Towards topological applications with hybrid superconducting devices

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Hybrid superconductor/semiconductor devices constitute a powerful platform where intriguing topological properties can be investigated. In this talk we present a different approach on hybrid systems in which topological properties can emerge. A deep understanding of all prerequisites and fundamental aspects of hybrid structures, such as proximity effect and correlations, is crucial in view of the investigation and realization of new states of matter. Here we present Josephson junction devices formed by a high-mobility InAs quantum-well bridging two Nb superconducting contacts. By means of transport measurements we reveal both supercurrent flow and well-developed quantum Hall plateau in magnetic field, demonstrating the potential of hybrid devices to investigate the coexistence of superconductivity and Quantum Hall effect. We also discuss a different, fully tunable, hybrid semiconductor/superconductor device, in which the width, area, and supercurrent of the two arms of a SQUID-like geometry can be independently controlled by means of electrostatic gating. These developments pave the way to new devices for topological purposes. Prospects for the realization of novel and exotic states of matter, such as parafermions, will be discussed.

References:

[1] S. Guiducci, M. Carrega, G. Biasiol, L. Sorba, F. Beltram, and S. Heun, *Towards quantum Hall effect in Josephson junction device*, ArXiv:1805.02862 (2018).

[2] A. Iorio, M. Rocci, L. Bours, M. Carrega, V. Zannier, L. Sorba, S. Roddaro, F. Giazotto, and E. Strambini, *Vectorial control of the spin-orbit interaction in suspended InAs nanowires*, ArXiv:1807.04344 (2018).

[3] L. Mazza, J. Viti, M. Carrega, D. Rossini, and A. De Luca, *Energy transport in an integrable parafermionic chain via generalized hydrodynamic*, Phys. Rev. B 98, 075421 (2018).

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