实验物理中心2023年（1-4月）研究生考核报告

汇报人：司梅雨

导师：阮曼奇/黄永盛

目录

- Microwave-electron Compton backscattering;

[1] Si, M., Huang, Y., Chen, S., Wang, P., Duan, Z., Lan, X., ... & Zhang, J. (2022). High energy beam energy measurement with microwave–electron Compton backscattering. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, *1026*, 166216.

[2] Si, M., Chen, S., Huang, Y., Ruan, M., Tang, G., Lan, X., ... & Lou, X. (2022). The linear and nonlinear inverse Compton scattering between microwaves and electrons in a resonant cavity. *The European Physical Journal D*, *76*(4), 1-8.

- Positron acceleration;

[1] Coherent Transition Radiation (CTR);

[2] An ultra-intense infrared radiation field generated by a relativistic electron beam in a micro-tube;

According to the Lorentz back-transformation of coordinates, the **relativistic Poisson's equation** in the laboratory frame can be written as

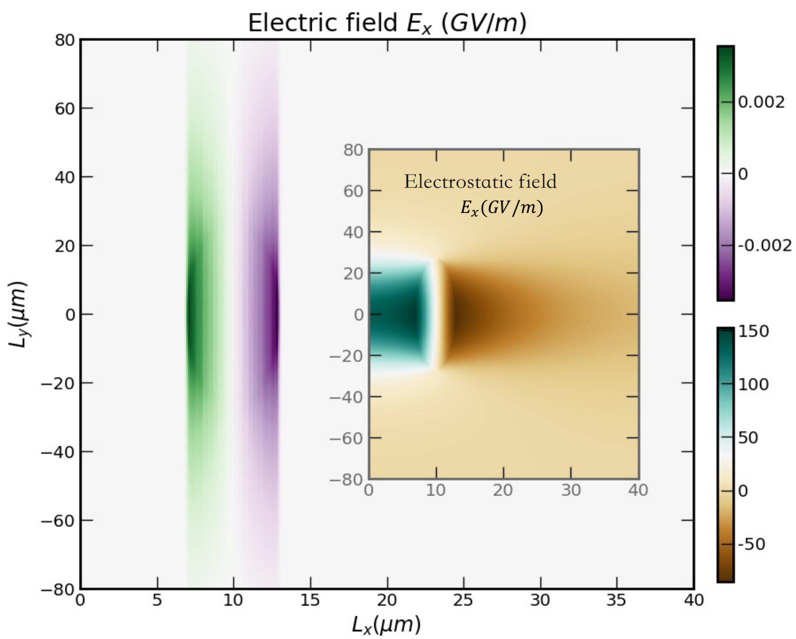
$$[\frac{1}{\gamma_0^2}\frac{\partial^2}{\partial^2_{x^2}} + \frac{\partial^2}{\partial^2_{y^2}} + \frac{\partial^2}{\partial^2_{z^2}}]\Phi = -\rho_b.$$

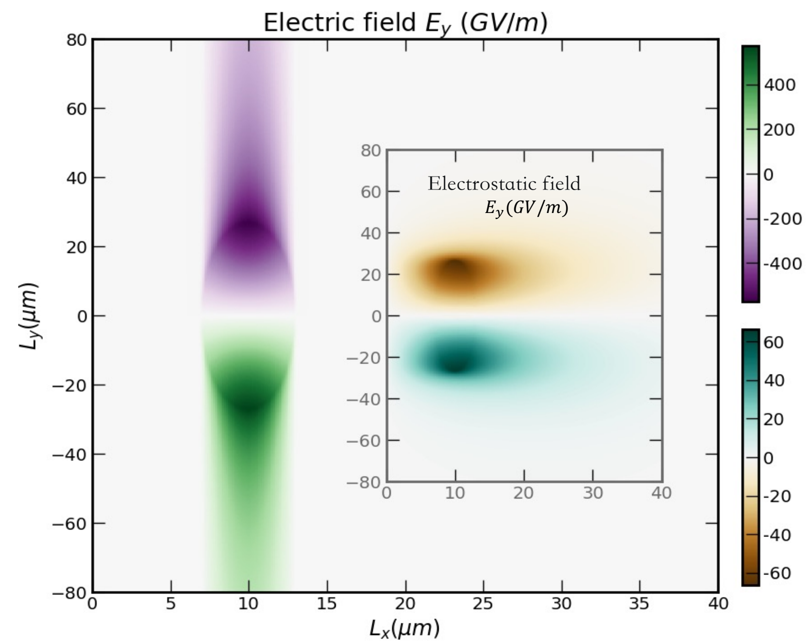
Initial current: $J(x, t = 0) = \beta_0 \rho_b \neq 0$

$$E_x = -\frac{1}{\gamma_0^2}\partial_x \Phi;$$

$$\sim \frac{1}{\gamma_0^2}(10^6)$$

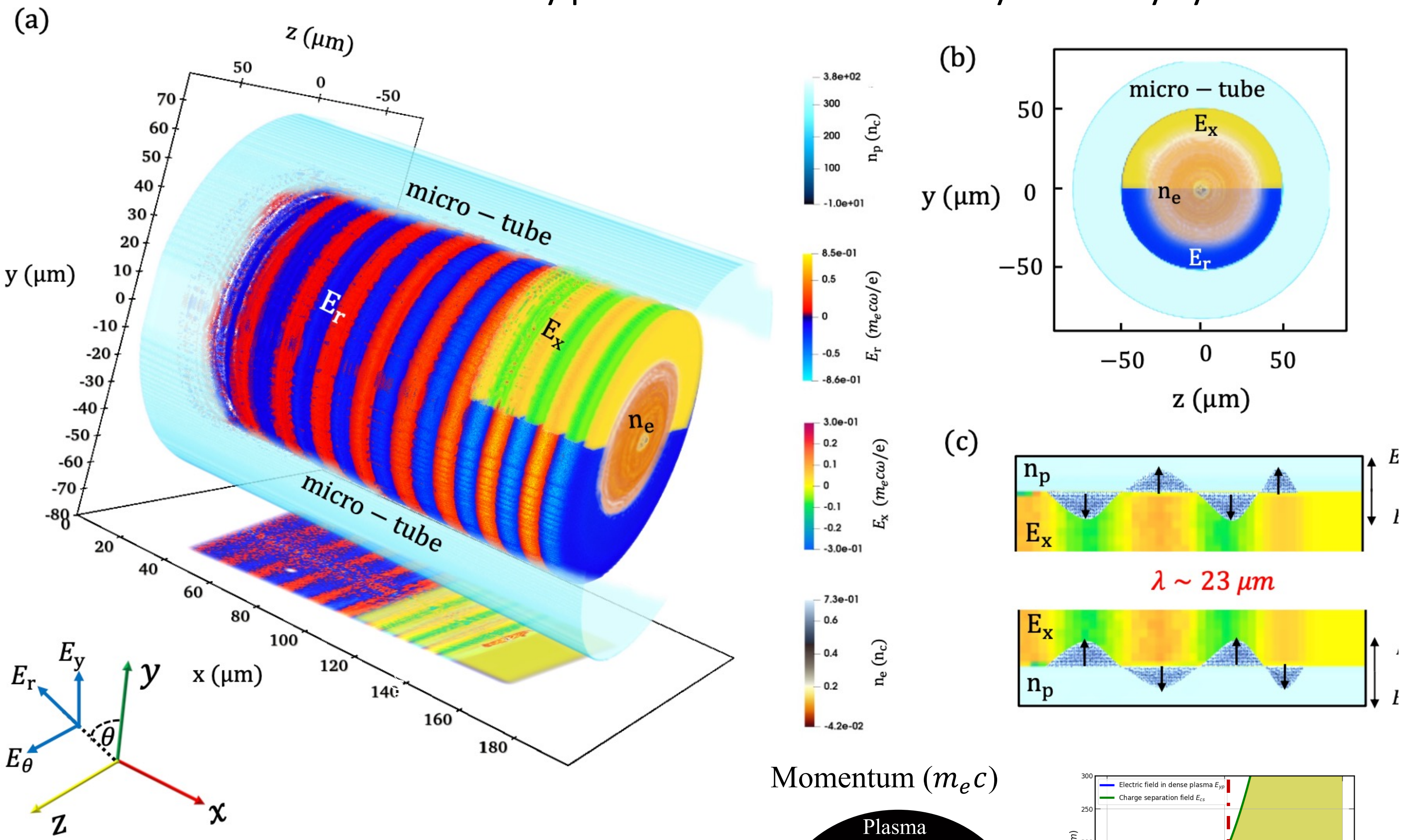
$$E_y = -\partial_y \Phi.$$

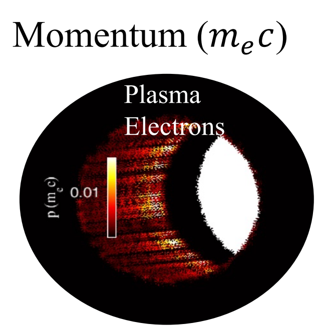


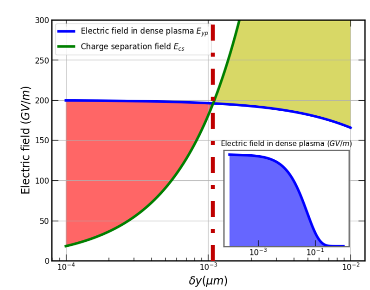


Cylindrical coordinates PIC simulation

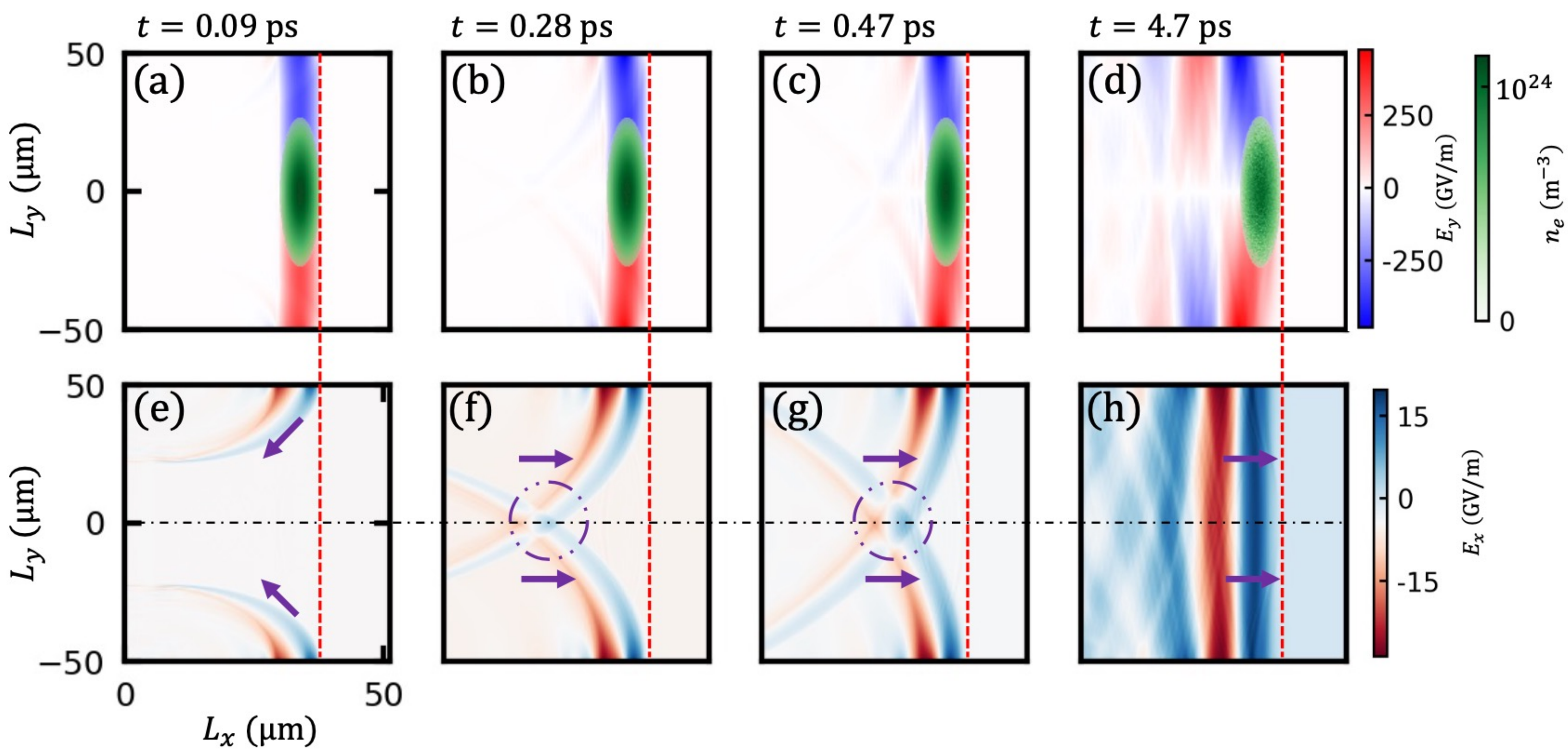
The radiation fields are radially polarized and the field is cylindrically symmetric.



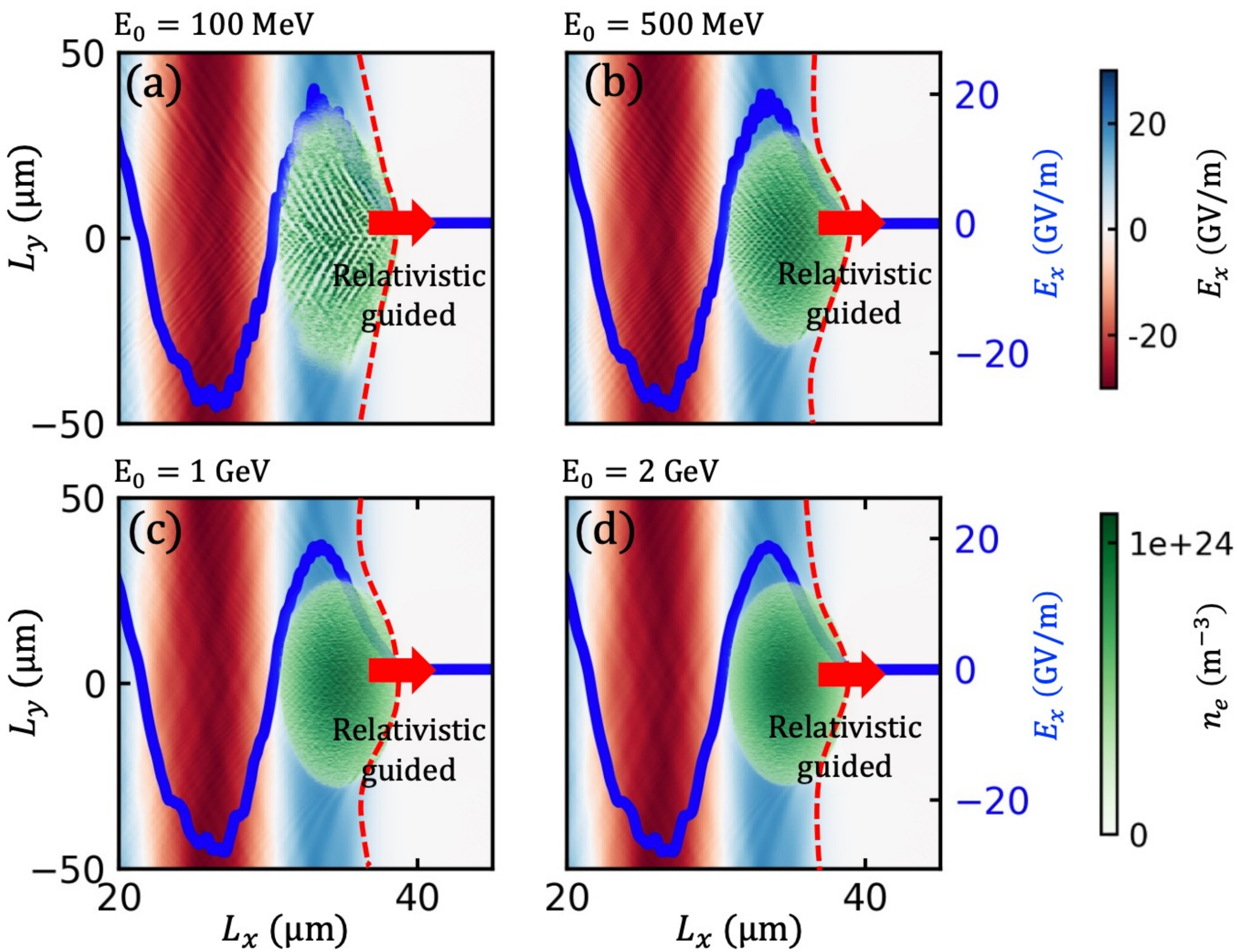




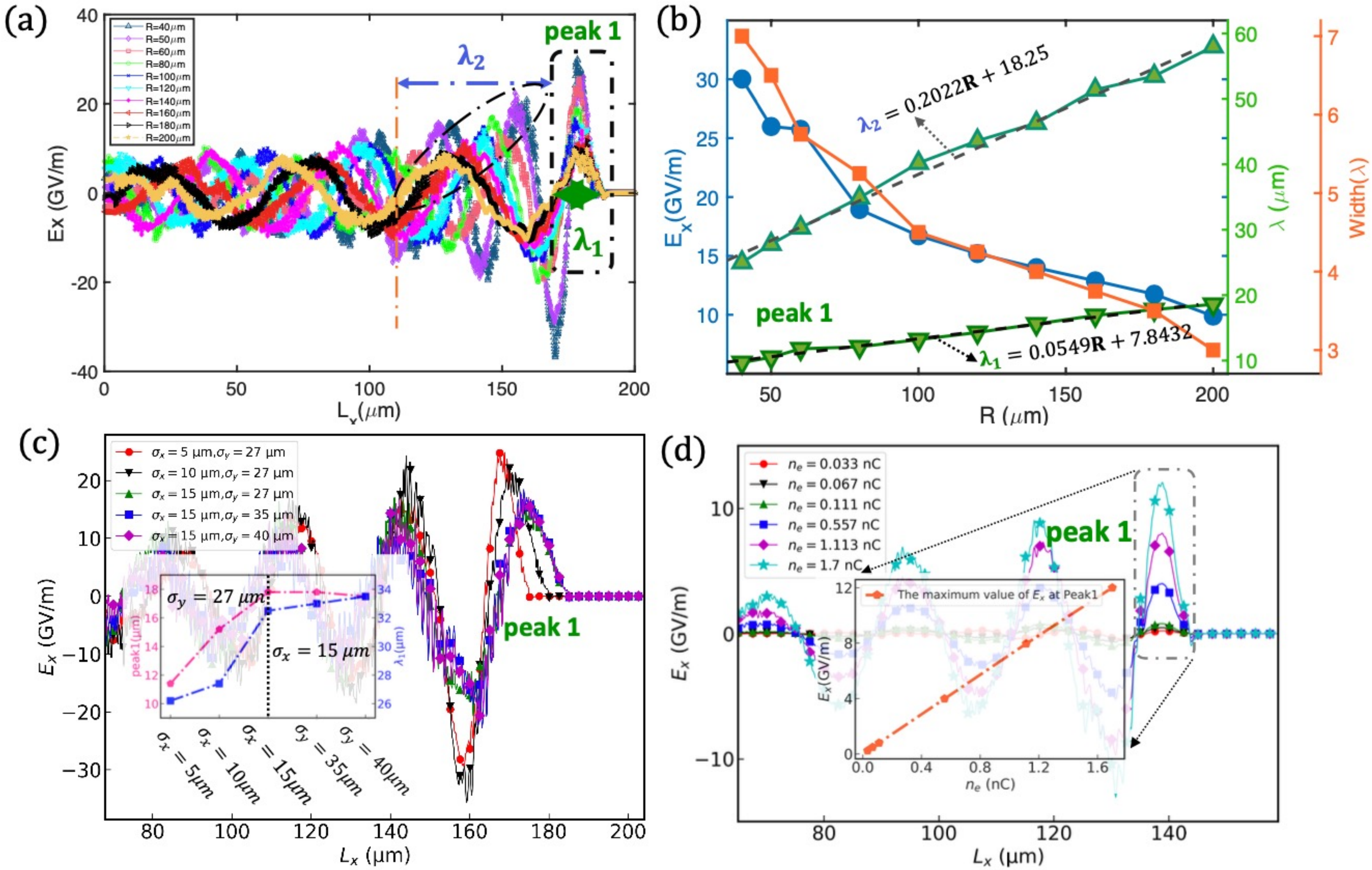
Radiation field stable-mode generation and relativistic-guided by a e– beam



Radiation field stable-mode generation and relativistic-guided by a e- beam

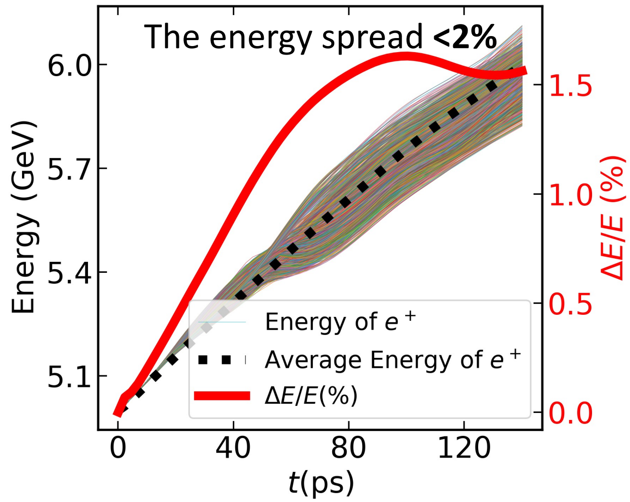


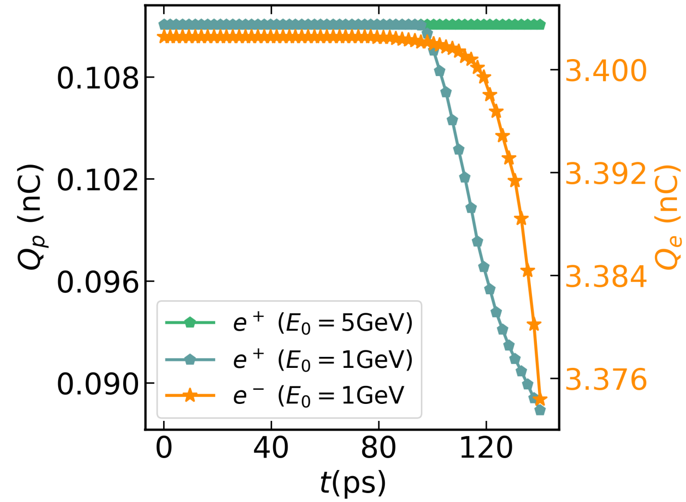
A tunable wavelength and intensity of the radiation field



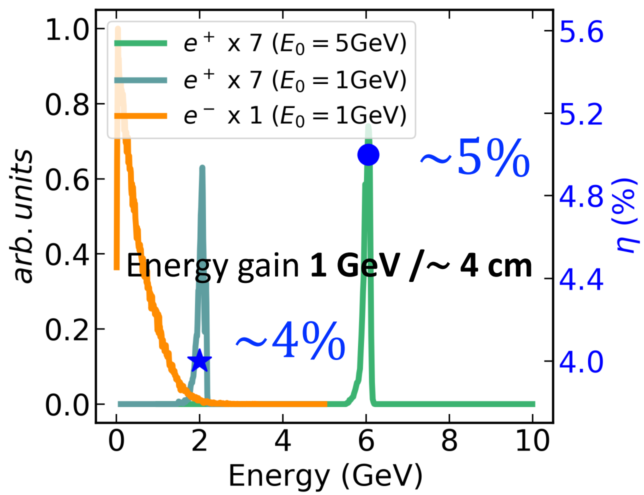
The simulation results of e^+ acceleration in a micro-tube.

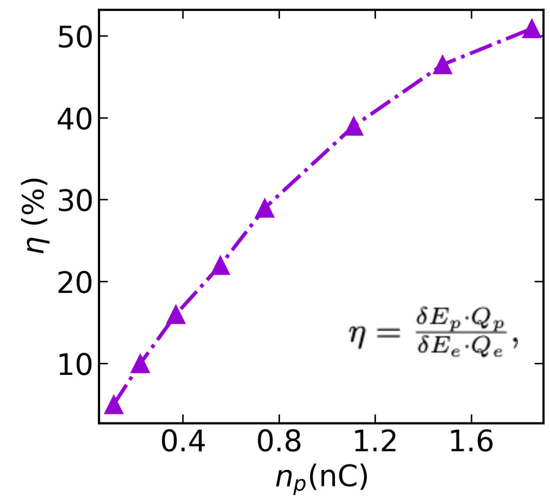
The driving electron bunch is 1 GeV, with a 3.402 nC beam charge.



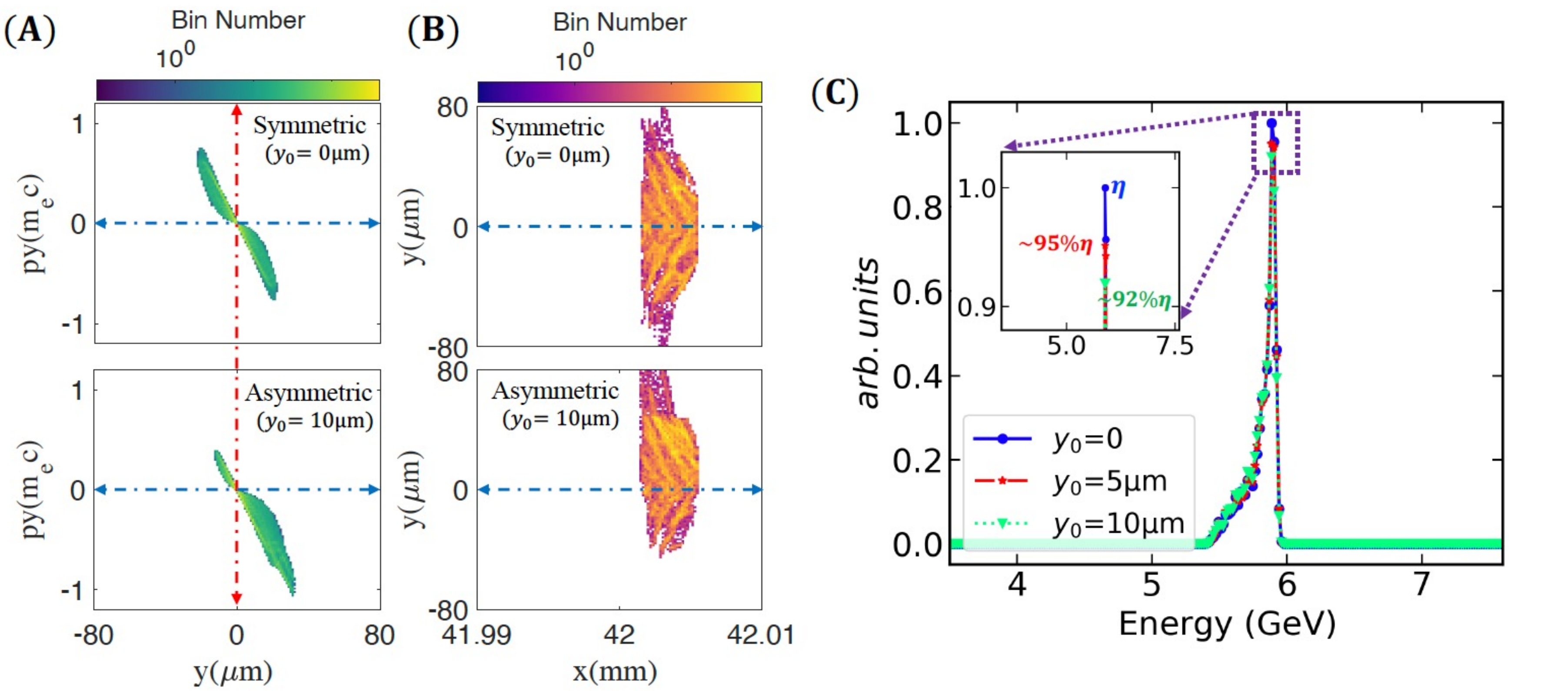


The witness positron bunch has an initial energy of 5 GeV or 1 GeV and a beam charge of 0.111 nC.



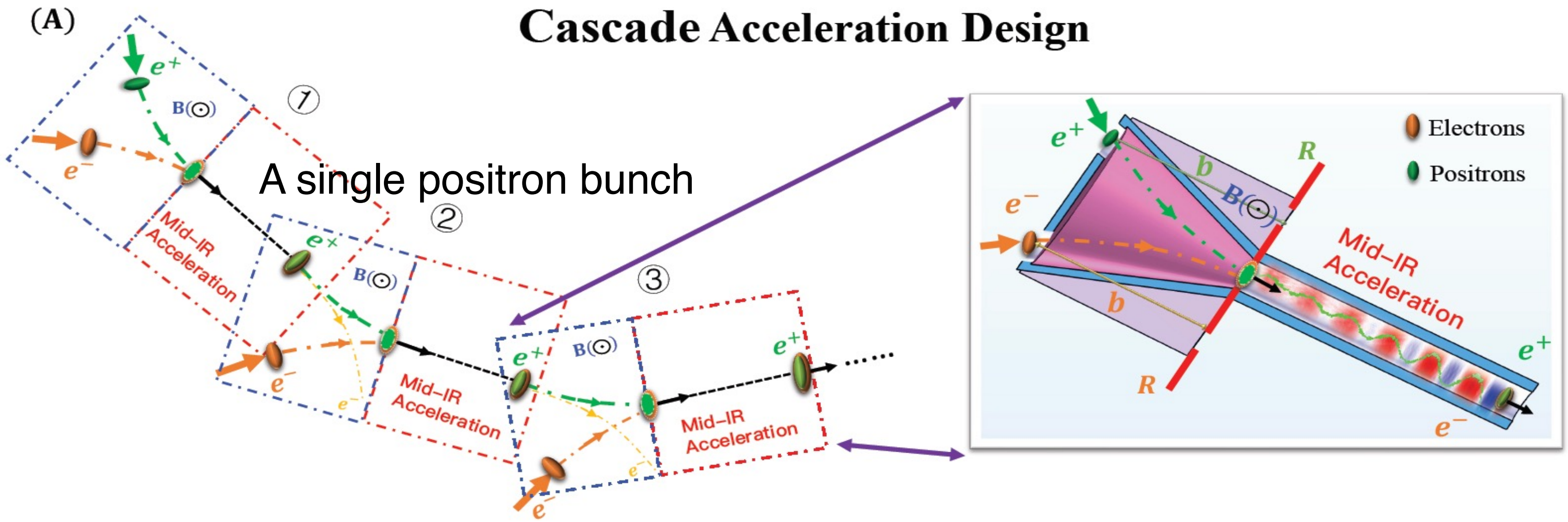


Analysis of transverse off-axis injection of positron bunch

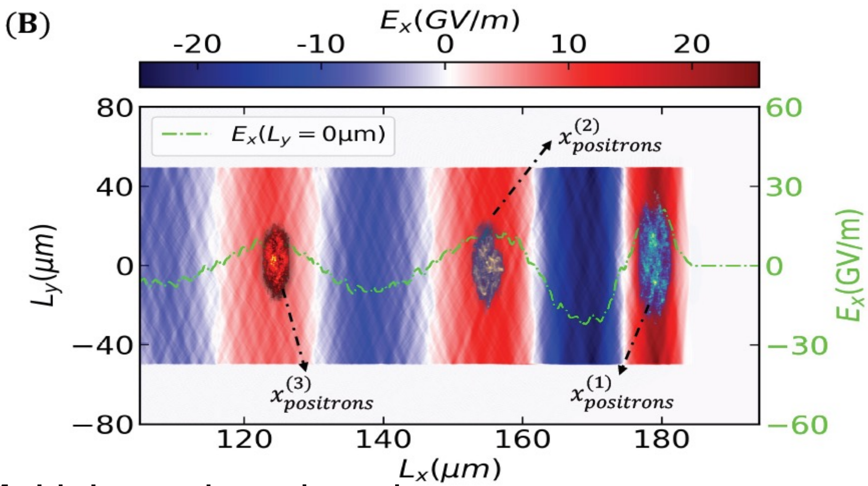


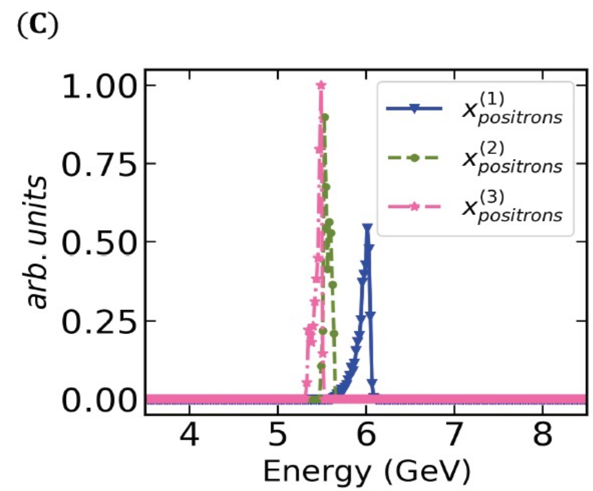
The symmetric and asymmetric phase-space/density distribution of positron bunch.

Cascade Acceleration Design

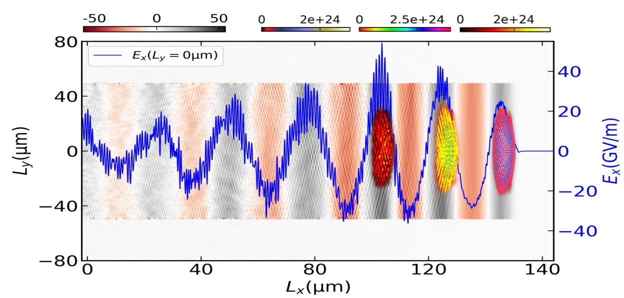


A single positron bunch





Multiple positron bunches



总结与展望

1. The acceleration of positrons from initial 1 GeV to 126.8 GeV with a charge of ~10 pC over a distance of 1 m. The energy spread of accelerated po[…]rons is 2.2%.

Positron acceleration by terahertz wave and electron beam in p[…]el

Zhangli Xu[1], Baifei Shen[1,*], Meiyu Si[2,3], Yongshe[…]

CTR

2. The simulation results show that the 30 MeV positron bunch accelerates to a maximum cutoff energy of 2.3 GeV in 700ps with the driving electron beam energy of 1GeV.

3. Study on the mechanism of relativistic electron beam […]ng radiation field.

Relativistic electron beam

4. High efficiency stable positron acceleratio[…]tra-intense few-cycle mid-IR field generated by a relativistic elec[…] in a micro-tube. The positron bunch is accelerated from an ini[…]verage energy of 5 GeV to 6 GeV within 140 ps; the relative energy spread of the positron bunch was 1.56%.

Thanks for your attention！