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Tailoring topological superconductivity using supercurrents[1]

PANAGIOTIS KOTETES, ANDREAS HEIMES, DANIEL MENDLER, ALEXANDER SHNIRMAN, GERD SCHÖN, Karlsruhe Institute of Technology — Recent experiments have provided the first promising indications of Majorana fermions (MFs) in heterostructures consisting of semiconducting wires and superconductors in the presence of a Zeeman field. By performing a complete classification of engineered topological superconductors (TSCs) [1] we predict that MFs are accessible in quasi-1d Rashba semiconductors with proximity induced superconductivity, even in the absence of magnetism. The only requirement is the presence of a Josephson current, with a suitable direction of flow. Here, we demonstrate how MFs emerge in our proposed setup when multi-wire or multi-channel semiconductors are involved. The crucial effect of the supercurrent flow is to convert the inter-wire/channel spin-orbit coupling into an effective Zeeman term. Finally, we further extend the particular scheme and discuss how the control of supercurrents can be also used to engineer and manipulate TSC in antiferromagnetically doped conventional superconductors.

[1] P. Kotetes, 2013 *New J. Phys.* **15** 105027 (Focus issue on MFs).

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