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Quantum tasks in holography

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We consider an operational restatement of the holographic principle, which we call the principle of asymptotic quantum tasks. Asymptotic quantum tasks are quantum information processing tasks with inputs given and outputs required on points at the boundary of a spacetime. The principle of asymptotic quantum tasks states that tasks which are possible using the bulk dynamics should coincide with tasks that are possible using the boundary. We extract consequences of this principle for holography in the context of asymptotically AdS spacetimes. Among other results we find a novel connection between bulk causal structure and the phase transition in the boundary mutual information. Further, we note a connection between holography and quantum cryptography, where the problem of completing asymptotic quantum tasks has been studied earlier. We study the cryptographic and AdS/CFT approaches to completing asymptotic quantum tasks and consider the efficiency with which they replace bulk classical geometry with boundary entanglement.

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