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Single-Atom-Resolved Imaging in a Triangular Optical Lattice

HIDEKI OZAWA, RYUTA YAMAMOTO, TAKESHI FUKUHARA, RIKEN CEMS

— Frustrated spin systems belong to one of the most demanding problems of magnetism and condensed matter physics. The simplest geometrical spin frustration occurs in the triangular structure with antiferromagnetic interactions. A large variety of characteristic spin configuration can arise due to competition between the interactions and the geometry of the lattice. Recently, there have been considerable advances in the direction of simulating quantum magnetism by using a quantum gas microscope (QGM) technique. In our group, we are engineering an experimental setup of ^{87}Rb atoms in an optical triangular lattice with QGM, which will enable us to acquire insights into real-space properties in the frustrated spin system. The QGM measurement is associated with heating of atoms due to photon scattering and therefore requires a cooling mechanism. We adopt a Raman sideband cooling (RSC) scheme for that purpose. As a result of machine-learning optimization of RSC parameters, we achieved a long lifetime during the fluorescence imaging. We also picked up a single layer of the triangular lattice planes by using a combination of a magnetic field gradient and a microwave transition. We will report on detecting fluorescence signals from atoms in a single-atom-resolved manner.

Hideki Ozawa
RIKEN CEMS

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