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QGP Thermalization in Early Stage —Entropic Manifestetion of Multi-particle Entanglement in Early Stage of HIC

Sunday, 26 October 2025 17:15 (20 minutes)

The early-stage thermalization of the Quark-Gluon Plasma (QGP) is important process in high energy collision. However, our understanding of thermalization of isolated quantum systems in this stage stills remains limited. This talk aims to explore QGP thermalization from the perspective of entropy in isolated many-body quantum systems. To solve the long-standing problem of the entropy paradox of pure quantum state, we introduce a new notion of correlation entropy based on the symmetry of many-body correlations (the E group) and its representations. I shall derive a more subtle relation that makes a precise connection between many-body entanglement and thermalization. Building on this framework, I will demonstrate how the spontaneous breaking of correlation symmetry leads to effective entropy, with key properties such as the extensivity, which is non-trivial in understanding thermalization of isolated quantum system and partially solving the difficulty of entanglement description in BH (black hole) information paradox hopefully.
Finally, I will present examples involving spin correlations and evolving many-body quantum systems. Experimental data and simulations in heavy ion collision for the QGP entropy evaluation will be discussed.
Further topics can be discussed include the transition from low to high temperatures, peculiar features of ground state entropy, and other aspects characterizing entropy during thermalization.

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