The Schwinger Effect (Pair Production from Vacuum):
Interference Effects and Laser Pulse Shape

Gerald V. Dunne

Department of Physics, University of Connecticut, Storrs, CT 06269

The Schwinger effect is the non-perturbative production of electron-positron pairs when an external electric field is applied to the quantum electrodynamical (QED) vacuum. The inherent instability of the vacuum in an electric field was one of the first non-trivial predictions of QED, but the effect is so weak that it has not yet been directly observed. However, new developments in ultra-high intensity lasers may bring us to the verge of this extreme ultra-relativistic regime.

I describe recent developments concerning the effect of pulse shape, such as carrier phase and chirp, on the spectrum of produced particles. This requires an extension of the standard WKB treatment of Bogoliubov transformations, to incorporate the Stokes phenomenon, in order to describe interference effects quantitatively rather than merely qualitatively. The result is a simple and practical expression for interference between multiple saddle points. Many of these effects have direct analogues and applications in strong-field AMO physics.

References