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Superconductivity and anti-ferromagnetism through Bose-Fermi mixture on optical lattices. JEREMY BRACKETT, THEJA DE SILVA, Augusta University — Motivated by the recent experimental progress with ultra-cold atoms, we investigate the physics of a Bose-Fermi mixture on a two dimensional optical lattice. We treat the system parameters such that 2-component fermions are in a deep external trap and weakly interacting bosons are in a shallow external trap, however both of these atoms are subjected to the same optical lattice. In this parameter regime, the bosons form a Bose-Einstein condensate and mediate an attractive interaction between fermions through low energy Bose excitations. As a result, the dynamics of the fermions can be described by the single band Hubbard model that involves on-site repulsive interaction and elementary excitation mediated attractive interactions. Using a mean field theory, we derive an effective action up to the quartic order in both d-wave superconducting and anti-ferromagnetic order parameters. Using this Landau energy functional, we then discuss the phase transition and study the competition and/or cooperation of anti-ferromagnetism and d-wave superconductivity in the system.

Theja De Silva
Augusta University

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