Entanglement Structure, Causality, and Energy Conditions in QFTs

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By the theory of general relativity, energy conditions dictate important aspects of our space-time, such as cosmological singularity and black hole thermodynamics. The ultimate validity of energy conditions relies on examining them in the framework of quantum field theories (QFTs). This task appeared to be very difficult in the past. However, significant progresses have been made recently. In this talk, I will discuss our works along this line, leading to proofs of the averaged null energy condition (ANEC) [1] and the quantum null energy condition (QNEC) [2]. I will show that these energy conditions are related to novel aspects in QFTs, such as the entanglement structure, causality, as well as their conjunction. If time allows I will also discuss the connection to RT surface dynamics in AdS/CFT [3].

References:

[1] Modular Hamiltonian for deformed half-spaces and the ANEC, T. Faulkner, R. Leigh, O, Parrikar, H. Wang, JHEP 1609 038 (2016).

[2] A general proof of the QNEC, S. Balakrishnan, T. Faulkner, Z. Khandker, H. Wang, arXiv:1706.09432 [hep-th].

[3] A modular toolkit for bulk reconstruction, T. Faulkner, M. Li, H. Wang, arXiv:1806.10560 [hep-th].