

Title: Exotic phases of ultracold Bosons and Fermions in an optical lattice

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Abstract: The recent observation of quantum phase transition of interacting bosons in an optical lattice has opened up a new area to study synthetic correlated materials. We consider the possibilities to observe various exotic phases, particularly 'supersolid' phase and 'charge-density wave' (CDW) state, in dipolar bosons and hardcore 'Bose-Fermi' mixtures in an optical lattice. Phase diagram and collective excitation energies are obtained by using 'slave-boson' and Gutzwiller's variational method. Finally we discuss experiments which can test our theory.