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.