Leviton Wavefunctions on Fractional Quantum Hall Edges

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Abstract

A Leviton on an integer quantum Hall edge is created by applying a Lorentzian voltage pulse (1,2). It is described by a single excitation on the Fermi sea. It has the minimal excitation property (i.e., no hole is generated) and the minimal noise property (noise of its tunneling current at a quantum point contact is minimal). Leviton is expected to be useful in realization of electron quantum optics. A natural question is whether the notion of the minimal excitation is generalized to the fractional quantum Hall regime (3).
To answer the question, we develop a theoretical approach based on wavefunctions on fractional quantum Hall edges rather than the conventional approach with Green's functions. We obtain many-body wavefunctions of the excitations generated by single or multiple Lorentzian voltage pulses. Based on the wavefunctions, we infer minimal excitation and minimal noise properties of the Levitons, introducing the concept of anyonic holes and fermionic holes on fractional quantum Hall edges. We propose experimental setups with which one observes the minimal noise properties with distinguishing the anyonic and fermionic holes.

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