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Single collective excitation of nanofiber-coupled atomic arrays

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Developing light-matter interfaces is a crucial capability with unique applications to quantum optics and quantum information networks. Our group focuses on the study of interactions between photons guided by nanoscale waveguides and arrays of trapped atoms. Nanoscale waveguides offer a compelling platform because of the tight transverse confinement of the propagating light, strong photon-atom coupling in single pass, and the potential long-range atom-atom interaction mediated by the guided photons. Our platform, based on an optical nanofiber, already allowed the demonstration of an all-fibered optical memory. Then, by using an optical lattice in the evanescent field surrounding the nanofiber, we demonstrated large Bragg reflection by the 1D array of trapped atoms.

Our latest result concerns the initialization of a single collective excitation coupled to the nano-waveguide. The excitation is heralded by the detection of a Raman scattered photon in the nanofiber. We are then able to readout the atomic state and retrieve a single photon in the guided mode with an efficiency of up to 25%. This result is the first demonstration of an atomic entangled state preferentially coupled to a waveguide. It is a milestone in the context of the emerging waveguide-QED approach, with applications to quantum networking, quantum non-linear optics and quantum many-body physics.

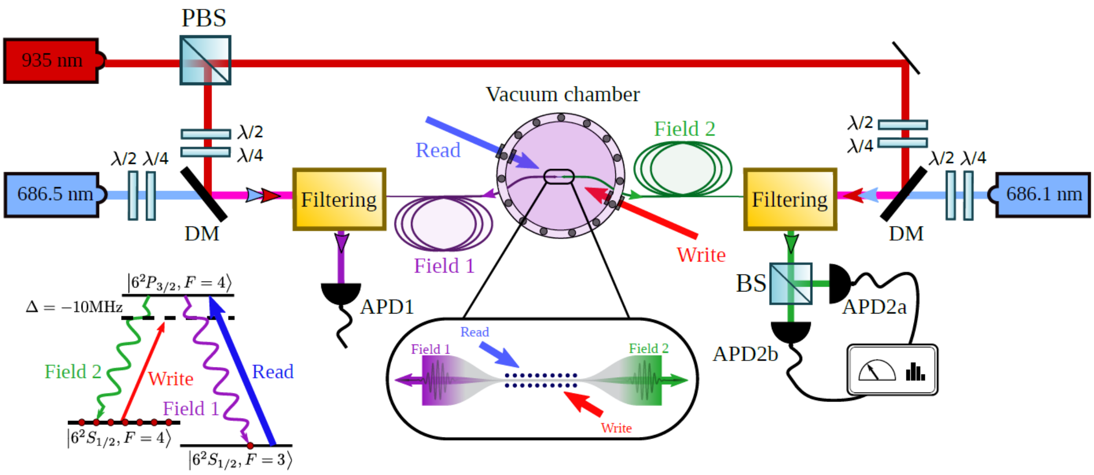

Figure 1: (a) Setup and (b) atomic levels used for single collective excitation generation.

Choix de session parallèle

6.3 Nanofibre optique: une nouvelle plateforme pour l'optique et l'information quantique

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