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4:30 pm at MPI-PKS

Majorana vs. Andreev bound states

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Abstract: In my talk, I will review a current status of experiments and theory in the field of topological superconductivity. Andreev bound states (ABSs) form in normal sections of a Rashba nanowire that is only partially covered by a superconducting layer [1,2]. These ABSs are localized close to the ends of the superconducting section and can be pinned to zero energy over a wide range of magnetic field strengths even if the nanowire is in the non-topological regime. These signatures are reminiscent of those expected for Majorana bound states (MBSs) but occur here in the non-topological regime. For finite-size nanowires (typically $\lesssim$1 μm in current experiments), the ABS localization length is comparable to the length of the nanowire. The probability density of an ABS is therefore non-zero throughout the nanowire and differential-conductance calculations reveal a correlated zero-bias peak (ZBP) at both ends of the nanowire. When a second normal section hosts an additional ABS at the opposite end of the superconducting section, the combination of the two ABSs can mimic the closing and reopening of the bulk gap in local and non-local conductances accompanied by the appearance of the ZBP. As a result, conductance measurements of correlated ZBPs at the ends of a typical superconducting nanowire or an apparent closing and reopening of the bulk gap in the local and non-local conductance are not conclusive indicators for the presence of MBSs.

[1] R. Hess, H. F. Legg, D. Loss, and J. Klinovaja, Phys. Rev. B 106, 104503 (2022)
[2] C. Reeg, O. Dmytruk, D. Chevallier, D. Loss, and J. Klinovaja, Phys. Rev. B 98, 245407 (2018).
[3] R. Hess, H. F. Legg, D. Loss, and J. Klinovaja, arXiv:2210.03507