THE QUANTUM SPACETIME SEMINAR SERIES

Entanglement in ghost systems

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Certain generalizations of the Ryu-Takayanagi formulation of holographic entanglement entropy lead to certain complex extremal surfaces in de Sitter space, assuming dS/CFT formulated using the wavefunction of the universe equated with the CFT partition function. The areas are negative in dS4 (where the dual CFT central charge is real and negative). Towards exploring this further, we study the replica formulation of entanglement entropy in some toy 2-dim ghost CFTs and argue that negative entanglement entropy arises given certain conditions. We also study a simple toy model of two "ghost-spins", where a single ghost-spin is defined as a 2-state spin variable with indefinite norm. This corroborates some of the above. We develop this further by studying systems of entangled spins and ghost-spins regarded as toy models for theories with negative norm states. Analysing the von Neumann entropy of the reduced density matrix by tracing over the ghost-spins gives sensible interpretations for even numbers of ghost-spins and more generally reveals new entanglement patterns.

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