Terahertz time-domain magneto-spectroscopy of spin-split heavy-hole gases in strained Ge quantum wells: the Rashba and optical quantum Hall effects

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Differently than other spectroscopy techniques, THz-TDS provides phase-resolved measurements and, therefore, the chance to investigate quantum coherent phenomena in systems such as two dimensional hole or electron gases (2DHGs, 2DEGs) [1].
By means of THz-TD magneto-spectroscopy (THz-TDMS) and polarisation resolved (PR) THz-TDMS, a thorough characterisation of high mobility 2DHGs in modulation-doped strained germanium quantum wells (sGe-QWs) will be presented [2,3].

The strong non-parabolic character of the valence bands in Ge resulted in spin-split cyclotron resonances. The density, effective mass, mobility as well as the "Rashba spin-splitting energy" of the examined 2DHGs were obtained by modelling the experimental longitudinal and transverse conductivity at 2K (Drude model). The Rashba splitting consists on spin-split states at zero magnetic field, a remarkable feature for spintronic applications which arises from the structure inversion asymmetry due to the modulation doping.

In addition, a normalisation of the transverse conductivity allowed the observation (for the first time in 2DHGs) of the optical quantum Hall effect (OQHE).

[1] J. Lloyd-Hughes, J. Phys. D: Appl. Phys. 47, 374006 (2014)
[2] M. Failla et al., Phys. Rev. B 92, 4, 045303 (2015)
[3] M. Failla et al., New Journal of Physics 18, 11, 113036 (2016)