

Théorie conforme des champs et systèmes quantiques à plusieurs corps  
21 août – 9 septembre 2022

Conformal field theory and quantum many-body physics  
August 21 – September 9, 2022

**Chia-Chuan Liu**  
(Université de Montréal)

## **Entanglement negativity versus mutual information in the quantum Hall effect and beyond**

---

We study two entanglement measures in a large family of systems including incompressible quantum Hall states: the logarithmic negativity (LN), and mutual information (MI). For pure states, obtained for example from a bipartition at zero temperature, these provide distinct characterizations of the entanglement present between two spatial subregions, while for mixed states (such as at finite temperature) only the LN remains a good entanglement metric. Our focus is on regions that have corners, either adjacent or tip-touching. We first obtain non-perturbative properties regarding the geometrical dependence of the LN and MI in a large family of isotropic states, including fractional quantum Hall states. A close similarity is observed with mutual charge fluctuations, where super-universal angle dependence holds. For the MI, we can make stronger statements due to strong subadditivity. We give ramifications of our general analysis to conformal field theories (CFTs) in two spatial dimensions.

We then explicitly verify these properties with integer quantum Hall states. To do so we develop two independent approaches to obtain the fermionic LN, which takes into account Fermi statistics: an overlap-matrix method, and a real-space lattice discretization. At finite temperature, we find a rapid decrease of the LN well inside the cyclotron gap at integer fillings. We further show that the LN decays faster compared to the MI at high temperatures.