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Rydberg-Atom Quantum Simulation and Chern Number Characterization of a Topological Mott Insulator ALEXANDRE DAUPHIN, Université libre de Bruxelles - Universidad Complutense, MARKUS MUELLER, MIGUEL-ANGEL MARTIN-DELGADO, Universidad Complutense — In this talk we consider a system of spinless fermions with nearest and next-to-nearest neighbor repulsive Hubbard interactions on a honeycomb lattice within the mean-field treatment, and propose and analyze a realistic scheme for analog quantum simulation of this model with cold atoms in a two-dimensional hexagonal optical lattice. Besides a semimetallic and a charge-density-wave ordered phase, the system exhibits a quantum anomalous Hall phase, which is generated dynamically, i.e. purely as a result of the repulsive fermionic interactions and in the absence of any external gauge fields. We establish the topological nature of this dynamically created Mott insulating phase by the numerical calculation of a Chern number, and study the possibility of coexistence of this phase with the other phases characterized by local order parameters. Based on the knowledge of the mean-field phase diagram, we then discuss in detail how the interacting Hamiltonian can be engineered effective ly by state-of-the-art experimental techniques for laser-dressing of cold fermionic ground-state atoms with electronically excited Rydberg states that exhibit strong dipolar interactions.

[1] A. Dauphin, M. Mueller, and M. A. Martin-Delgado, arXiv:1207.6373. Submitted to PRA and accepted on Sep 26, 2012.

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