TAYLORING TOPOLOGICAL SUPERCONDUCTIVITY USING SUPERCURRENTS

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Recent experiments have provided the first promising indications of Majorana fermions (MFs) in artificial topological superconductors (TSCs). Most of these experimental efforts focus on hybrid devices consisting of semiconducting wires with strong Rashba spin-orbit coupling placed in proximity to a conventional SC, while a Zeeman field is additionally applied. Other existing theoretical proposals, do not involve the presence of spin-orbit interaction but instead require the development of helical magnetism. In a recent work [1], we performed a complete classification of engineered TSC and revealed that MFs are accessible in *quasi-1d* Rashba semiconductors with proximity induced superconductivity, even in the *absence* of any type of magnetism. The only requirement in the latter systems, is the presence of a Josephson current, flowing transversely to the principal axis of the semiconductor. Here, we show how MFs emerge for the simplest implementation of this type of quasi-1d platforms, which consists of two coupled single channel Rashba semiconducting wires deposited on top of a Josephson junction. The crucial effect of the supercurrent flow is to "convert" the inter-wire spin-orbit coupling into a Zeeman term. We present the detailed topological phase diagram and make a connection to a setup involving a two-channel quasi-1d semiconductor.

[1] P. Kotetes, arXiv:1305.0131 (2013).