

Optimization of Laser Wakefield Acceleration for High-Quality Electron Beams

- **Speaker:**
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- **Date & Place:**
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 Société Française de Physique Accélérateurs

LES JOURNÉES ACCÉLÉRATEURS 2025

ROSCOFF DU 7 AU 10 OCTOBRE 2025

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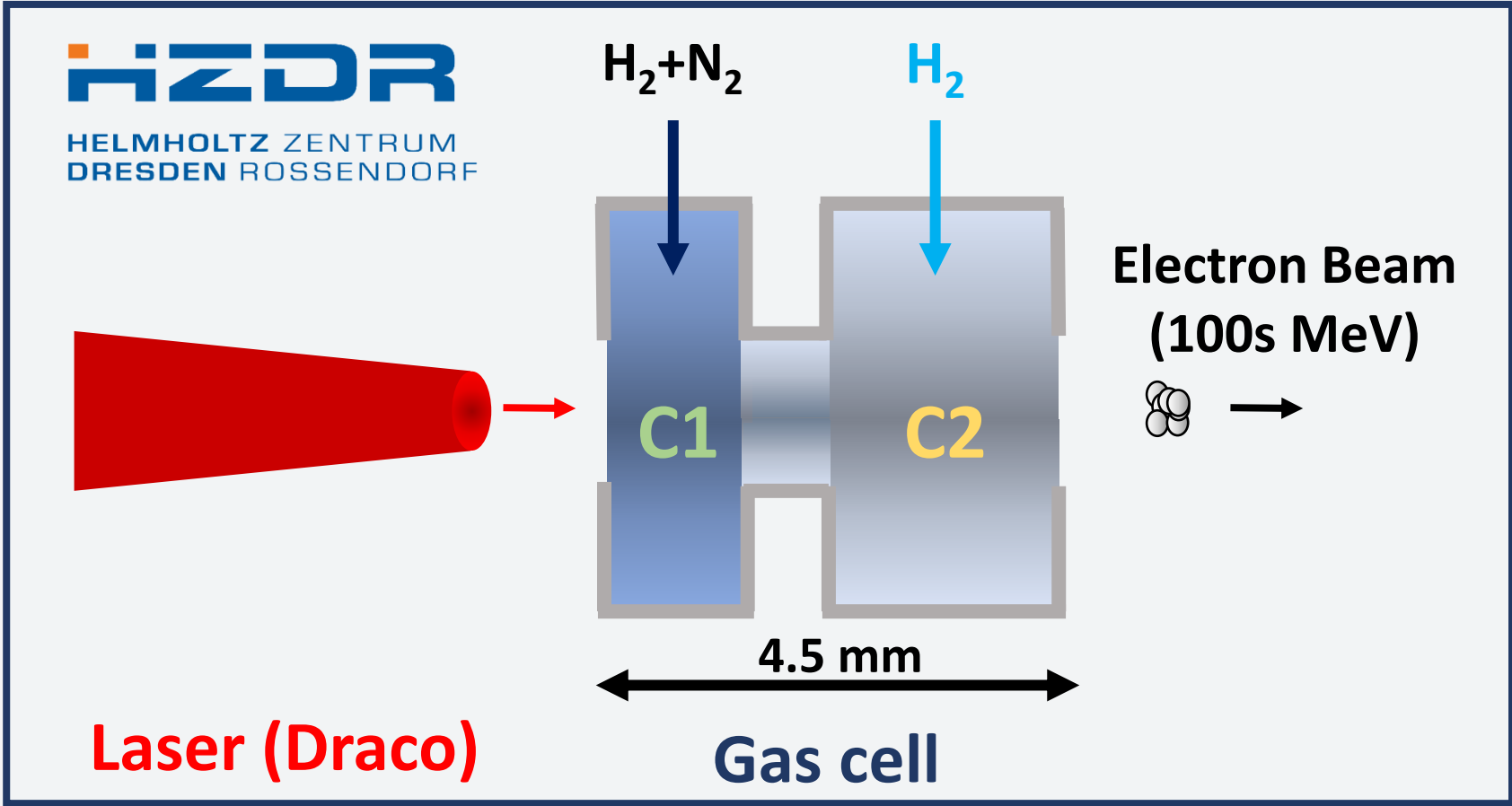
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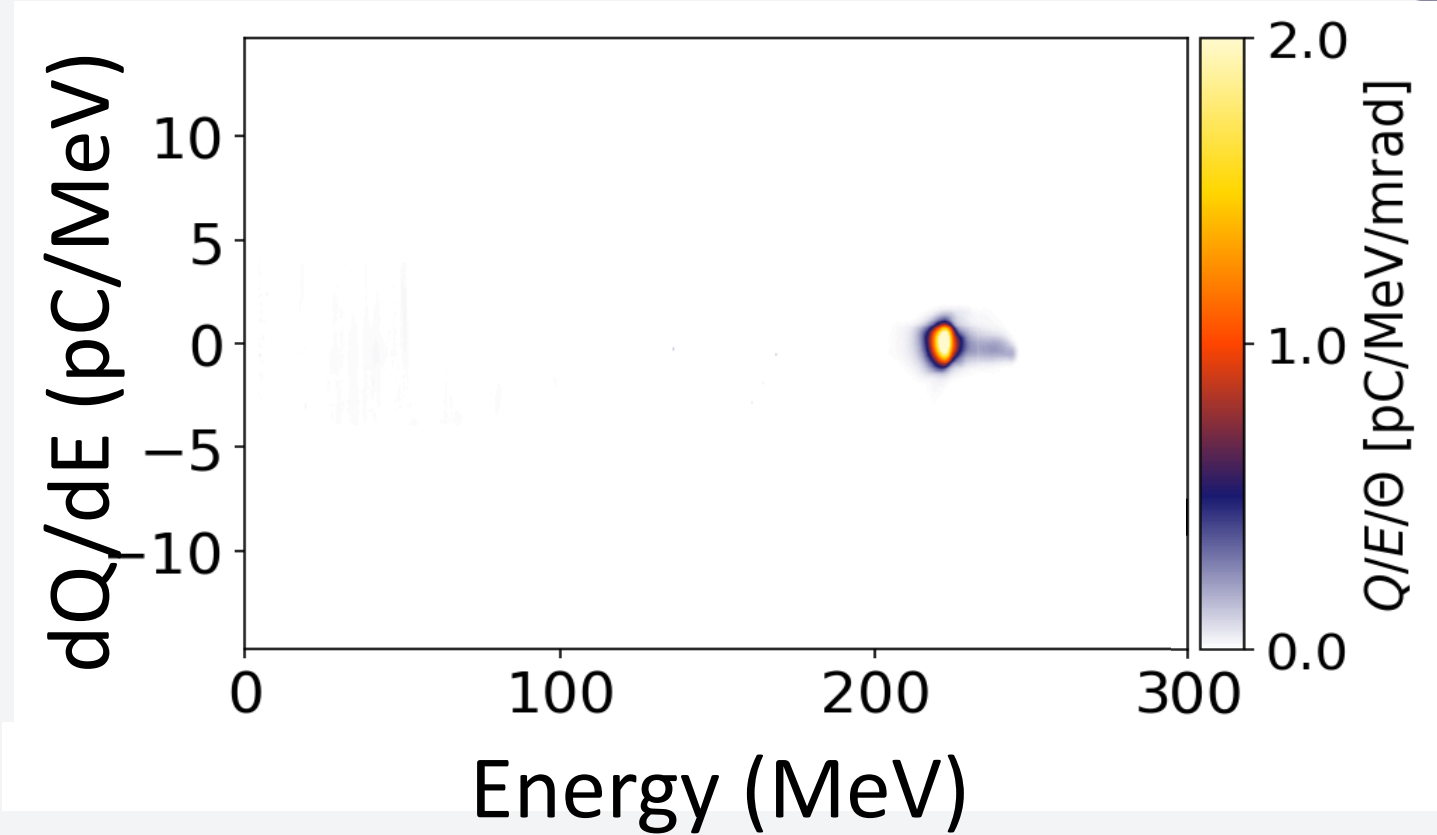
INFORMATIONS
[HTTP://ACCELERATEURS.FR](http://ACCELERATEURS.FR)

Experiment of Laser Wakefield Acceleration at HZDR



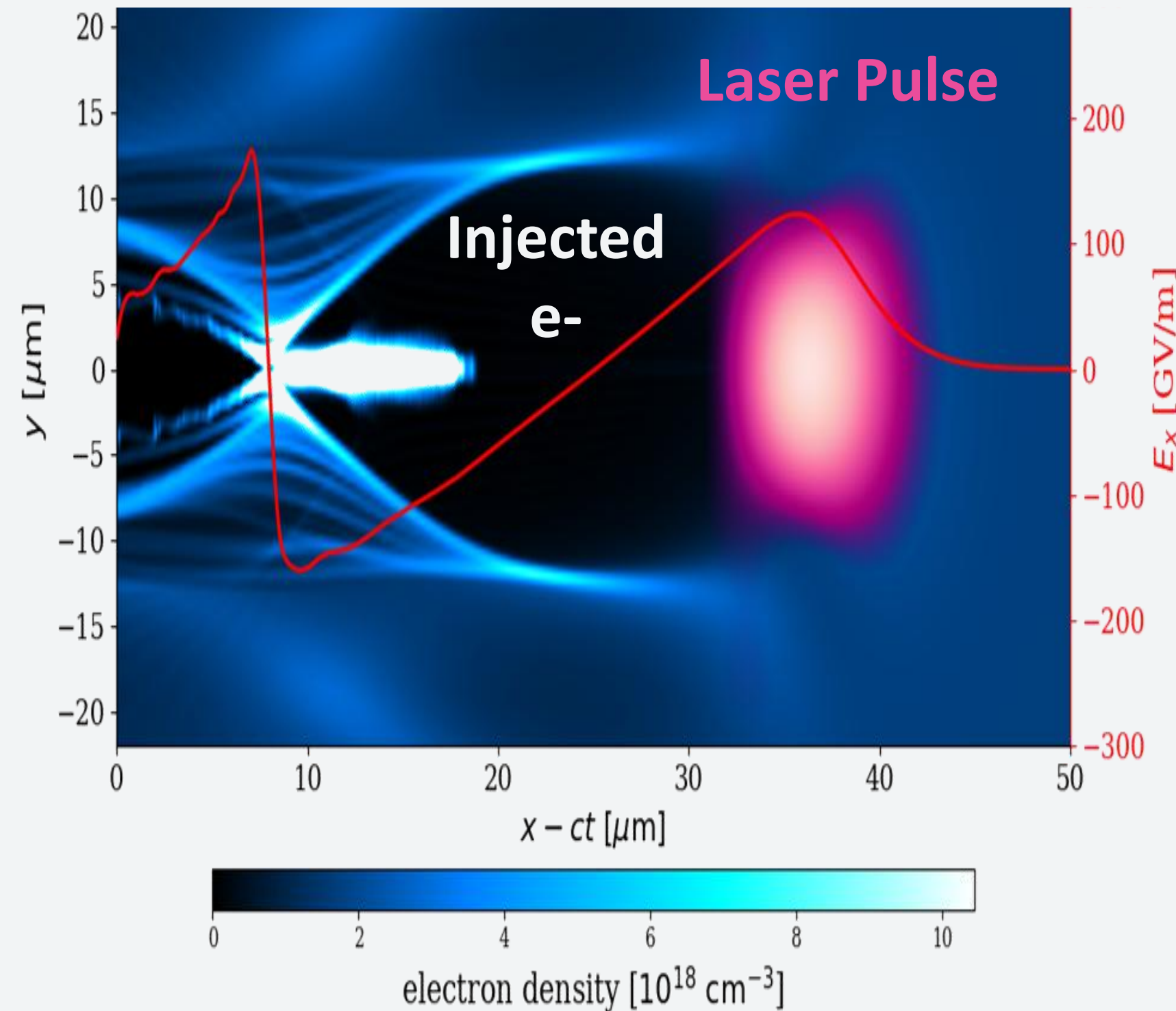
P1 [mbar]	10s of mbar
P2 [mbar]	10s of mbar
% of [N ₂] in C1	5 – 15%
Laser Energy (J)	2 – 2.6 J



Peak Energy (MeV)	221
Q_{FWHM} (pC)	18.7
ΔE (MeV)	5.82

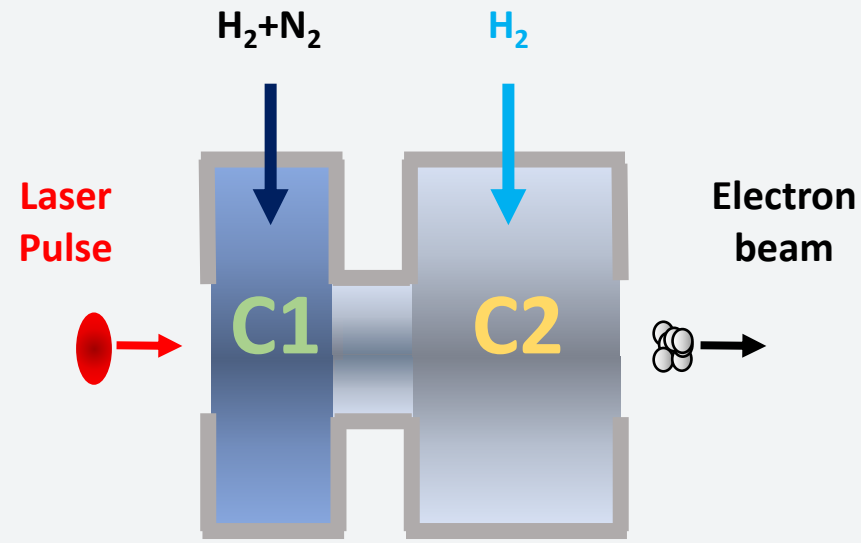
LWFA with ionization injection is used in a tailored density profile

Example of PIC simulation snapshot showing acceleration of a trapped electron bunch in the plasma cavity.

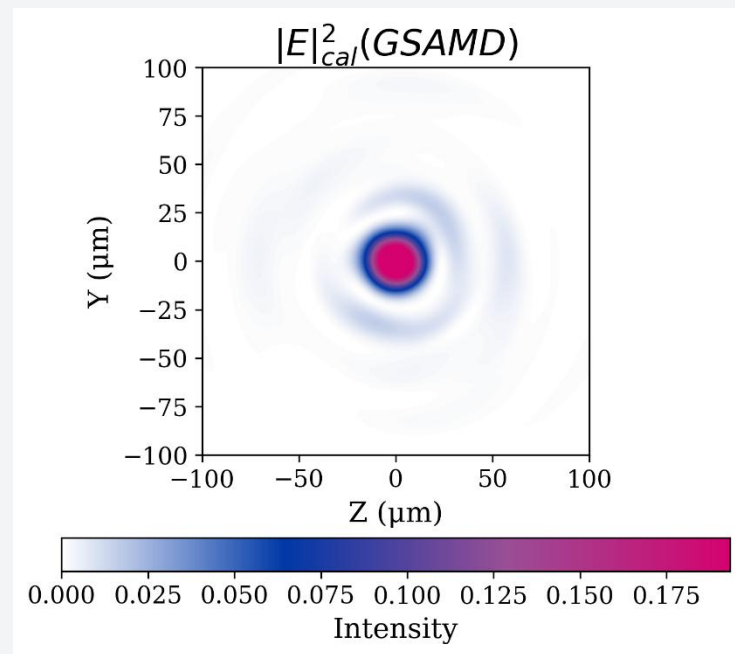


Background
electron density

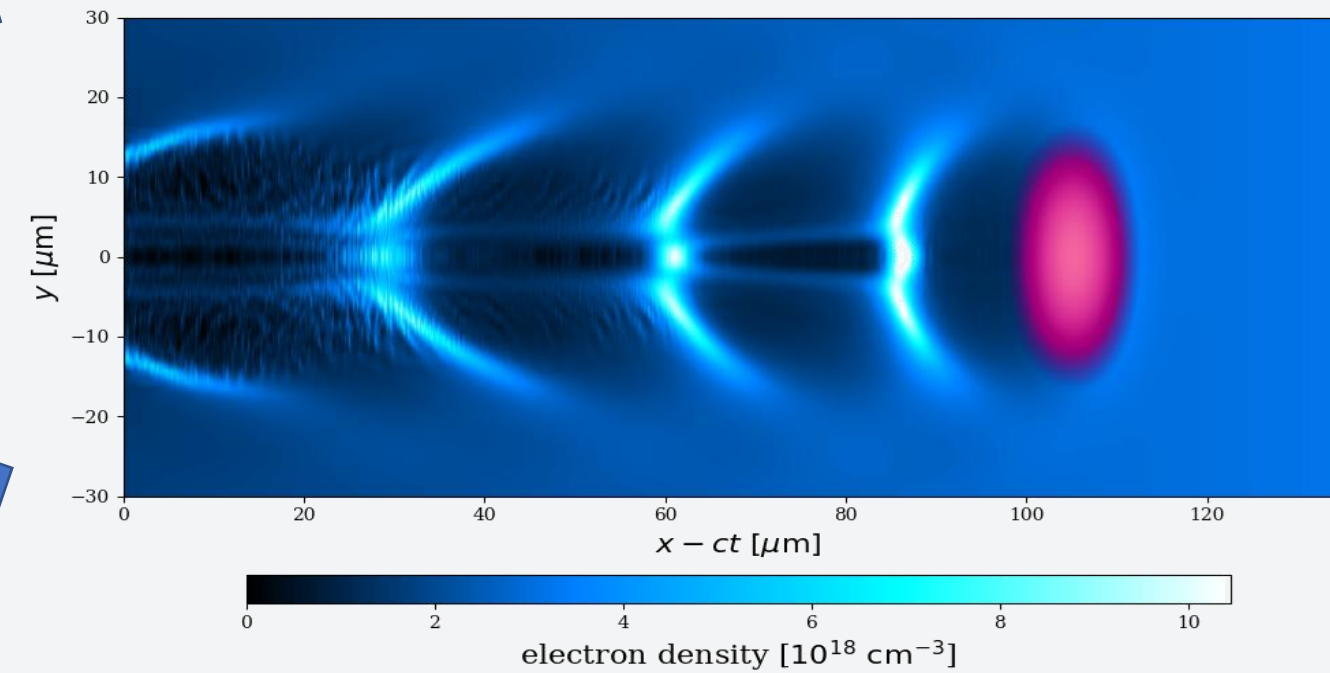
Simulation Methods and Workflow



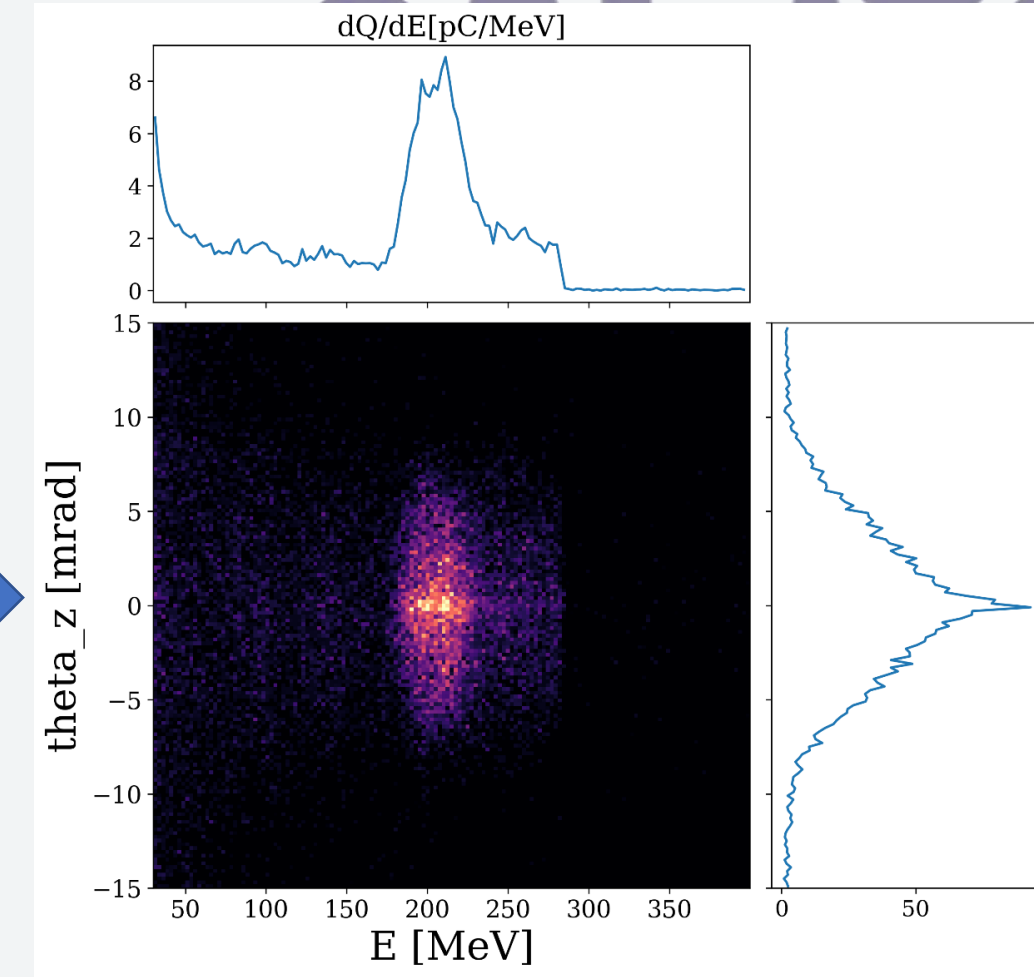
Estimate of plasma density profile in gas cell using OpenFOAM



Model for laser pulse from experimental data

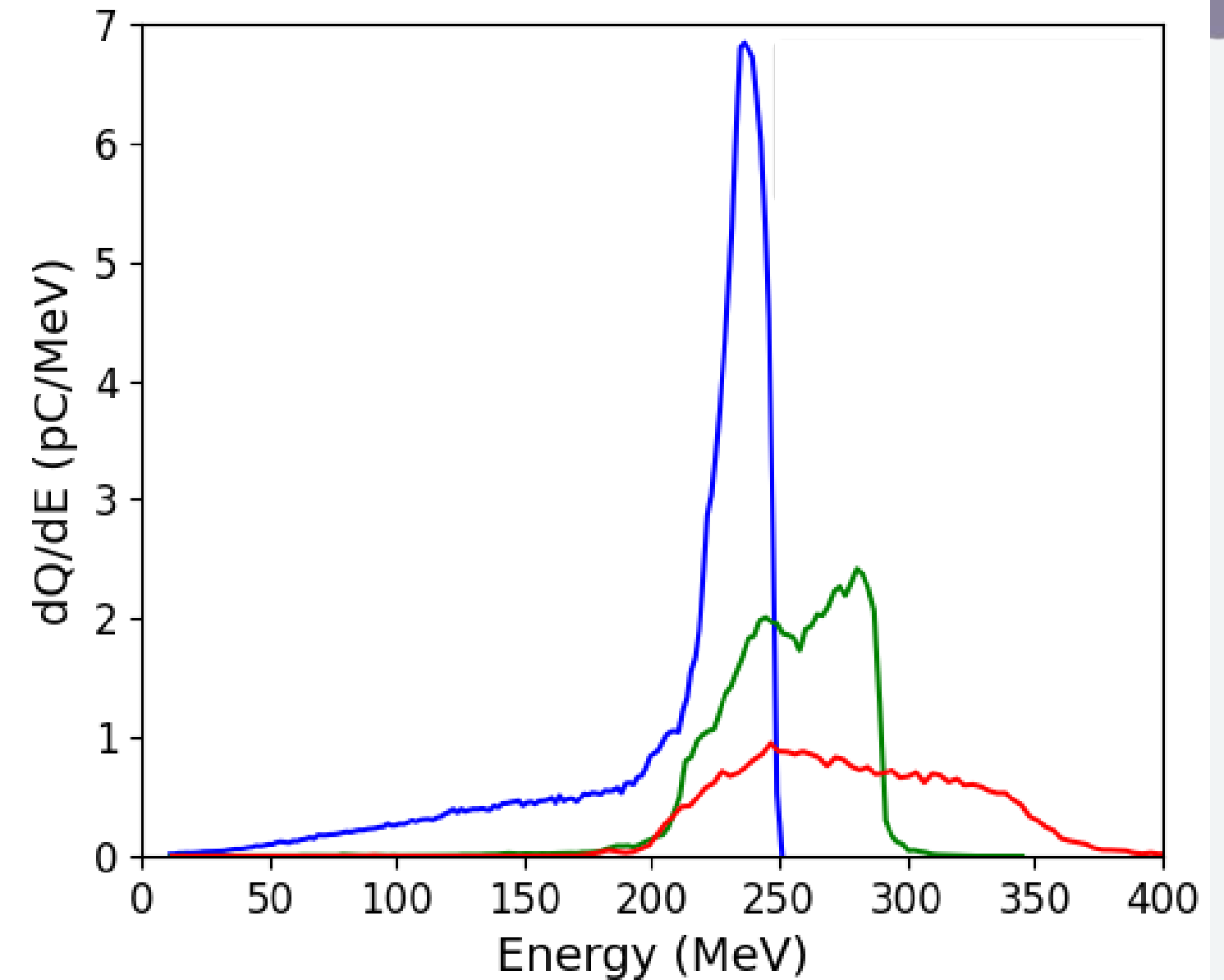
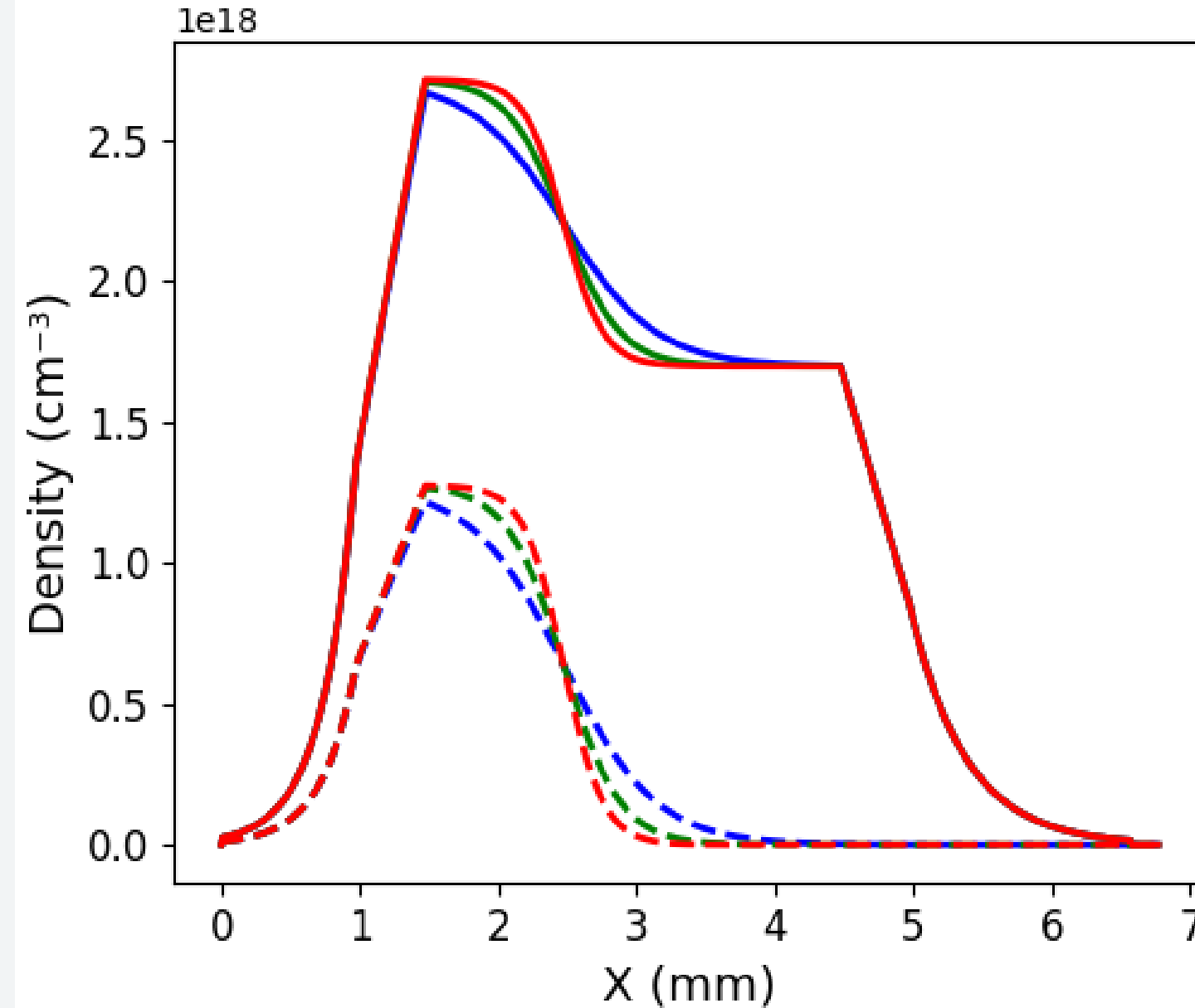


PIC Simulation using Smilei)



Electron Beam spectrum

The steepness of Nitrogen density down-ramp controls the shape of the electron beam spectrum



Summary

PIC simulations provide valuable insight into how varying parameters in LWFA, such as laser energy and plasma plateau density, influence the properties of the electron beam.

PIC simulations of laser wakefield acceleration with ionization injection in a tailored gas-cell density profile show that the density down-ramp steepness plays a crucial role in shaping the electron beam properties.

Discover more at my poster!

