



INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

IPARCOS



Preprint Series in Particles and Cosmos Physics
n° IPARCOS-UCM-26-050

Vacuum entanglement in a time-dependent electric field

by **Á. Álvarez-Domínguez, L. J. Garay,
M. Martín-Benito, I. Sanz-González**

October 2026

Plaza de las Ciencias, 1 28040 Madrid, Spain

www.ucm.es/iparcos/

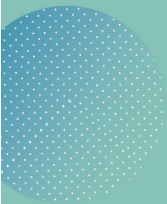


UNIVERSIDAD
COMPLUTENSE
MADRID



INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

IPARCOS



Abstract

We analyze the correlations of the vacuum state of a charged scalar field by constructing localized observables in two disjoint regions. We consider a time-dependent homogeneous electric field and examine the time evolution of correlations by relating it with the particle-antiparticle creation through the Schwinger effect. Our results show that the electric field increases the mixedness of the states and enhances total correlations, while the distillable entanglement among the regions decreases, vanishing at a finite time for sufficiently intense pulses within the non-perturbative pair-production regime. We also discuss the effect of anisotropy induced by the external background, showing that the distribution of correlations acquires a nontrivial directional dependence.



UNIVERSIDAD
COMPLUTENSE
MADRID