The Influence of Spatio-Temporal Couplings on Laser Wakefield Accelerators

Carola Zepter[1,2], Andreas Seidel[1,2], Matt Zepf[1,2,3], Malte Kaluza[1,2,3], Alexander Sävert[2,3]
[1] *Institute of Optics and Quantum Electronics, 07743 Jena, Germany,*
[2] *Helmholtz-Institute Jena, 07743 Jena, Germany,*
[3] *GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany*
carola.zepter@uni-jena.de

We report on experiments investigating the influence of spatio-temporal couplings (STCs) in the laser focus on stimulated Raman Side Scattering and electron acceleration. We find a discrepancy between the measured scattering angles and classical theory. At the same time, the angle changes with propagation of the driving laser pulse. This mismatch can be resolved if the pulse front tilt (PFT) of the laser pulse is taken into account. We developed an analytic model to describe the propagation of a Gaussian laser pulse exhibiting first order STC around the focal plane, which describes the observed behaviour. Using 2D-PIC Simulations we can reproduce the experimental results.
Additionally, we report on the influence of laser pulse front tilt on the accelerated electrons in a laser wakefield accelerator. Experiments with the JETi-200 Laser are presented which show controllable electron beam steering depending on the pulse front tilt.

Acknowledgments

This work was supported by the Bundesministerium für Bildung und Forschung (BMBF) grants 05K19SJC and 05K19SJB. The research leading to the presented results received additional funding from the European Regional Development Fund and the State of Thuringia (contract No. 2019 FGI 0013).