Fiber interfaces between single atoms and single photons

Sébastien Garcia,
PhD student
Laboratoire Kastler Brossel, ENS/CNRS/UPMC
Paris, France

Abstract :

The experimental study of entangled quantum states of single particle ensembles requires development of compact, robust and versatile systems. Motivated by miniaturization, stability et flexibility provided by optical fibers as light wave-guides, we present two experiments where optical fibers are used as interfaces for single atoms trapping and single photons collection into their guided modes.

The first experiment combines a singlemode fiber with an aspherical lens to produce a dipole beam in which we trap a single rubidium atom by collisional blockade. This fiber-pigtailed optical tweezer is a simple, compact and versatile tool for single cold atom production. Cooling and light-assisted collisional loss rate in the dipole trap are increased by modulating the dipole beam intensity. We discuss the modulation and beam polarization effects on atom lifetime. With this setup, we created a triggered single photon source, whose photons have *a priori* well defined spatial and spectral mode due to the optical fiber and the atomic transition.

In a second part, we present the design of an experiment which couples optimally a trapped single atom register to a fiber Fabry-Pérot cavity and where a high numerical aperture lens allows individual imaging and addressing. We discuss required parameters for mirror phase and birefringence. A sub-micron precision laser ablation setup is built to create and to analyze *in situ* desired mirror shapes on optical fiber end faces. Then, we present the produced double resonant fiber cavities with controlled birefringence. Eventually, we describe the created experimental setup for fast cold atom cloud production and transport towards the cavity.