong nonlinearities due to the tight light confinement, high vapor density and long interaction length. We observe efficient nonlinear optical interactions viz. four-wave mixing and two-photon absorption at ultralow powers, orders of magnitude lower than those in bulk vapor cells. We demonstrate all-optical intensity and phase modulation with <20 photons, i.e. a few attojoules of energy, in our Rb-PBGF system at fast timescales of <5 ns, thus showing its potential for exploring nonlinear effects at ultralow powers for quantum information applications.



Bio – Vivek Venkataraman is a final year Ph.D. student in the Quantum and Nonlinear Photonics group of Prof. Alexander L. Gaeta in the School of Applied and Engineering Physics at Cornell University. He has been exploring nonlinear optical interactions at ultralow light-levels with rubidium atoms in hollow-core fibers as part of his graduate research. He received an M.S. in Applied Physics from Cornell University in 2009. Prior to coming to the US for graduate studies, Vivek obtained a B.Tech. in Electrical Engineering from the Indian Institute of Technology, located in his hometown of Delhi, in 2006. He worked on modeling and simulation of nanoscale strained-silicon transistors for his undergraduate thesis.