

Electron Acceleration in Graphene Layers

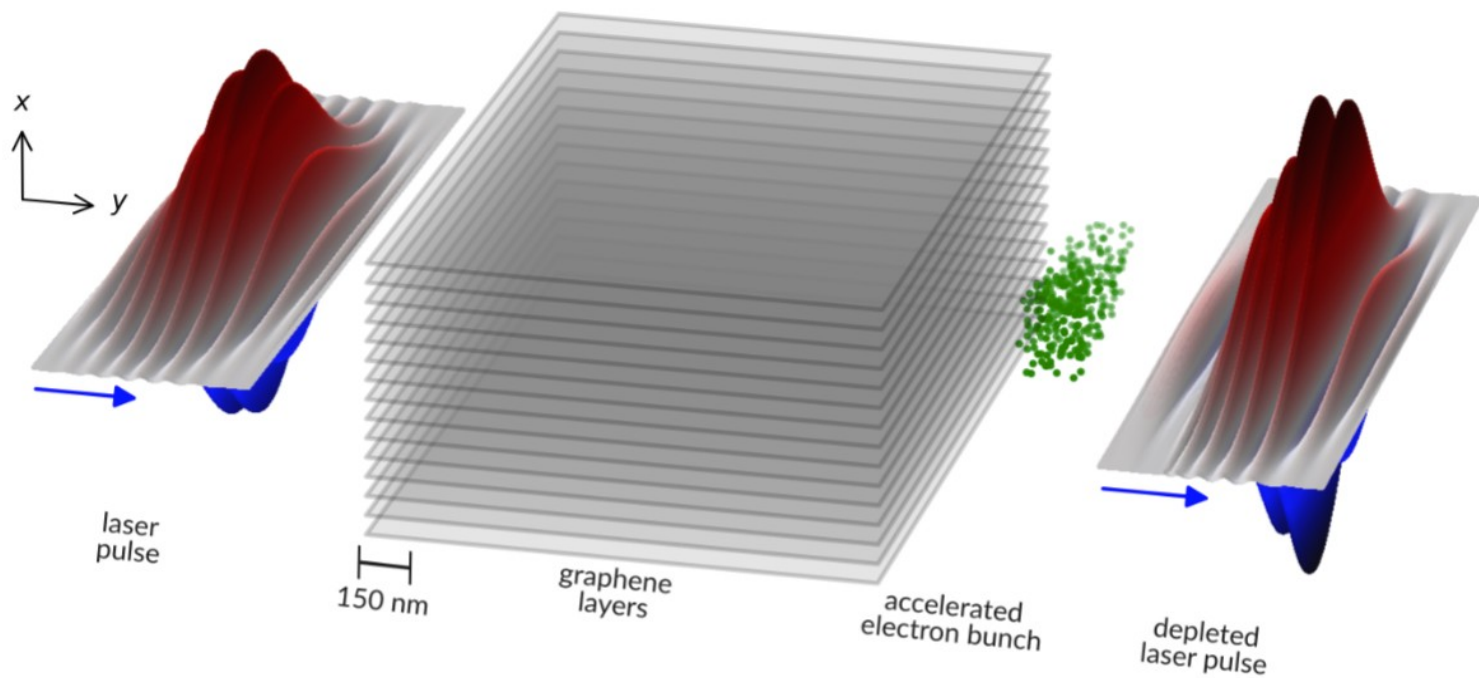
The Catapult Concept:
Self-Injection Through Edge Plasma Oscillation

Pros:

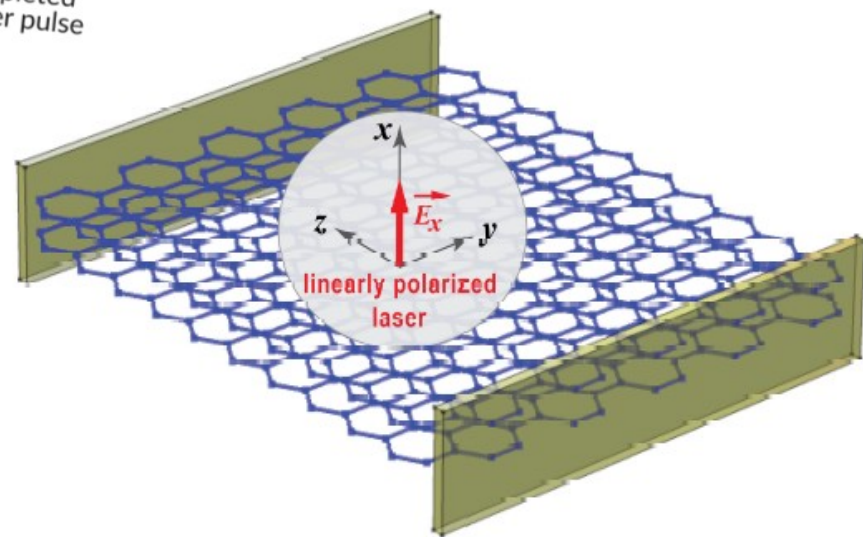
1. *Largest energy gain rate (TeV/m)*
2. *Fastest injection (fs)*
3. *Shortest bunch (<1 fs)*
4. *Smallest emittance (10^{-3} mm-mrad)*

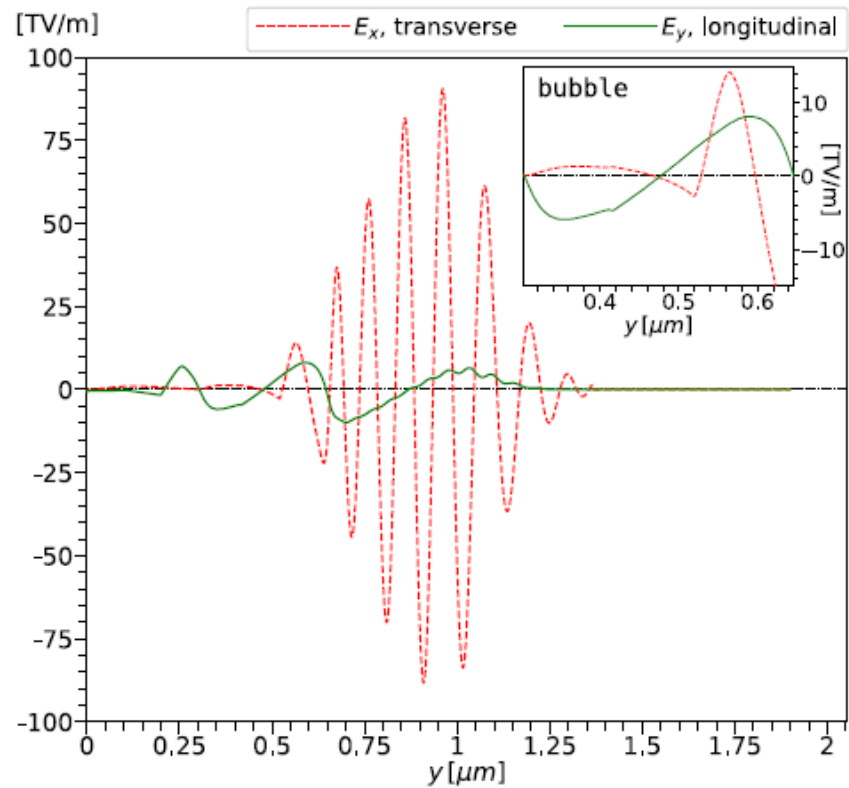
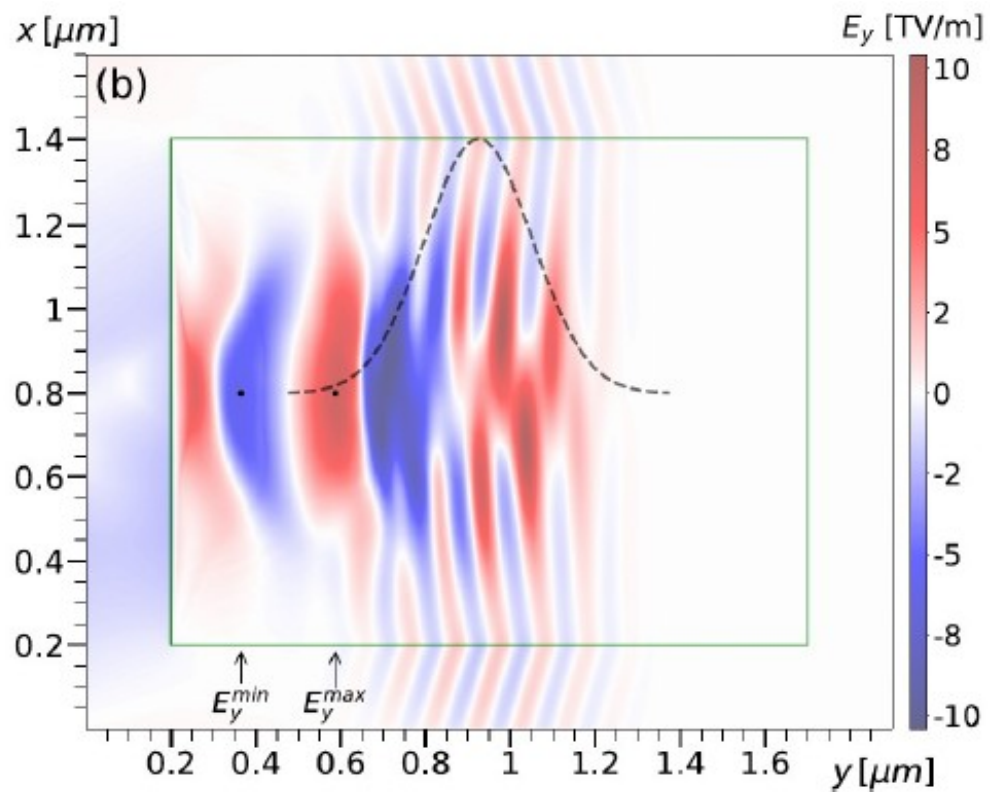
Cons:

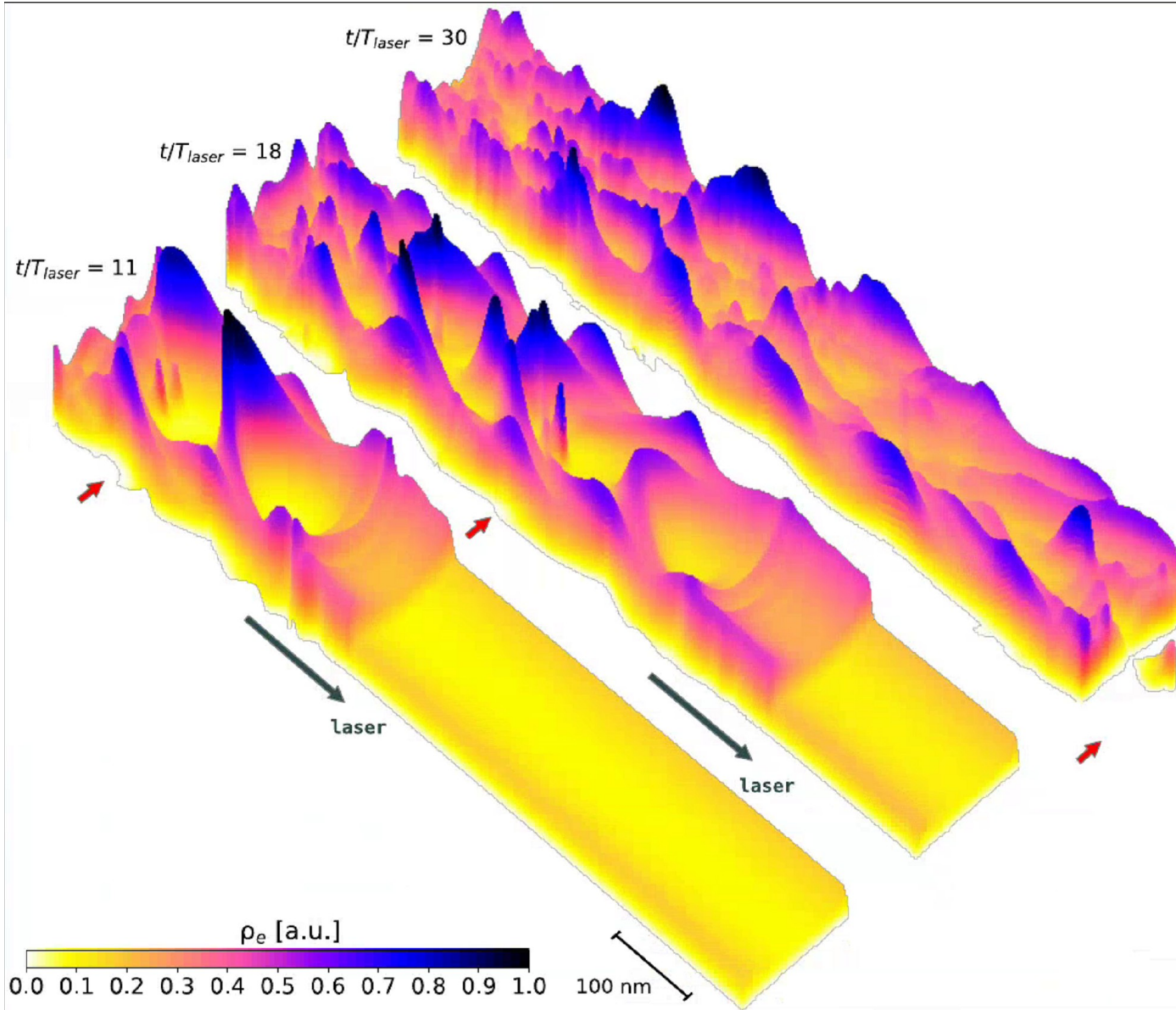
1. *Laser not available*
2. *Difficult to produce target*

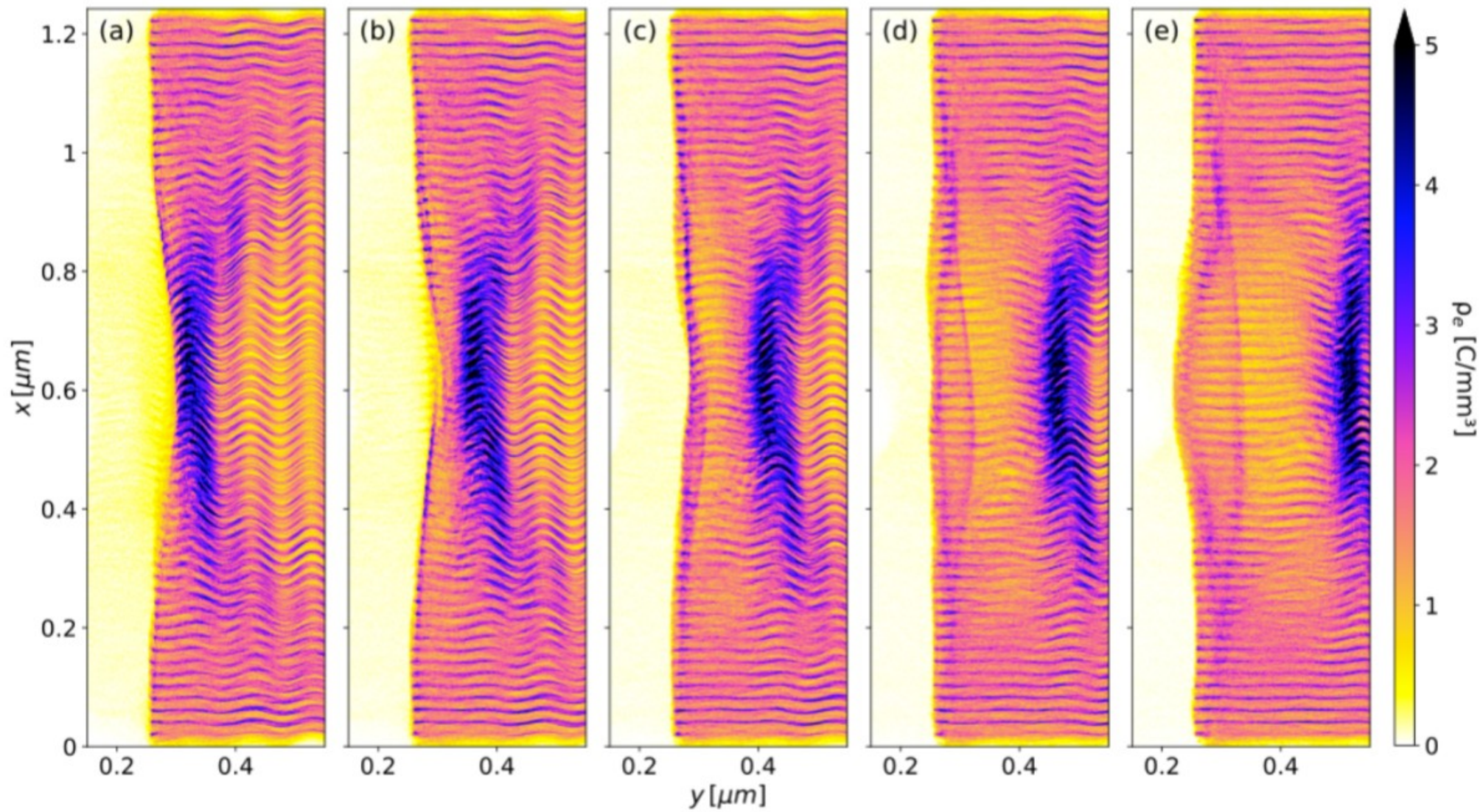


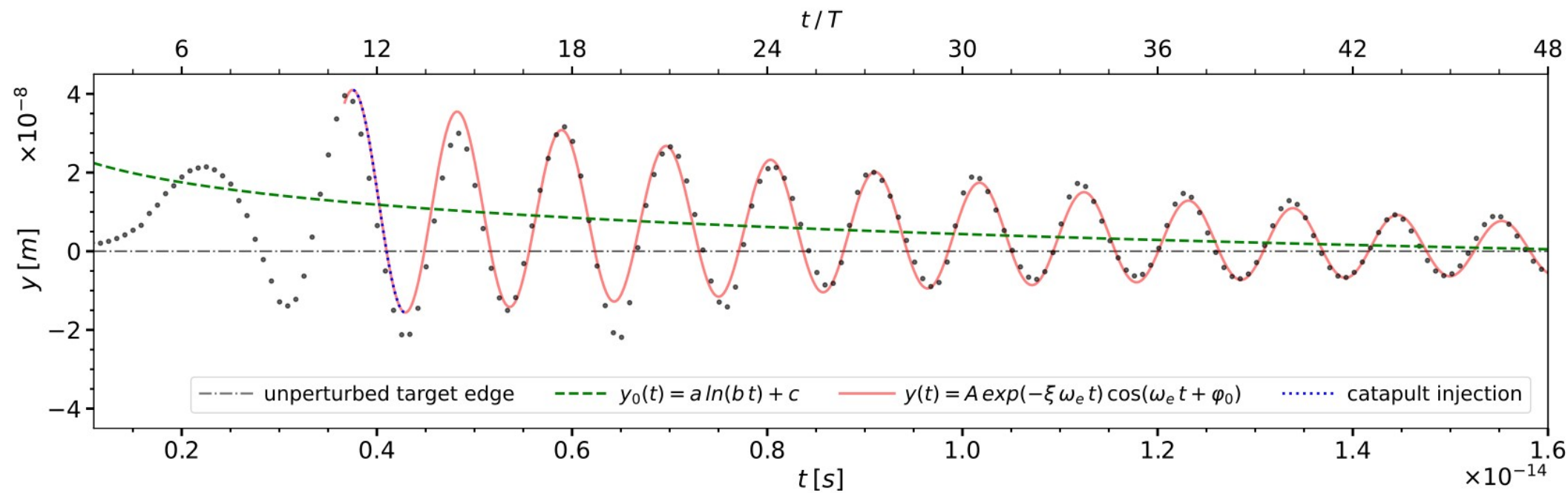
Quantity	Value	Unit
wavelength, λ	100	nm
period, T	0.334	fs
peak intensity, I_0	10^{21}	W/cm ²
spot size (FWHM), w_0	0.4	μm
focal point, y_f	0.25	μm
pulse energy, E	8	mJ
pulse length (9 cycles), Δt	3	fs
potential vector, a_0	2.7	-

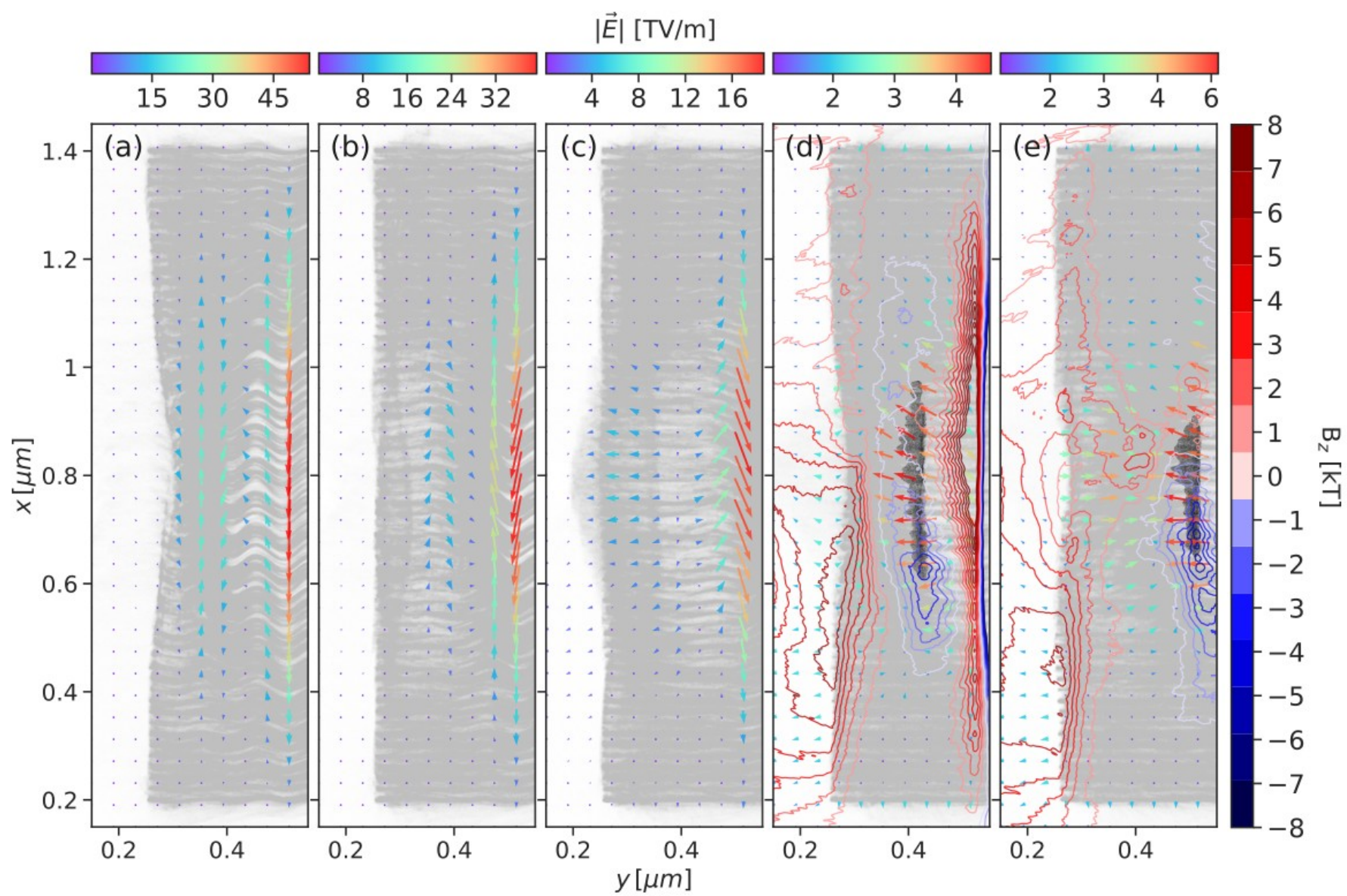


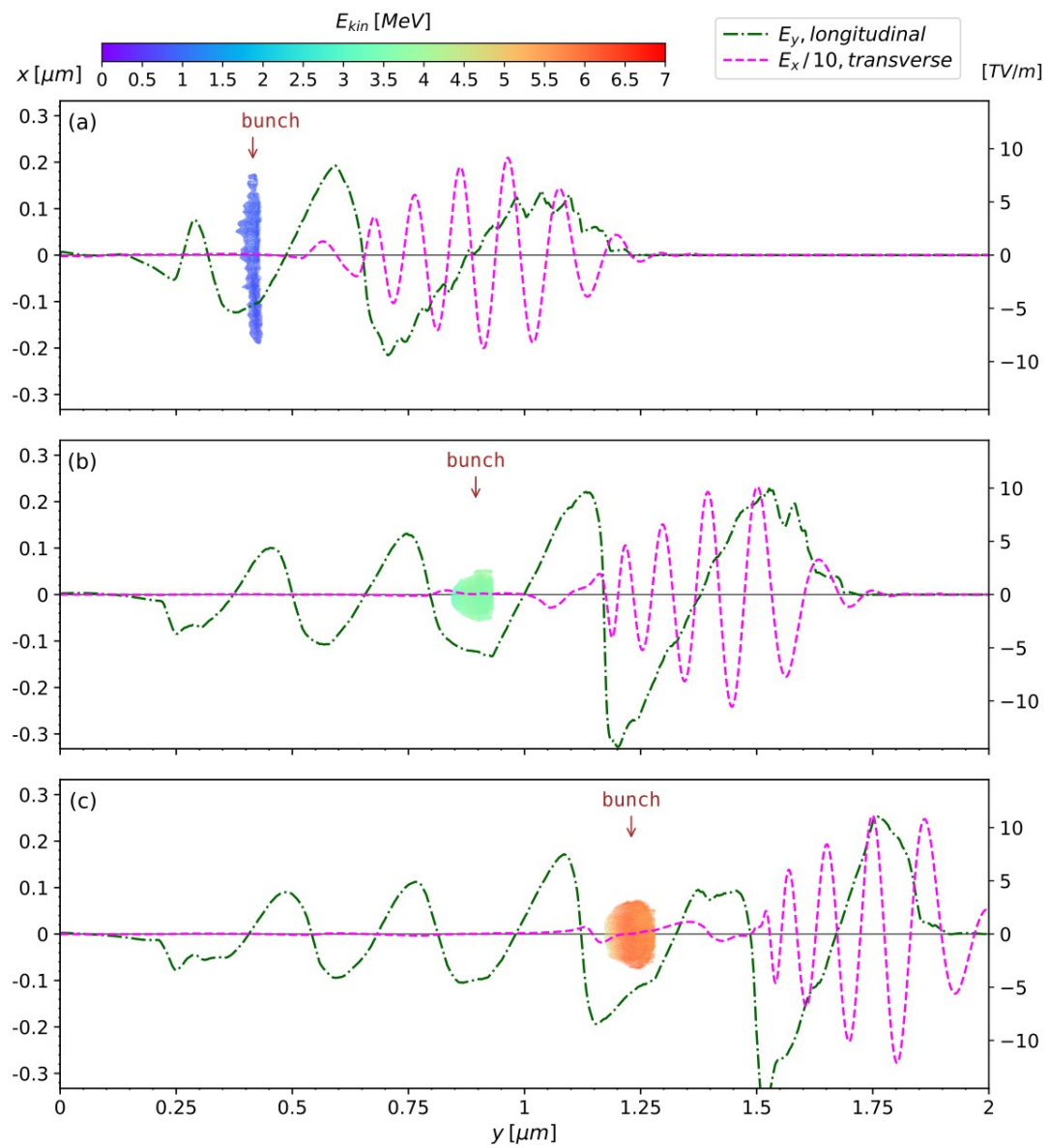




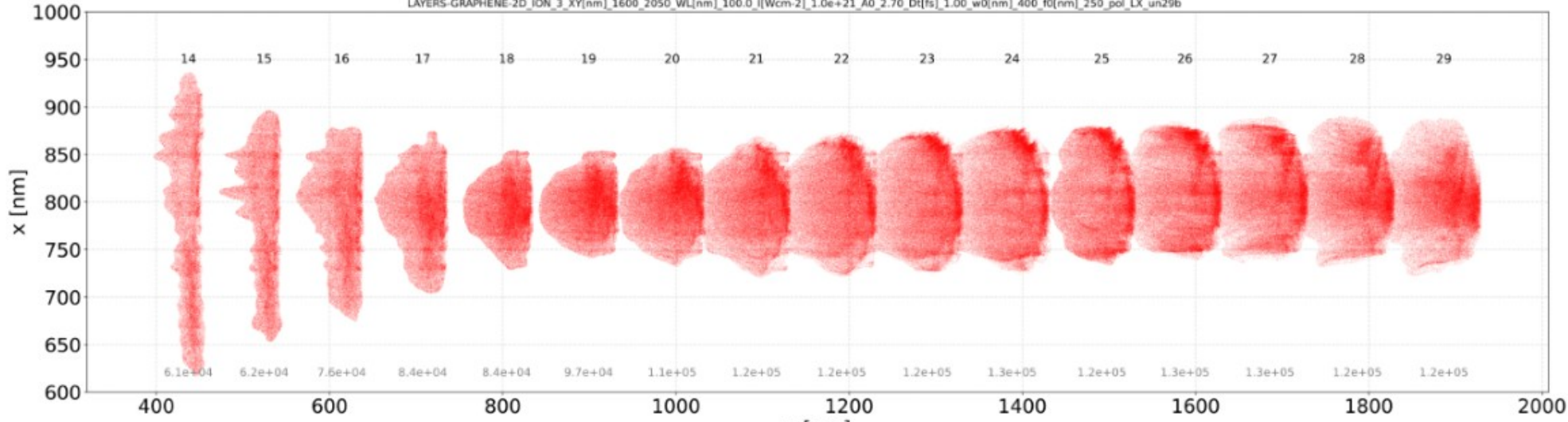




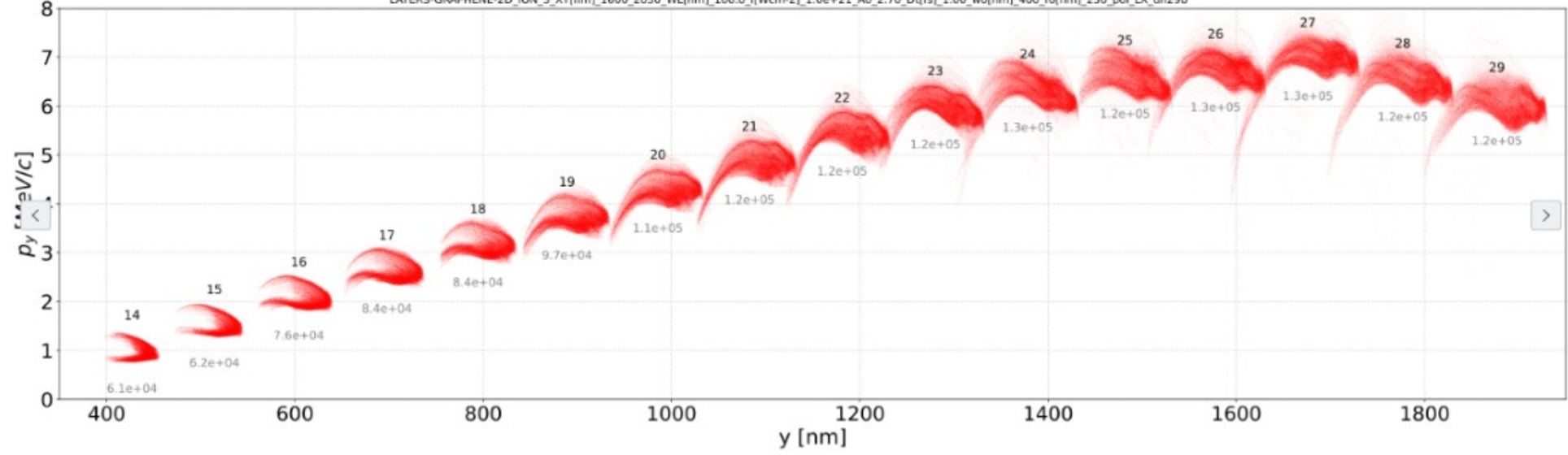


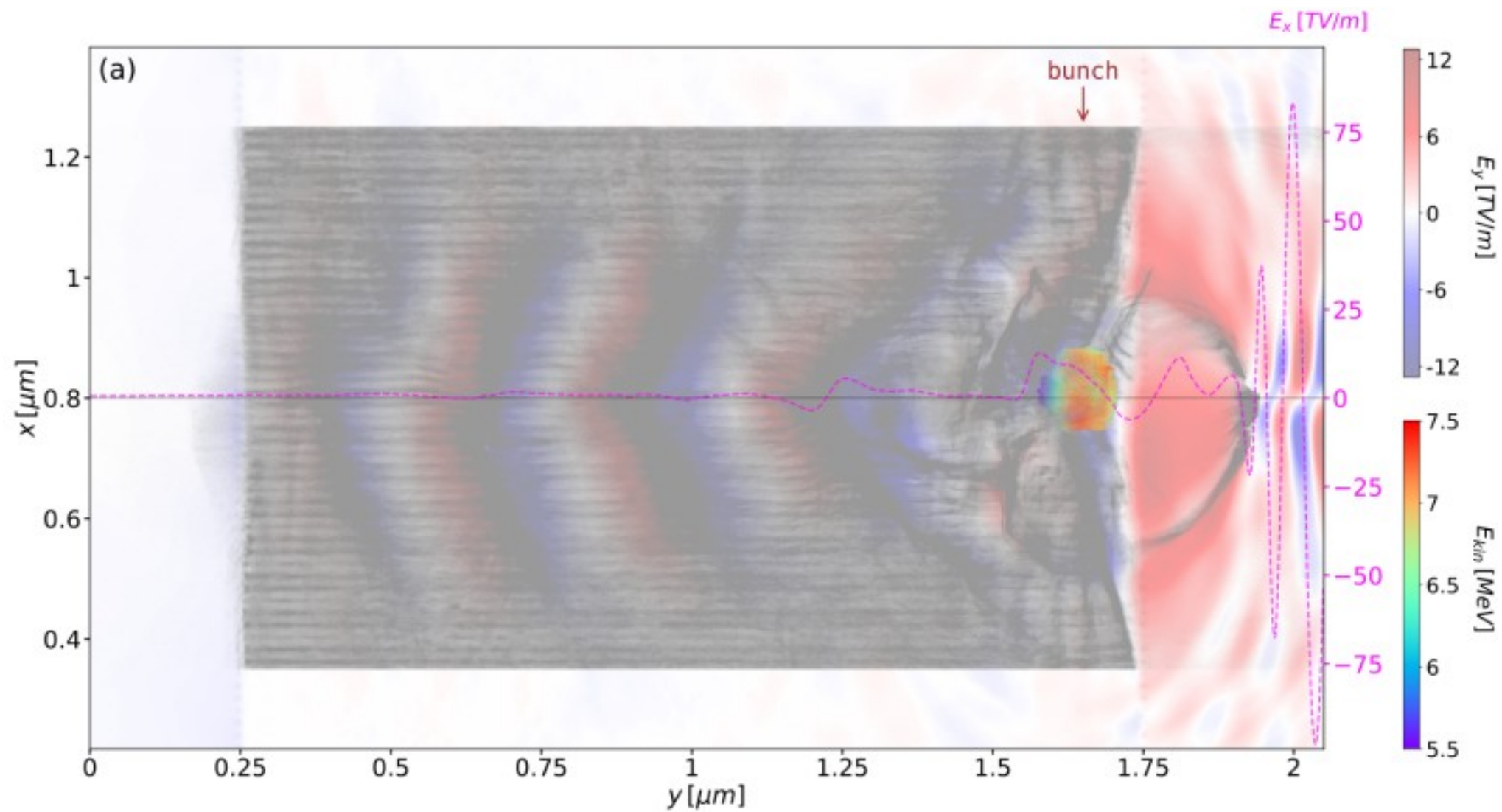


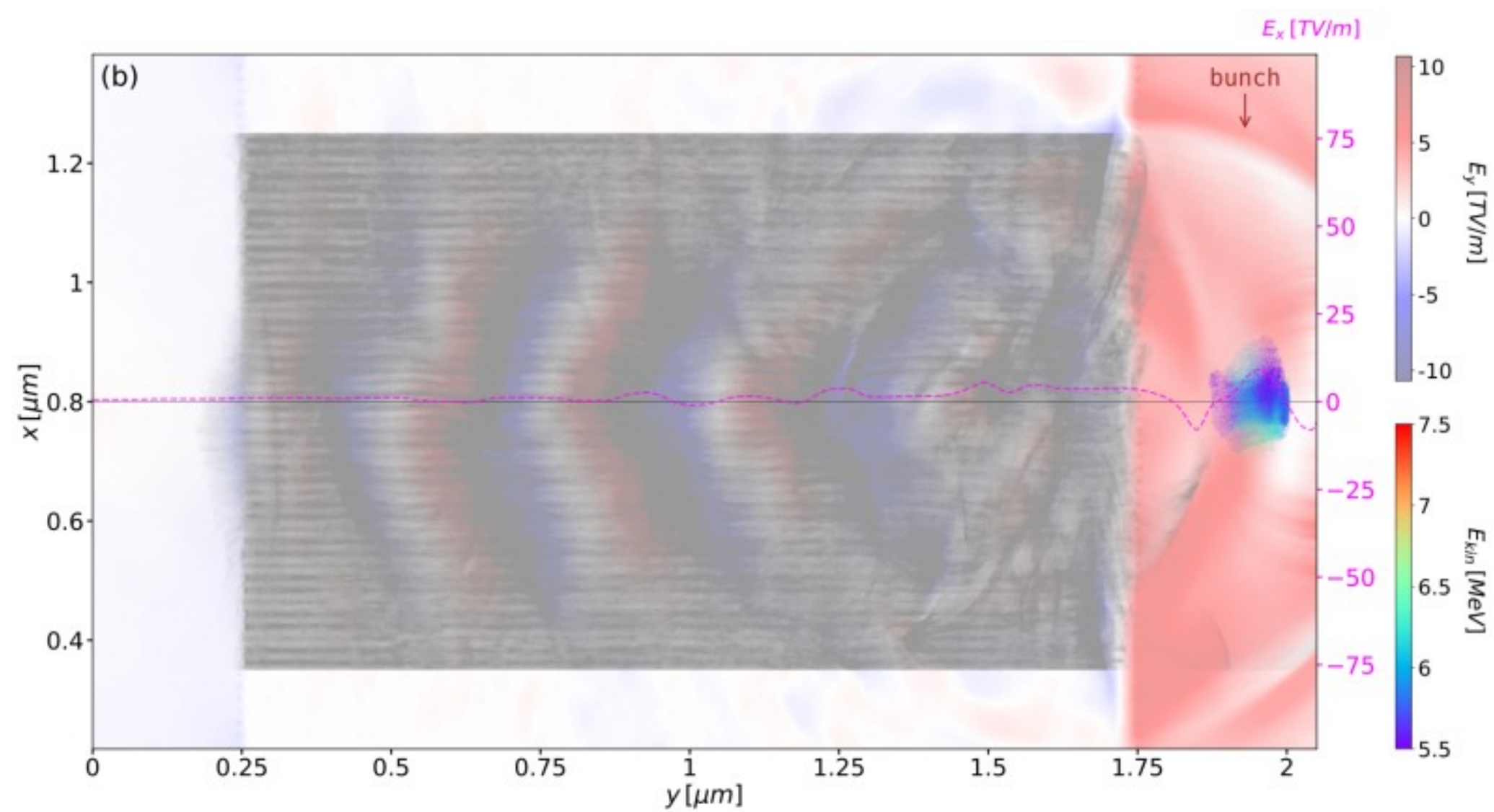
uniform 29b : $\lambda = 100 \text{ nm}$ | $I_0 = 1.0e+21 \text{ W/cm}^2$ | $a_0 = 2.70$ | $w_0 = 400 \text{ nm}$ | $f_0 = 250 \text{ nm}$ | mesh = 0.135 nm | $\Delta t = 3.00 \text{ fs}$ | PPC = 10 | weights = 0.03, 0.08
LAYERS-GRAPHENE-2D_ION_3_XY[nm]_1600_2050_WL[nm]_100.0_I[Wcm-2]_1.0e+21_A0_2.70_Dt[fs]_1.00_w0[nm]_400_f0[nm]_250_pol_LX_un29b

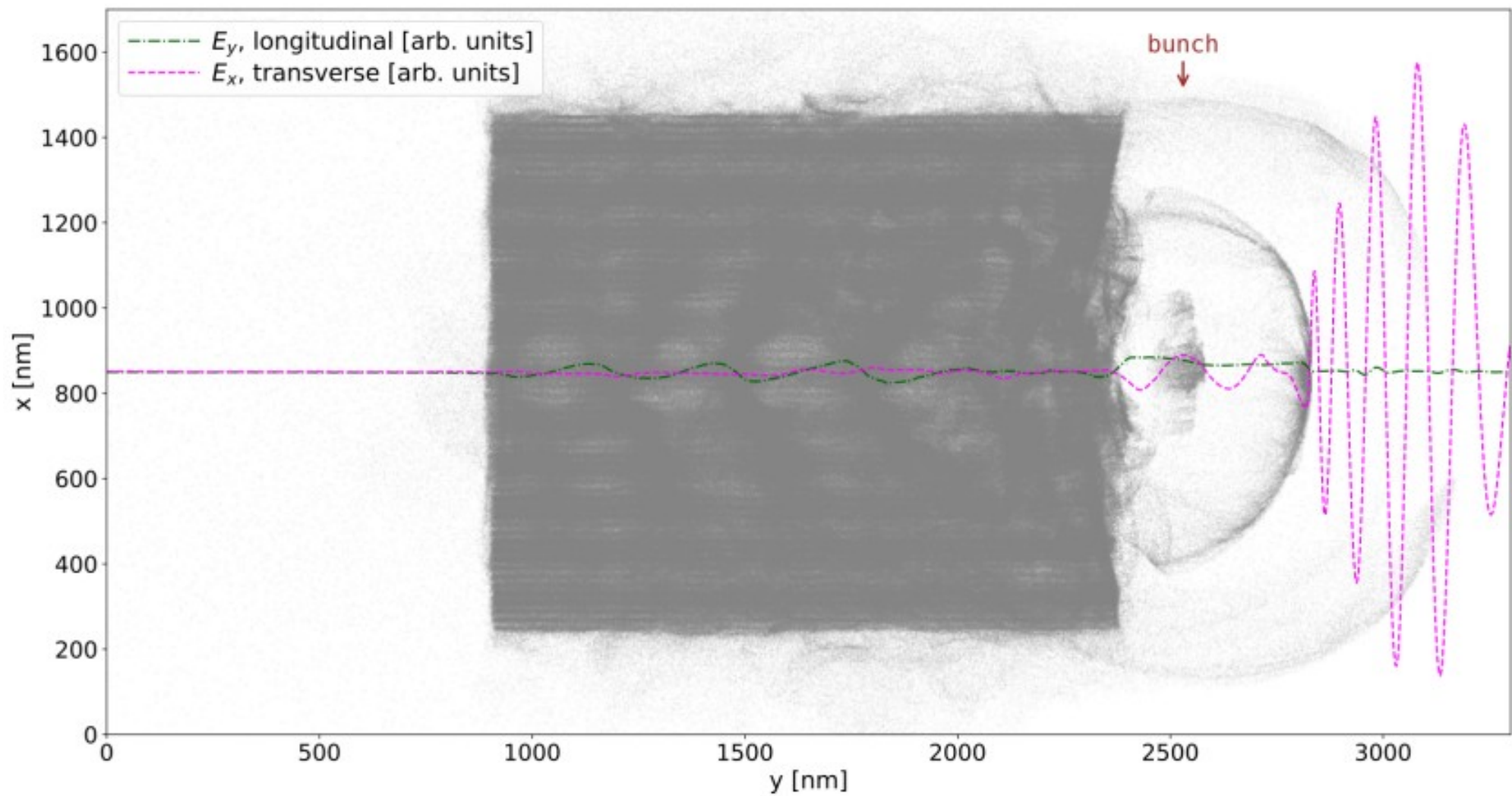


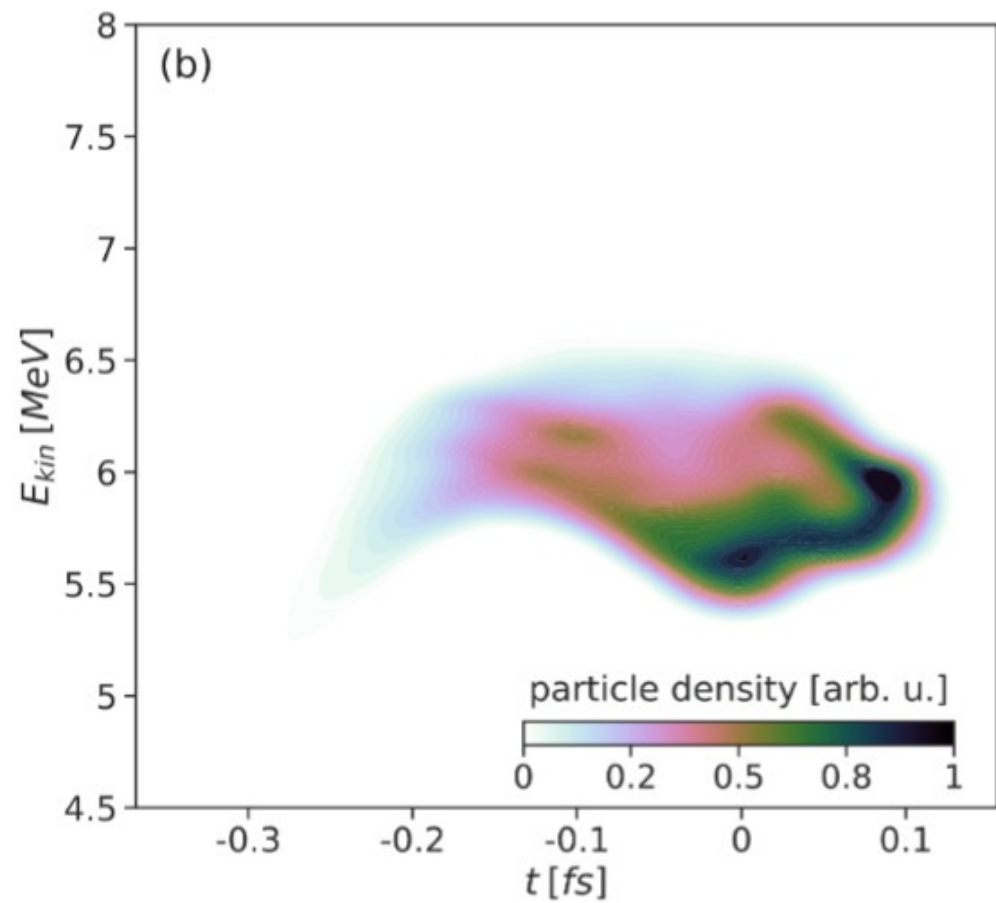
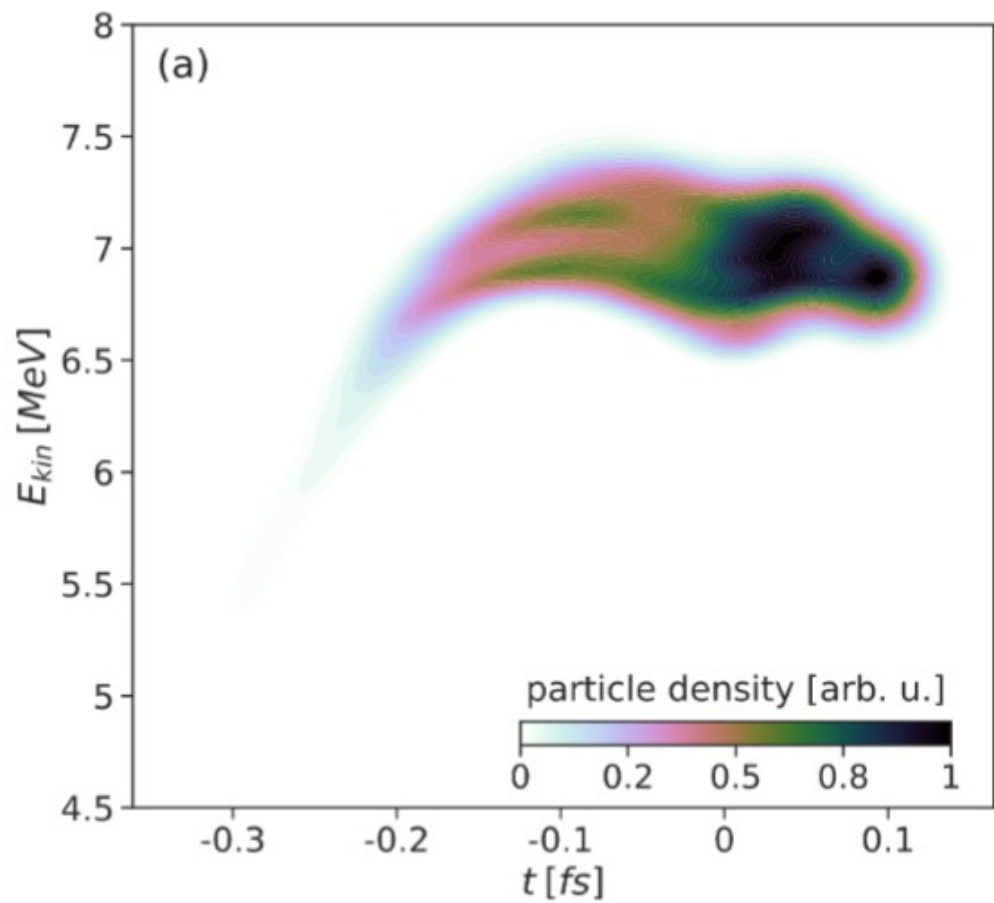
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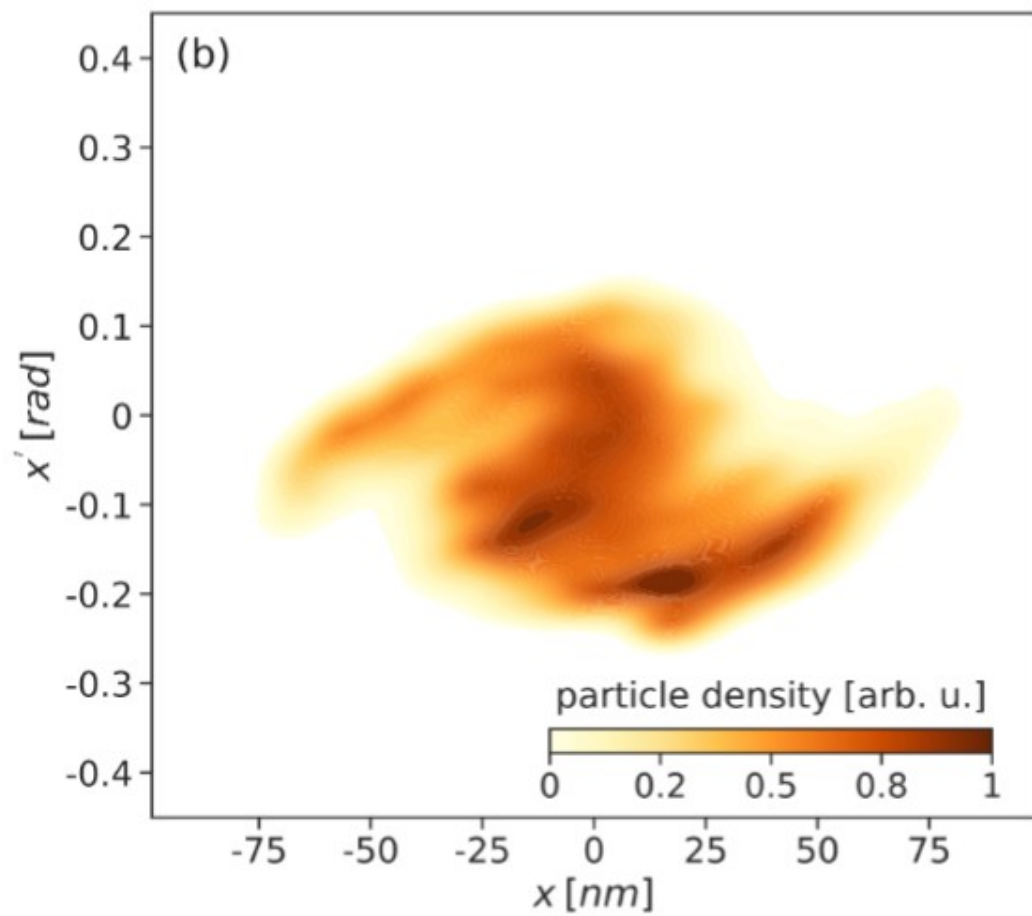
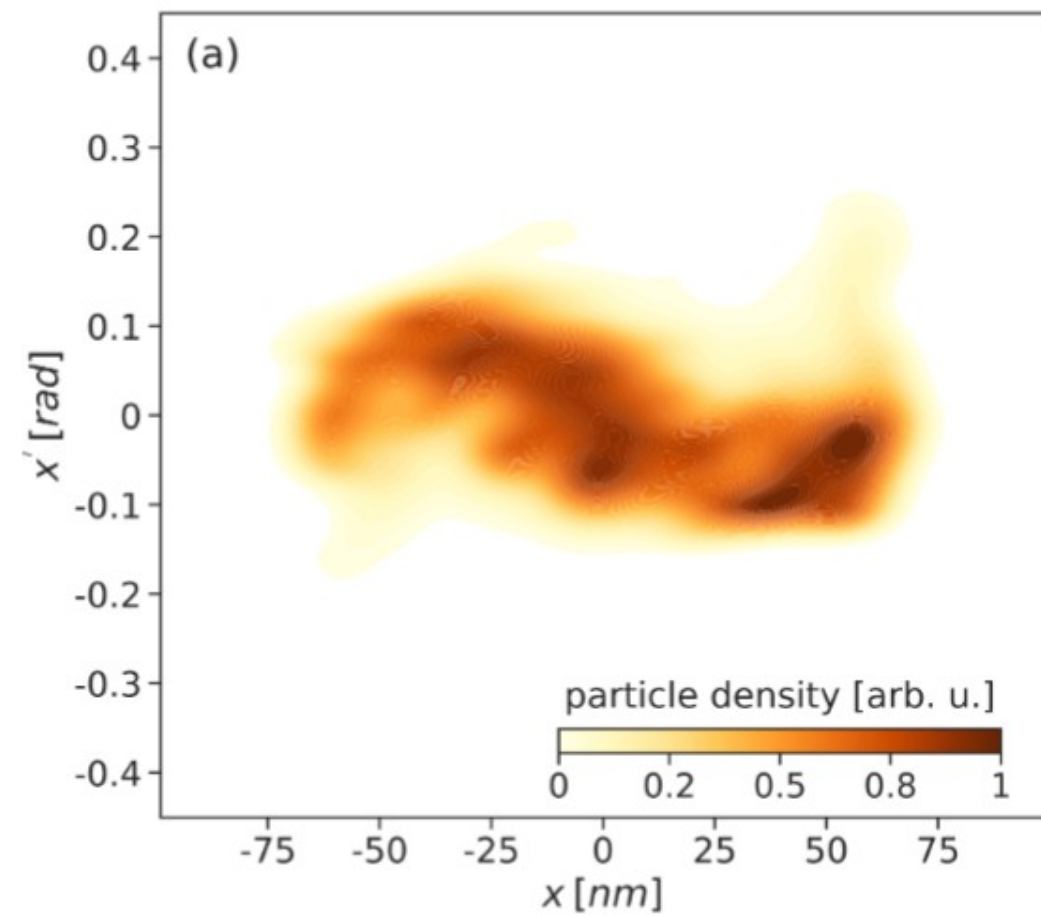


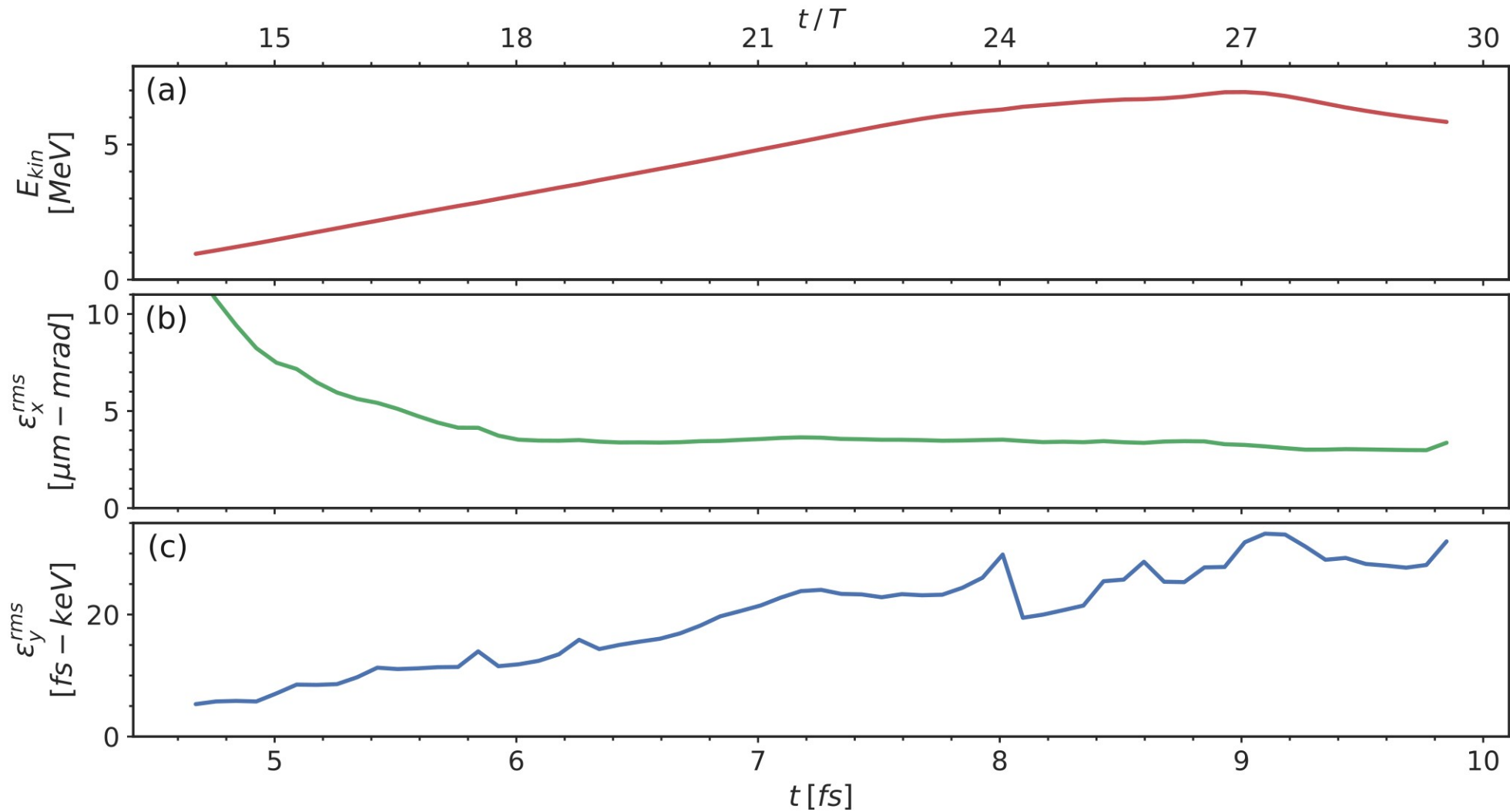












Quantity	Value at		Unit
	$t/T = 27$	$t/T = 30$	
Kinetic energy, E_{kin}	6.94	5.77	MeV
Energy spread (FWHM), ΔE	7.40	12.29	%
Longitudinal rms emittance (unnormalized), ε_y	31.85	31.75	fs-keV
Transverse rms emittance (unnormalized), ε_x	3.25×10^{-3}	3.11×10^{-3}	mm-mrad
Total charge (3D equivalent), q	2.55		pC
Transverse size (FWHM), Δx	103	65	nm
Transverse divergence (FWHM), $\Delta x'$	220	317	mrad
Longitudinal duration (FWHM), Δt	0.208	0.209	fs
Relativistic velocity factor, β	0.998	0.996	-
Relativistic Lorentz factor, γ	14.580	12.287	-