SYSA 2: Single Atoms II

Time: Thursday 14:00–15:00 Location: A 320

Invited Talk SYSA 2.1 Th 14:00 A 320

Detecting single ultra cold atoms — •Jörg Schmiedmayer — Atominstitut, TU-Wien, Stadionallee 2, 1020 Vienna, Austria

Two different settings detecting single atoms by fluorescence are presented.

The first is a detector for trapped atoms [1], fully integrated on an atom chip, consisting of a tapered lensed single-mode fiber for precise delivery of excitation light and a multi mode fiber to collect the fluorescence, both mounted SU-8 holding structures on an atom chip. Single Rb atoms propagating freely in a magnetic guide are detected with an efficiency of 66% with a signal to noise ratio in excess of 100.

The second is a single atom camera that allows imaging of ultra cold quantum gases in expansion [2]. Atoms fall through a sheet of resonant excitation light and the emitted fluorescence photons are imaged onto an amplified CCD camera using a high numerical aperture optical system. We demonstrate single-atom detection for dilute atomic clouds with high efficiency where at the same time dense Bose-Einstein condensates can be imaged without saturation or distortion.

These detectors can be used to probe atom-atom correlations in ultra cold degenerate quantum many body systems.

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[1] M. Wilzbach, et al. Opt.Lett. 34, 259 (2009).
[2] R. Bücker, et al. NJP, 11, 103039 (2009).

Invited Talk SYSA 2.2 Th 14:30 A 320

Entanglement of two individual neutral atoms using Rydberg blockade — •Tatjana Wilk, Alpha Gaëtan, Charles Evellin, Janik Wolters, Yevhen Miroshnychenko, Philippe Grangier, and Antoine Browaeys — Institut d'Optique, Campus Polytechnique - RD128, 91127 Palaiseau cedex, France

The interaction between atoms in Rydberg states is enhanced by many orders of magnitude compared to ground state atoms. This effect can be used to turn on and off the interaction between single atoms at distances on the order of micrometers. In particular the simultaneous excitation of more than one atom to a Rydberg state is strongly suppressed. A decade ago this so-called Rydberg blockade effect was proposed for the implementation of fast quantum gates for neutral atoms and for the creation of entanglement between them [1]. Only recently two experiments have demonstrated the realization of such schemes [2]. Here, we report on our work of the generation of entanglement between two individual ^{87}Rb atoms in hyperfine ground states $|F{=}1, m_F{=}1\rangle$ and $|F{=}2, m_F{=}2\rangle$ which are held in two optical tweezers separated by 4 μm. The entangled state is generated in about 200 ns using pulsed two-photon excitation. We quantify the entanglement by applying global Raman rotations on both atoms. [1] D. Jaksch et al., *Phys. Rev. Lett.* **85**, 2208 (2000). M.D. Lukin et al., *Phys. Rev. Lett.* **87**, 037901 (2001). [2] L. Isenhower et al., *arXiv:* 0907.5552 (2009). T. Wilk et al., *arXiv:* 0908.0454 (2009).