Time and spectrally resolved THz photoconductivity in quantum Hall devices

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Quantum Hall (QH) systems interact effectively with THz radiation, because the Landau gap energy is of the order of the photon energy around 10meV. The first investigations were made over 20 years ago, but the photoconductivity mechanisms have not been completely understood jet and are matter of discussions.

In this study a pulsed p-Ge laser, which provides 1.7THz to 2.5THz (corresponding to wavelengths of 180µm to 120µm) is used as THz source. Detailed time resolved photoconductivity (PC) measurements are done on different Corbino shaped GaAs/AlGaAs heterostructures near the second QH plateau. The sample current is measured during the excitation with laser pulses. We find that the relaxation process depends on the applied voltage and on the mobility of the sample, as shown in Fig. 1. Relaxation times of approx. 10ns to 100ns are observed. A simple model is suggested to explain the results.

In addition we discuss spectrally resolved PC measurements. The PC is measured in dependence on magnetic field at different photon energies, as shown in Fig. 2. This is investigated for different source drain voltages V_{SD} and electron concentrations, tuned by a gate. The spectral response is fitted by a Lorentz function with the full width at half maximum Γ. Γ corresponds to the spectral resolution and decreases with increasing sample mobility. A width of Γ ≈1meV is found for the best sample.

QH devices are promising for high sensitive THz detectors. The short response time and the useful spectral selectivity, discussed in this work, are important for application, too.

Further we present similar measurements on HgTe/HgCdTe quantum wells under QH conditions. To our knowlege these are the first measurements of this type. The small effective mass principally shifts the effects to lower magnetic fields, which might be useful for application.

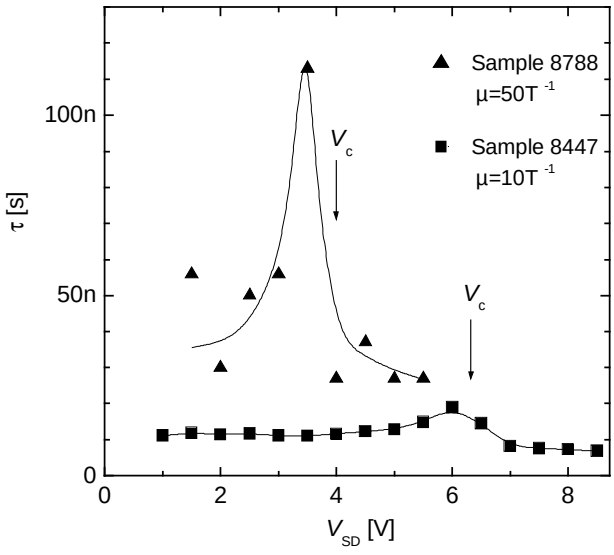

FIG. 1: Relaxation time versus source drain voltage for two samples with different mobility µ. The breakdown values V_c are marked.

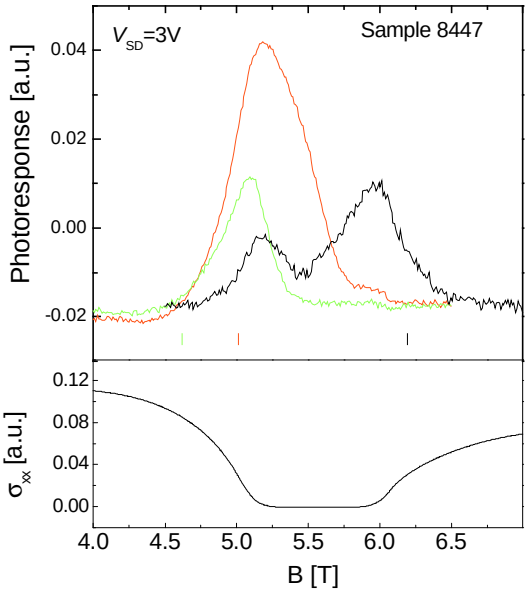

FIG. 2: Transport curve in the lower part and photoresponse versus magnetic field for three different photon energies in the upper part.

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