



## Physical Sciences Seminar

# The exciting life of quasiparticles trapped between superconductors

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Host: Georgios Katsaros

In a non-superconducting material linking two superconductors, discrete quasiparticles states are formed as electrons and holes are transmuted into each other through successive Andreev reflection processes at both interfaces. The energy of these Andreev bound states depends on the phase difference between the complex order parameters of the superconductors. As a result, such a weak link carries a supercurrent and behaves as an inductance that depends on the occupation of the Andreev states. I will review a series of experiments performed on atomic-size contacts [1] and on semiconducting nanowire weak links [2,3,4] relying on the techniques of circuit Quantum Electrodynamics, which consist in probing a quantum circuit through a coupled resonator [5]. They reveal the rich physics of Andreev Bound States, from the basics to the effects of spin-orbit coupling and of Coulomb interactions.[1] Coherent manipulation of Andreev states in superconducting atomic contacts, C. Janvier, L. Tosi, L. Bretheau, . . . Girit, M. Stern, P. Bertet, P. Joyez, D. Vion, D. Esteve, M. F. Goffman, H. Pothier, and C. Urbina, Science 349, 1199 (2015). [2] Spin-Orbit Splitting of Andreev States Revealed by Microwave Spectroscopy, L. Tosi, C. Metzger, M. F. Goffman, C. Urbina, H. Pothier, Sunghun Park, A. Levy Yeyati, J. Nygrd, and P. Krogstrup, Phys. Rev. X 9, 011010 (2019). [3] Circuit-QED with phase-biased Josephson weak links, C. Metzger, Sunghun Park, L. Tosi, C. Janvier, A. A. Reynoso, M. F. Goffman, C. Urbina, A. Levy Yeyati, and H. Pothier, Phys. Rev. Research 3, 013036 (2021).[4] Signatures of interactions in the Andreev spectrum of nanowire Josephson junctions, F. J. Matute Caadas, C. Metzger, Sunghun Park, L. Tosi, P. Krogstrup, J. Nygrd, M. F. Goffman, C. Urbina, H. Pothier, A. Levy Yeyati, <https://arxiv.org/abs/2112.05625>. [5] From Adiabatic to Dispersive Readout of Quantum Circuits, Sunghun Park, C. Metzger, L. Tosi, M. F. Goffman, C. Urbina, H. Pothier, and A. Levy Yeyati, Phys. Rev. Lett. 125, 077701 (2020).

**Tuesday, May 3, 2022 11:30am - 12:30pm**

Heinzel Seminar Room / Office Bldg West (I21.EG.101)

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