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Ultracold quantum gasses in optical lattices

- Studies on many-body problems via cold atoms-

NTT

Motivation

The advanced experimental technique in atomic physics allows us to create an artificial crystal, so-called “optical lattice”, inside ultracold atomic gases by laser lights. We theoretically study the quantum properties of this system and explain the recent experimental results quantitatively.

Originality

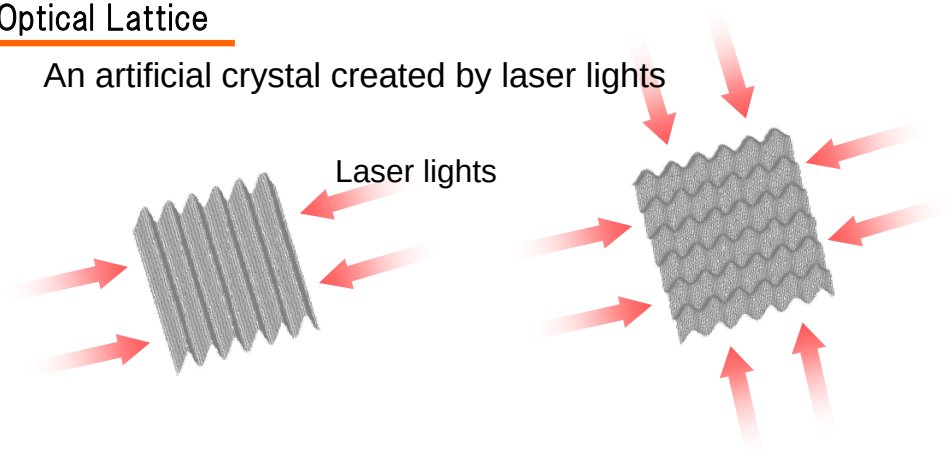
Cold atoms trapped in optical lattices are ideal model systems for investigating the many-body problems which have been studied for many years in condensed matter physics. These systems are thus considered as a quantum simulator. Our numerical analyses provide the precise information about complicated quantum many-body states of cold atoms.

Impact

The unresolved problems in condensed matter physics such as metal-insulator phase transition and high-Tc superconductivity can be clarified via cold atoms. One can also realize a quantum computer by using atoms on the lattice sites as quantum bits.

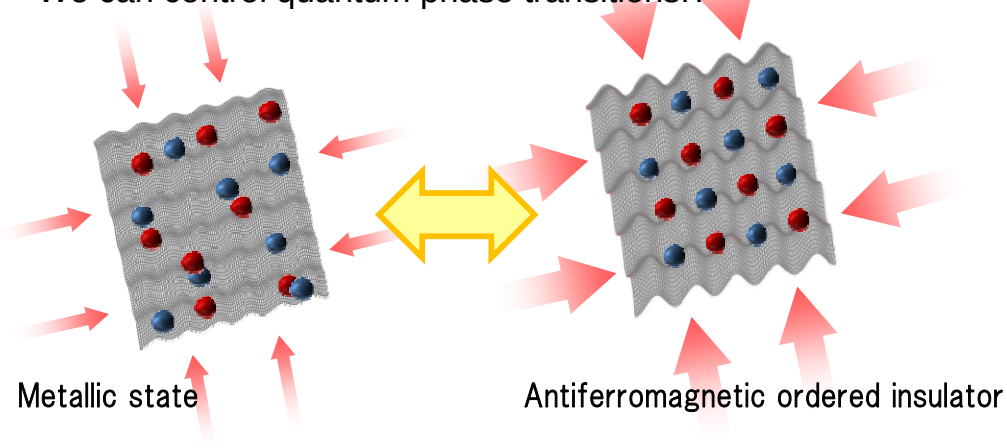
Optical Lattice

An artificial crystal created by laser lights



Quantum simulator

We can control quantum phase transitions!?



Cold atoms with two internal degree of freedoms
(correspond to electrons in solid)

サイエンスプラザ 2009 ナノサイエンスが拓く量子の世界

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