Microwave response of fractional quantum Hall droplets with quasiparticle tunneling

Fumihiro Murabayashi[1], Ryotaro Sano[1], Flavio Ronetti[2], Jérôme Rech[2], Thierry Martin[2], Thibaut Jonckheere[2], and Takeo Kato[1]

[1] *Institute for Solid State Physics, University of Tokyo, Kashiwa 277-8581, Japan*
[2] *Aix Marseille Univ, Université de Toulon, CNRS, CPT, Marseille, France*

The study of anyonic excitations in the edge states of fractional quantum Hall (FQH) systems has been pursued for many years [1,2], and recent research has made significant progress in probing their statistical properties [3,4]. So far, the statistics of anyons have mainly been investigated through measurements of edge currents and current noise. A new measurement scheme has been proposed that utilizes the interaction between microwaves and an isolated FQH droplet without employing lead contacts [5]. In this setup, microwave radiation is absorbed when the incident frequency resonates with the edge modes, resulting in measurable changes in the amplitude and phase of the transmitted signal. Furthermore, it has been proposed that the statistical properties of anyons could be probed by introducing a quantum point contact (QPC) and performing microwave spectroscopy.

In this study, we numerically evaluate the microwave response of the edge states using quantum Monte Carlo simulations that incorporate nonperturbative effects of inter-edge scattering, and compare the results with analytical calculations based on second-order perturbation theory in the inter-edge coupling strength [6]. Our analysis focuses on the shift of the resonance peak position and the linewidth of the microwave absorption spectrum.

Using this approach, we capture experimentally relevant features not addressed in previous work [5], including coupling-strength-dependent peak shifts and temperature-induced changes in the linewidth. Moreover, we find that higher-order effects become more pronounced as the Landau-level filling factor decreases, leading to enhanced peak shifts and related spectral features [6].

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