THE MAJORANA STM AS A PERFECT DETECTOR OF ODD-FREQUENCY SUPERCONDUCTIVITY

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We propose a novel scanning tunneling microscope (STM) device in which the tunneling tip is formed by a Majorana bound state (MBS). This peculiar bound state exists at the boundary of a one-dimensional topological superconductor. Since the MBS has to be effectively spinless and local, we argue that it is the smallest unit that exhibits odd-frequency superconducting pairing. Odd-frequency superconductivity is characterized by an anomalous Green function which is an odd function of the time arguments of the two electrons forming the Cooper pair. As such, our Majorana STM can be used as the perfect detector of odd-frequency superconductivity. This is because a supercurrent between the Majorana STM and any other superconductor can only flow if the latter system exhibits odd-frequency pairing. To illustrate our concept, we consider the tunneling problem between the Majorana STM and a quantum dot in the vicinity of a conventional superconductor, as illustrated in Figure 1. In the (superconducting) quantum dot, the effective pairing can be tuned from even- to odd-frequency behavior by applying an external magnetic field. As expected, a supercurrent may only flow through the junction when an odd-frequency triplet pairing is induced in the dot.

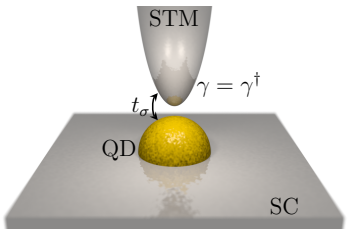

Figure 1. Majorana STM coupled to a quantum dot (QD) in proximity of a conventional superconductor (SC). The scanning tip features the Majorana bound state γ, which can probe – via tunneling coupling t_σ – any unknown superconductor with odd-frequency pairing.

[1] O. Kashuba, B. Sothmann, P. Burset, and B. Trauzettel. arXiv:1612.03356.