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A density-functional design of an interaction-driven Chern insulator for an optical lattice system SOTA KITAMURA, NAOTO TSUJI, HIDEO AOKI, Department of Physics, University of Tokyo — One of the most intriguing proposals for many-body effects in topological systems is a possibility of interaction-induced spontaneous symmetry breaking toward topological insulators, which is sometimes called a "topological Mott insulator (TMI)". While TMI has been theoretically examined in various tight-binding models such as a checkerborad lattice, condensed-matter realization of the TMI has yet to come. Here we propose to look for a TMI in cold atoms on optical lattices by exploiting their high controllability, and have actually designed an optical lattice for realizing TMI. One of key ingredients in the TMI is large inter-site interaction, which is usually too small in cold-atom systems with short-ranged interactions. We have resolved this by employing a spin-dependent optical lattice potential. Emergence of TMI is then confirmed from first principles for the system in continuous space by extending the existing density-functional theory for cold atom systems to accommodate non-collinear spin structures inherent in topological phases. Namely, the proposed system does indeed exhibit a phase transition from a semimetal to a Chern insulator over a wide region in the phase diagram against the interaction strength and lattice potential parameters.

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