CUNLU ZHOU, Université de Sherbrooke

Modular-Annihilator Parent Hamiltonians for Purified Gibbs States

Purified Gibbs states provide a bridge between finite-temperature physics, dissipative dynamics, and ground-state preparation. In this talk, I will present an exact finite sum-of-squares (SoS) construction of their parent Hamiltonians and the associated Lindbladian based on modular annihilators. Given a finite set of Hermitian generators, the corresponding modular annihilators yield a frustration-free SoS representation without continuous time integrals or an explicit decomposition into Bohr-frequency sectors. The purified Gibbs state remains a common zero mode while the freedom to choose and combine the generators can be used to optimize the spectral properties of the parent Hamiltonian. For interacting systems, where the modularly dressed generators are not available in closed form, we introduce a Krylov–Lanczos approximation scheme and bound the resulting ground-state error in terms of the modular approximation error and the parent Hamiltonian gap. Numerical results illustrate the accuracy of the interacting construction depends on temperature, interaction strength, and Krylov dimension. arXiv:2608.30272.