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Disorder Driven Fractional Quantum Hall To Insulator Transitions[1]

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It is well known that disorder plays a key role in determining the stability of quantum Hall states and thus the extent of quantum Hall plateaus. As a result, there have been several numerical studies of plateau transitions in the integer quantum Hall regime for non-interacting electrons in two dimensions. By contrast, studies of interacting electrons with disorder in two dimensions in the fractional quantum Hall regime have received relatively less attention in numerical studies, because of computational complexity. After reviewing previous attempts at addressing this numerically challenging issue [1-2], I will describe our recent investigation [3] of the effect of disorder on quantum entanglement properties of the Laughlin state at $\nu = 1/3$ filling. We find that a suitably defined entanglement entropy function serves as a good diagnostic of the transition from the fractional topological state to an Anderson insulator, and provides a numerically more efficient method of locating the transition than previous approaches. Further, it enables a study of the critical behavior, not obtainable previously. Studies of entanglement eigenvalue statistics [3], as well as extension to disorder-driven transitions from other fractional states [4] will also be described. REFERENCES: [1] D. N. Sheng, X. Wan, E. H. Rezayi, K. Yang, R. N. Bhatt and F. D. M. Haldane, Phys. Rev. Lett. 90, 256802 (2003); [2] X. Wan, D. N. Sheng, E. H. Rezayi, K. Yang, R. N. Bhatt and F. D. M. Haldane, Phys. Rev. B 72, 075325 (2005); [3] Zhao Liu and R. N. Bhatt, Phys. Rev. Lett. 117, 206801 (2016) Editors Suggestion; [4] Zhao Liu and R. N. Bhatt (in preparation).

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