Time-domain braiding of anyons

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Résumé

Experimental evidence of anyon fractional statistics has been so far exclusively obtained in the DC regime, without possibility of a time-domain study. We demonstrate here the on-demand generation of subnanosecond single anyon current pulses. These pulses are artificial anyons whose fractional statistics can be continuously tuned by varying the fractional charge carried by each pulse (1,2,3). In this work, we use artificial anyons as a probe to study the dynamics of the tunneling of bulk topological anyons in the time domain.
We implement a Hong-Ou-Mandel (HOM) experiment between two artificial anyons at a quantum point contact (QPC) in a fractional quantum Hall fluid at filling factor nu=1/3. The incoming artificial anyons and the tunneling topological anyons braid at the QPC, thus effectively probing the role of anyon braiding on the characteristic timescale of anyon tunneling. We measure as proposed in (3) a HOM dip in the current noise at the outputs of the QPC, which width depends on the characteristic timescale for tunneling. By comparing integer and fractionally charged pulses, we observe that anyon dynamics is controlled by the scaling dimension, contrasting with the electron case where without braiding, the timescale for tunneling is set by the temporal width of the current pulses.

This experiment provides a new route for studying the role of braiding on the dynamics and temporal correlations of topological excitations. It also opens the way to a new generation of experiments where anyons are emitted on-demand in a circuit.

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