Forum de Physique Statistique @ ENS

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Titre : *Bulk & Boundary Entanglement Entropy in the Quantum Hall Effect : Exact Results*

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Résumé : *Ideas coming from quantum information theory have provided invaluable insights and powerful tools for quantum many-body systems. One of the most basic tools in the arsenal of quantum information theory is entanglement entropy. A particularly striking phenomenon is the area law of entanglement entropy, which has been widely discussed in recent years in condensed matter and quantum field theories. Typically, one considers a many-particle state and a geometric partition of the space in two sub-regions. The von Neumann entropy of the reduced state of a sub-region measures the degree of entanglement between the two regions. The area law states that the leading semiclassical asymptotics of the entanglement entropy is proportional to the volume of the boundary of the sub-region. I will start with an introduction to quantum entanglement, entanglement entropy, and their applications in condensed matter. I will present some exact results obtained with L. Charles in the context of the (integer) quantum Hall effect regarding both the entanglement entropy and full counting statistics, namely proof of the Area law (arXiv :1803.03149) in the bulk of the quantum Hall droplet. I will conclude with some recent results obtained with J.M. Stephan (arXiv :1911.10125) showing how the entanglement entropy is capable of detecting the critical one-dimensional modes at the boundary of the quantum Hall droplet.*