Title:	Topological Characterization and Investigation of Unconventional Superconducting Phases in Monolayer/Bilayer Models
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Issue Date:	10-Oct-2019
Abstract:	In the first part of this dissertation, the effects of spin-dependent disorder on a con- ventional BCS superconductor is studied using Bogoliubov-de Gennes methods on a two dimensional attactive Hubbard model (AHM) and the results by Nanguneri et al., 2012 are reproduced. Next, by making use of a generalized definition of superconduct- ing pairing order parameter mean-field calculations are performed on two dimensional Extended Attractive Hubbard Model (EAHM) and exotic unconventional SC phase di- agrams are constructed. It is found that the nearest neighbour attractive interaction supports unconventional superconducting (SC) phases by allowing these phases to ex- ist as a self-consistent broken symmetry solution at the mean-field level. These phases are then characterized based on their band structure in cylinder geometry and Chern indices. In the second part, the monolayer SC model is generalized to a bilayer model by coupling a two-dimensional EAHM to a tight-binding model via inter-layer tunnelling and the proximity induced behaviour of SC order is explored with a focus on inducing topologically non-trivial SC character into the metallic layer. We show that interlayer tunnelling can drive changes in topology of the Bogoliubov quasiparticle bands leading to SC topological transitions. Finally, It is shown that these transitions can also be con- trolled by experimentally viable control parameters, the bandwidth of the metallic layer and the gate potential (Batra et al., 2019). The generic nature of the model used in this work suggests this can be applicable to a wide class of systems that invoke proximity effect. Our finding may open up a new route to discover topological superconductors which are considered to provide a fault-tolerant platform for topological quantum com- puting.
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