## Abstract Submitted for the DAMOP11 Meeting of The American Physical Society

Ultracold atoms in optical lattices: beyond the Hubbard model SEBASTIANO PILATI, PING NANG MA, Theoretische Physik, ETH Zurich, CH-8093 Zurich, Switzerland, XI DAI, Institute of Physics, Chinese Academy of Science, Beijing China, MATTHIAS TROYER, Theoretische Physik, ETH Zurich, CH-8093 Zurich, Switzerland — We investigate the properties of strongly interacting gases in optical lattices. We address the regime of weak and intermediate optical potentials, where the conventional description in terms of the single (or few) band Hubbard model is not valid. In this interesting regime intriguing quantum phenomena appear due to the interplay between strong inter-atomic interactions and the external periodic potential. In the case of bosonic atoms, we introduce a novel path-integral Monte Carlo technique which allows to simulate the superfluid to insulator transition in continuous space. For Fermions, we apply Kohn-Sham Density Functional Theory (DFT) using a new energy-density functional for repulsive Fermi gases. The first results based on a local spin density approximation show evidence of a ferromagnetic phase due to repulsive interactions. As an outlook, we will discuss how the development of DFT for ultracold atomic gases can form a strong link between materials science and atomic physics.

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