Abstract Submitted
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Stability of Majorana fermions in proximity-coupled topological insulator nanowires[1] ASHLEY COOK, MARCEL FRANZ, University of British Columbia — It has been shown previously [1] that a finite-length topological insulator nanowire, proximity-coupled to an ordinary bulk s-wave superconductor and subject to a longitudinal applied magnetic field, realizes a one-dimensional topological superconductor with an unpaired Majorana fermion localized at each end of the nanowire. Here we show that the unpaired Majorana fermions persist in this system for any value of the chemical potential inside the bulk band gap of order 300 meV in Bi_2Se_3, and, remarkably, also outside this gap in smaller domains, by computing the Majorana number. From this calculation, we also show that the unpaired Majorana fermions persist when the magnetic flux through the nanowire cross-section deviates significantly from half flux quantum. Lastly, we demonstrate that the unpaired Majorana fermions persist in strongly disordered wires with fluctuations in the on-site potential ranging in magnitude up to the size of the bulk band gap. These results suggest this solid-state system should exhibit the elusive Majorana particles under conditions accessible enough for their long sought-after experimental realization.

[1] A. Cook and M. Franz, Phys. Rev. B (in press, arXiv:1105.1787)

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Ashley Cook
University of British Columbia

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