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Measurement of filling factor 5/2 quasiparticle interference[1]

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A standing problem in low dimensional electron systems is the nature of the 5/2 fractional quantum Hall state: its elementary excitations are a focus for both elucidating the state's properties and as candidates in methods to perform topological quantum computation. Interferometric devices may be employed to manipulate and measure quantum Hall edge excitations. Here we use a small area edge state interferometer designed to observe quasiparticle interference effects. Oscillations in transmission consistent in detail with the Aharanov-Bohm effect are observed for integer and fractional quantum Hall states (filling factors 2, 5/3 and 7/3) with periods corresponding to their respective charges and magnetic field positions. With these charge calibrations, at filling factor 5/2 and at lowest temperatures periodic transmission through the device consistent with quasiparticle charge e/4 is observed. The principal finding of this work is that in addition to these e/4 oscillations, periodic structures corresponding to e/2 are also observed at filling factor 5/2 and at lowest temperatures. Properties of the e/4 and e/2 oscillations at 5/2 are examined with the device sensitivity sufficient to observe the relative prevalence of e/4 and e/2 oscillations, transitions between the periods, and temperature evolution of the 5/2 quasiparticle interference. Among possible etiologies, this presence of an effective e/2 period may empirically reflect an e/2 quasiparticle charge, or may reflect multiple passes of the e/4 quasiparticle around the interferometer. These results are discussed within a potential picture of e/4 quasiparticle excitations possessing non-Abelian statistics. Some critical consistencies are met between the experimental results and properties of non-Abelian e/4 quasiparticles. These studies demonstrate the capacity to perform interferometry on 5/2 excitations and reveal properties important for understanding this state and its excitations.

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