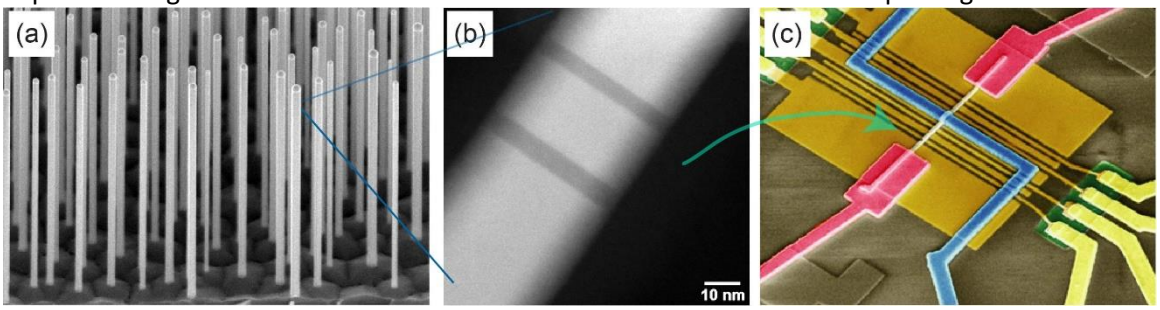
Scientific Area	Quantum Nanodevices
Topic title	Quantum transport in superconductor-semiconductor nanowire hybrid devices with axially built-in quantum dots as spectrometers
Main host institution	Department of Physics / University of Basel https://www.physik.unibas.ch/news.html
Supervisor/institution	Christian Schönenberger https://nanoelectronics.unibas.ch/
Co-Supervisor/institution	Fabrizio Nichele (IBM) https://www.zurich.ibm.com/
Mentor[1]/institution	Dominik Zumbühl https://zumbuhllab.unibas.ch/news.html
Secondment institution	IBM https://www.zurich.ibm.com/

Topic description

The project is motivated by the recent excitement of the appearance of topological phases and Majorana bound states (MBSs) in semiconducting nanowires (NWs) with strong spin-orbit interaction (SOI) coupled to a superconductor (SC) in magnetic field. To unravel the emergence of MBSs in single and coupled NWs, we develop new probes with which the proximity gap and proximity-induced bound states can be quantified. Our approach is based on measuring both DC and AC transport, the latter also at GHz frequencies using reflectometry. As a complementary test, we can also study the microwave radiation in the GHz domain emitted by the quantum device. With the current project we aim to deepen our understanding of the superconductive proximity effect in a NW with strong SOI by studying the evolution of the gap spectroscopically. For the latter we exploit quantum dots (QDs) as spectrometers. Here, the QDs are established by heteroepitaxy during growth. This is done in collaboration with Prof. Lucia Sorba from CNR-Nano at Pisa, where the InAs NWs are grown (see figure). These QDs are very promising due to the large confinement potential. We further plan to test different SCs beyond Al, e.g. Pd and MoRe, and optimize the evaporation together with collaborators from the Niels-Bohr Institute in Copenhagen.



(a) InAs with built in quantum dots defined (b) by two InP barriers. (c) shows a NW with bottom gates (orange), a superconducting (blue) middle contact and two normal metal contacts (red).

Recommended applicant's profile

We look for a highly motivated student (preferably a physicist) who has a dedication for experimental work in the field of quantum science and technology and is ready to collaborate and share knowledge and experience in a team. We expect a strong dedication and commitment to push the frontiers of experimental physics. Requirement: you need to have a profound understanding of quantum and solid state physics as it is taught in a physics curriculum.

[1] Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the ESR, including career matters with an external perspective and provide mediation in the case of disputes.

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