

Nonperturbative phase diagram of interacting disordered Majorana nanowires

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Majorana fermions (MF) have recently attracted a lot of attention in condensed matter systems. In a seminal work, Kitaev [1] constructed a simple model for a one-dimensional (1D) topological superconductor with p-wave pairing, hosting Majorana edge states at each end. Parallel to Kitaev's work, a disordered version of the same toy model has been studied by Motrunich et al, who showed that these these edge states survive the presence of moderate disorder [2]. We develop a Gaussian variational approach in replica space to investigate the phase diagram of a one-dimensional interacting disordered topological superconducting wire in the strong coupling regime. This method allows for a non-perturbative treatment in the disorder strength, electron-electron interactions and the superconducting pairing amplitude. We find only two stable phases: a topological superconducting phase, and a glassy, non-topological localized phase, characterized by replica symmetry breaking [3].

A. Yu. Kitaev, *Phys. Usp.* 44 (suppl.), 131 (2001).

1. O. Motrunich, K. Damle, and D. A. Huse, *Phys. Rev. B* 63, 224204 (2001).

2. F. Crépin, G. Zaránd, and P. Simon, *Phys. Rev. B* 90, 121407 (2014).