Anyonic exchange on the edge of a fractional quantum Hall state

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Résumé

Under strong magnetic fields, electrons that are confined to two spatial dimensions can exhibit a fractional quantum Hall state where the elementary particles carry only a fraction of the electron charge. These exotic excitations, called anyons, moreover behave under the interchange of two individuals neither as fermions nor as bosons but are characterized instead by a non-trivial exchange phase. The experimental proof of these anyons and their exchange phase was performed only recently, in 2020. Recent experiments have notably demonstrated that a quantum point contact on the edge channels of a fractional quantum Hall (Laughlin) state is able to reveal the anyonic phase from noise measurements.

This lecture will present an introduction to anyons within the fractional quantum Hall effect, exploring their imprint along the edge of the system. Using quantum constrictions called quantum point contacts (QPC), anyons can be randomly transferred between two edges of a fractional quantum Hall conductor. This lecture will focus on the use of current noise measurements to characterize the exotic properties of anyons. The anyon fractional charge was extracted over twenty years ago from noise measurements implemented in sample geometry comprising a single QPC. Recent experiments performed in more complex geometries where several QPCs are used as anyon sources and anyon beam-splitters have revealed the anyon fractional statistics. In these geometries, we will present how anyon tunneling at a QPC can be understood as a 1+1 space-time braiding mechanism between anyons. This mechanism mirrors the conventional anyonic braiding observed when a quasiparticle adiabatically encircles another.

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