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Revealing Quantum Statistics with a Pair of Distant Atoms

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Quantum statistics have a profound impact on the properties of systems composed of identical particles. At the most elementary level, Bose and Fermi quantum statistics differ in the exchange phase, either 0 or π, which the wave function acquires when two identical particles are exchanged. I will report on a scheme to directly probe the exchange phase with a pair of massive particles by physically exchanging their positions [1]. Importantly, the particles always remain spatially well separated, thus ensuring that the exchange contribution to their interaction energy is negligible and that the detected signal can only be attributed to the exchange symmetry of the wave function. I will discuss an implementation of this scheme using a pair of ultracold atoms that are initially prepared in the motional ground state of two distict lattice sites of a polarization-synthesized optical lattice [2].

1. C. F. Roos, A. Alberti, D. Meschede, P. Hauke, and H. Häffner, "Revealing Quantum Statistics with a Pair of Distant Atoms,"Phys. Rev. Lett. **119**, 160401 (2017).
2. C. Robens, J. Zopes, W. Alt, S. Brakhane, D. Meschede, and A. Alberti, "Low-Entropy States of Neutral Atoms in Polarization-Synthesized Optical Lattices,"Phys. Rev. Lett. **118,** 065302 (2017).

Primary author: Dr ALBERTI, Andrea (Institut für Angewandte Physik)

Co-author: Prof. MESCHEDE, Dieter (Institut für Angewandte Physik)

Presenter: Dr ALBERTI, Andrea (Institut für Angewandte Physik)

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