A single atom detector integrated on an atom chip: fabrication, characterization and application

Mon, 2010-06-07 09:08 - Donatella Rosetti [1] **Date:** 2010-09-09

Reference:
D. Heine, W. Rohringer, D. Fischer, M. Wilzbach, T. Raub, S. Loziczky, XiYuan Liu, S. Groth, B. Hessmo, J. Schmiedmayer
New J. Phys., 12, 095005 (2010)

We describe a robust and reliable fluorescence detector for single atoms that is fully integrated into an atom chip. The detector allows spectrally and spatially selective detection of atoms, reaching a single atom detection efficiency of 66 %. It consists of a tapered lensed single-mode fiber for precise delivery of excitation light and a multi-mode fiber to collect the fluorescence. The fibers are mounted in lithographically defined holding structures on the atom chip. Neutral 87Rb atoms propagating freely in a magnetic guide are detected and the noise of their fluorescence emission is analyzed. The variance of the photon distribution allows to determine the number of detected photons / atom and from there the atom detection efficiency. The second order intensity correlation function of the fluorescence shows near-perfect photon anti-bunching and signs of damped Rabi-oscillations. With simple improvements one can boost the detection efficiency to > 95 %.

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