Ultrathin Optical Fiber Applications for Quantum Technologies

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Ultrathin optical fibers (see Fig. 1), with diameters on the order of the propagating light wavelength, have already demonstrated their versatility across a number of different areas, such as sensing, microparticle manipulation, cold atom physics, and as optical couplers. The intense evanescent light field at the fiber waist is one of the main advantages offered by these systems as it allows us to achieve ultrahigh light intensities that would otherwise be difficult to obtain in a standard laboratory. Here, I will present our recent work related to the fields of atomic physics and quantum optics. In one experiment, we embed ultrathin fibers into a laser-cooled sample of rubidium atoms for studies related to Rydberg atom formation near a dielectric surface or for the study of degenerate and nondegenerate two-photon processes in an atomic medium. In another experiment, we have fabricated nanostructured ultrathin fibers that combine a Bragg grating with a cavity for enhanced photon coupling from a quantum emitter. Overall, the versatility of these fibers for many different experimental platforms – particularly if one goes beyond the basic, single mode fiber design - will be discussed.

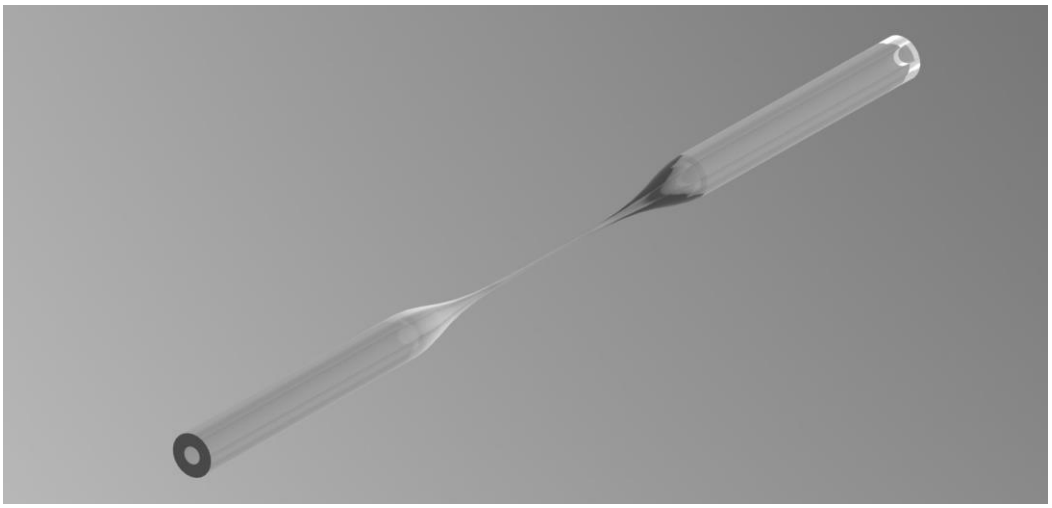

Fig. 1: Schematic representation of an ultrathin optical fiber. Standard fiber pigtails are located at either end and the region of interest for interactions is at the very thin fiber waist.