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Towards the Detection of Momentum Entangled Atom Pairs MICHAEL KELLER, MATEUSZ KOTYRBA, MAXIMILIAN EBNER, ANTON ZEILINGER, Institute for Quantum Optics and Quantum Information (IQOQI) Vienna / University of Vienna — We present our work towards the creation and detection of momentum entangled states of metastable helium (He*) atoms. Starting from a Bose-Einstein condensate (BEC) of metastable helium, stimulated Raman transitions transfer momentum onto the atoms. Subsequent collisions between two counterpropagating matter waves lead to atom pairs that are entangled in their momentum degree of freedom. This state represents a three-dimensional version of the one discussed in the Einstein-Podolsky-Rosen gedankenexperiment. By using a position resolved micro-channel plate (MCP) detector the high internal energy of the He* atoms of almost 20 eV per atom allows for efficient detection of individual atoms with a high spatial and temporal resolution. We show that a double double-slit as well as a ghost interference scheme can be used to show the entanglement and that those schemes are feasible with experimental restrictions in our setup. We discuss the main challenges in the experimental realization and present the present status of the experiment.

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