MAR12-2011-005390

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Interferometric evidence for non-Abelian quasiparticles at filling factor 5/2

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The 5/2 fractional quantum Hall state charge e/4 excitations are proposed to follow non-Abelian statistics [1]. In edge state interference these purported non-Abelian quasiparticles should display period e/4 Aharonov-Bohm oscillations if the interfering quasiparticle encircles an even number of localized e/4 charges, but suppression of oscillations if an odd number is encircled [2-3]. To test this, we have performed swept area interference measurements at 5/2 [4-5]. 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 enclosed localized e/4 quasiparticle number. This observed aperiodic alternation is consistent with proposed non-Abelian e/4 properties: the e/4 oscillations occur for encircling an even number of localized quasiparticles over their aperiodic spatial distribution, and the lower amplitude e/2 oscillations are observed when encircling an odd number as the e/4 oscillations are suppressed, allowing observation of the persistent smaller Abelian e/2 oscillations. 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: such interchange is observed in these measurements. In further experiments with the goal of understanding specific e/4 edge propagation properties, a series of interferometers of different sizes have been tested. The range of device dimensions has allowed measurement of the e/4 quasiparticle propagation attenuation length, demonstrating that small interferometric pathlengths are necessary to observe the interference oscillations. The stability in phase and amplitude of the e/4 oscillations has been tested with respect to sample dimensions, time, and temperature using this set of interferometers, and these results will be discussed.

[1] Moore, G. and Read, N., Nucl. Phys. B360, 362 (1991).
[2] Stern, A. and Halperin, B. I., Phys. Rev. Lett. 96, 016802-016805 (2006).
[3] Bonderson, P., Kitaev, A. and Shtengel, K., Phys. Rev. Lett. 96, 016803-016806 (2006).
[4] Willett, R.L., Pfeiffer, L.N., West, K.W., PNAS 106: 8853-8858 (2009).
[5] Willett, R.L., Pfeiffer, L.N., West, K.W., PRB 82: 205301 (2010).