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THz Magnetophotoresponse and spin-orbit effects in the 2DEG in a HgTe quantum well

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There is considerable current interest in HgTe because of its interesting "inverted" band structure and large spin-orbit interaction, and because it is a topological insulator under quantum confinement and shows a quantum spin Hall effect.[1] We have studied 6 nm

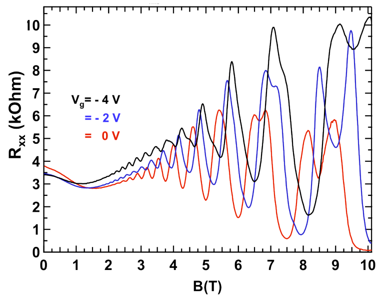

Fig. 1. Gate voltage dependence of Rxx at 4.2K.

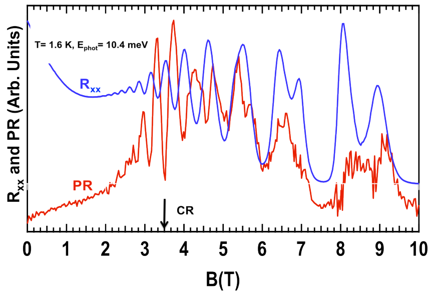

Fig. 2. PR (10.4 meV) and R_{xx} at 1.6 K

HgCdTe/HgTe quantum-well samples ("normal" band structure; $n_s = 1.55 \times 10^{12}$ cm^{-2}; $\mu = 1.64 \times 10^5$ cm^2 /V-sec) to measure effects of the (large) spin-orbit interaction. Application of electric fields via a gate creates an asymmetric potential in the growth direction that can result in a significant Rashba spin-splitting; gate bias also permits varying the electron density by up to 30%. Similar gated samples with the inverted band structure (larger wells) have shown extremely large Rashba spin splitting.[2] We have used photoresponse (PR) excited by several lines from an optically pumped THz laser (Fig 2) and R_{xx} (Fig. 1) and R_{xy} measurements to probe the high frequency and dc response of the Γ_6 conduction band electrons in fields up to 10 T. The R_{xx} oscillations show beating behavior at 4.2 K at large negative gate voltages indicative of Rashba spin splitting. Both R_{xx} and R_{xy} show complex behavior at 1.6 K at high fields. We find $m^* = 0.039m_e$ and $g = -18$ at $V_g = 0$ from a combination of transmission CR measurements and tilted field S-dH experiments. This is consistent with model fits to the PR vs. B, where we simulated the PR using the usual 2D expression for the oscillatory part of ρ_{xx} and a model of CR carrier heating. The difference between resonant heating (Lorentzian temperature profile – laser on) and a background (bath temperature - laser off) yields a difference (proportional to the PR) that exhibits the resonant absorption as an envelope of S-dH oscillations with a maximum that is close to the CR resonant field. The fits yield the carrier density, m*, scattering times and the g-factor (visibility of spin splitting is enhanced in the PR at low-intermediate fields). Attempts to measure electron spin resonance in the PR have thus far proven inconclusive. Detailed analyses of these results will be presented. Work was supported in part by NSF MWN DMR 1008138.

[1] M. Koenig, S. Wiedmann, C. Bruene et al., Science **318**, 766 (2007)
[2] J. Hinz, H Buhmann, M. Schaefer, et al., Semicond. Sci. Technol. **21**, 501 (2006)