



Contribution ID: 64

Type: **Poster**

The Schwinger mechanism with perturbative electric fields

Monday, 24 June 2019 17:00 (20 minutes)

I discuss spontaneous particle production from the vacuum (the Schwinger mechanism) in the presence of a strong slow electric field superimposed by a fast weak electric field. I analytically/numerically show that a QED analog of the Franz-Keldysh effect occurs, which significantly modifies the spectrum of the produced particles. I also show that a non-trivial spin-dependence appears in the production even without magnetic fields due to the intrinsic spin-orbit coupling in the Dirac equation if the weak electric field is transverse with respect to the strong electric field. Implications to experiments/observations (e.g. heavy ion collisions, lasers) and relations to the dynamically assisted Schwinger mechanism are also discussed.

[1] H. Taya “Franz-Keldysh effect in strong-field QED,” PRD 99, 056006 (2019)

[2] X.-G. Huang, M. Matsuo, H. Taya, “Spontaneous generation of spin current from the vacuum by strong electric fields,” arXiv:1904.07593

[3] X.-G. Huang, H. Taya, “Spin-dependent dynamically assisted Schwinger mechanism,” arXiv:1904.08200

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Session Classification: Poster session