RobustSuperQ – Job offer

A 2-year Post-doc or a 3-year PhD position

Circuit Quantum Electrodynamics with Hybrids Quantum Hall Josephson Junctions

Job description

Hybridizing superconductivity with the quantum Hall (QH) effect has notable potential for designing circuits capable of inducing and manipulating non-Abelian states for topological quantum computation. A variety of QH states exhibits remarkable properties, as full spin polarization, helical phases with spin-momentum locking [1], fractionalization of charges into anyons quasiparticles, or a non-local nature and non-commutative braiding properties for non-Abelian anyons.

Last year, our group demonstrated the first Josephson junction made with graphene operating in the quantum Hall regime [2] up to a record magnetic field of 8T. We showed that the supercurrent in this regime is carried by the QH edge states, which are one dimensional channel propagating unidirectionally at the edges of the sample (see Figure), resulting in an unusual chiral supercurrent [2].

The project builds on this breakthrough to explore more exotic regimes of the quantum Hall (QH) effect, where coupling with superconductivity is expected to proximity-induce non-conventional superconducting states, such as p-wave superconductivity and topological Andreev bound states with non-Abelian properties. Circuit quantum electrodynamics techniques under strong magnetic field will be developed to perform microwave spectroscopy of the chiral Andreev bound states formed on various quantum Hall ground states, and explore their unusual and topological properties.

[1] *Helical quantum Hall phase in graphene on $StrTiO_3$*, L. Veyrat et al. Science 367, 781 (2020) arxiv:1907:02299

[2] *Evidence for chiral supercurrent in quantum Hall Josephson junctions*, H. Vignaud et al. Nature 624, 545 (2023) arxiv:2305.01766

At the Néel Institute, Grenoble, France

https://neel.cnrs.fr/ and http://sacepe-quest.neel.cnrs.fr/

Starting date

As soon as possible

Job requirements

The candidate must have

- For Postdoctoral positions: A Ph.D. in mesoscopic quantum device physics or a related field.
- For Ph.D. positions: A Master's degree in quantum physics or solid-state physics.

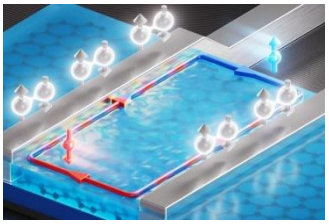
What We Offer:

- In-depth involvement in our groundbreaking research projects.
- Collaborative work environment with interaction with international leading experts.
- Opportunities for professional development, conference presentations, and publications.

How to apply

Please send your application to Benjamin Sacépé (benjamin.sacepe@neel.cnrs.fr),

Required documents: CV, diploma transcripts, e-mail supervisor/ recommendation contact



Figure| Graphene quantum Hall Josephson junction. The supercurrent that is a mixture of electrons (blue) and holes (red) is carried non-locally by the chiral quantum Hall edge channel [2].

PROGRAMME ET EQUIPEMENTS PRIORITAIRES DE RECHERCHE QUANTIQUE

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