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Talk Title: Quantum transport with cold atoms

Abstract: Cold atom technology poses a powerful platform to study the transport of quantum matter [1]. The interaction between atoms, the type of atoms and their confinement can be designed to simulate quantum transport phenomena that are often difficult to realize within solid state devices. Recent advances in light-shaping techniques make it possible to engineer circuits of flowing atoms while freely adjusting the circuit geometry. Using these methods, we study fundamental questions about quantum transport in various types of atomic circuits.
The current flowing through fermionic ring-lead systems can be controlled by gauge fields applied to the ring. We show that this so-called Aharonov-Bohm effect is absent for bosonic atoms [2,3].
For transport through atomic Y-junctions, we find negative reflections that resemble Andreev-reflections known from metal-superconductor interfaces [3].
Further, we show that topological pumping within atomic ring systems can be used to create highly entangled NOON states [4].
These proposals can be implemented in state-of-the-art cold atom experiments to improve our understanding of quantum transport and to build novel quantum devices.

[1] T. Haug "Quantum transport with cold atoms" (2020) https://scholarbank.nus.edu.sg/handle/10635/190520
[2] T. Haug, H. Heimonen, R. Dumke, L.-C. Kwek, and L. Amico "Aharonov-Bohm effect in mesoscopic Bose-Einstein condensates." Physical Review A 100.4 (2019) https://journals.aps.org/pra/abstract/10.1103/PhysRevA.100.041601
[3] T. Haug, R. Dumke, L.-C. Kwek, and L. Amico "Andreev-reflection and Aharonov–Bohm dynamics in atomtronic circuits." Quantum Science and Technology 4.4 (2019) https://doi.org/10.1088/2058-9565/ab2e61
[4] T. Haug, R. Dumke, L.-C. Kwek, and L. Amico "Topological pumping in Aharonov–Bohm rings." Communications Physics 2.1 (2019) https://doi.org/10.1038/s42005-019-0229-2