

CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé
SÉMINAIRE

***** horaire inhabituel *****

Lundi 24 Juin 2013 à 11h15

Orme des Merisiers SPEC Amphi Bloch, Bât.774

**Sub-gap states and zero-bias anomalies in hybrid
superconductor-semiconductor nanowire devices**

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Following recent theoretical proposals [1,2], the past years have seen an increasing experimental effort towards the realization and detection of Majorana fermions (MFs) in hybrid superconductor-semiconductor nanowire devices [3-7]. Experiments have mainly focused on tunnel spectroscopy measurements aimed at the detection of zero-energy Majorana states. In this approach, the main sought after signature is a zero-bias peak (ZBP) in the conductance that should emerge in the superconducting regime and at finite magnetic fields. This ZBP should be robust against magnetic-field and gate-voltage variations. ZBPs of this kind have been found in recent experiments [3-7]. Yet their interpretation in terms of MFs remains to be convincingly established, especially since a variety of other physical mechanisms are known to yield similar signatures. By carefully studying some of these alternative mechanisms, this work aims to contribute important knowledge useful for the quest of MFs. We present low temperature electron transport measurements on hybrid devices based on InAs/InP core/shell nanowires. We investigate the magnetic properties of the sub-gap states. In a magnetic field, the Zeeman splitting of the spinful sub-gap states can induce a quantum phase transition, characterized by a ZBP [8]. These peaks mimic several signatures of MFs, including persistence over an extended magnetic field, as well as their expected angular dependence. We also show that at finite magnetic fields, a “soft” gap is induced in the superconducting contacts, leading to the appearance of Kondo ZBPs in the superconducting regime [9].

- [1] R. M. Lutchyn, J. D. Sau and D. Das Sarma, PRL 105, 077001 (2010).
- [2] Y. Oreg, G. Refael and F. von Oppen, PRL 105, 177002 (2010).
- [3] V. Mourik *et al.*, Science 336, 1003 (2012).
- [4] M. T. Deng *et al.*, Nano Lett. 12, 6414 (2012).
- [5] A. Das *et al.*, Nature Phys. 8, 887 (2012).
- [6] A. D. K. Finck *et al.*, PRL 110, 126406 (2012).
- [7] H. O. H. Churchill *et al.*, arXiv:1303.2407.
- [8] E. J. H. Lee *et al.*, arXiv:1302.2611 (2013).
- [9] E. J. H. Lee *et al.*, PRL 109, 186802 (2012).

A coffee break will be served at 11h00. The seminar will be given in English.