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Local Unitary Invariant Polynomials in the Limit of Large Dimension – Characterization and Distinction of Quantum States

mardi 24 juin 2025 16:00 (30 minutes)

In this presentation, we explore the structure of multipartite quantum entanglement through the lens of local unitary (LU) invariants. We begin with the bipartite case, where entanglement entropy admits a clear LU-invariant characterization via the Schmidt decomposition. We then extend the discussion to multipartite systems, where no canonical notion of spectrum exists and the classification problem becomes significantly more challenging. Motivated by the search for universal features of entanglement that typically emerge in the large-dimension limit, we focus on geometrically inspired quantities—most notably, the notion of compatibility. Building on these ideas, we introduce a tree-based construction of LU-invariant polynomials, offering both an algebraic and combinatorial framework to probe the structure of entanglement. We further analyze the ability of these invariants to distinguish between inequivalent quantum states. Finally, we discuss potential connections with holography, where such invariants may, in the context of random tensor networks, admit dual interpretations as geometric cuts in the bulk.

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