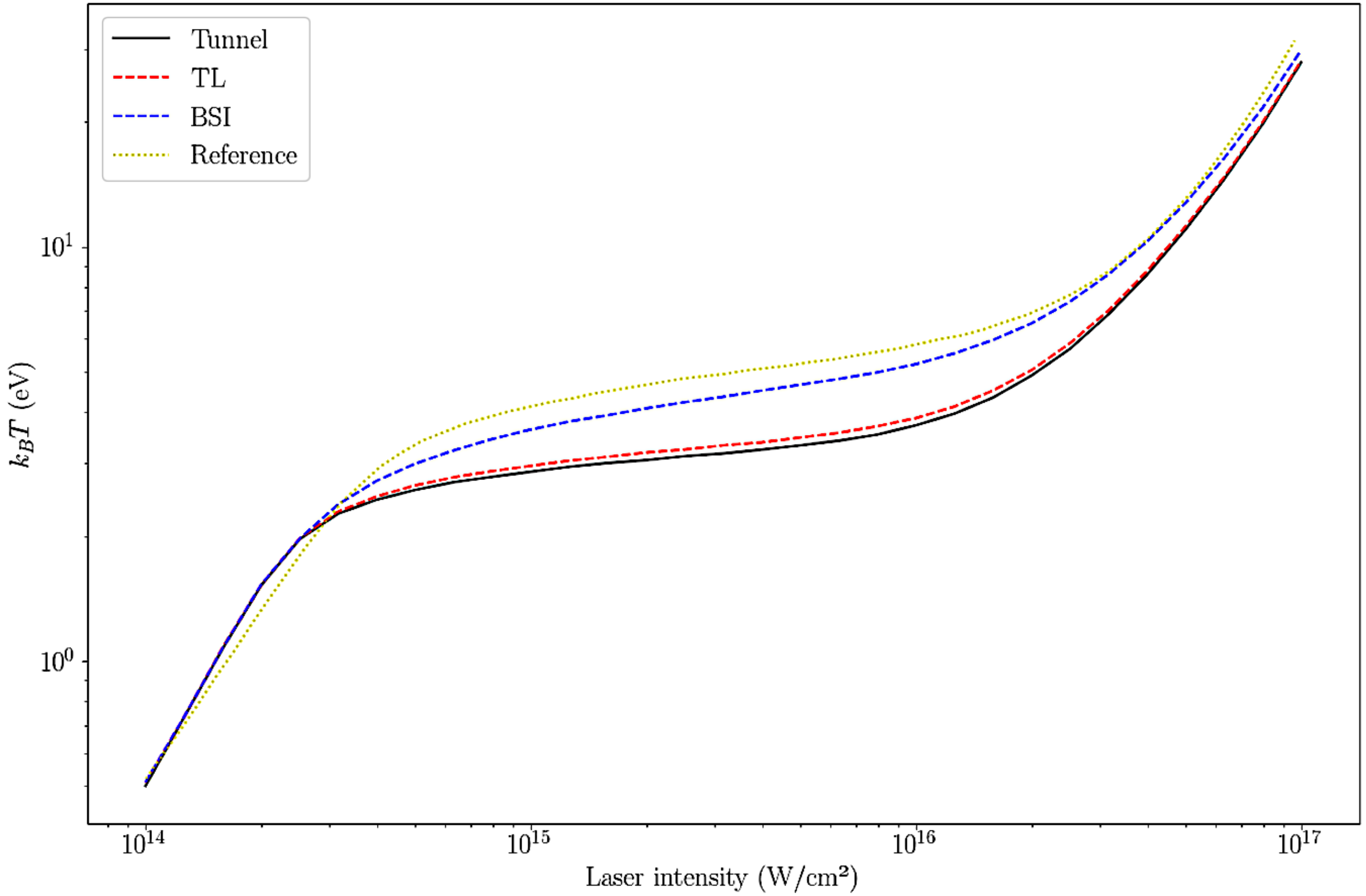
Barrier Suppression Ionization impacts on HOFI channel formation (A. Beck, LLR)

The ionization/heating induced by the laser is at the origin of the **HOFI channel** formation. « Barrier Suppression Ionization » must be taken into account.

Agreement is found between **Smilei** and **WarpX** implementations on a wide range of laser intensities.



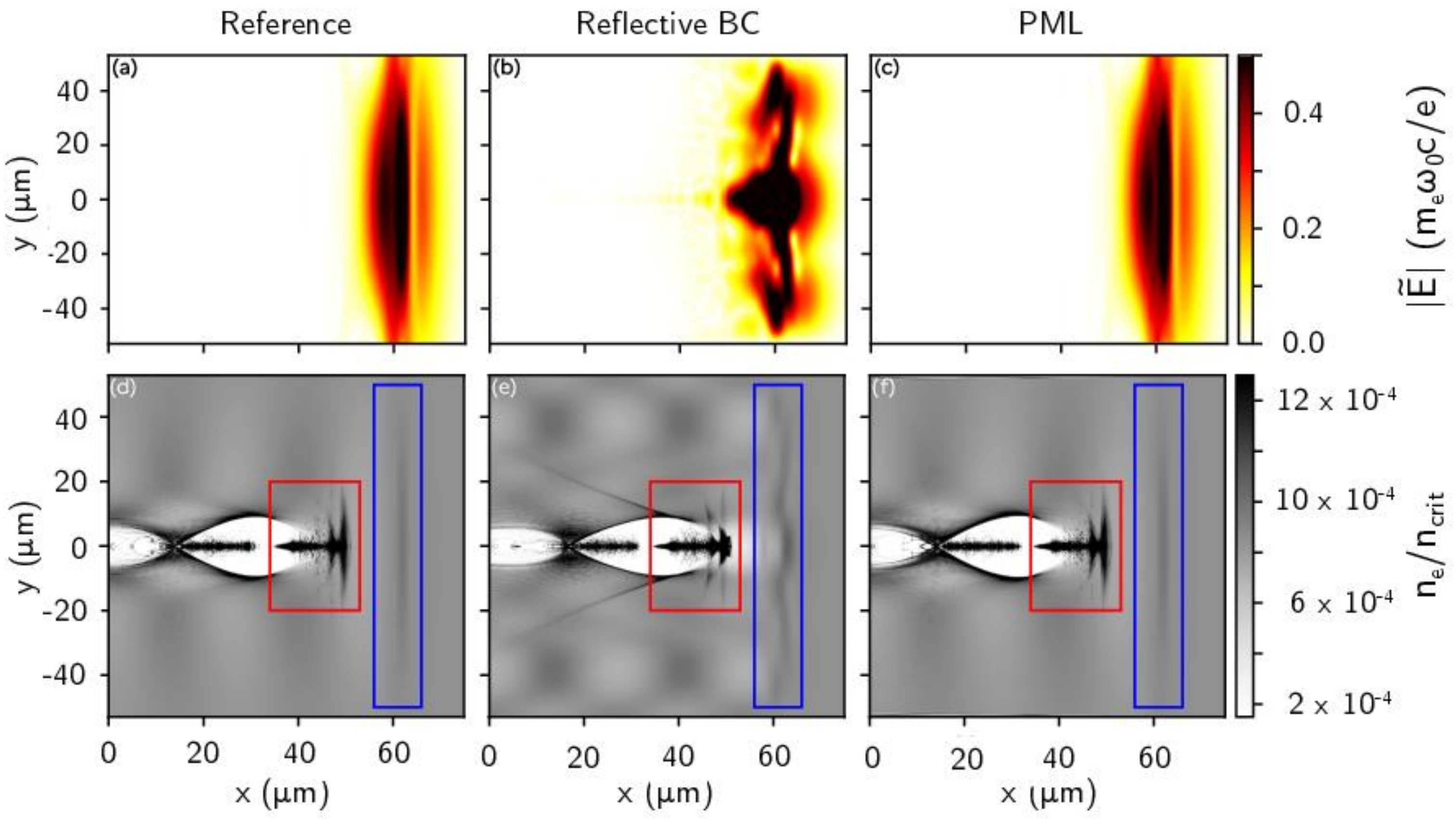
Reference data from

Mewes et al. , Phys. Rev. Research 5, 033112 (2023)

Perfectly Matched Layers for the laser envelope equation (A. Beck, LLR)

Significant improvement of the Boudary Conditions for the envelope model in **Smilei**.

Particularly critical in the case of **long laser propagation** simulations.



A. Beck, G. Bouchard, F. Massimo, A. Specka (2024), https://arxiv.org/abs/2409.06287
submitted to Computer Physics Communications

LPGP activities related to EuPRAXIA

Funded by the European Union

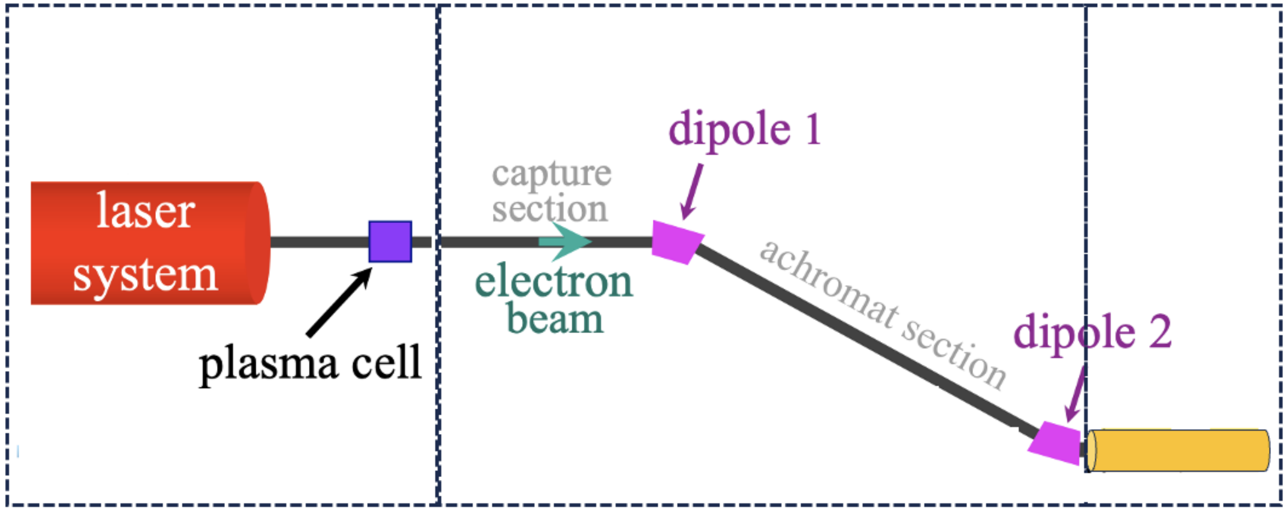
ITFIP team

- **B. Cros (permanent):** team leader, experiments
- **G. Maynard (permanent, retired):** theory and simulation
- **C. Ballage (permanent):** gas cell design and experiments
- **O. Vasilovici (permanent):** gas cell experiments
- **F. Massimo (permanent):** theory and simulation
- **L. T. Dickson (PhD, at LPGP until 2023):** experiments
- **I. Moulanier (PhD candidate):** theory and simulation
- **L. S. Theunis (PhD candidate):** theory and simulation, gas cell design, simulation and experiments

Main recent research activities

- Design and testing of gas cells to produce high-quality electron beams through LWFA (collab. UHI100, HZDR)
- Numerical design of a high-quality LWFA-based injector, including plasma+transport line (collab. IRFU)
- Development of novel field reconstruction technique GSA-MD
- High-accuracy modelling of experiments using the reconstructed laser field from experiments
- Development of the PIC code Smilei (collab. LLR, LULI, MdlS in Saclay)

Design study for a high-quality LWFA-based electron source, + transport line for multistage plasma acceleration



Electron beam @ exit of transport line (baseline: AWAKE requirements for e- injector)

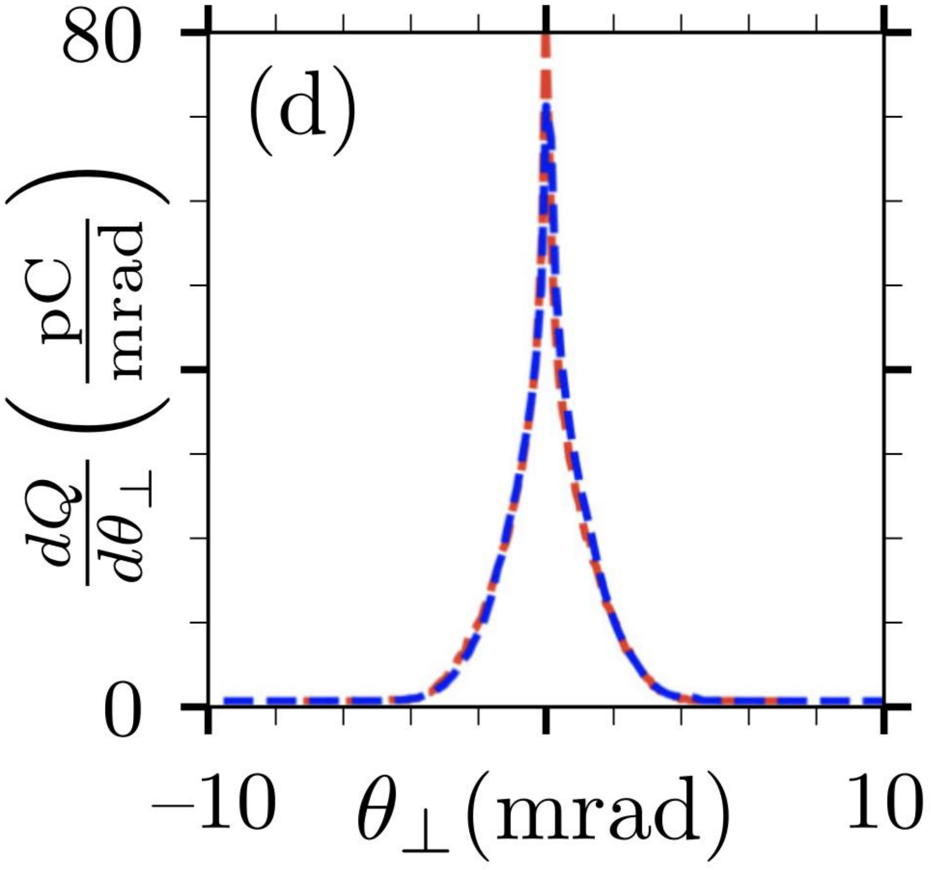
TABLE V. Beam parameters obtained at the transport line exit. To be compared with the top-level requirements in Table I.

Beam parameter	Obtained at the transport line exit
Charge Q	≥ 100 pC
Mean energy E	194 MeV
Normalized emittance ϵ_x	≤ 4 μm rad
Normalized emittance ϵ_y	≤ 0.7 μm rad
Beam size σ_x	4.8 μm
Beam size σ_y	6.0 μm
Beam size σ_z	67.7 μm
Twiss α_x	0.006
Twiss α_y	−0.05
Dispersion $D_{x,y}$	0
$D'_{x,y}$	0

S. Marini et al., *Phys. Rev. Accel. Beams* 27, 063401 (2024)

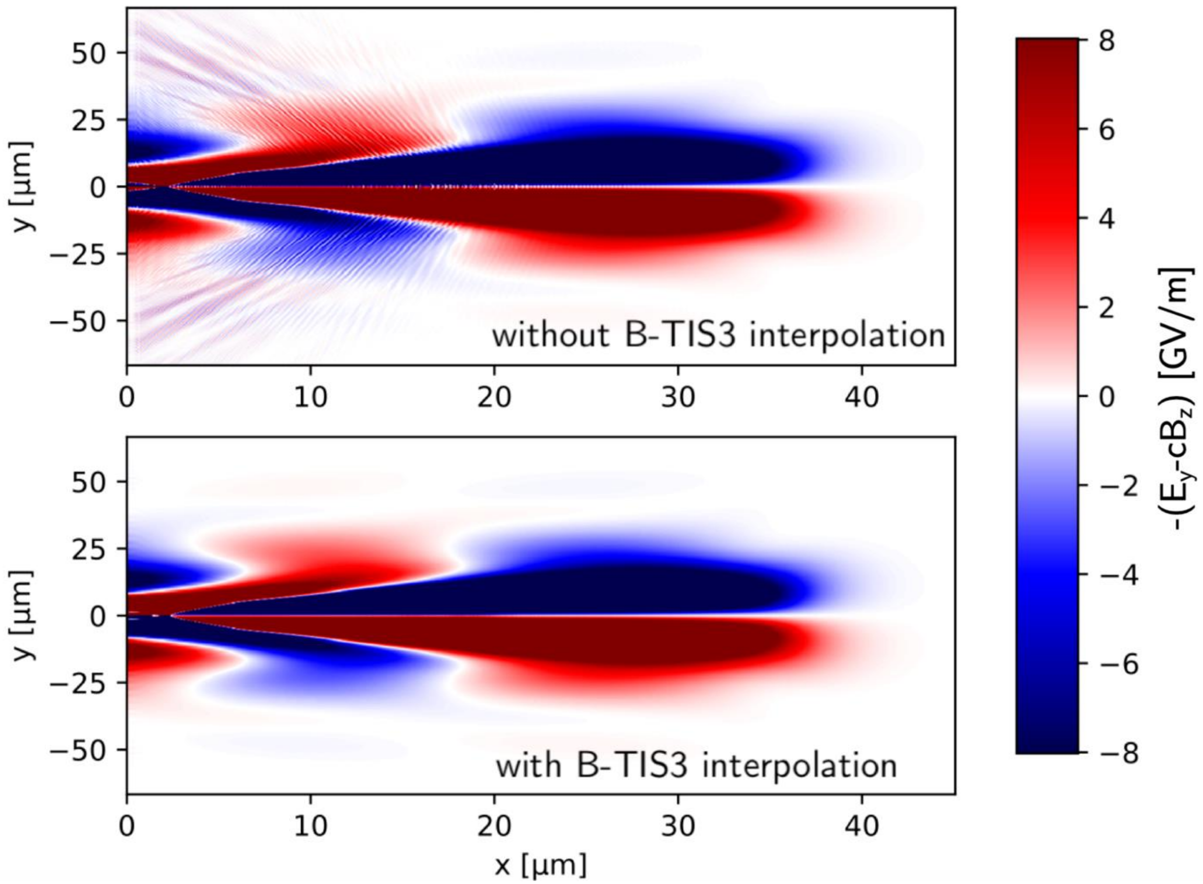
FBPIC, spectral solver

Smilei, FDTD+B-TIS3 interpolation



S. Marini et al, PRAB (2024)

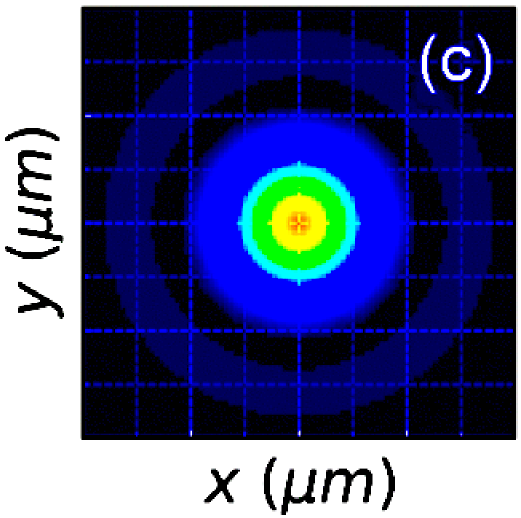
Envelope PIC simulations in cylindrical geometry

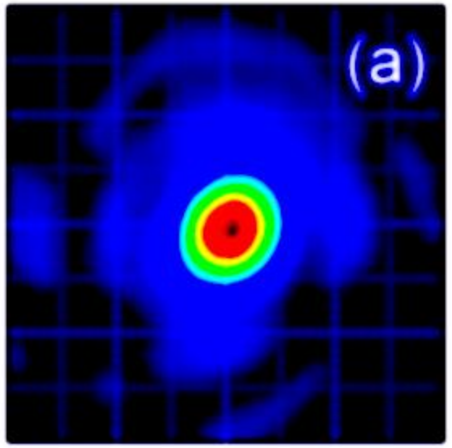


B-TIS3 scheme in cartesian geometry:

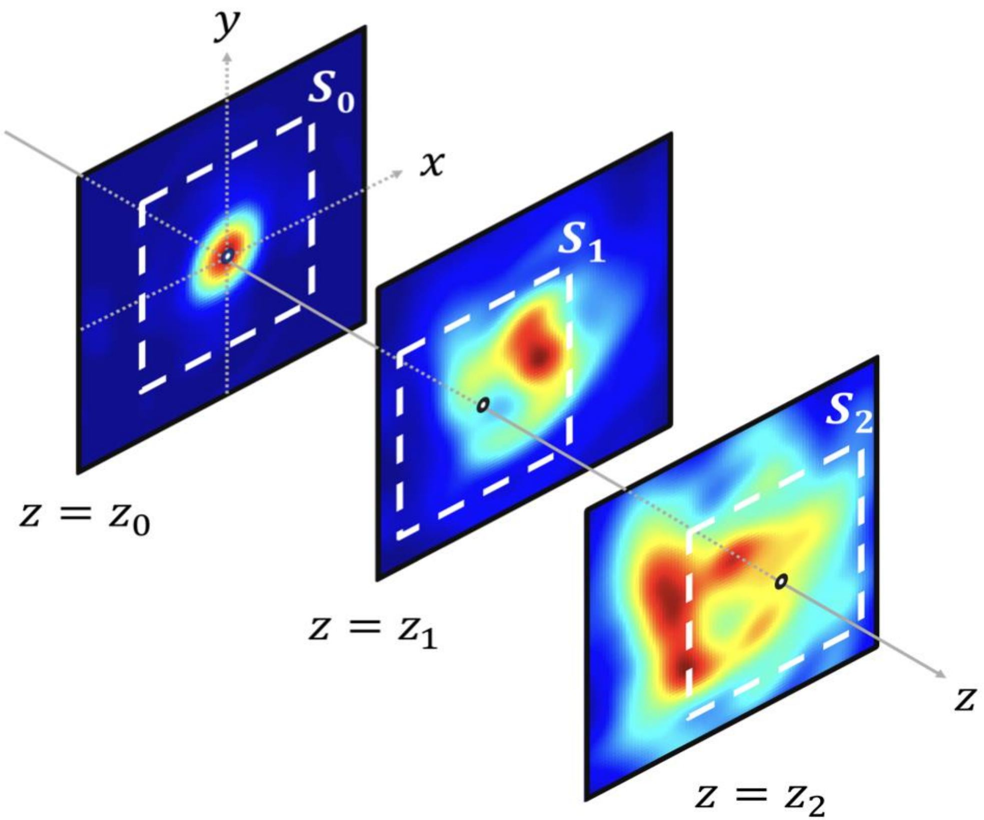
P.-L. Bourgeois, X. Davoine, Journal of Plasma Physics (2022)

Novel algorithm GSA-MD to reconstruct laser field from experimental data





GSA-MD Algorithm



LWFA Simulations with ”ideal” (symmetric) laser:
- easier and faster to run
- easier and faster to analyse
- quantitatively less accurate

LWFA Simulations with ”realistic” (asymmetric) laser:
- more cumbersome run
- more difficult to analyse
- quantitatively accurate

Fluence (= [field amplitude]^2) data measured at transverse planes is used to reconstruct the laser phase (and field)

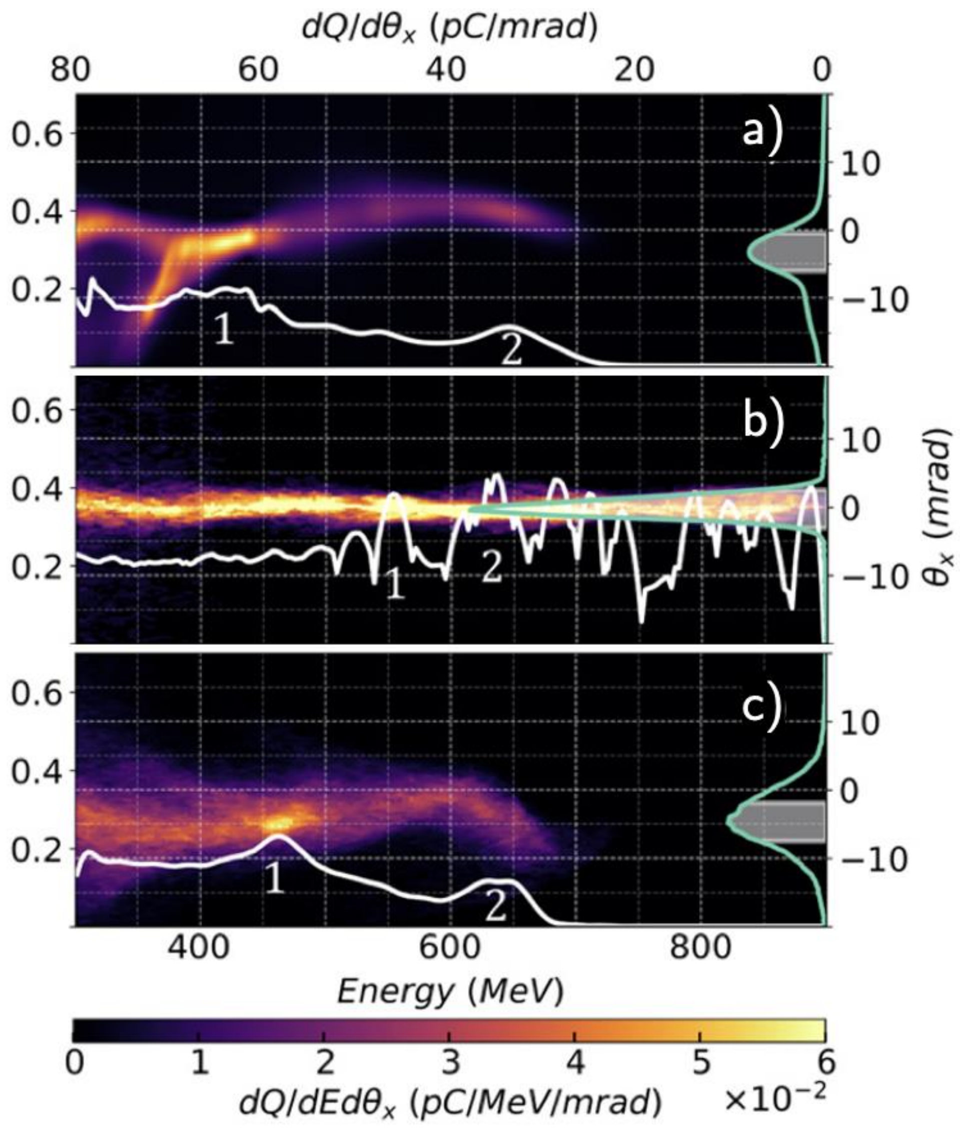
(Algorithm description in **I. Moulanier et al., J. Opt. Soc. Am. B 40(9), 2450-2461 (2023)**)

Funded by the European Union

Experiment

Simulation, Gaussian laser

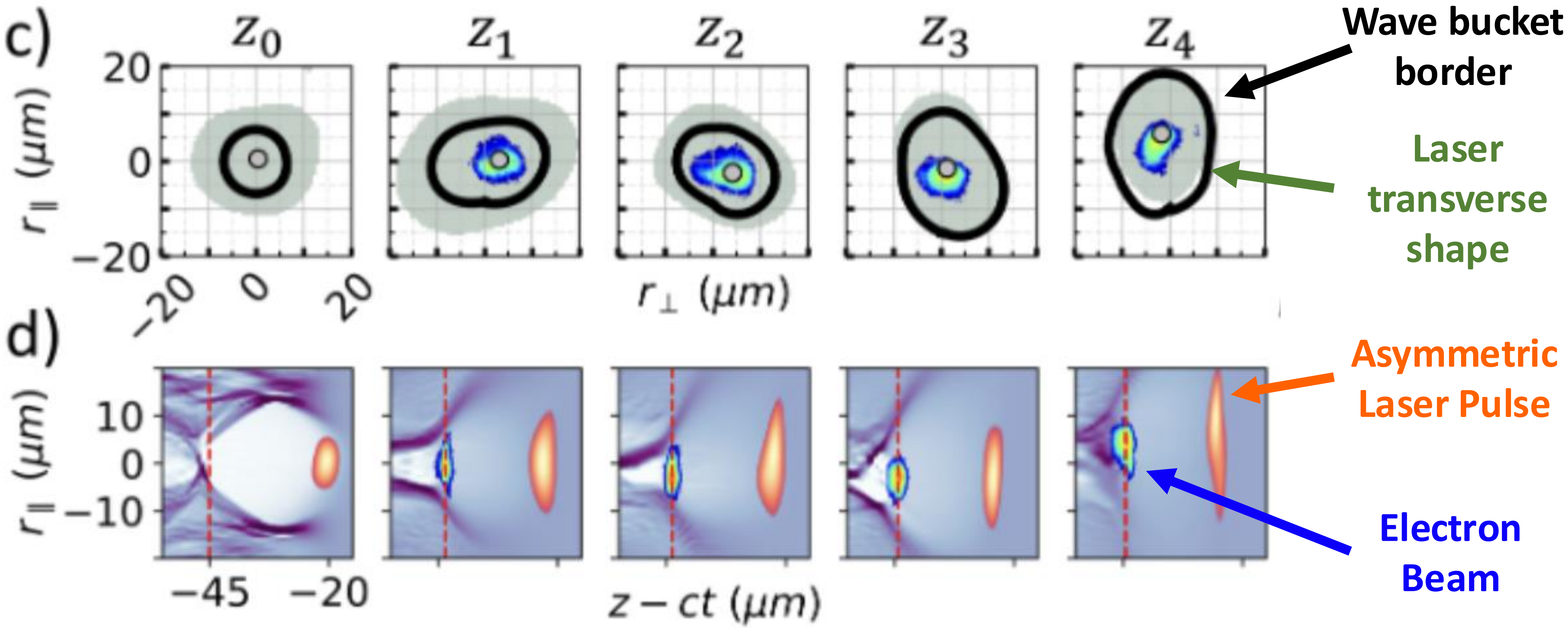
Simulation, reconstructed laser



I. Moulanier et al., Physics of Plasmas 2023

Reconstructed laser fields allow to study the effects of asymmetric (realistic) laser energy distributions in LWFA

Funded by the European Union



simulation from from **I. Moulanier et al., submitted to the EAAC23 Proceedings**
using laser field reconstructed from fluence measurements through the GSA-MD algorithm

(See also **I. Moulanier et al., *Phys. Plasmas* 30, 053109 (2023); L. Dickson et al, PRAB 25, 101301 (2022)**)