LPAW 2023
Laser and Plasma Accelerators Workshop 2023
lpaw23@tecnico.ulisboa.pt

Spin and polarization in effects in high-intensity laser-plasma interactions

Daniel Seipt[1], Qian Qian[2], Chris P. Ridgers[3], Tom Blackburn[4], Alec G. R. Thomas[2]
[1] *Helmholtz Institut Jena, Fröbelstieg 3, 07743 Jena, Germany*
[2] *Gérard Mourou Center for Ultrafast Optical Sciences, University of Michigan, Ann Arbor, MI 48109, USA*
[3] *York Plasma Institute, Department of Physics, University of York, York, YO10 5DD, United Kingdom*
[4] *Department of Physics, University of Gothenburg, SE-41296 Gothenburg, Sweden*
d.seipt@hi-jena.gsi.de

Until recently the effects of particle spin and polarization were often not considered in high-intensity laser-plasma interactions. However, with the enduring increase in achievable peak intensity, effects of radiation reaction and QED play an increasingly important role for high-intensity laser plasma interactions when the particles' quantum parameter $\chi \sim 1$ [1]. Here we will elaborate how electron-spin and photon-polarization will be a relevant subject in high-intensity laser-plasma and laser-beam interactions in the near future due to the fundamental QED processes in strong fields being sensitive to the particle polarization [2].

We will discuss numerical results for various scenarios where spin and polarization effects have been shown to be relevant, such as shower-like and avalanche-like QED cascades [3]. Emphasis will be placed on possible scenarios for generating spin-polarized electron beams for future plasma-based high-energy-physics colliders [4]. We will also discuss a promising experimental scenario to explore how the polarization state of highly linearly polarized gamma-rays influences their subsequent conversion into electron-positron pairs.

Acknowledgments

This work is supported by the US National Science Foundation Award #2108075.

References

[1] P. Zhang, S. S. Bulanov, D. Seipt, A. V. Arefiev, A. G. R. Thomas, Relativistic Plasma Physics in Supercritical Fields, Physics of Plasmas 27, 050601 (2020).
[2] A. Fedotov, A. Ilderton, F. Karbstein, B. King, D. Seipt, H. Taya, G. Torgrimsson, Advances in QED with intense background fields, arXiv:2203.00019.
[3] Daniel Seipt, Christopher P. Ridgers, Dario Del Sorbo, Alec G. R. Thomas, Polarized QED cascades, New J.Phys. 23, 053025 (2021).
[4] Daniel Seipt, Dario Del Sorbo, Christopher P. Ridgers, Alec G. R. Thomas, Ultrafast Polarization of an Electron Beam in an Intense Bi-chromatic Laser Field, Phys. Rev. A 100, 061402 (2019).