Contribution ID: **3** Type: **Oral Presentation**

Hyperinvariant Spin Network States - An AdS/CFT Model from First Principles

We study existence and limitations for hyperinvariant tensor networks incorporating a local SU(2) Gauss constraint (HITs). As discrete implementations of the celebrated anti de-Sitter/conformal field theory (AdS/CFT) correspondence, holographic states and codes have created methodological and conceptual bridges between the fields of quantum information, entanglement theory and quantum gravity. Adding SU(2) symmetry onto the tensor network allows for a direct connection to spin network states, a basis of the kinematic Hilbert space of loop quantum gravity (LQG). We show that important aspects of the AdS/CFT correspondence are realized in certain quantum states of the gravitational field in LQG, thus justifying, from first principles, a class of models introduced by [Pastawski et al., 2015]. An approximate duality of bipartite entanglement on the boundary and a geodesic path length in the bulk is given on HITs, as the expectation value of the path length operator of LQG exactly matches the graph length previously used to show this duality. We provide examples of HITs and show clear boundaries for their existence in the form of no-go theorems that exclude absolutely maximally entangled (AME) states as well as general holographic codes from local SU(2) invariance.

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Session Classification: B - Contributed Talk