OSIRIS boosted frame simulations

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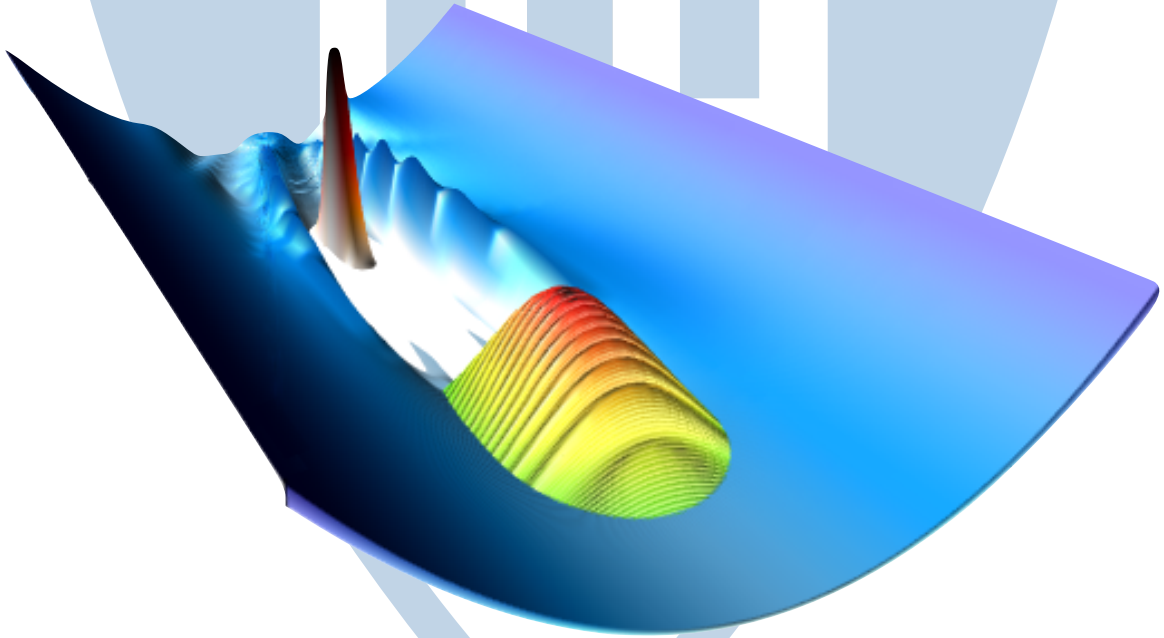


Instituto Superior Técnico

GoLP/IPFN

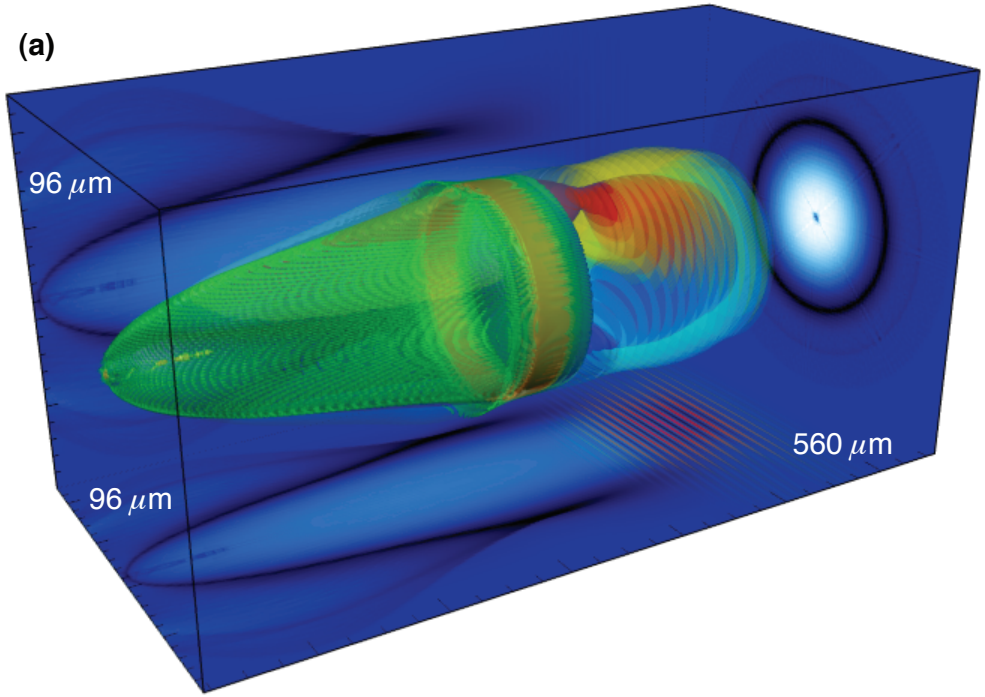
Challenges for next generation lasers

	Self-guiding		External-guiding
	Self Injection I*	Self Injection II**	External Injection**
Laser			
a0	53	5.8	2
Spot [μm]	10	50	101
Duration [fs]	33	110	224
Plasma			
Density [cm^{-3}]	1.5×10^{19}	2.7×10^{17}	2.2×10^{16}
Length [cm]	0.25	22	500
e- Bunch			
Energy [GeV]	**3**	**13**	**53**
Charge [nC]	14	2	1.5
Simulation time [days in 512CPUs]	**1**	**400**	**12,000**

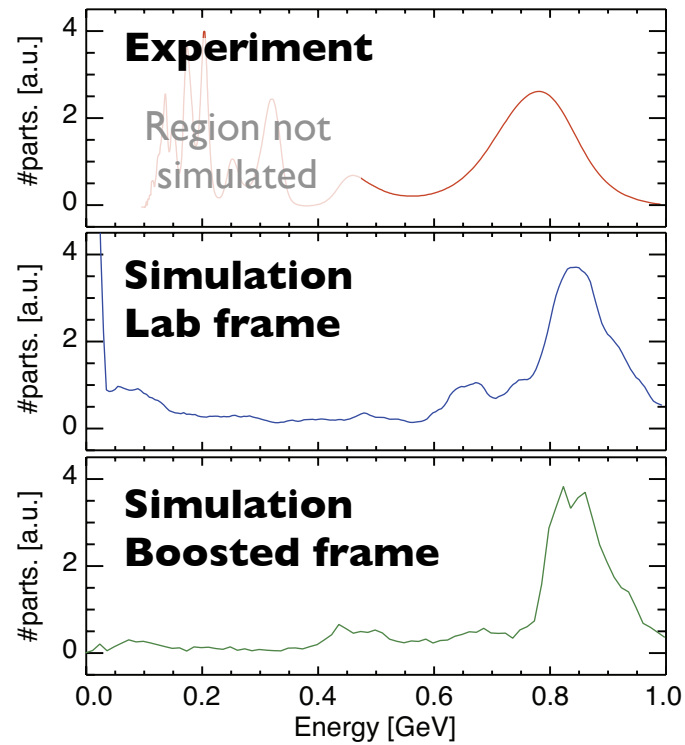
* S. Gordienko and A. Pukhov PoP (2005)
** W. Lu *et al.* PR-STAB (2007)

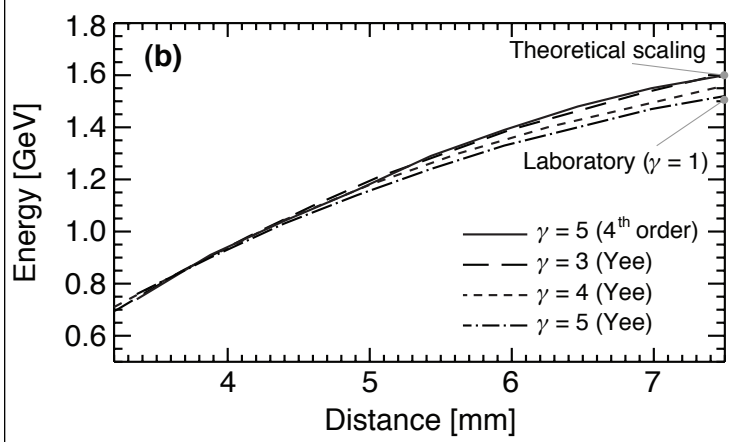
Boosted Frames benchmarks

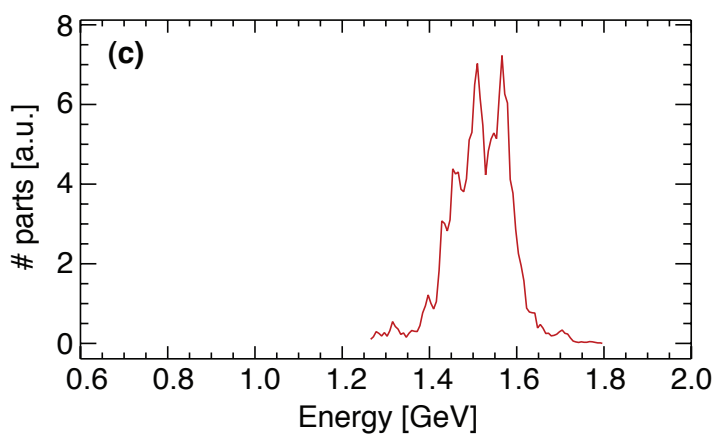
Self-injection of 1.5GeV beam



Experiment/Lab/Boost



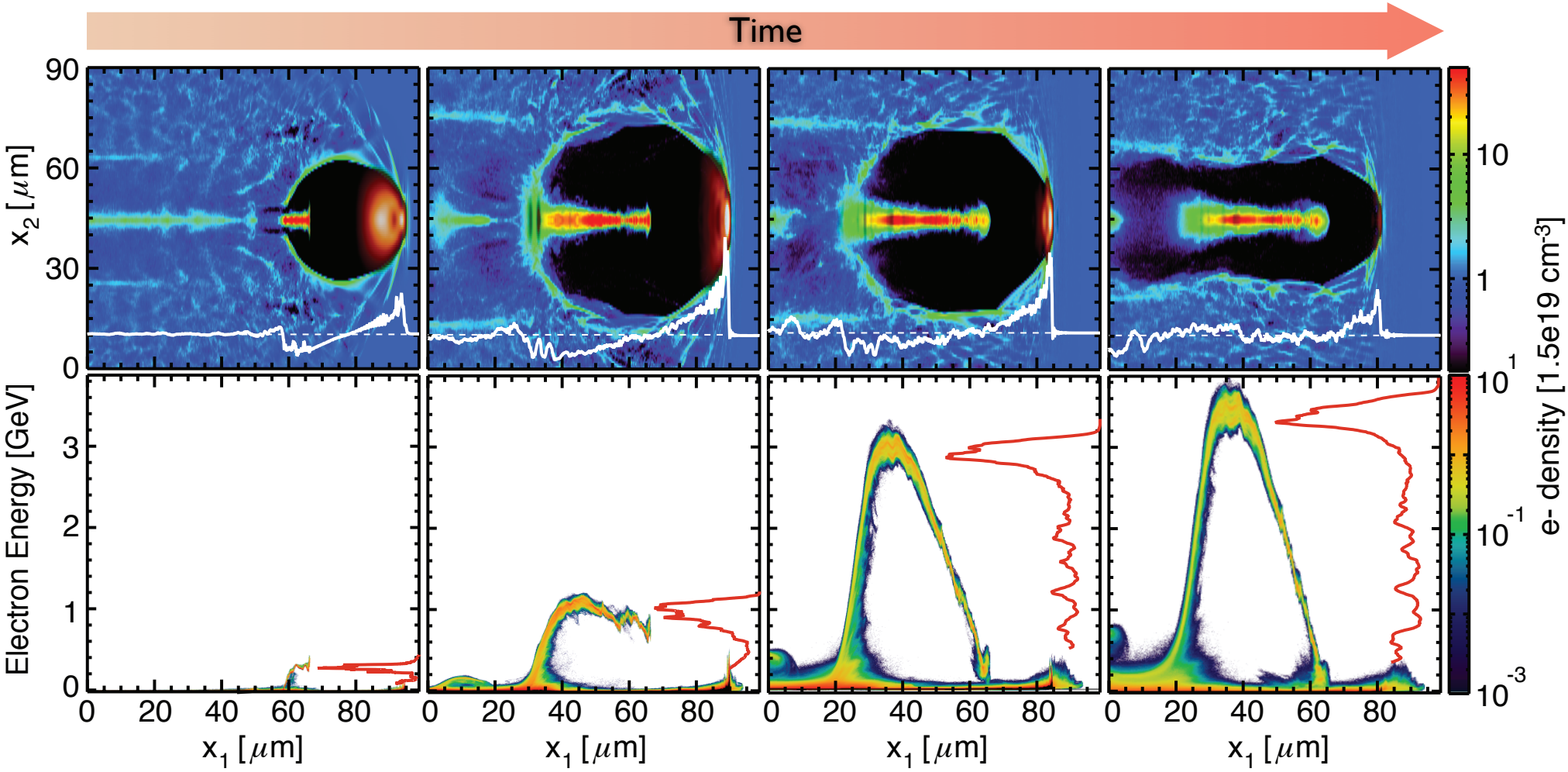




~20x faster
than lab simulation

+3GeV self-injection in strongly nonlinear regime

Extreme blowout a_0=53

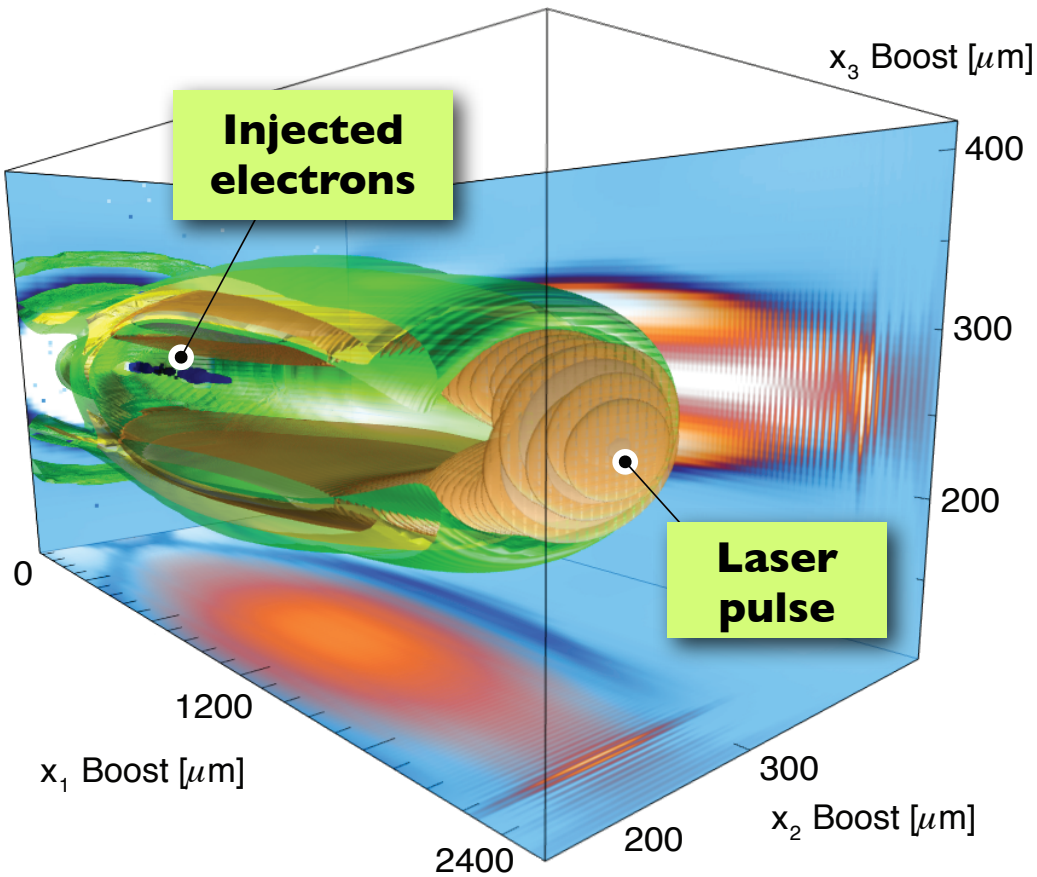


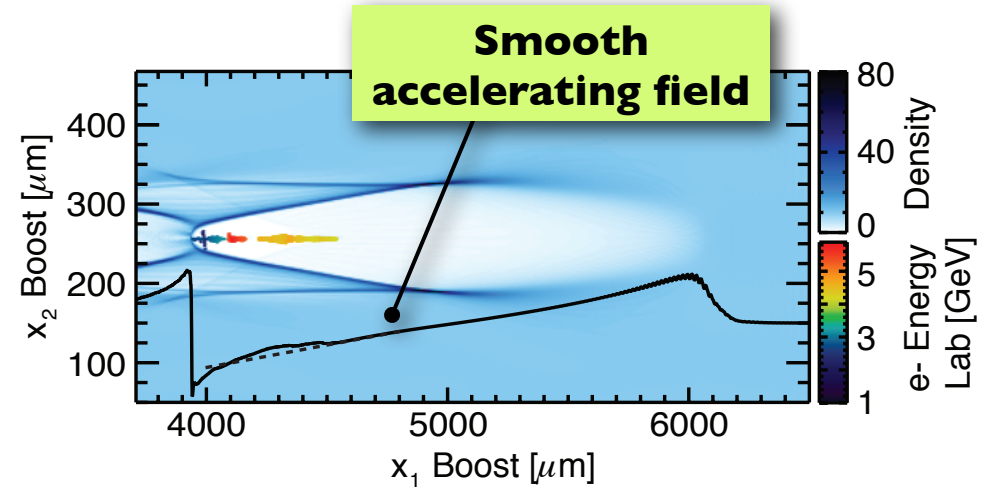
Laboratory frame
3000x256x256 cells
~10^9 particles
10^5 timesteps

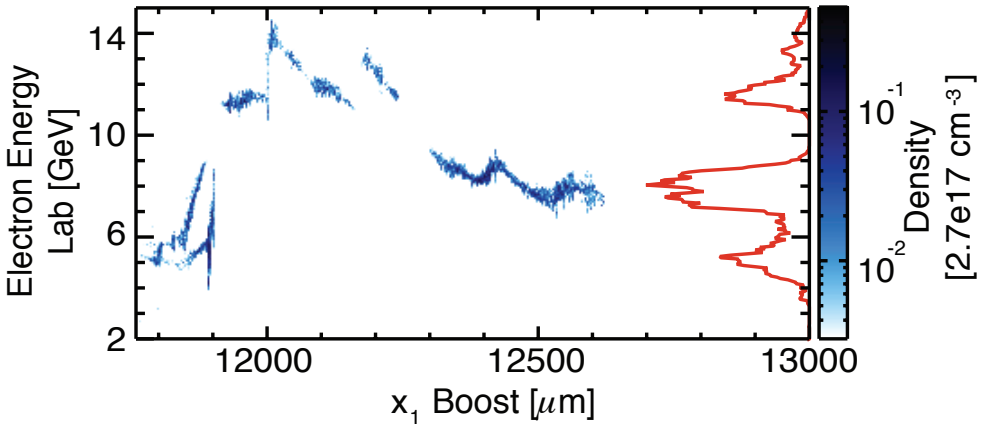
3.4 GeV
17 nC

+10GeV self-injection in nonlinear regime

Controlled self-guided a_0=5.8





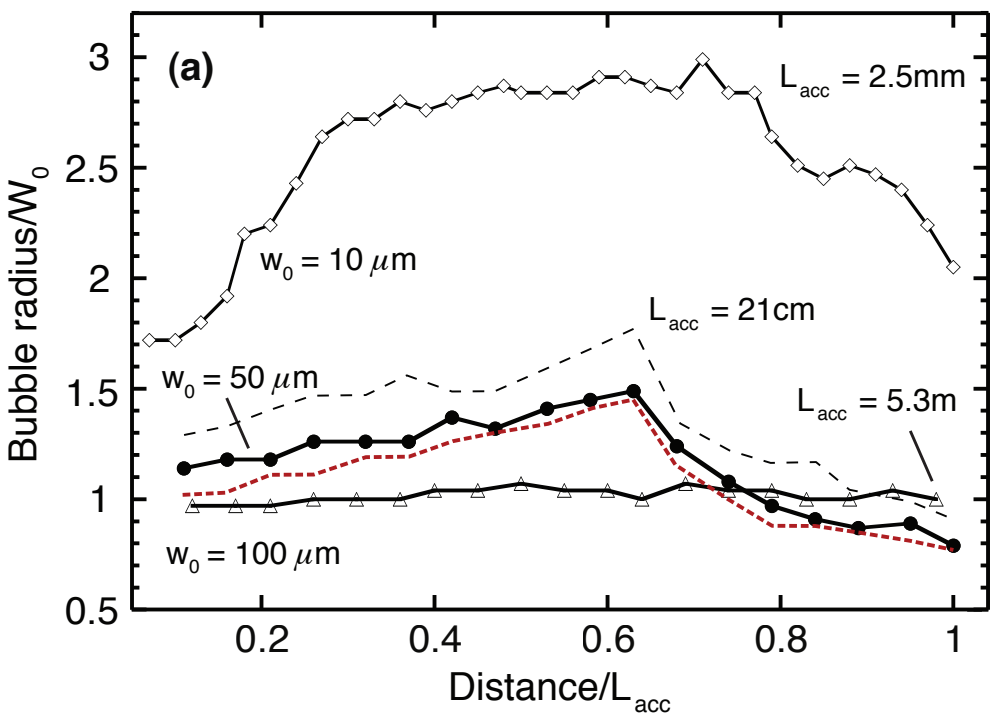


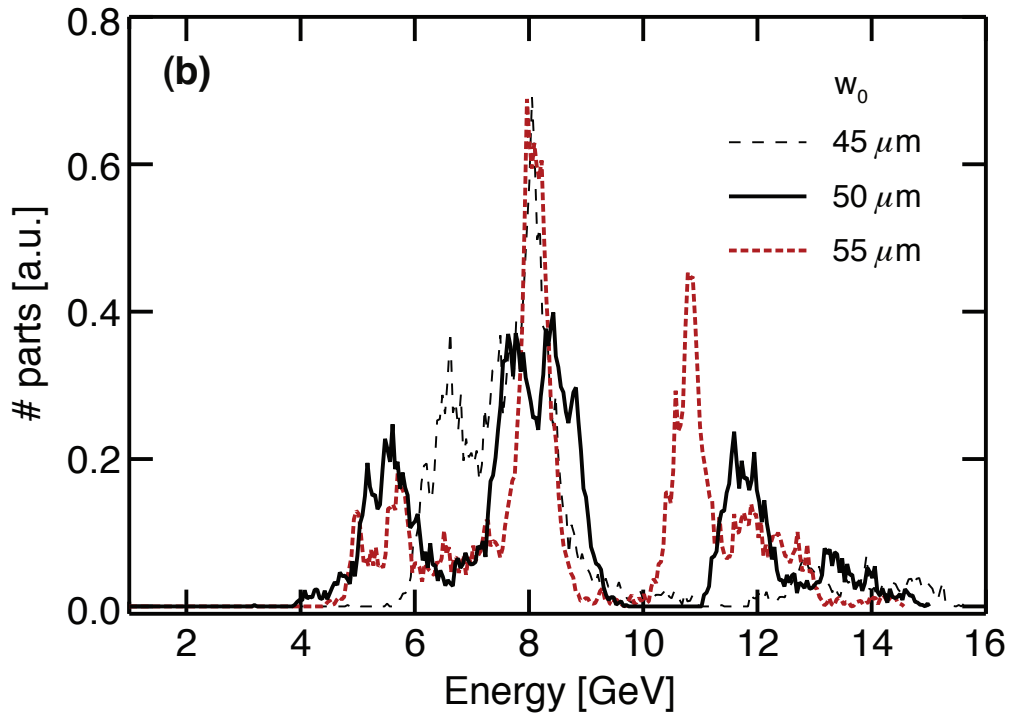
Boosted frame
7000x256x256 cells
~10^9 particles
3×10^4 timesteps
Υ=10

~300x faster
than lab simulation

7-12 GeV
1-2 nC

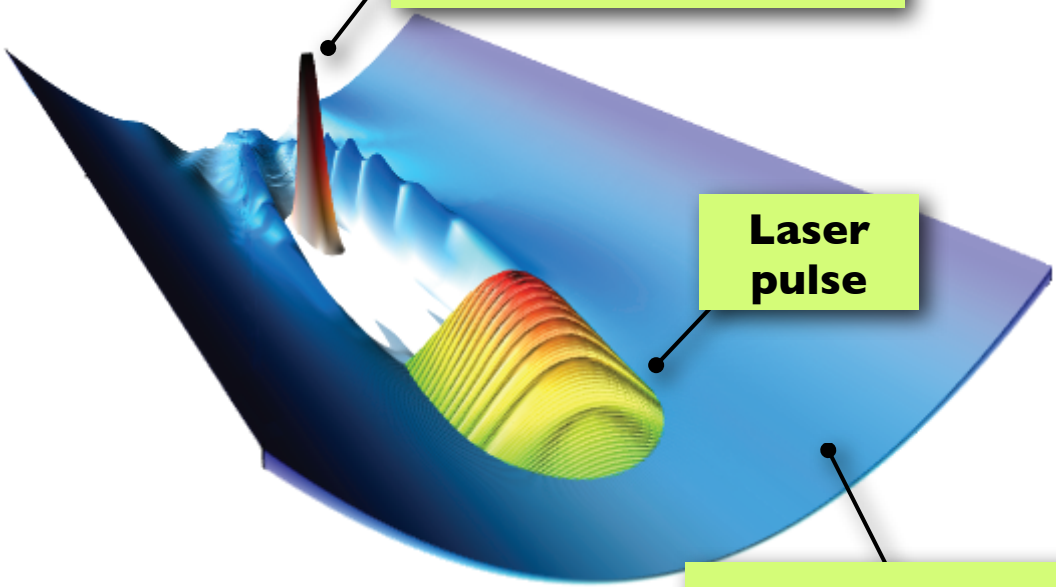
Regime comparison and fine-tuning





+40GeV with externally injected beams

Channel guided a_0=2

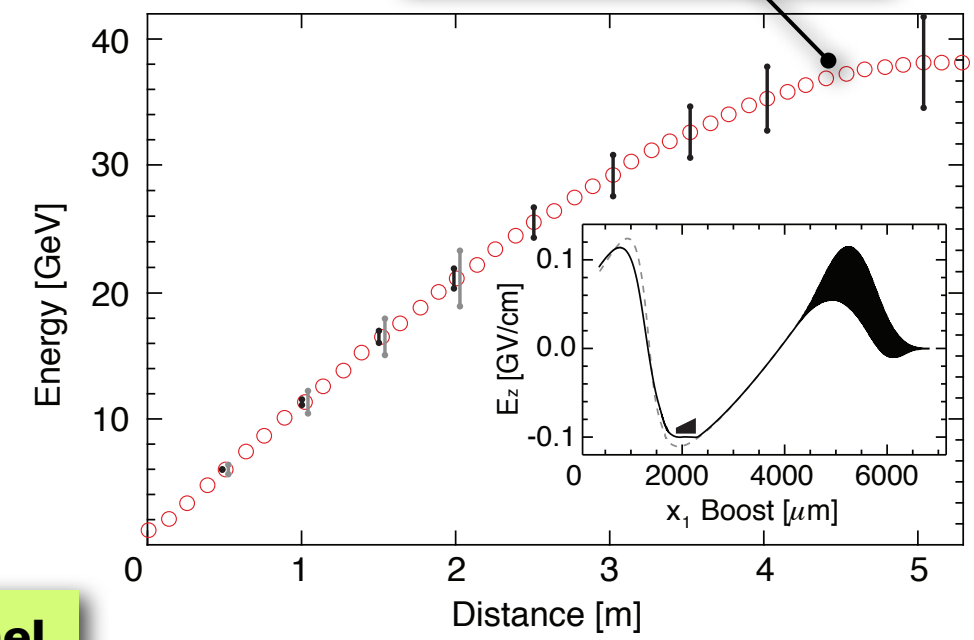


Tailored injected beam to minimize final energy spread

Laser pulse

Guiding channel
Length: 5.28m
Density: 2.2e16 cm^{-3}

Stable accelerating field for over 5 meters



Boosted frame
8000x128x128 cells
~5×10^8 particles
2×10^5 timesteps
Υ=10

~300x faster
than lab simulation

40 GeV
~1 nC