PHYSIKALISCHES KOLLOQUIUM

Wintersemester 2024/25

Das Kolloquium findet (soweit nicht anders angegeben) **jeweils montags um 16:15 Uhr in Präsenz im Röntgen-Hörsaal** des Physikalischen Instituts, Hubland Campus Süd, Universität Würzburg **und online via Zoom statt**.
Zugangsdaten siehe https://www.physik.uni-wuerzburg.de/aktuelles/veranstaltungen-aus-der-physik/physikalisches-kolloquium/

28.10.2024

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Terahertz Quantum Effects in 2D Materials

Abstract

Due to causality-related correspondence between static and dynamic properties of physical systems, quantum oscillations observed in DC response must reveal their counterpart in the optical domain. Moreover, the conductivity, as well as its quantum corrections, gain additional imaginary parts in the dynamic regime. This finally leads to several novel effects in terahertz magnetooptics compared to static results.

“Classical” terahertz spectra of conducting systems are dominated by the cyclotron resonance (CR at 0.55 T in Fig.1). Besides characterization of the charge carriers, even such information as the band structure of several 2D system can be extracted from these data.

Typical quantum corrections to the optical spectra shown in Fig. 1 are, e.g., optical analogy to the microwave-induced resistance oscillations (MIRO-like, low fields). Above the cyclotron resonance the dynamic equivalent of the Shubnikov - de Haas oscillations (optical SdH) is observed in the samples with moderate mobilities.

In strong magnetic fields the quantum effects dominate, leading to quantized Faraday rotation of light. Especially in magnetically-doped 2D topological insulators the quantum of

the rotation angle is directly seen in experiments and it is equal to the fine structure constant $\alpha \approx 1/137$. We believe that this unitless physical constant provides a fundamental bridge between solid state physics, cosmology and mathematics.

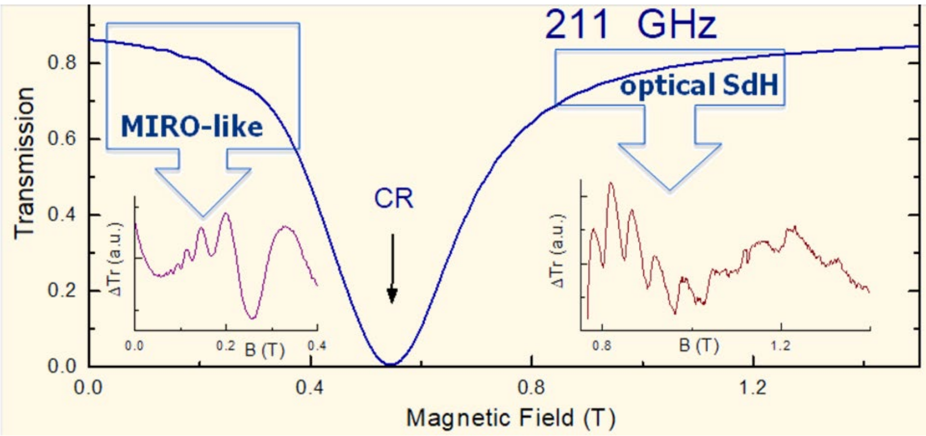

Fig.1. Simultaneous observation of three magneto-dynamic effects in a field-dependent transmission of GaAs quantum well.
- Low fields: optical analogy of microwave-induced resistance oscillations (MIRO);
- B = 0.55 T: cyclotron Resonance (CR);
- High fields: optical analogy of the Shubnikov - de Haas oscillations (SdH) in transmission.

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Porod, Prof. Dr. Hinkov, Dr. Leisegang, Dr. Ünzelmann, Hr. Baumbach