Contribution ID: **4** Type: **not specified**

Probing quantum Hall systems through entanglement entropy and charge fluctuations

Monday 1 December 2025 09:40 (1 hour)

Understanding how quantum information is distributed in many-body systems can reveal hidden structures and universal properties. In quantum Hall phases, the Li-Haldane conjecture provides a powerful guide: it proposes a bulk-edge correspondence for entanglement, asserting that the entanglement (or modular) Hamiltonian lies in the same universality class as the effective 1D Hamiltonian that would govern the gapless edge modes if the fluid were physically confined to the subregion of interest. In this talk, I will explore how entanglement and charge fluctuations are distributed across symmetry sectors in both integer and fractional quantum Hall states. The integer quantum Hall effect offers an ideal testing ground. Free-fermion methods allow exact calculations, making it possible to verify the Li-Haldane conjecture explicitly and to track how the shape and geometry of the subregion imprint themselves on entanglement properties. For fractional quantum Hall states, one can instead employ high-precision matrix product state simulations. The resulting symmetry-resolved entanglement spectra can be directly compared to the conjecture's predictions, showing striking agreement and revealing how distinct neutral and charged velocities shape the structure of finite-size effects. Together, these results provide one of the most stringent tests of the Li-Haldane conjecture to date and highlight its remarkable explanatory power in organizing and interpreting symmetry-resolved entanglement across quantum Hall phases.

Presenter: ESTIENNE, Benoit