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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Theory of Condensed Matter: Hard Condensed Matter

Dec. 11, 2018 at 2 p.m.
Galilei Room, 01-128 (Staudinger Weg 9)

Maxime Garnier
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Many Majorana zero modes around the deformable edge of a magnetic skyrmion

Magnetic skyrmions are nanoscale particle-like spin configurations that are efficiently created and manipulated. They hold great promises for next-generation spintronics applications. In parallel to thesedevelopments, the interplay of magnetism, superconductivity and spin-orbit coupling has proved to be a versatile platform for engineering topological superconductivity predicted to host non-abelianexcitations, Majorana zero modes (MZMs).
In this talk, after an introduction to topological superconductivity and a quick survey of the experimental status of MZMs, I will focus on the theoretical analysis of magnetic skyrmions proximitized by conventional superconductors. We show that a topological superconducting phase can emerge in these systems and uncover a whole flat band of these modes on the edge of the magnetic texture, in contrast to a previously reported MZM in the core of the skyrmion [1]. I will discuss in details the origin of these MZMs based on a procedure introduced in [2] that relates our problem to the the extensively-studied Rashba nanowire model [3, 4]. We find that these modes are remarkably stable to electronic and geometric perturbations which we investigate by a combination of analytical arguments and numerical tight-binding calculations. Additionally, this analysis reveals that the number of MZMs on the edge scales linearly with its perimeter. I will then discuss possible experimental realizations and consequences of this phenomenon and argue that this system is suitable for the realization of the topological Kondo effect and of electron teleportation.

[1] G. Yang, P. Stano, J. Klinovaja & D. Loss, PRB 93, 224505 (2016). [2] F. Wu & I. MArtin, PRB 95, 224503 (2017).

[3] R. M. Lutchyn, Jay D. Sau & S. Das Sarma, PRL 105, 077001 (2010). [4] Y. Oreg, G. Refael & F. von Oppen, PRL 105, 177002 (2010)

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