Cold-atom quantum simulation of U(1) lattice gauge-Higgs model
KENICHI KASAMATSU, Dept. of Phys. Kinki Univ., YOSHIHITO KUNO, Dept. of Appl. Phys., Nagoya Inst. of Tech., YOSHIRO TAKAHASHI, Dept. of Phys. Kyoto Univ., IKUO ICHINOSE, Dept. of Appl. Phys., Nagoya Inst. of Tech., TETSUO MATSUI, Dept. of Phys. Kinki Univ. — We discuss the possible methods to construct a quantum simulator of the U(1) lattice gauge-Higgs model using cold atoms in an optical lattice. These methods require no severe fine tunings of parameters of atomic-interactions in contrast with the other previous literature. We propose some realistic experimental setups to realize the atomic quantum simulator of the U(1) lattice gauge-Higgs model in a two-dimensional optical lattice. Our target gauge-Higgs model has a nontrivial phase structure, i.e., existence of the phase boundary between confinement and Higgs phases, and this phase boundary is to be observed by cold-atom experiments. As a reference to such experiments, we make numerical simulations of the time-dependent Gross-Pitaevskii equation and observe the real-time dynamics of the atomic simulators. Clarification of the dynamics of this gauge-Higgs model sheds some lights upon various unsolved problems including the inflation process of the early universe.

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