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The Majorana-Hubbard Model

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A superconductor in a magnetic field in proximity with a topological insulator is predicted to have a Majorana mode (corresponding to a Hermitian fermion operator) at the centre of each vortex core. The low energy Hamiltonian for these fermion operators has both hopping terms and interaction terms. By tuning the chemical potential in the topological insulator it is possible to set the hopping terms to zero so that the dimensionless interaction strength becomes infinite. This motivate solving for the complete phase diagram of the model as a function of interaction strength. I will discuss results on this model in both 1 and 2 dimensions based on a combination of mean field theory, quantum field theory and Density Matrix Renormalization Group techniques.

Primary author: Prof. AFFLECK, Ian (University of British Columbia)

Co-authors: Prof. RAHMANI, Armin (Western Washington University);   Dr PIKULIN, Dmitry (Microsoft Station Q);   Mr WAMER, Kyle (University of British Columbia);   Prof. FRANZ, Marcel (University of British Columbia);   Mr TUMMURU, Tarun (University of British Columbia);   ZHU, Xiaoyu (Xi'an Jiaotong University)

Presenter: Prof. AFFLECK, Ian (University of British Columbia)

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