Contribution ID: **5** Type: **not specified**

Tearing down spacetime with quantum disentanglement

Wednesday 17 January 2024 15:30 (30 minutes)

A longstanding enigma within AdS/CFT concerns the entanglement entropy of holographic quantum fields in Rindler space. The vacuum of a quantum field in Minkowski spacetime can be viewed as an entangled thermofield double of two Rindler wedges at a temperature $T = 1/2\pi$. We can gradually disentangle the state by lowering this temperature, and the entanglement entropy should vanish in the limit $T \to 0$ to the Boulware vacuum. However, holography yields a non-zero entanglement entropy at arbitrarily low T, since the bridge in the bulk between the two wedges retains a finite width. We show how this is resolved by bulk quantum effects of the same kind that affect the entropy of near-extremal black holes. The large quantum fluctuations in the geometry of the bridge bring down to zero the density of entangled states in the Boulware vacuum. We also construct unentangled Boulware states in de Sitter space.

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