Non-equilibrium transport in multi-terminal topological superconductor systems

T. Jonckheere[a*], J. Rech[a], A. Zazunov[b], R. Egger[b], T. Martin[a]

a. Centre de Physique Théorique, CNRS, Aix-Marseille Univ., Campus de Luminy, case 907, 13009 Marseille

b. Institut fur Theoretische Physik, Heinrich Heine Universität, D-40225 Düsseldorf, Germany

∗ thibaut.jonckheere@cpt.univ-mrs.fr

A topological superconductor (TS) nanowire has unique properties, including a Majorana bound states at each of its ends. These Majorana bound states have a strong impact on the transport properties. While most studies of the transport have been devoted to the transport between two TS or between a TS and a normal metal electrode, considering a 3-terminal system allows to explore more subtle properties of the Majorana bound states. These 3-terminals systems have the potential to uncover new physics, and to give access to new ways to characterize unambiguously the presence of Majorana bound states in experiments.

I will first present results on a topological superconductor beam splitter,[1] where a central TS nanowire is connected to two normal leads which are set at arbitrary voltages. Using a Hamiltonian formalism, we compute the mean current and the current-current correlations. We observe that the sign of the current-current correlations is opposite to the case of a standard BCS superconductor beam splitter, and we show that this is a direct consequence of the electron-hole symmetric nature of the majorana bound state.

Then I will show results for a 3-terminal system made of 3 TS nanowires.[2] There the behavior is richer and more complex. The mean current shows features typical of multiple Andreev reflection (MAR) processes, while the current-current correlations can reach huges values. I will explain how this surprising behaviour is due to a combination of MAR processes and fluctuations created by direct coupling between the Majorana bound states.

[1] T. Jonckheere, J. Rech, A. Zazunov, R. Egger and T. Martin Phys. Rev. B **95**, 054514 (2017)

[2] T. Jonckheere, J. Rech, A. Zazunov, R. Egger and T. Martin, *in preparation*