Contribution ID: **59** Type: **Talk**

Spin- and momentum-correlated atom pairs mediated by photon exchange

Thursday 6 July 2023 08:30 (25 minutes)

Quantum gases coupled to high-finesse optical resonators are a versatile platform to simulate many-body quantum systems, offering a high degree of experimental control. All-to-all interactions between the atoms naturally arise in such systems from the coupling of the atoms to a cavity mode, while cavity leakage facilitates real-time access to the dynamics of this open quantum system.
Here, we report on the production of correlated atomic pairs in specific spin and momentum modes mediated by the exchange of cavity photons. Our implementation relies on Raman scattering between different spin levels of a spinor Bose-Einstein condensate, which is induced by the interplay of a running-wave transverse laser and the vacuum field of an optical cavity. Far-detuned from Raman resonance, a four-photon process gives rise to collectively enhanced spin-mixing dynamics. We investigate the statistics of the produced pairs and explore their non-classical character through noise correlations in momentum space. Our results offer prospects for quantum-enhanced sensing and for the quantum simulation of lattice gauge theories and quantum-information scrambling.

Authors: FINGER, Fabian (ETH Zurich); ROSA-MEDINA, Rodrigo (ETH Zurich); REITER, Nicola Alexandra (ETH Zurich); CHRISTODOULOU, Panagiotis (ETH Zurich); DONNER, Tobias (ETH Zurich); ESSLINGER, Tilman (ETH Zurich)

Presenter: REITER, Nicola Alexandra (ETH Zurich)

Session Classification: Quantum Sensors II