

University of California at San Diego – Department of Physics – Prof. John McGreevy

**Physics 211C (239) Phases of Quantum Matter,  
Spring 2021  
Assignment 5**

**Due 12:30pm Monday, May 10, 2021**

Thanks for following the submission guidelines on [hw01](#). Please ask me by email if you have any trouble.

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**1. Quasiparticle wavefunctions.**

(a) Use the parton construction of the Laughlin  $\nu = \frac{1}{m}$  state to construct wavefunctions for the quasihole and quasiparticle.

(Hint: add or remove a single parton. Don't forget to project onto the lowest Landau level.)

(b) Construct a wavefunction with *two* quasiholes and use it to verify their statistics.

**2. Hall plateaux as a crazy manifestation of quantum oscillations.** Check the claim that the hierarchy states at fillings  $\nu = \frac{\nu^*}{2\nu^* \pm 1}$  for  $\nu^* \in \mathbb{Z}$  can be regarded as an extreme version of quantum oscillations in the HLR state at  $\nu = \frac{1}{2}$ .

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

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

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

**4. Excitations of hierarchy states.** Find the torus groundstate degeneracy, and the [charges](#) and statistics of the quasiparticle excitations of the abelian incompressible FQH state at  $\nu = \frac{2}{5}$ .