Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Microwave Spectroscopy of the Valley Splitting in a Silicon/Silicon-Germanium Two Dimensional Electron Gas SRIJIT GOSWAMI, J.L. TRUITT, CHARLES TAHAN, L.J. KLEIN, K.A. SLINKER, D.W. VAN DER WEIDE, S.N. COPPERSMITH, ROBERT JOYNT, R.H. BLICK, MARK A. ERIKSSON, University of Wisconsin-Madison, J.O. CHU, P.M. MOONEY, IBM Research Division, T. J. Watson Center — The strain in silicon/silicon-germanium quantum wells reduces the usual six-fold degeneracy of the silicon conduction band, leaving a pair of degenerate bands in the growth direction. Quantum confinement in the silicon well further splits this degeneracy, leading to a small, but extremely important energy gap (the valley splitting) between these lowest two levels. We perform microwave spectroscopy, electron valley resonance (EVR), between these two states. Transport measurements at 0.25 K in a silicon/silicon-germanium two dimensional electron gas (2DEG) are used to detect microwave absorption at the valley splitting energy. The lineshapes are similar to those observed in electrically detected electron spin resonance signals. The valley splitting is found to increase linearly with an applied perpendicular magnetic field. The valley splitting peak shows a dramatic (seven-fold) increase in width as the temperature is increased from 0.23 K to 0.35 K. These results indicate that in moderate magnetic fields the silicon valley degeneracy can be completely removed in low temperature quantum devices.

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Date submitted: 02 Dec 2004 Electronic form version 1.4