

Charge, spin and heat transport in superconducting nanostructures with generic spin fields

We are looking for a PhD student to work on a cooperative project between the theory group at LOMA (<https://www.loma.cnrs.fr>) (Prof. Alexandre Buzdin and J r me Cayssol), University of Bordeaux, and the Mesoscopic Physics Group (Sebastian Bergeret and Dario Bercioux) at the Donostia International Physics Center (DIPC) in San Sebastian (<http://cfm.ehu.es/mesoscopics/>).

The PhD student will be proposed the choice between different topics in the field of **quantum transport through superconducting hybrid structures combining exotic materials (strong spin-orbit coupled metals, Dirac materials and topological insulators) with conventional superconductors**.

During the PhD the candidate will be introduced to the quasiclassical technique to deal with spin interactions in superconducting heterostructures. Topological effects in superconductors with strong spin-orbit and spin-splitting effects will be derived and illustrated within this methodology. More generally a nonequilibrium description of superconducting spintronics will be developed. Ultimately, the developed formalism will be applied to concrete situations, specially when charge, spin and heat currents are coherently coupled. Another possible direction will be to investigate the effect of a periodic external driving on such exotic phases using the Floquet formalism: time-dependent driving (from GHz to optical frequency) produces non-equilibrium populations of charge carriers and may also change the topological character of electronic bands.

The project concentrates on hot topics of condensed matter physics and will fill a gap in material science, since it will focus specifically on the difficulties to observe topological effects in experimentally accessible heterostructures. In addition, the extended quasiclassic methods will be helpful for the mesoscopic physics community for the description of spin-dependent interactions in quite generic terms and for the design of experiments in the emergent field of superconducting spintronics.

Candidates should be motivated students with a good background in quantum mechanics and statistical physics, communication skills and good English knowledge. The total duration of the thesis is **36 months: 18 months at LOMA (Bordeaux University) and 18 months at DIPC (San Sebastian)**. The PhD student will have a unique chance to have an international experience to work in two groups from different countries.

Contact and calendar:

The interested candidates are invited to submit CV and motivation letter to Prof. J r me Cayssol via email (jerome.cayssol@u-bordeaux.fr) **before 5 June 2016**.

Notification of successful candidate: end of June

The starting time for this PhD position is between 1 October and 15 December, 2016 in University of Bordeaux.