



Contribution ID: 37

Type: **not specified**

Breakdown of Quasilocality in Long-Range Quantum Lattice Models

Thursday 25 July 2019 12:15 (15 minutes)

I will discuss how one can use tensor network state techniques, in particular matrix product states in 1D, to study the nonequilibrium dynamics of correlations in quantum lattice models in the presence of long-range interactions. For exponents larger than the lattice dimensionality, a Lieb-Robinson-type bound effectively restricts the spreading of correlations to a causal region, but allows supersonic propagation. I will present numerical results for the XXZ spin chain, which reveal the presence of a sound cone for large exponents and supersonic propagation for small ones. This addresses the issue of propagation of information in the quantum realm in the presence of long-range interactions, which could be realized by gravitational interactions in a cosmology context.

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