Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Heterostructure design and growth conditions necessary for electron mobility exceeding 30x10^6 cm^2/Vs in GaAs quantum wells SAEED FALLAHI, Department of Physics and Birck Nanotechnology Center, Purdue University, GEOFFREY GARDNER, Schools of Materials Engineering and Birck Nanotechnology Center, Purdue University, JOHN WATSON, Department of Physics and Birck Nanotechnology Center, Purdue University, MICHAEL MANFRA, Department of Physics, Birck Nanotechnology Center and Schools of Materials Engineering and Electrical and Computer Engineering, Purdue University — Ultra-high purity GaAs/AlGaAs heterostructures remain the preeminent semiconductor platform for the study of strong correlations in low dimensions. In particular, the study of fragile fractional quantum Hall states such as ν =5/2 and ν =12/5 in the 2$^{\text{nd}}$ Landau level requires low disorder samples. While low temperature mobility is often specified as a parameter quantifying sample quality, it does not encode all information necessary to quantify disorder relevant to the fractional quantum Hall effect. Here we describe the heterostructure design considerations and molecular-beam-epitaxy growth conditions needed to achieve an electron mobility >30x10^{6}cm^2/Vs. In particular, we report on the impact of several modulation doping schemes on mobility and the quality of transport in the 2$^{\text{nd}}$ Landau level. We also detail constraints on starting source material purity for the achievement of high mobility. In our work high mobility has been achieved primarily through improvements in starting source materials and heterostructure design rather than improvements in vacuum quality.

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Date submitted: 14 Nov 2014 Electronic form version 1.4