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Longitudinally homogeneous medium of tunable length for Rydberg EIT STEFFEN SCHMIDT, DANIEL TIARKS, GIOVANNI GIRELLI, STEPHAN DÜRR, GERHARD REMPE, Max-Planck-Institute of Quantum Optics — In electromagnetically induced transparency (EIT), an initially opaque medium is made transparent for probe light by applying a strong control beam. As this is a quantum interference effect, it relies on the coherence of the system. In Rydberg EIT, the energy of a Rydberg state depends on the density of the surrounding ground state atoms. If the density of ground state atoms is position dependent, then the density-dependent resonance shift causes dephasing which deteriorates the performance of EIT [1]. The transverse inhomogeneity can be suppressed by tightly focusing the light. To avoid problems from a longitudinal inhomogeneity, we prepare a longitudinally homogeneous medium by an appropriate design of an optical dipole trap. The trap has the additional feature that the length of the medium is tunable between 20 and 300 μm. A long medium makes it possible to remain at low atomic density, so that the dephasing rate is low, and simultaneously to reach high optical depth, so that the effects of Rydberg blockade can be large.
[1] S. Baur et al. Phys. Rev. Lett. 112, 073901 (2014).

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