Unconventional Josephson Effects in Hybrid Superconductor-Semiconductor Junctions

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Abstract

Hybrid supeconductor-semiconductor nanowires came into focus due to their promise for realizing Majorana modes. They were also tried in quantum circuits such as transmon qubits and parametric amplifiers. The same factors that make them interesting for these applications are also associated with a host of interesting Josephson effects. The structures tend to be ballistic or quasi-ballistic, come with gate-voltage control, exhibit strong spin-orbit coupling, large g-factors and transparent interfaces. Because of this, we took to studying higher-order Josephson effects, Josephson phi0-junctions, the combination of these that leads to Josephson diode phenomena, as well as supercurrents through single one-dimensional subbands. We also keep an eye on effects related to Majorana and topology such as spin-polarized supercurrents and fractional Josephson effects, but so far have not found those.

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