

University of California at San Diego – Department of Physics – Prof. John McGreevy
Physics 230 Quantum Phases of Matter, Spr 2024
Assignment 5

Due 11pm Thursday, May 9, 2024

1. **Charges of quasiparticles in abelian CS EFT.**

In an abelian CS theory with K -matrix K , show that a quasiparticle with charge ℓ^I under CS gauge field a^I has electric charge

$$q_l = tK^{-1}l.$$

2. **Quasiparticle wavefunctions.**

- (a) Use the flux-threading argument starting from the Laughlin $\nu = \frac{1}{m}$ state to construct wavefunctions for the quasihole and quasiparticle. That is, write down a wavefunction of N electrons with the property that it acquires a phase $e^{\pm i\theta}$ when the coordinate z_i of *any* electron is taken around the point $z_i = w$ by an angle θ : $z_i - w \rightarrow e^{i\theta}(z_i - w)$, $\forall i = 1..N$.

In the latter case, don't forget to project onto the lowest Landau level.

Alternatively, you can try to use the parton construction, *i.e.* add or remove a single parton.

- (b) Using the plasma analogy, show that your quasihole wavefunction produces a localized charge deficit of charge $1/m$.
- (c) Construct a wavefunction with *two* quasiholes and use it to verify their statistics (by adiabatically moving them around each other and computing the resulting Berry phase).