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Position and state control of neutral atoms using optical tweezers — •YEVHEN MIROSHNYCHENKO, WOLFGANG ALT, IGOR DOTSENKO, MKRTYCH KHUDAVERDYAN, STEFAN KUHR, DIETER MESCHER, DOMINIK SCHRADER und ARNO RAUSCHENBEUTEL — Institut fuer Angewandte Physik, Universitaet Bonn, Wegelerstr. 8, D-53115, Bonn

We optically determine the position of individual neutral Cs atoms in a standing wave optical dipole trap with sub-wave length resolution. Together with our 'optical conveyor belt technique' [1], we are able to place single atoms at a predetermined position along the dipole trap axis with an precision of 300 nm. The relative position of two atoms can be determined with the precision of 55 nm. We fully understand the sources of uncertainties of our setup [2].

In order to actively control the relative position, we have built a second standing wave dipole trap orthogonal to the first one. Using the second trap as optical tweezers, we extract a selected atom out of a string of atoms in the first trap, and place it back at a desired position with respect to the other atom.

We furthermore use the controlled transport of atoms to robustly manipulate their hyperfine state via a transport induced adiabatic passage [3]. This technique could be advantageously applied in cavity QED.

[1] S. Kuhr et al., Science 293, 278 (2001)

[2] I. Dotsenko et al., submitted for publication

[3] M. Khudaverdyan et al., to be published