Fine-tuned Majorana states in quantum dot systems

R. Seoane Souto[1,2]*

A. Tsintzis[1], and M. Leijnse[1,2]

[1]*Division of Solid State Physics and NanoLund, Lund University (Sweden)*
[2]*Center for Quantum Devices, Niels Bohr Institute, University of Copenhagen (Denmark)*
*Current affiliation: *Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC (Spain)*

Ruben.seoane_souto@ftf.lth.se
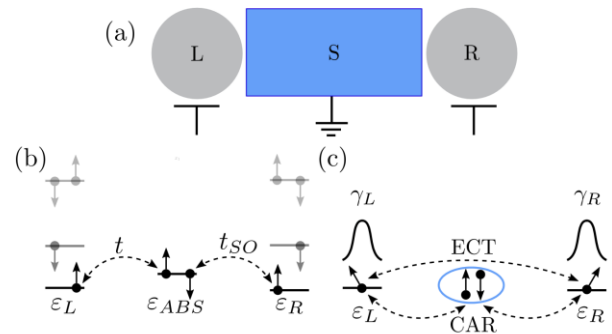
Figures

Figure 1: (a) Minimal setup to obtain Majorana states, formed by two quantum dots coupled via a superconductor. (b) Energy sketch of the system, where the middle region hosts an Andreev state. (c) Sketches for cross Andreev (CAR) and elastic cotunneling (ECT) processes, whose amplitudes are equal at the Majorana sweet spot.

Majorana bound states are quasi-particles with non-abelian statistics that are highly desirable for fundamental research and potential applications in quantum computing [1]. The Kitaev model predicts that these states can appear at the ends of quantum dot-superconductor chains [2]. Recently, a two-site version of such a chain has been reported [sketch in Fig. 1(a)], where non-topological Majorana bound states may appear at a "sweet spot" in the system's tuning [3]. We analyse the problem from the theory side, including many-body interactions, absent in the early studies [4]. We show that high and poor quality Majorana states can appear in the system for different configurations. We developed ways to distinguish between these two states using transport measurements. We also propose experiments to show their non-abelian exchange properties [5], a main challenge in the field.

References

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