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Complexity for Quantum Fields: Quenches, Gaussian States and Purifications

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We apply the recently developed notion of complexity for field theory to a quantum quench through a critical point in 1+1 dimensions. We begin with a toy model consisting of a quantum harmonic oscillator, and show that complexity exhibits universal scalings in both the slow and fast quench regimes. We then generalize our results to a one-dimensional harmonic chain, and show that preservation of these scaling behaviors in free field theory depends on the choice of norm. Applying our setup to the case of two oscillators, we quantify the complexity of purification associated with a subregion. We find that the complexity of subregions is subadditive, and comment on potential implications for holography.

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