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Long range transport of ultra cold atoms in a far-detuned 1D optical lattice

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We present a novel method to transport ultra cold atoms in a focused optical lattice over macroscopic distances of many Rayleigh ranges. With this method ultra cold atoms were transported over 5 cm in 250 ms without significant atom loss or heating. By translating the interference pattern together with the beam geometry the trap parameters are maintained over the full transport range. Thus, the presented method is well suited for tightly focused optical lattices that have sufficient trap depth only close to the focus. Tight focusing is usually required for far-detuned optical traps or traps that require high laser intensity for other reasons. The transport time is short and thus compatible with the operation of an optical lattice clock in which atoms are probed in a well designed environment spatially separated from the preparation and detection region.

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