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Investigation of Particle-Hole Symmetry in the Fractional Quantum Hall Effect at the Lowest Landau Level Using Realistic Hamiltonians¹

EDUARDO PALACIOS, MICHAEL PETERSON, California State University Long Beach — Electrons confined to two-dimensions experience the fractional quantum Hall effect (FQHE) at low electron densities, high magnetic fields, and low temperatures. FQHE states are topologically ordered phases characterized by the fractional filling factor ν which is the electron number divided by the Landau level (LL) degeneracy. Alternatively, under particle-hole conjugation one can consider system in terms of holes (the absence of an electron). The total number of holes in a fractionally filled LL is simply the LL degeneracy minus the number of electrons. Hence, the fractional filling factor of holes is $\nu_h = 1 - \nu$. Naively, if the system maintains particle-hole symmetry, then if the FQHE occurs at filling factor ν it will also occur at filling factor $1 - \nu$ with all the same properties. However, realistic effects such as finite magnetic fields, disorder, etc. can break particle-hole symmetry at the level of the Hamiltonian. We study the nature of particle-hole symmetry on the FQHE in the lowest Landau level under realistic conditions numerically using exact diagonalization.

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Eduardo Palacios
California State University Long Beach

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