Exotic Superconducting Phases of Ultracold Atom Mixtures on Triangular Lattices

SHAN-WEN TSAI, University of California, Riverside, LUDWIG MATHEY, Harvard University, ANTONIO H. CASTRO NETO, Boston University — We study two-dimensional Bose-Fermi mixtures of ultracold atoms on a triangular optical lattice, in the limit when the velocity of bosonic condensate fluctuations is much larger than the Fermi velocity\(^1\). Interactions, lattice geometry and frustration lead to a rich phase diagram in this system. Using functional renormalization group techniques we show that this phase diagram contains exotic superconducting and spin-density wave phases. For spin-1/2 fermions on an isotropic lattice we find a competition of \(s\)-, \(p\)-, extended \(d\)-, and \(f\)-wave symmetry, as well as antiferromagnetic order. For an anisotropic lattice, we further find an extended \(p\)-wave phase. A Bose-Fermi mixture with spinless fermions on an isotropic lattice shows a competition between \(p\)- and \(f\)-wave symmetry.

\(^1\) L. Mathey, S.-W. Tsai, A.H. Castro Neto, cond-mat/0609212