Abstract Submitted
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Relativistic Vortices in Bose-Einstein Condensates[1] LAITH HADDAD, LINCOLN CARR, Colorado School of Mines — We present two different approaches to the formation of vortices for a Bose-Einstein condensate in a honeycomb optical lattice. In the first approach, we consider vortices in the condensate order parameter. These are multi-component localized solutions of the nonlinear Dirac equation with nontrivial rotation about a core phase singularity [1]. They are different from ordinary spinor vortices because the Berry phase induced by the lattice background supports a remarkable boson-fermion mapping in the quasi-particle operator statistics [2]. Another type of vortex occurs when we add a mass gap by including distortions of both the nearest neighbor and next-nearest neighbor hopping, as well as a staggered chemical potential between the two sublattices. Vortices with fractional statistics emerge when the superfluid order parameter is integrated over a topological defect in the mass gap.
[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 [2] L. H. Haddad and L. D. Carr, "Relativistic Linear Stability Equations for the Nonlinear Dirac Equation in Bose-Einstein Condensates," Submitted to Europhysics Letters Jan. 2011. http://arxiv.org/abs/1006.3893

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