Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Evolution of the Fractional Quantum Hall States in the Second Landau Level H.C. CHOI, W. KANG, University of Chicago, S. DAS SARMA, University of Maryland, L.N. PFEIFFER, K.W. WEST, Alcatel-Lucent — Study of the energy gap of the fractional quantum Hall effect (FQHE) in the second Landau level will be presented. Two symmetrically doped GaAs/AlGaAs quantum well samples with densities $n = 3.2 \times 10^{11}\text{cm}^{-2}$ and $n = 2.8 \times 10^{11}\text{cm}^{-2}$ with respective mobilities of $\mu = 28.3 \times 10^{6}\text{cm}^2/\text{Vs}$ and $\mu = 10.5 \times 10^{6}\text{cm}^2/\text{Vs}$ were studied. In the higher mobility sample, clear FQHE states are observed at filling factor $\nu = 5/2$, 7/3, 8/3, 14/5, 11/5, 12/5, 16/7, and 19/7. Some of the higher order FQHE states disappear in the lower mobility sample, and clear FQHE states are observed at $\nu =$ 5/2, 7/3, 8/3, 14/5, and 11/5. The energy gaps of the FQHE states at $\nu = 5/2$, 7/3 and 8/3 in the higher mobility sample are found to exceed 500mK. The energy gaps of the $\nu = 5/2$, 7/3 and 8/3 states in the lower mobility sample are typically reduced by more than 50% in comparison. Our measured gap for $\nu =$5/2 state, which is less than 1/5 of the theoretical gap, can be understood when the finite width correction and disorder broadening are factored in. Evolution of the energy gap with mobility shows that the even-denominator FQHE state at $\nu = 5/2$ is the most robust FQHE state in the second Landau level. In addition, the $\nu = 7/3$ and 8/3 states are unlikely to be the second Landau level analog of the Laughlin states at $\nu = 1/3$ and 2/3 in the lowest Landau level.

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Date submitted: 27 Nov 2007 Electronic form version 1.4