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**Diagnosis of phase transitions in disordered fractional quantum Hall liquids using quantum entanglement**[1] ZHAO LIU, Dahlem Center for Complex Quantum Systems and Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany, R. N. BHATT, Department of Electrical Engineering, Princeton University, Princeton, NJ 08540 — The conventional method to study phase transitions from fractional quantum Hall (FQH) liquids to a localized phase induced by disorder has relied on the collapse of the mobility gap and Hall conductance [1,2]. Here, we scrutinize this issue from the perspective of quantum entanglement. We consider electrons in the disordered lowest Landau level at Laughlin filling fractions $\nu = 1/m$ with either Haldane's pseudopotentials or Coulomb interaction. We find that the derivative of the orbital-cut von-Neumann entropy with respect to the disorder strength has a sharp peak, which diverges with system size, providing a clear fingerprint of the transition from FQH liquids to a localized phase. Further, the fluctuation of the entropy with different cut boundaries is utilized to examine whether the ground states are localized in some region. We also investigate the level statistics of the entanglement spectrum, as well as the low-lying spectrum of the Hamiltonian to extract more information about the phase transition. Our method can be applied to study many-body localization in other topological systems. [1] D. N. Sheng *et al.*, Physical Review Letters **90**, 256802 (2003). [2] Xin Wan *et al.*, Physical Review B **72**, 075325 (2005).

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Zhao Liu
Freie Univ Berlin

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