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Deconfinement and Error Thresholds in Holography

Abstract

We review recent progress on the emergence of spacetime geometry from entanglement in the AdS/CFT correspondence and its connection to quantum error correction. By treating AdS/CFT as a quantum error correcting code, we demonstrate that holographic conformal field theories admit an algebraic error threshold against thermal noise, which is related to the confinement–deconfinement phase transition. This implies that quantum information can survive for a long time without decohering when the thermal noise is below a threshold, suggesting that, in principle, such large N gauge theories can function as stable quantum memories. We then apply geometric intuition from holography and the Hawking–Page phase transition to motivate the conformal field theory result, and comment on potential extensions to other confining theories. In particular, we show that the corruption of logical information above the threshold can be seen as information being engulfed by a black hole in the dual holographic spacetime in one higher dimension.