Abstract Submitted
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Quasiparticle Spectrum of 2-d Dirac Vortices in Optical Lattices[1]

LAITH HADDAD, LINCOLN CARR, Colorado School of Mines — Bose-Einstein condensates (BEC's) in a honeycomb optical lattice are described by a nonlinear Dirac equaton (NLDE) in the long wavelength, mean field limit [1]. The bipartite structure of the lattice appears as pseudospin in the multi-component BEC with states above and below the Dirac point playing the roles of particles and antiparticles. Although much work has been done on NLDE's, the bulk of the literature deals with models with Poincare invariant nonlinearites. In contrast our equations break Poincare symmetry providing an opportunity to study phenomenological models in cosmology and particle physics where this symmetry is not manifest. We present the associated linear stability equations and apply them to the case of weak contact interactions to obtain the quasiparticle energies, states, and stabilities of vortex solutions of the mean field equations. We discuss future applications of our results to problems at the interface between condensed matter and particle physics.

[1] L. H. Haddad and L. D. Carr, "The Nonlinear Dirac Equation in Bose-Einstein Condensates: Foundation and Symmetries," Physica D: Nonlinear Phenomena, v. 238, p. 1413 (2009). http://arxiv.org/pdf/0803.3039v1

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