Charge Sensing an Andreev Molecule

DAVID VAN DRIEL
Bart Roovers, Francesco Zatelli, Tom Dvir, Alberto Bordin, Guanzhong Wang, Nick van Loo, Jan C. Wolff, Sasa Gazibegovic, Ghada Badawy, Erik P. A. M. Bakkers, Leo P. Kouwenhoven

QUTECH, LORENTZWEG 1, DELFT, THE NETHERLANDS

D.VANDRIEL@TUDELFT.NL

Majorana zero modes appear at the ends of a Kitaev chain, which can be engineered by coupling quantum dots (QDs) to superconductors. A two-site Kitaev chain can hold so-called "Poor Man's Majorana's" at a fine-tuned spot in parameter space [1, 2]. While not being topologically protected, they do have non-Abelian properties which can be probed in an anion fusion experiment [3]. Pairwise parity readout of Majorana's is needed to show fusion, which can be done by sensing the charge of a QD coupled to the Majoranas [4]. This requires a sensor dot being able to resolve the charge of a superconductor-semiconductor system. In this talk, we demonstrate charge sensing of an Andreev Bound State (ABS) in a hybrid semiconductor-superconductor nanowire.
First, we show that the charge sensor can detect the change of charge during the singlet-doublet transition of an ABS. Second, we resolve the continuously changing charge of an ABS which remains in the singlet state. Finally, we couple two ABSs and sense the hybridisation of charge of the combined Andreev Molecule. Our results demonstrate that QDs can be used for charge sensing Kitaev chain systems.

References

1. [1] Leijnse, Martin, and Karsten Flensberg. Physical Review B 86.13 (2012): 134528.
2. [2] Dvir, Tom, et al. Nature 614.7948 (2023): 445-450.
3. [3] Liu, Chun-Xiao, et al. arXiv preprint arXiv:2212.01653 (2022).
4. [4] Széchenyi, Gábor, and András Pályi. Physical Review B 101.23 (2020): 235441.

Figures

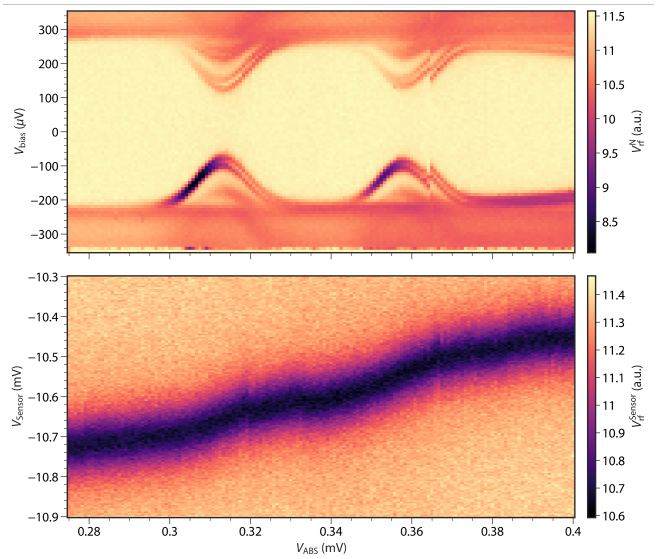

Figure 1: top. RF conductance of an ABS for varying hybrid gate and bias. **Bottom.** Charge sensor response measured simultaneously for varying hybrid gate and sensor gate.

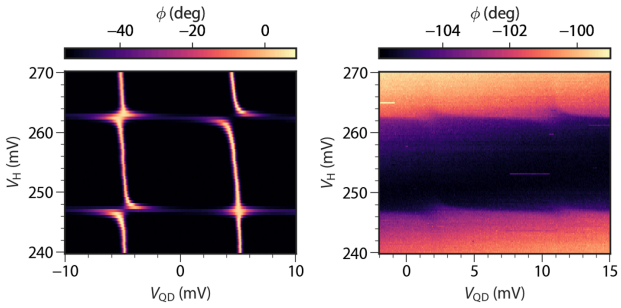

Figure 2: Left. Charge stability diagram measured in reflected phase of two coupled ABSs. **Right.** Charge sensor phase response response of the coupled ABS system.