7th European Advanced Accelerator Conference

EAAC2025

Contribution ID: **587** Type: **Poster (participant)**

Laser post-compression for dephasingless laser-wakefield experiments of electron acceleration

Tuesday, 23 September 2025 19:00 (1h 30m)

Laser-wakefield electron acceleration (LWFA) is an important alternative to conventional accelerators, that was proposed by Tajima and Dawson [1]. To achieve higher electron energies, a new concept has been recently proposed based on laser fields with spatio-temporal coupling and focused by axiparabolic mirror. The aim is to have a long focal depth with phase-matched regime of wakefield acceleration [2].

As shown theoretically in [2], the electron energy gain obtained with phase-locked condition can be one order of magnitude or higher than with standard self-guided laser-plasma accelerators, at the same laser energy level, with gain increases when using shorter pulses.

We present our results intended to achieve shorter pulse durations by post-compressing [3] 27 fs, 1 J pulses from a Ti:Sa laser, based on self-phase modulation in fused silica. By characterizing the spatial and temporal profiles we can make further steps towards the usability of post-compressed high-power laser pulses in dephasingless LWFA experiments.

[1] Tajima, T. and Dawson, J. "Laser Electron Accelerator", Phys. Rev. Lett. 43, 267-260 (1979)
[2] Caizergues, C. et al. "Phase-locked laser-wakefield electron acceleration", Nat. Photonics 14, 475-479 (2020)
[3] Khazanov, E. et al. "Nonlinear compression of high-power laser pulses: compression after compressor approach,"Physics-Uspekhi 62(11), 1096-1124 (2019)

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Session Classification: Poster Session

Track Classification: PS3: Laser technology