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EVIDENCE FOR NON-ABELIAN QUASIPARTICLES AT FILLING FACTOR 5/2

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Abstract:

It is a theoretical conjecture that $5/2$ fractional quantum Hall state charge $e/4$ excitations may obey non-Abelian statistics. In edge state interference these purported non-Abelian quasiparticles should display period $e/4$ Aharonov-Bohm oscillations[1] if the interfering quasiparticle encircles an even number of localized $e/4$ charges, but suppression of oscillations if an odd number is encircled. To test this hypothesis, we have performed swept area interference measurements at $5/2$. We observe an alternating pattern of $e/4$ and $e/2$ period oscillations in resistance for a large change in the interferometer area, with the area sweep changing the number of enclosed localized $e/4$ quasiparticles.[2] This aperiodic alternation is consistent with proposed non-Abelian properties: the $e/4$ oscillations occur for encircling an even number of localized quasiparticles, and the lower amplitude $e/2$ oscillations are observed when encircling an odd number. The large amplitude $e/4$ oscillations dominate the measurement when the localized quasiparticle number is even, but at odd number they are suppressed, allowing observation of the smaller $e/2$ oscillations that may be persistent throughout the measurement. The aperiodic alternation corresponds to the area sweep sampling an expected aperiodic spatial distribution of localized quasiparticles. Importantly, adding localized quasiparticles to the encircled area by changing magnetic field can change the parity of the enclosed quasiparticle number and should induce interchange of the expressed $e/4$ and $e/2$ periods: Just such interchange of the $e/4$ and $e/2$ oscillation periods is observed in measurements discussed here, with agreement between the measured and calculated values of B-field necessary to add a single quasiparticle to the interferometer area. These results are specifically consistent with proposed non-Abelian $e/4$ quasiparticle properties.

[1] R.L. Willett, L.N. Pfeiffer, K.W. West, Proc. Natl. Acad. Sci. U.S.A. **106**, 8853 (2009); "Measurement of filling factor $5/2$ quasiparticle interference with observation of charge $e/4$ and $e/2$ period oscillations"

[2] R.L. Willett, L.N. Pfeiffer, K.W. West, Phys. Rev. B. **82**, 205301 (2010); "Alternation and interchange of $e/4$ and $e/2$ period interference oscillations consistent with filling factor $5/2$ non-Abelian quasiparticles"