Dynamical mean-field theories for Rényi entanglement entropy of Fermi and non-Fermi liquids: Hubbard and Sachdev-Ye-Kitaev models

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Quantum entanglement, lacking any classical counterpart, provides a fundamentally different route to characterize the quantum nature of many-body states. I will discuss an implementation of a new path integral method for fermions to compute entanglement for extended subsystems in the Hubbard model within dynamical mean field theory (DMFT), and for Sachdev-Ye-Kitaev (SYK) and related models in the large-*N* limit. The new path integral formulation measures entanglement by applying a ``kick" to the underlying interacting fermions. I will show that the Renyi entanglement entropy can be extracted efficiently within the DMFT framework by integrating over the strength of the kick term. I will discuss the characterization of metallic and Mott insulating phases of the Hubbard model in equilibrium through the second Renyi entropy of a subsystem and the entropy to entanglement crossover in the correlated metallic phase. I will discuss the application of the method to extract sharp sigantures of quantum phase transition in the entanglement entropy across an NFL to fermi liquid (FL) transition, and to obtain nontrivial system-size scaling of entanglement in a diffusive SYK chain.