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Quantum Temporal Superposition: the case of QFT

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Quantum field theory is completely characterized by the field correlations between spacetime points. In turn, some of these can be accessed by locally coupling to the field simple quantum systems, a.k.a. particle detectors. In this work, we consider what happens when a quantum-controlled superposition of detectors at different space-time points is used to probe the correlations of the field. We show that, due to quantum interference effects, two detectors can gain information on field correlations which would not be otherwise accessible. This has relevant consequences for information theoretic quantities, like entanglement and mutual information harvested from the field. In particular, the quantum control allows for extraction of entanglement in scenarios where this is otherwise provably impossible.

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