Induced Superconductivity in Hybrid Nanowires: Hysteretic Magnetotransport and Intrinsic Magnetic Fields

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Strong spin-obit semiconducting nanowires (NWs) in proximity to a conventional superconductor have for some time now been the focus of research in the field of topological superconductivity. These topological states require strong Zeeman fields to emerge which puts constraints on device design and operation. A new set of NWs with such properties, in addition to a ferromagnetic insulator layer offer a possible relaxation of these constraint as they provide an intrinsic magnetic field inside the material. We report magneto transport measurements of Josephson devices implementing these hybrid NWs consisting of an InAs core with a ferromagnetic insulator EuS layer (covered by a protective Aluminium oxide cap) and contacted by two Al electrodes. This geometry shows a hysteretic behaviour in transport with respect to the axial applied magnetic field direction and bias current polarization. The hysteresis of the transport map suggests a significant effective Zeeman field in the material.

References

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Figures

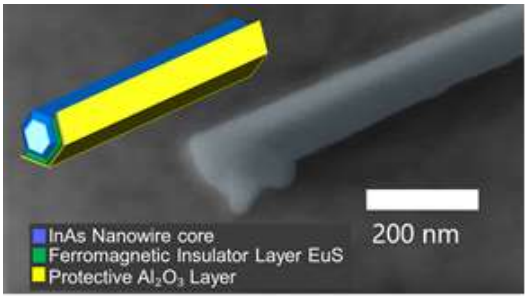

Figure 1: SEM image of a typical NW used in the experiment and an illustration of the nanowire and its constituents in the top left corner.

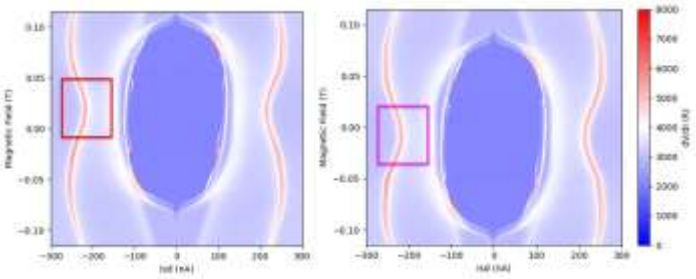

Figure 2: Differential resistance measurements of a InAs-EuS NW Josephson junction with the right panel representing the differential resistance after a 500 mT field was applied in positive direction along the nanowire axis and magnetic field is stepped from positive to negative values, vice versa for the left panel. Note the hysteresis of the map highlighted in the red and purple box.