Single-photon interference due to motion in an atomic collective excitation

Wed, 2017-05-03 11:39 - Ryan Hanley [1] **Date:** 2016-12-19

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Reference:
arXiv:1612.05467v1

URL:
https://arxiv.org/abs/1612.05467 [2]

Quantum-state engineering is of critical importance to the development of quantum technologies. One promising platform is thermal atomic vapours, because they offer long coherence times with reproducible and scalable hardware. However, the inability to address isolated atomic states in a controlled manner, due to multi-level degeneracy and motional broadening, is a major obstacle to their wider application. Here we show how the atomic motion can be exploited to prepare robust and tunable collective quantum states. A strong magnetic field allows individual control over the internal atomic states and a ladder-type excitation with strong laser dressing allows tunable selection of the external (motional) states. The prepared states consist of a single excitation stored as a robust collective superposition of two velocity classes, whose coherent nature is demonstrated by measuring collective quantum beats. Excellent agreement between experiment and theory demonstrates the high degree of control over state preparation, making strongly dressed thermal vapours in large magnetic fields a promising platform for quantum optics and atom-state engineering.

- H2020 [3]
- RySQ [4]
- 15.10.En Atomic ensembles [5]
- 01.40.+n Entanglement as a resource for information processing [6]
- Result [7]
- 03.40.+t Thermal/mixed state entanglement [8]