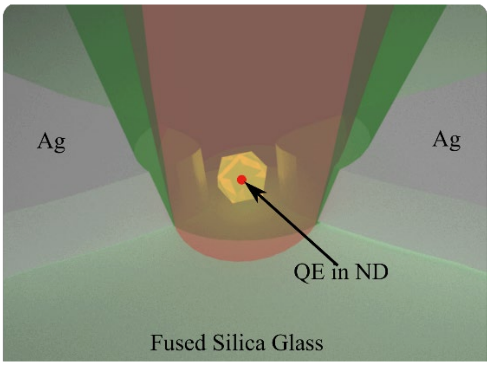
Thesis Title: Enhancing emission properties of single photon sources	
Suggested by: Shailesh Kumar	**Possible Supervisor(s): Shailesh Kumar, Sergey I. Bozhevolnyi**

Project Description:

Single photon sources are key resources for quantum technologies. There are many light sources, which can be used for generation of single photons. For example, single organic molecules, color centers in diamonds, quantum dots, etc. Single photon sources, in general, have issues such as low photon generation rate, wide spectrum of generated photons and poor polarization. These issues can be solved by fabricating nano-structures around single photon sources. In this master project, the aim will be to utilize nano-structures for enhancing the emission properties of single photon sources.

Plasmonic (metallic) structures can allow for very confined modes, either as a waveguide or as a cavity. This can give rise to enhanced decay rates for the emitter. With plasmonic waveguides coupled to single photon sources, one can efficiently channel the emission into waveguides. By utilizing nanostructures which work as nano-cavity as well as antennas, the directivity of the emitted photons can be increased. In the master project, a particular structure will be simulated, first, to optimize the structure, and then fabrication and characterization will be done.

Fabrication of nano-structures will be done utilizing electron-beam lithography. Properties of single photons will be measured in our optical set-up. In the optical set-up we have state-of-the-art equipment to measure lifetime of the emitter and spectrum of emitted photons. We will also utilize a Hanbury Brown and Twiss set-up to characterize single photon sources, to confirm whether we are, in fact, detecting single photons.

(a)


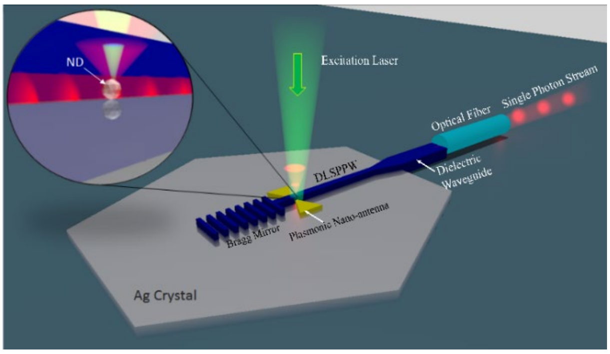
(b)


Figure 1: (a) Plasmonic-cavity with a single photon emitter (QE: quantum emitter) (b) plasmonic antenna utilized for channeling of photons into a dielectric loaded surface plasmon polariton waveguide (DLSPPW) which is eventually coupled to an optical fiber.

In Figure 1, two examples of nano-structures coupled to single photon sources are presented. Figure 1 (a) shows a single photon emitter placed in the nano-sized gap in a bow-tie antenna. Figure 1 (b) shows a single photon emitter coupled to a plasmonic nanocavity which together with a Bragg grating directs the emission into a DLSPPW and eventually into an optical fiber. Such structures can enhance the emission rate as well as other properties of emitted photons and can be useful for photonic quantum technologies.