
Anyonic Braiding and Andreev-like Processes in the Fractional Quantum Hall effect

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Abstract

Edges of the fractional quantum Hall (FQH) host anyonic quasiparticles, having a charge e^* which is a fraction of the electron charge (e.g. $e^*=e/3$), and a fractional or "anyonic" braiding statistics, which is intermediate between bosons and fermions. In this talk I will theoretically describe two consequences of these properties, recently observed in experiment.

The first is due to the mismatch between the fractional charge e^* of the excitations in the system, and the electron charge e tunneling between two distinct FQH droplets. This results in a process similar to the Andreev reflection occurring between a normal metal and a superconductor. I find our theoretical results (1) to match well that of the recent experiments (2).

Secondly, I consider anyonic statistics through the anyon collider experiment, where the noise created at a quantum point contact by two incoming streams of anyonic quasiparticles allows to measure the anyonic statistics (3, 4). Here, I will show that taking into account the finite extension of the anyonic quasiparticles is crucial to have a correct description of the anyonic braiding. Importantly, this leads to results in agreement with the experimental observations for composite fractions of the FQHE, like $= 2/5$ (5).

(1) K. Iyer, T. Martin, J. Rech, and T. Jonckheere. Quasiparticle andreev reflection in the Laughlin fractions of the fractional quantum hall effect.

Phys. Rev. B, 108:155404, Oct 2023.

(2) P. Glidic, O. Maillet, C. Piquard, A. Aassime, A. Cavanna, Y. Jin, U. Gennser, A. Anthore, and F. Pierre. Quasiparticle andreev scattering in the $= 1/3$ fractional quantum hall regime. *Nature Communications*,

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(3) M. Ruelle, E. Frigerio, J.-M. Berroir, B. Plaçais, J. Rech, A. Cavanna, U. Gennser, Y. Jin, and G. Fève. Comparing fractional quantum hall Laughlin and Jain topological orders with the anyon collider. *Phys. Rev. X*, 13:011031, Mar 2023.

(4) P. Glidic, O. Maillet, A. Aassime, C. Piquard, A. Cavanna, U. Gennser, Y. Jin, A. Anthore, and F. Pierre. Cross-correlation investigation of anyon statistics in the $\nu = 1/3$ and $2/5$ fractional quantum hall states. *Phys. Rev. X*, 13:011030, Mar 2023.

(5) K. Iyer, F. Ronetti, B. Grémaud, T. Martin, J. Rech, and T. Jonckheere. Finite width of anyons changes braiding signatures. In preparation, planned submission on arXiv and *Phys. Rev. Lett.* before the meeting.