

量子物理学・ナノサイエンス第 446 回セミナー

Probing anyons properties in quantum Hall edge transport

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- 日程** : 7月7日 (火) 13:30 -
- 場所** : 本館1階 M112 講義室

概要

Anyons, quasiparticles with exchange statistics intermediate between bosons and fermions, are among the most distinctive excitations of fractional quantum Hall systems. Their fractional charge has long been accessed through shot-noise measurements at quantum point contacts, but a direct and robust detection of their braiding statistics remains a central challenge. In this seminar, I will discuss several transport-based approaches to probing anyonic properties in fractional quantum Hall edge states.

First, I will show how the finite spatial width of anyons can strongly affect braiding-induced transport signatures, even when this width is extremely small. This effect is especially relevant for hierarchical states and provides a possible explanation for recent experiments at filling factor ($\nu=2/5$). I will then discuss photo-assisted shot noise as a tool to identify multiple tunneling charges in states with several edge modes, focusing on the case ($\nu=2/3$), where different quasiparticle charges may tunnel simultaneously at a quantum point contact.

Finally, I will present proposals for directly measuring the anyonic statistical angle using controlled time-dependent transport. These setups rely on anyons emitted from a QPC source and braided either around a fractional quantum Hall droplet or through a closed-loop geometry on a single chiral edge. In these schemes, the time-dependent current and current cross-correlations carry signatures governed by the statistical phase, while suitable protocols allow the extraction of the anyonic angle without requiring independent knowledge of non-universal parameters. Together, these results highlight how edge transport can provide experimentally accessible and theoretically sharp probes of fractional charge, braiding, and anyonic statistics.

The following published papers are related to this work:

<https://arxiv.org/abs/2311.15094>

<https://arxiv.org/abs/2502.15909>

<https://arxiv.org/abs/2503.17008>

<https://arxiv.org/abs/2506.09774>

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