# Dipolar extended Fermi-Hubbard Model in two-dimensions

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The ability to cool bosonic and fermionic atoms down to ultra cold temperatures in optical lattices has enabled the experimental emulation of model Hamiltonians for strongly correlated systems. Contrary to what happens in Condensed Matter systems, in optical lattices experiments one has control over the parameters of the model, such as interaction strenght, hopping amplitude, and population imbalance. Over the last decade the physics of the Hubbard Model has been intensively studied and the Mott state as well as antiferromagnetism have been observed.

An interesting recent experimental development in cold gases is the ability to create quantum degenerate bosonic and fermionic gases of magnetic atoms, leading to the study of magnetic dipolar interactions. The extended Bose-Hubbard model, was recently emulated with $^{168}$Er atoms in an optical lattice [1]. The study of fermionic systems with anisotropic interactions beyond on-site is clearly in order. Here we use the Lanczos method to explore the ground state phase diagram of the dipolar extended Fermi-Hubbard Model at half-filling and two-dimensions. The anisotropic character of the dipole-dipole interaction, nearest-neighbor as well as next-nearest-neighbor interactions are taken into account. We observe quantum phase transitions between Antiferromagnetic and different Charge Density Waves phases.

[1] S. Baier, M. J. Mark, D. Peter, K. Aikawa, L. Chomaz, Z. Cai, M. Baranov, P. Zoller and F. Ferlaino, Science **352**, 201 (2016).