DRF: Thesis SL-DRF-20-0704

RESEARCH FIELD

Mesoscopic physics / Condensed matter physics, chemistry & nanosciences

TITLE

Anyonic statistics of toplogical e/3 and e/5 fractionally charged excitations in the Quantum Hall Effect regime

ABSTRACT

In some quantum matter states, the current may remarkably be transported by carriers that bear a fraction e* of the elementary electron charge. This is the case for the Fractional quantum Hall effect (FQHE) that happens in two-dimensional systems at low temperature under a high perpendicular magnetic field. When the number of magnetic flux in units of h/e is a fraction of the number of electrons, a dissipationless current flows along the edges of the sample and is carried by anyons with fractional charge e/3, e/5, e/7, etc. These fractional excitations are believed to be anyons intermediate between fermions and bosons. However the evidence of anyonic statistics is still lacking.

We propose an original approach based on the manipulation of anyons by microwave photons as recently demonstrated in the group (Science 2019). The idea is to realize a single anyon source similar to the one developed for electrons based on Levitons (Nature 2013, Nature 2014). Combining 2 such sources would allow the 2-anyon interference required to evidence the anyonic statistics.

The thesis work will require the realization of the on-demand single anyon source using microwave Lorentzian pulses at ultra-low temperature in 14 Tesla magnetic field. The characterization will include electronic quantum noise measurements and coincidence measurements thanks to a new single charge detector

1] A Josephson relation for fractionally charged anyons, M. Kapfer, P. Roulleau, I. Farrer, D. Ritchie and D. C. Glattli (SCIENCE (2019) https://doi.org/10.1126/science.aau3539)

[2] Minimal-excitation states for electron quantum optics using levitons, J. Dubois, T. Jullien, F. Portier, P. Roche, A. Cavanna, Y. Jin, W. Wegscheider, P. Roulleau and D. C. Glattli, NATURE 502, 659-663 (2013)

[3] Quantum tomography of an electron, T. Jullien, P. Roulleau, B. Roche, A. Cavanna, Y. Jin and D. C. Glattli, Nature 514, 603–607 (2014)

LOCATION

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