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Holographic black hole evolution

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We revisit the black hole information problem in the context of the AdS/CFT correspondence. The formation and evaporation of small AdS black holes is governed by unitary time evolution in the dual gauge theory but how does this translate to the gravitational theory? We argue that the eigenstate thermalisation hypothesis can explain the validity of semiclassical gravity for local bulk observables. Small AdS black holes correspond to states with finite energy width in the holographic dual, and observables that are smooth functions on the classical phase space will self-average over a large number of energy eigenstates, exponential in the Bekenstein-Hawking entropy, giving expectation values that are consistent with semiclassical gravity up to small corrections. On the other hand, the semiclassical bulk description breaks down at leading order for transition amplitudes which probe the unitary evolution of the theory.

Presenter: THORLACIUS, Larus