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*Development of a metastable helium BEC as a platform for experiments with EPR-entangled matter waves*

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ABSTRACT

As of today, the experimental demonstration of the original Einstein-Podolsky-Rosen state has not been achieved in a matter wave system. Extending the photonic versions into the realm of massive particles will open up a new field where fundamentally different aspects of quantum mechanics can be tested, e.g. fermionic versions. For this goal, the realization of a Bose-Einstein condensate of metastable helium was achieved. A four-wave mixing process is suggested to generate such an EPR state in a system of a counter-propagating atom pair. The two atoms are entangled in the sum of their momenta and the difference of their positions. The Bose-Einstein condensate in combination with a delay-line detector offer a platform to perform experiments with the entangled atom pairs. The delay-line detector has been characterized and the feasibility to perform entanglement experiments has been analyzed.