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Localizing information in quantum gravity

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Locality is a powerful property of quantum field theory and implies that information can be strictly localized in regions of space, and is completely inaccessible from far away. On the other hand, the holographic nature of quantum gravity suggests that the theory is ultimately non-local and that information can never be localized deep inside some spacetime region, but rather is always accessible from the boundary. This is meant to hold as a non-perturbative statement and it remains to be understood whether quantum information can be localized within G_N perturbation theory. In this talk, I will address this problem from the point of view of the AdS/CFT correspondence. I will construct candidate local operators that can be used to localize information deep inside the bulk. They have the following two properties: they act just like standard HKLL operators to leading order at large N, but commute with the CFT Hamiltonian to all orders in 1/N. These operators can only be constructed in a particular class of states which have a large energy variance, for example coherent states corresponding to semi-classical geometries. The interpretation of these operators is that they are dressed with respect to a feature of the state, rather than to the boundary. The construction only works for sufficiently complicated states with large energ

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