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Time-of-flight imaging method to observe signatures of antiferromagnetically ordered states of ultracold fermionic atoms in an optical lattice KENSUKE INABA, MAKOTO YAMASHITA, NTT Basic Research Labs., JST CREST — Currently, the antiferromagnetic (AF) transition in the optical lattice system is attracting much interest in the field of atomic physics and also in condensed matter physics. Here, we theoretically propose a simple method to detect such AF states of fermionic atoms in an optical lattice by combining a time-of-flight (TOF) imaging method and a Feshbach resonance [1]. In this scheme, the nontrivial dynamics of fermionic atoms during the imaging process works as a probe with respect to the breaking of the translational symmetry in the AF state. Precise numerical simulations demonstrate that the characteristic oscillatory dynamics appears in TOF images, which can be easily observed experimentally. Our basic idea is to detect the artificially induced excitations of atoms which transfer the ordering vector Q in the momentum space, where Q characterizes the breaking of translational symmetry. Therefore, our proposal provides a general experimental idea for detecting translational symmetry broken states in optical lattices, which is largely unavailable in traditional condensed matter systems.

[1] K. Inaba and M. Yamashita, *Phys. Rev. Lett.* **105**, 173002 (2010) .

Kensuke Inaba
NTT Basic Research Labs., JST CREST

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