Polarized QED Cascades in Rotating Electric Fields

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One of the most striking predictions of strong-field QED is the formation of avalanche-type QED cascades at laser intensities approaching 10^{24} W/cm^2, turning an initially intense laser field into a hot and dense plasma of electrons, positrons and photons. In this talk, I will present our recent findings on the influence of particle polarization on cascade formation.

In our work, we take into account the spin and polarization of the electrons, positrons and photons for the strong-field QED processes of nonlinear Compton emission and pair production. We employ a kinetic equation approach for the electron, positron and photon distributions, each of them spin/polarization-resolved, with the QED effects of photon emission and pair production modelled by a spin/polarization dependent Boltzmann-type collision operator [1].

We find that the inclusion of particle polarization reduces the growth rate of the cascades. While this means that fewer particles are produced, we also found them to be highly polarized. We further found that the high-energy tail of the particle spectra is polarized opposite to that expected from Sokolov-Ternov theory, which cannot be explained by just taking into account spin asymmetries in the pair production process [2], but results significantly from "spin-straggling".

References

[1] D Seipt, C P Ridgers, D Del Sorbo and A G R Thomas, New J. Phys. **23**, 053025 (2021)

[2] D Seipt and B King, Phys. Rev. A **102**, 052805 (2020)