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In-Plane Field Magneto-transport in a Six-fold Degenerate Si-(111) 2DEG TOMASZ M. KOTT, BINHUI HU, ROBERT N. MCFARLAND, STEPHEN H. BROWN, BRUCE E. KANE, University of Maryland, College Park — In-plane magneto-transport is an effective tool for measuring sub-band occupancy and differentiating between effects such as the so-called "reentrant Metal-Insulator Transition" or a ferromagnetic to paramagnetic phase transition. Using a two-dimensional electron gas (2DEG) on high mobility (up to $100,000$ cm^2/Vs) hydrogen terminated Si-(111) surfaces [1], we have studied the magneto-resistance due to in-plane magnetic fields of this six-fold degenerate system. While high perpendicular field (up to 12 T) measurements indicate field-dependent valley splitting, parallel field data helps differentiate this dependence from spin dynamics. The application of an in-plane field polarizes the 2DEG into distinct sub-bands. I will present measurements of both spin and valley sub-band polarization in parallel magnetic fields from samples of various mobility ($10,000 - 100,000$ cm^2/Vs) and discuss these results in the context of the broader question of field-dependent valley splitting. In a simple picture of valley splitting on Si-(111) surfaces, one would expect two valley polarization fields in addition to the spin polarization. I will discuss how this interaction-free model fits with the perpendicular field measurements, and what we can learn about the six-fold degenerate system.
[1] R. N. McFarland et al., *Phys. Rev. B* **80** 161310R (2009)

Tomasz M. Kott
University of Maryland, College Park

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