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Dynamics of entanglement in expanding quantum fields

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The entanglement entropy associated to finite spatial regions for Gaussian states in quantum field theory is characterized in terms of local correlation functions on space-like Cauchy hypersurfaces. The framework is applied to explore an expanding light cone geometry in the particular case of the Schwinger model for quantum electrodynamics in 1+1 space-time dimensions. We observe that the entanglement entropy becomes extensive in rapidity at early times and that the corresponding local reduced density matrix is a thermal density matrix for excitations around a coherent field with a time dependent temperature. Since the Schwinger model successfully describes many features of multiparticle production in e+e− collisions, our results provide an attractive explanation in this framework for the apparent thermal nature of multiparticle production even in the absence of significant final state scattering.

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