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Quantifying disorder and its impact in the 2nd Landau level[1]

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Strong electronic correlations are evident in the 2nd Landau level (LL) of an ultra-high quality GaAs/AlGaAs two-dimensional electron gas (2DEG). The exotic fractional quantum Hall states at filling factors ν =5/2 and 12/5, as well as the reentrant integer quantum Hall states flanking half-filling, are a few examples presently under intense investigation. While it is generally accepted that samples must be of extremely low disorder to exhibit correlations in the 2nd LL, our understanding of how to quantify residual disorder and its impact on the states of interest remains primitive. In this talk we will critically examine how disorder is quantified for the 2DEG both at zero magnetic field and in the quantum Hall regime, and then compare the results of this analysis with measurements of the excitation gap at ν =5/2 in samples in which disorder is varied in a well-defined manner. Our results highlight the very different impact on the excitation gap generated by different types of disorder and the limitations of presently employed characterization methods.

[1]Work done in collaboration with the Csathy group, Purdue University