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Anomalous Effective Mass of Two-dimensional Holes in a Strong Parallel Magnetic Field YENTING CHIU, MEDINI PADMANABHAN, JAVAD SHABANI, MANSOUR SHAYEGAN, Department of Electrical Engineering, Princeton University, ROLAND WINKLER, Department of Physics, Northern Illinois University — We report effective hole mass (m*) measurements through analyzing the temperature dependence of the Shubnikov-de Haas oscillations in dilute (density $\sim 5\text{x}10^{10}\text{cm}^{-2}$) two-dimensional (2D) hole systems confined to a 20nm-wide, (311)A GaAs quantum well. In this system the 2D holes occupy two spin-subbands whose m* we measure to be ~ 0.2 (in units of free electron mass), in good agreement with the theoretical band calculations. We then apply a sufficiently strong (>10T) parallel magnetic field to fully depopulate one of the spin subbands, and measure m* for the populated subband. We find that this latter m* is close in magnitude to the m* we measure in the absence of the parallel field. This is a surprising observation as it is in stark disagreement with the results of our band calculations which take into account the spin-orbit interaction and the holes' finite layer thickness, and predict a large enhancement of m* in a strong parallel magnetic field.

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