Simulating Quantum Spin Models using Rydberg-Excited Atomic Ensembles in Magnetic Microtrap Arrays

Thu, 2016-08-04 11:37 - Shannon Whitlock [1] **Date:** 2016-07-31
Author(s):
Shannon Whitlock, Alexander W. Glaetzle, Peter Hannaford

Reference:
arXiv:1608.00251

URL:
http://arxiv.org/abs/1608.00251 [2]

We propose a scheme to simulate lattice spin models based on strong and long-range interacting Rydberg atoms stored in a large-spacing array of magnetic microtraps. Each spin is encoded in a collective spin state involving a single nP Rydberg atom excited from an ensemble of ground-state alkali atoms prepared via Rydberg blockade. After the excitation laser is switched off the Rydberg spin states on neighbouring lattice sites interact via general isotropic or anisotropic spin-spin interactions. To read out the collective spin states we propose a single Rydberg atom triggered avalanche scheme in which the presence of a single Rydberg atom conditionally transfers a large number of ground-state atoms in the trap to an untrapped state which can be readily detected by site-resolved absorption imaging. Such a quantum simulator should allow the study of quantum spin systems in almost arbitrary two-dimensional configurations. This paves the way towards engineering exotic spin models, such as spin models based on triangular-symmetry lattices which can give rise to frustrated-spin magnetism.

- 12.10.+i Simulations of many-body interactions [3]
- H2020 [4]
- QIPC [5]
- RySQ [6]
- 12.30.+u Universal quantum simulators with specific systems (e.g. trapped ions, optical lattices, etc.) [7]
- 15.10.En Atomic ensembles [8]
- Result [9]
- Quantum Simulation [10]

Source URL:
http://qurope.eu/db/publications/simulating-quantum-spin-models-using-rydberg-excited-atomic-ensembles-magnetic-micro

Links:
[1] http://qurope.eu/users/whitlock
[2] http://arxiv.org/abs/1608.00251
[3] http://qurope.eu/category/qics/10-quantum-computation/12-simulations/1210i-simulations-many-body-interactions
[4] http://qurope.eu/category/european-commission/h2020
[5] http://qurope.eu/category/qipc/qipc
[6] http://qurope.eu/category/projects/rysq
[7] http://qurope.eu/category/qics/10-quantum-computation/12-simulations/1230u-universal-quantum-simulators-specific-syst
[8] http://qurope.eu/category/qics/10-quantum-computation/15-implementations-quantum-optics/15

10en-atomic-ensembles
[9] http://qurope.eu/category/attribute/result
[10] http://qurope.eu/category/virtual-institute/quantum-simulation