



TOHOKU FORUM for CREATIVITY

Tohoku Forum for Creativity Thematic Program 2015

Fundamental Problems in Quantum Physics: Strings, Black Holes and Quantum Information

Seminar

Holographic quantum error-correcting codes: Toy models for the AdS/CFT correspondence

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Abstract

We propose a family of exactly solvable toy models for the AdS/CFT correspondence based on a novel construction of quantum error-correcting codes with a tensor network structure. Our building block is a special type of tensor with maximal entanglement along any bipartition, which gives rise to an exact isometry from bulk operators to boundary operators. The entire tensor network is a quantum error-correcting code, where the bulk and boundary degrees of freedom may be identified as logical and physical degrees of freedom respectively. These models capture key features of entanglement in the AdS/CFT correspondence; in particular, the Ryu-Takayanagi formula and the negativity of tripartite information are obeyed exactly in many cases. That bulk logical operators can be represented on multiple boundary regions mimics the Rindler-wedge reconstruction of boundary operators from bulk operators, realizing explicitly the quantum error-correcting features of AdS/CFT.

This is a joint work with Daniel Harlow, Fernando Pastawski and John Preskill.