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Development of integrated quantum circuits with chiral Tomonaga-Luttinger liquids

研究成果の概要

In this study, we focus on the chiral plasmon quasiparticles in quantum Hall edge states, with the aim of developing plasmon-based quantum circuits. The goal is to establish fundamental quantum technologies to achieve strong coupling with qubits and to explore the possibility of quantum information processing. This year, we studied the high-impedance properties of plasmons and explored the coupling of plasmon resonators and double quantum dot (DQD) charge qubits.

In order to establish the coupling of plasmons and qubits, experimental studies and numerical simulations are carried out. The purpose is to demonstrate the coupling characteristics and extract the coupling strength by studying the transport behaviors. Finite coupling manifests itself in two ways. First, under plasmon irradiation, electron transport in the DQD can be realized by absorbing or emitting single or multiple plasmon energy quanta. In current spectra measurement, we have successfully observed this plasmon-assisted electron tunneling process. In addition, the analysis of the plasmon resonance spectrum shows the influence of the electronic state in DQD on the resonance characteristics, which can be applied to the readout of the charge states in the quantum dot.

In principle, improvements to the present system are expected to construct a plasmon version of cavity quantum electrodynamic systems and explore the strong coupling regime.

【代表的な原著論文情報】

1) Chaojing Lin, Ko Futamata, Masayuki Hashisaka, Takafumi Akiho, Koji Muraki, Toshimasa Fujisawa, "Plasmon assisted tunneling in a double quantum dot coupled to a quantum-Hall plasmon resonator", 24aD1-9, JPS meeting, (2023/3/22).