

Chiral terahertz photocurrent in quantum point contact/quantum dot-split ring resonator coupled systems in the quantum Hall regime

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Electrical detection of strong coherent light-matter interaction using a quantum point contact (QPC) has been realized recently, which provides new ways for realizing ultrastrong coupling (USC) [1] and investigating quantum transport under the influence of cavity field [2]. However, the physical processes underlying this electrical detection method have not been fully understood, especially the origin of terahertz (THz) photocurrent in the USC regime [3]. Here we investigate THz-induced photocurrent in a coupled QPC-split ring resonator (SRR) system fabricated on a GaAs heterostructure wafer with a two-dimensional electron gas (2DEG) and report the dependence of the photocurrent on the polarities of a source-drain bias applied to the QPC and a magnetic field, as shown in Fig. 1. The photocurrent spectra in the middle and right panels of Fig. 1 show an anti-crossing between the cyclotron resonance of 2DEG and the resonance mode of the SRR. We show that the polarity of the THz photocurrent near the anti-crossing region depends only on the direction of the perpendicular magnetic field, indicating its chiral nature. Such a chiral photo-response does not result from electron heating or rectification, and it is successfully explained by nonequilibrium edge channel transport via light-matter interaction, through which the generation of Landau polaritons changes the electrochemical potential of the edge channels.

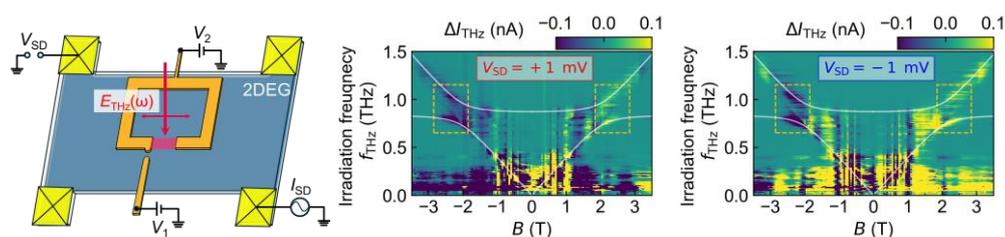


Fig.1 Schematic of QPC-SRR coupled system and colormap of THz-induced photocurrent at different magnetic fields and THz frequencies.

References:

- [1] Kuroyama, K., et al. *Physical Review Letters* 132.6 (2024): 066901.
- [2] Paravicini-Bagliani, Gian L., et al. *Nature Physics* 15.2 (2019): 186-190.
- [3] Kuroyama, K., et al. *Nano Letters* 23.24 (2023): 11402-11408.