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A general approximation scheme for addressing the black hole information paradox

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Abstract:

We develop a general approximation scheme for calculating quantum informational properties of a pure state that has equilibrated in a non-integrable quantum many-body system. For gravity systems, such as those involving black holes, this approximation gives a prescription for calculating entanglement entropies using Euclidean path integrals which is manifestly consistent with unitarity. Applied to recent models of evaporating black holes and eternal black holes coupled to baths, it provides a derivation of replica wormholes, and elucidates their mathematical and physical origins. In particular, it shows that replica wormholes can arise in a system with a fixed Hamiltonian, without the need for ensemble averages.

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