



UPPSALA  
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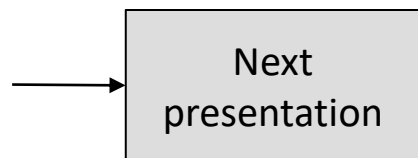
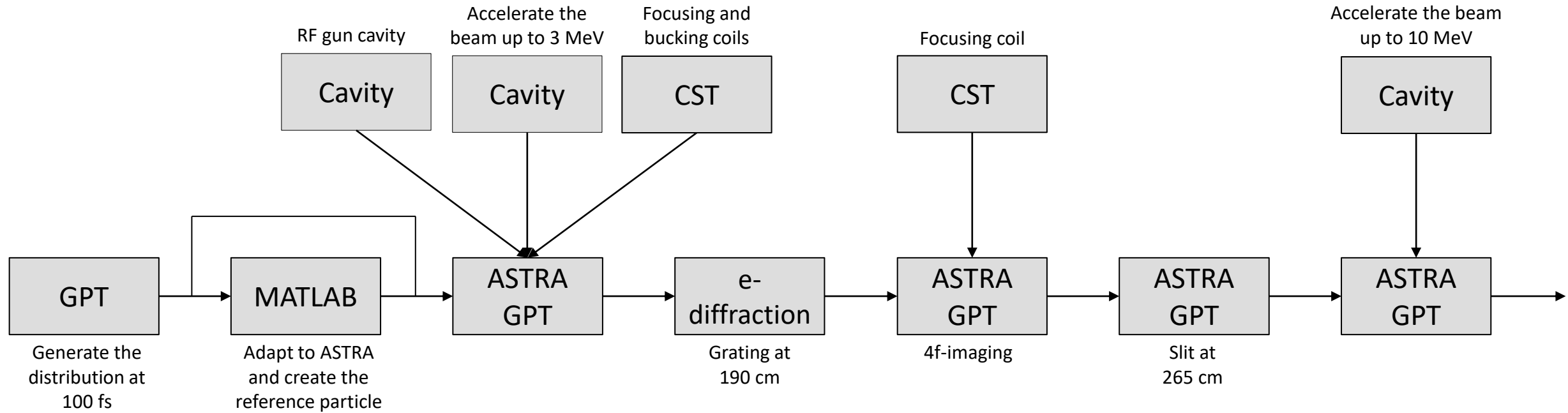
# SAC meeting on Ångström FEL

## Beam dynamics

09 November 2020

Kévin Pepitone – Zoltán Tibai





Emittance exchange





# Layout and fields



# Layout

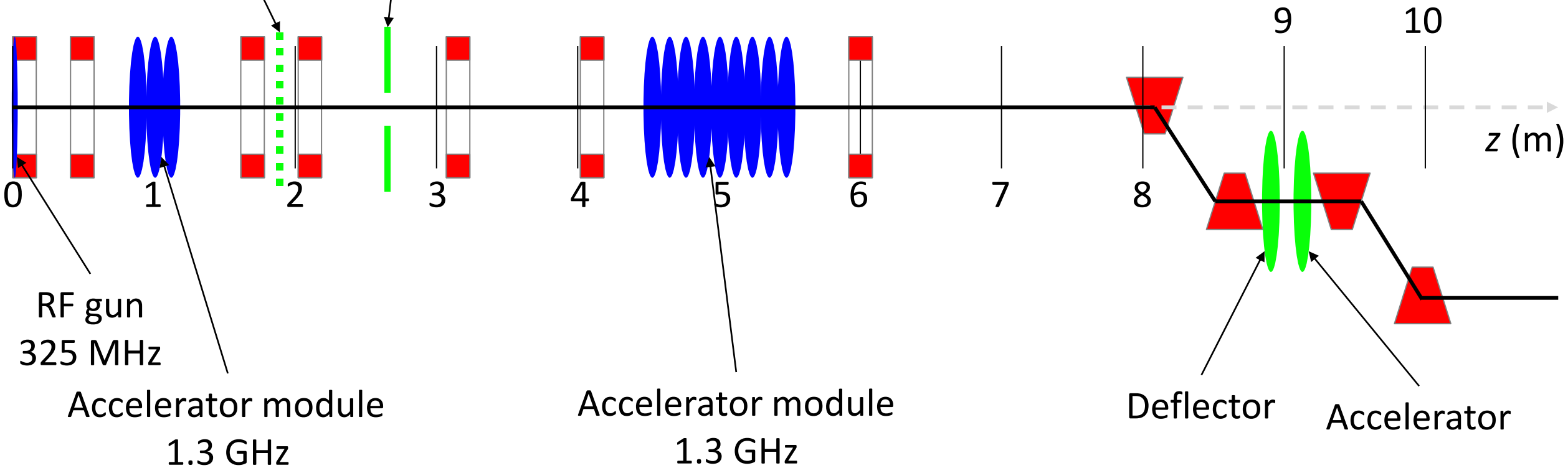


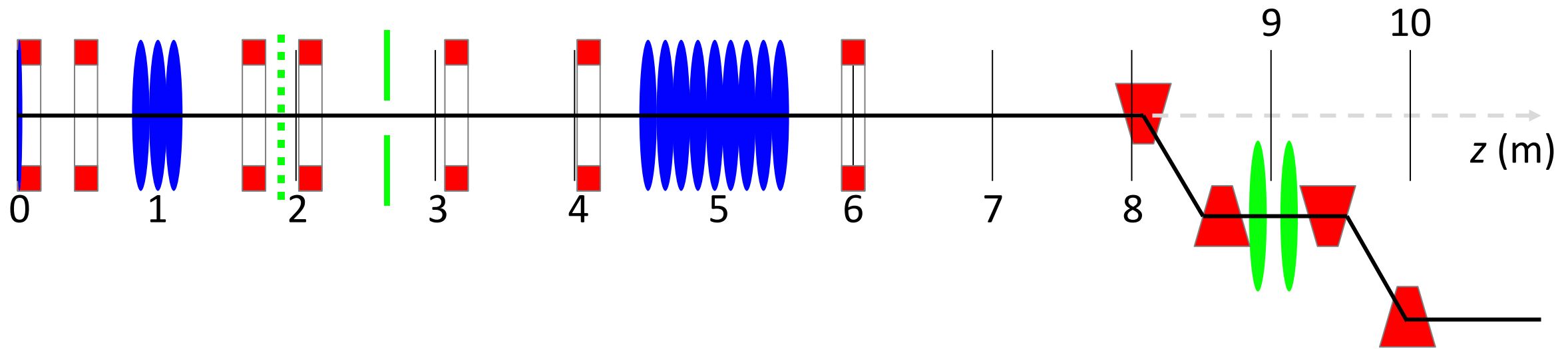
 Dipole

 Solenoid

Grating

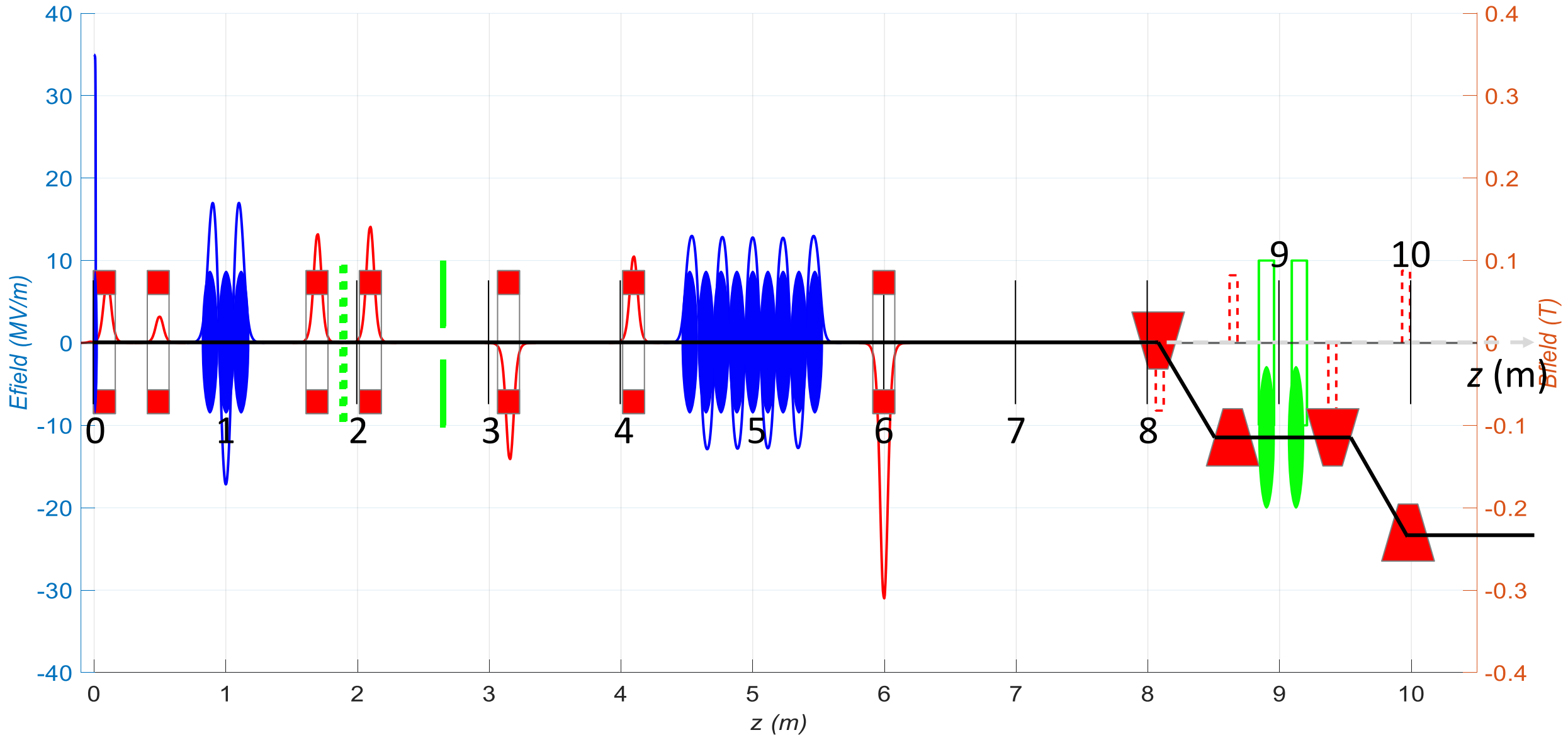
Slit

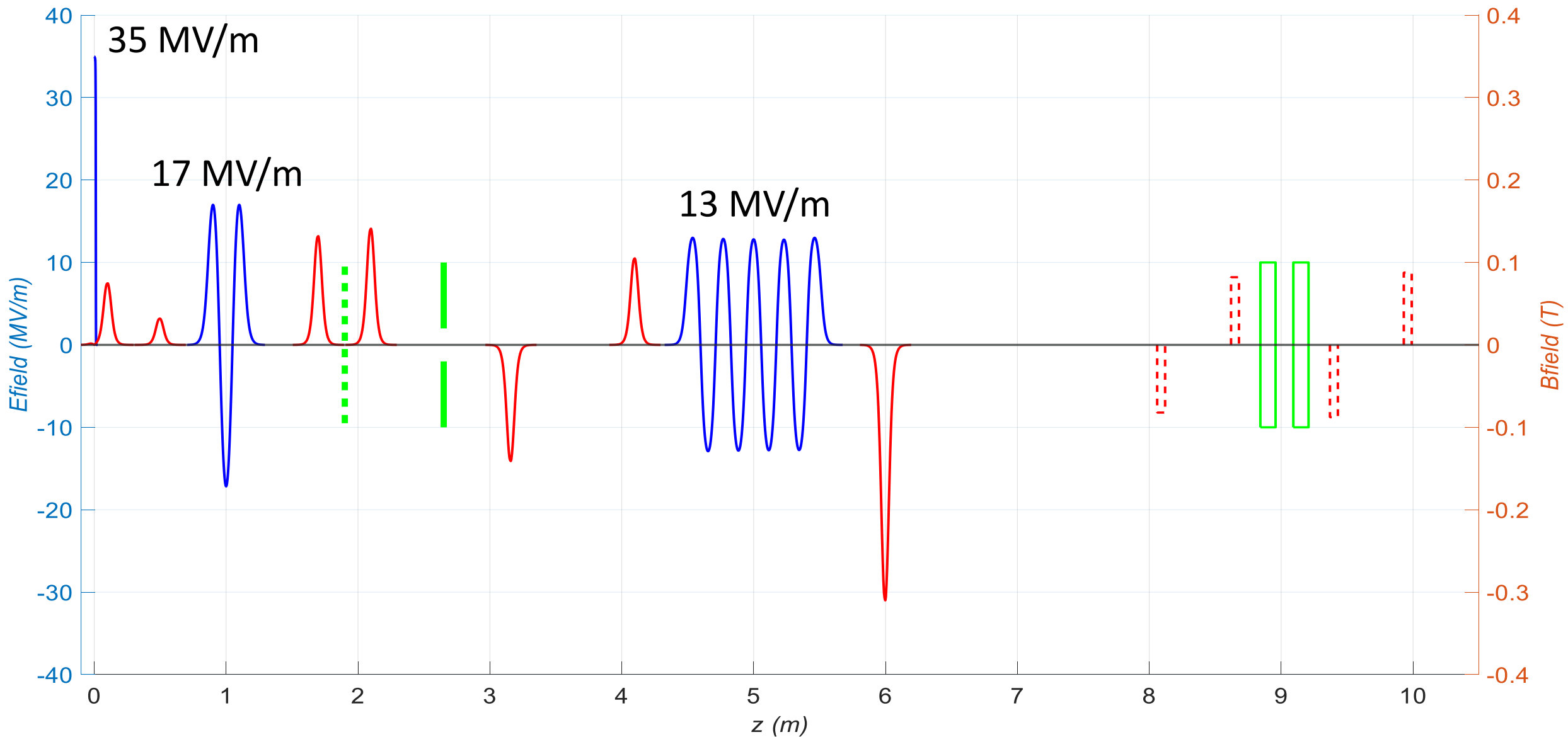


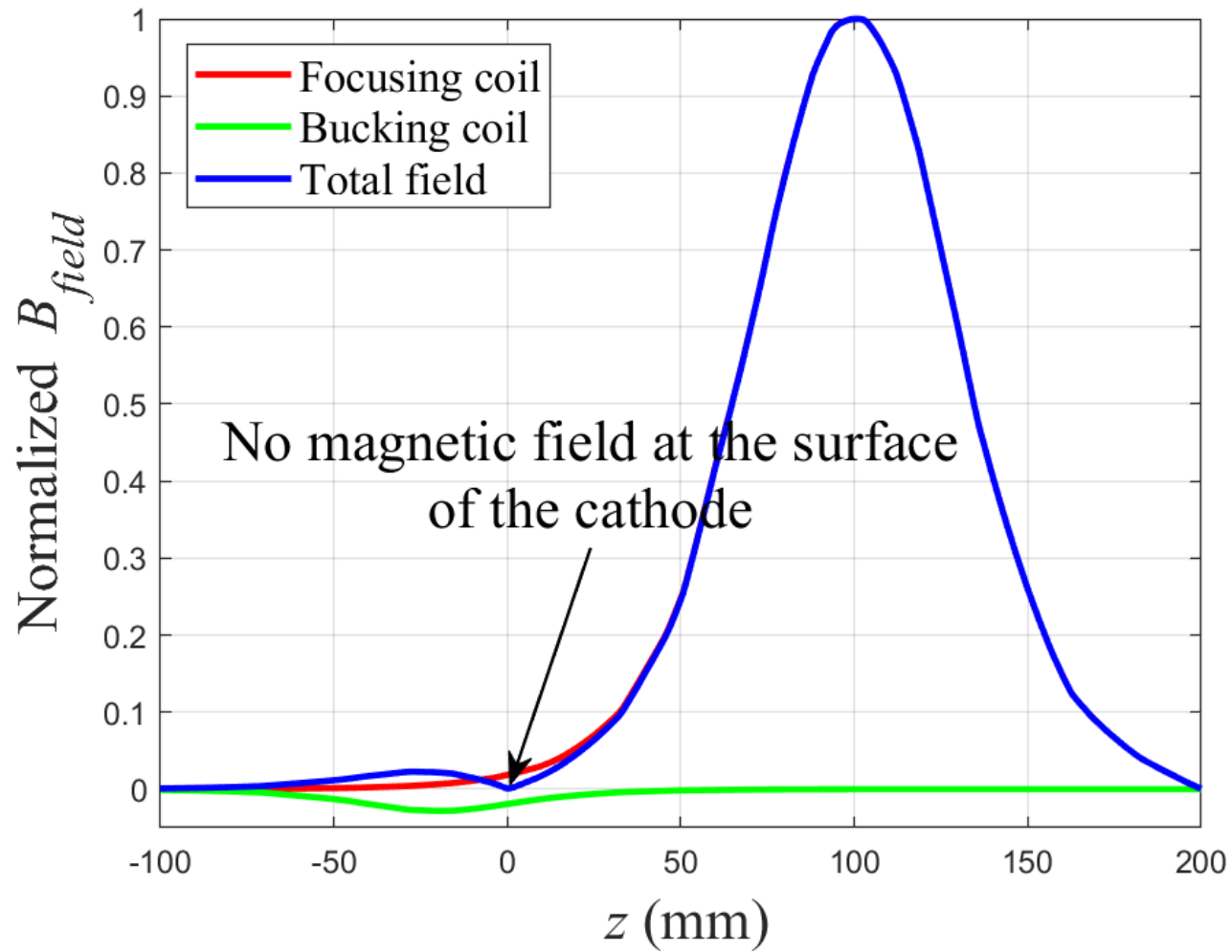




# Layout - Fields





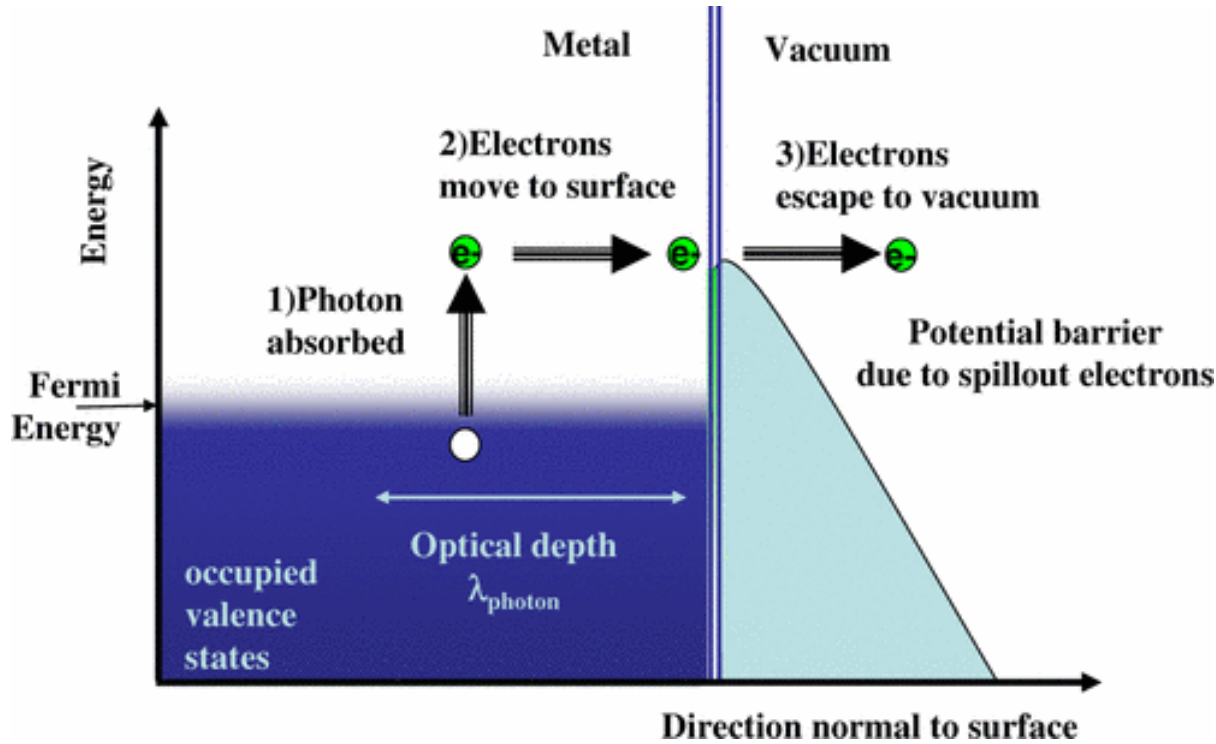


Parameter	Focusing coil	Bucking coil
Inner diameter	60 mm	60 mm
Outer diameter	102 mm	102 mm
Thickness	51.7 mm	22 mm
Nb of turns	1055	25



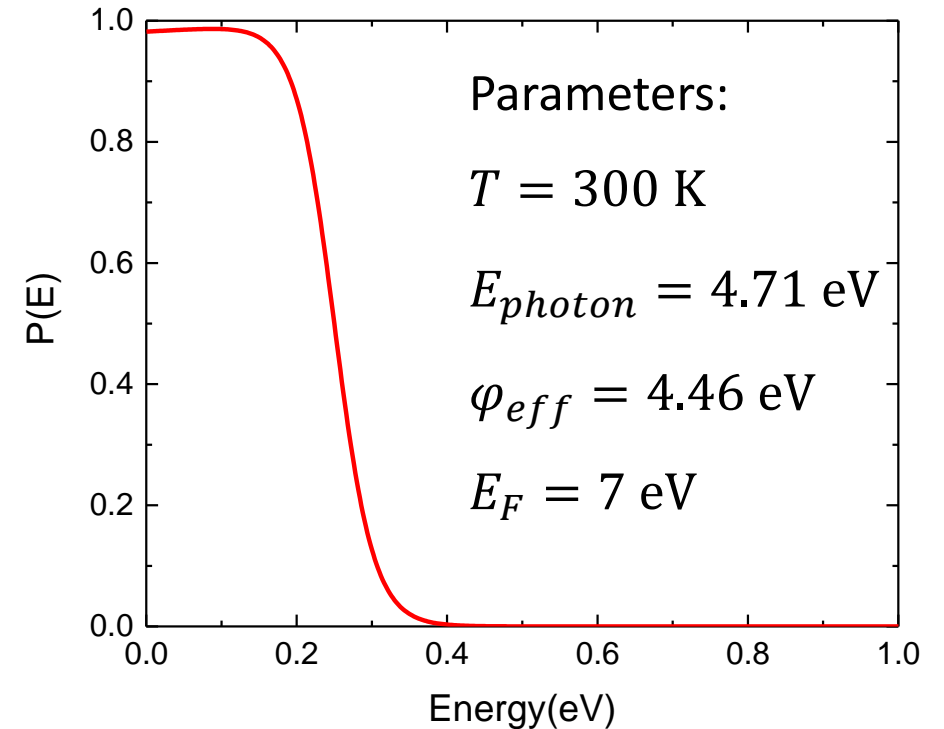


# Cathode – Electron distribution



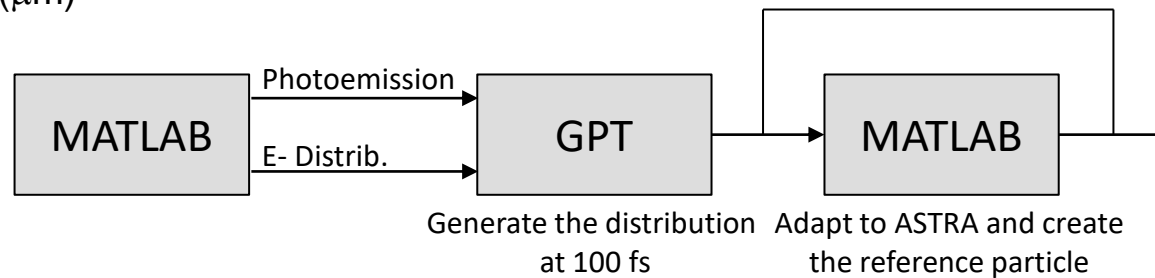
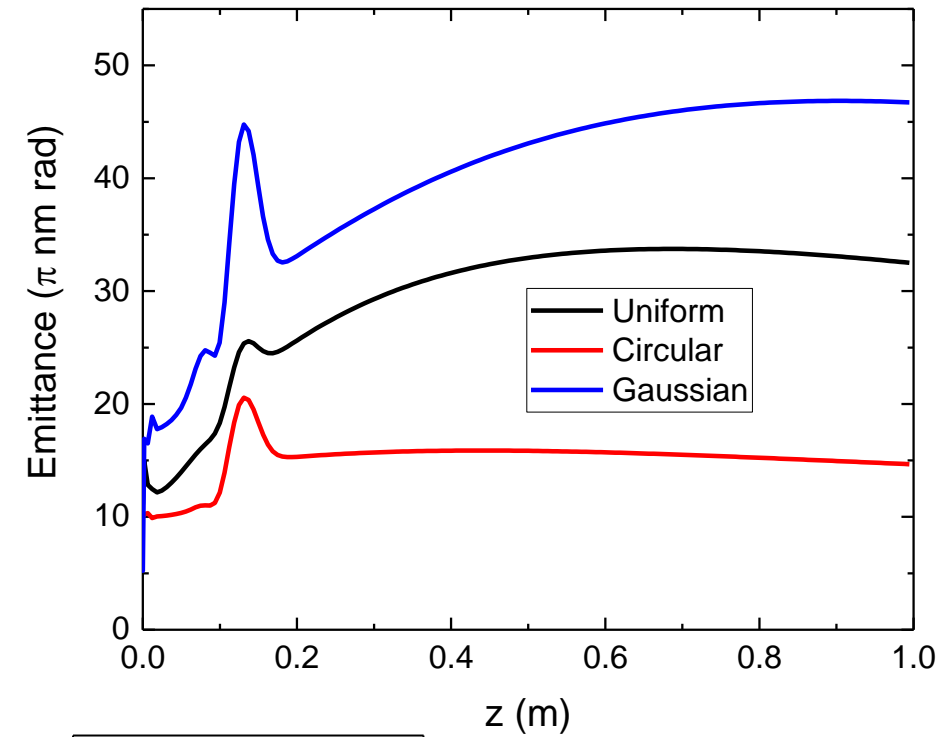
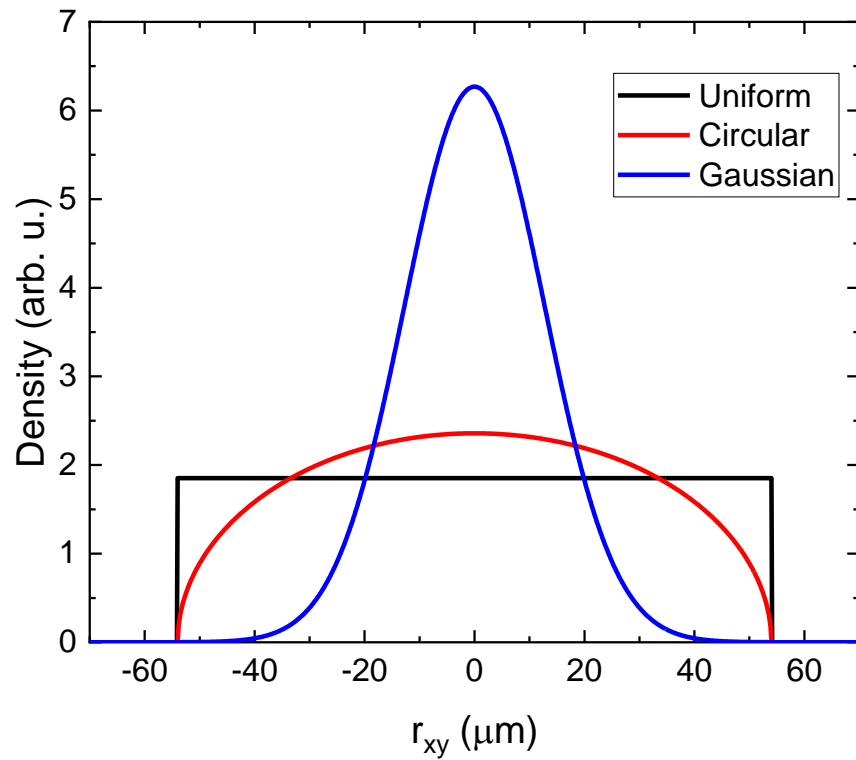
Fermi-Dirac probability function:

$$n(E) = g_c(E)f(E) \sim \sqrt{E} \frac{1}{1 + e^{\frac{E-E_F}{k_B T}}}$$



# Electron distribution

Parameters:  $r_{xy} = 54 \mu\text{m}$ ,  $\tau = 30 \text{ fs}$ ,  $Q = 160 \text{ fC}$ ,  $B_z = 0.075 \text{ T}$



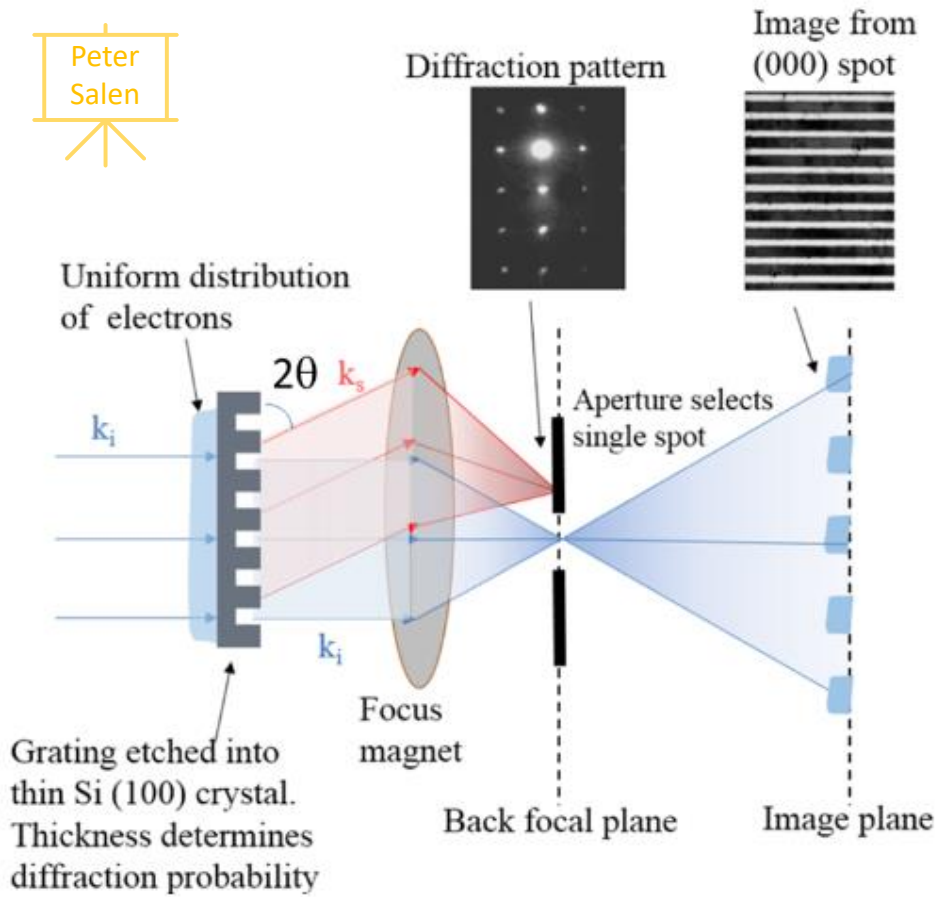


# Grating

# Electron diffraction and 4f-imaging

Peter Salen

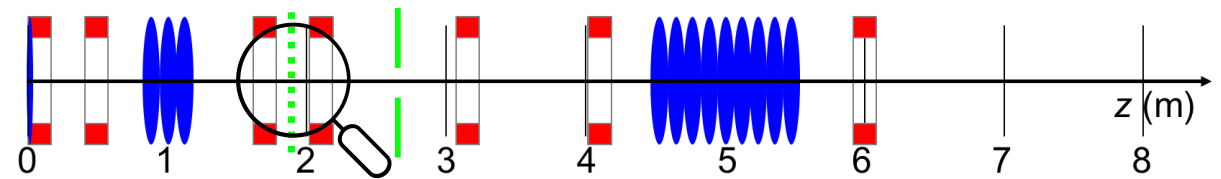
## Theory



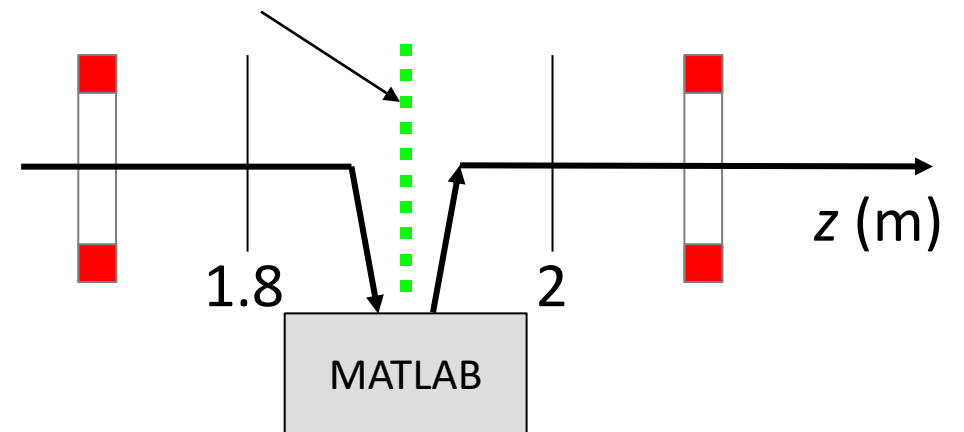
$$2\theta = 1.1 \text{ mrad}$$

W.S. Graves arXiv:1906.01525

## Simulation



## Grating

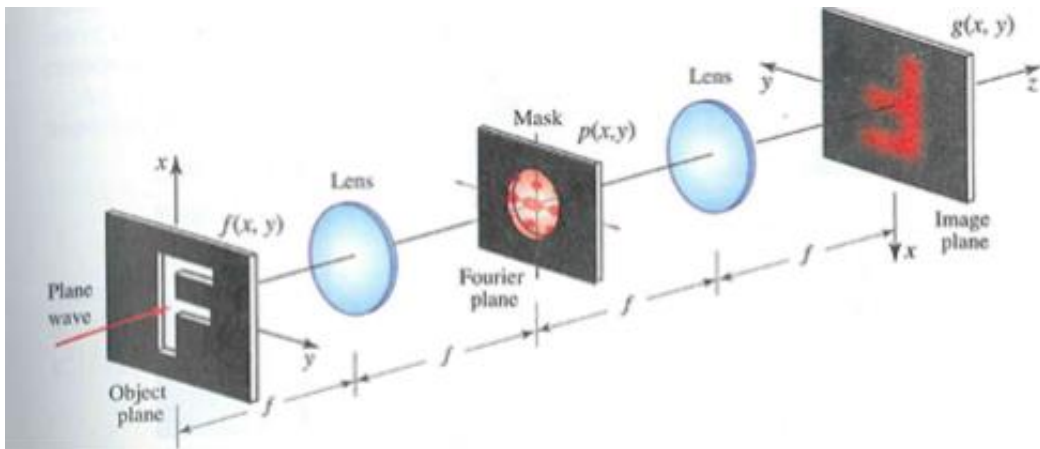


Kick in  $y$  depending on the position of the electron and period of 43%-57% ( $0^{\text{th}}$  order- $1^{\text{st}}$  order)

*Note that for the simulations the grating is 25.8-34.2  $\mu\text{m}$*

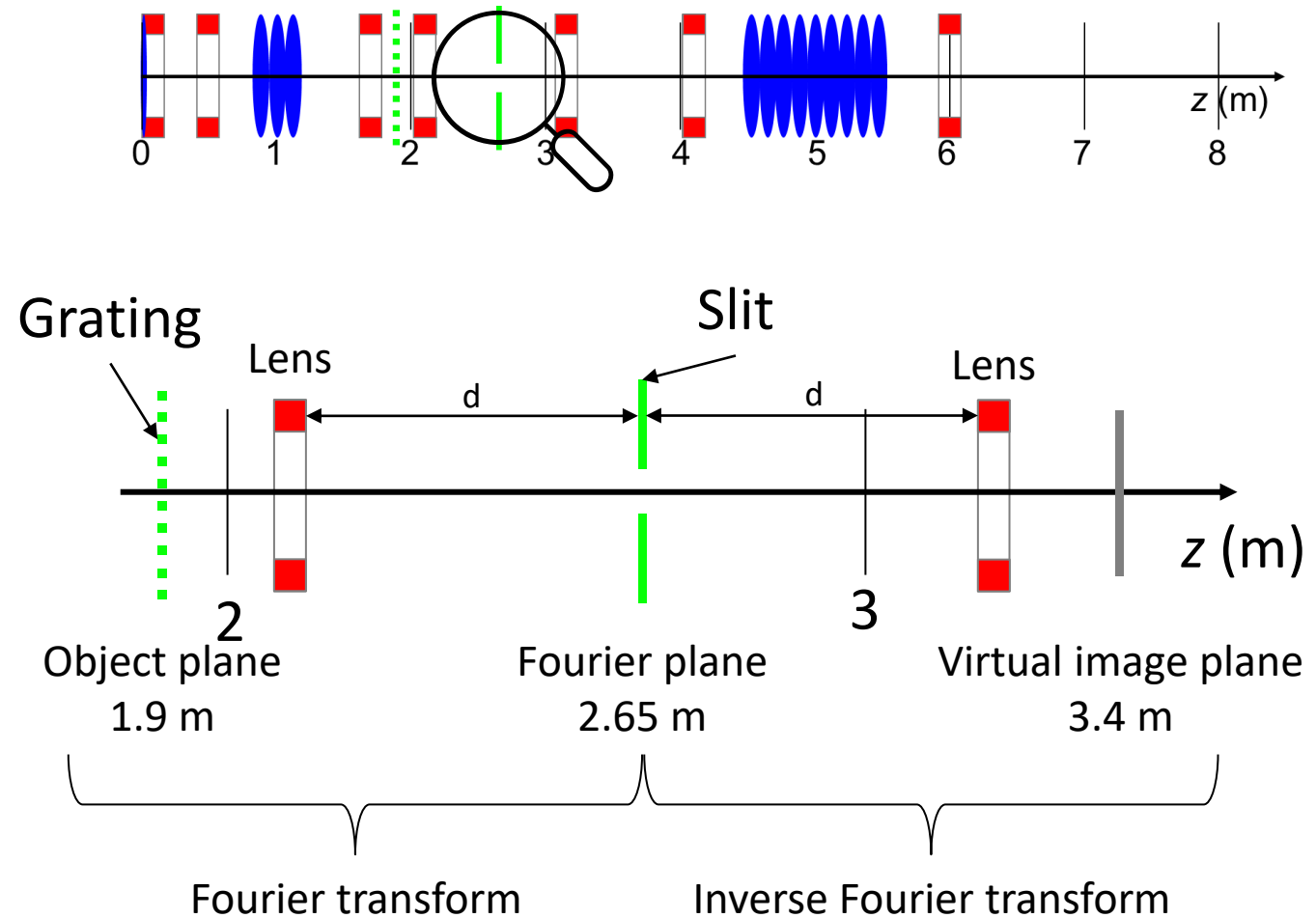
## Theory

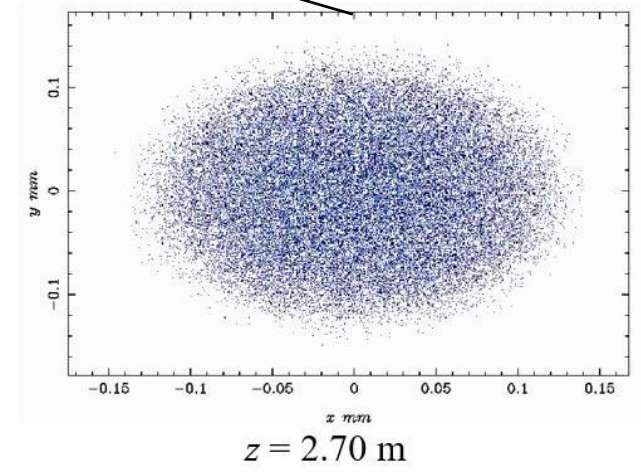
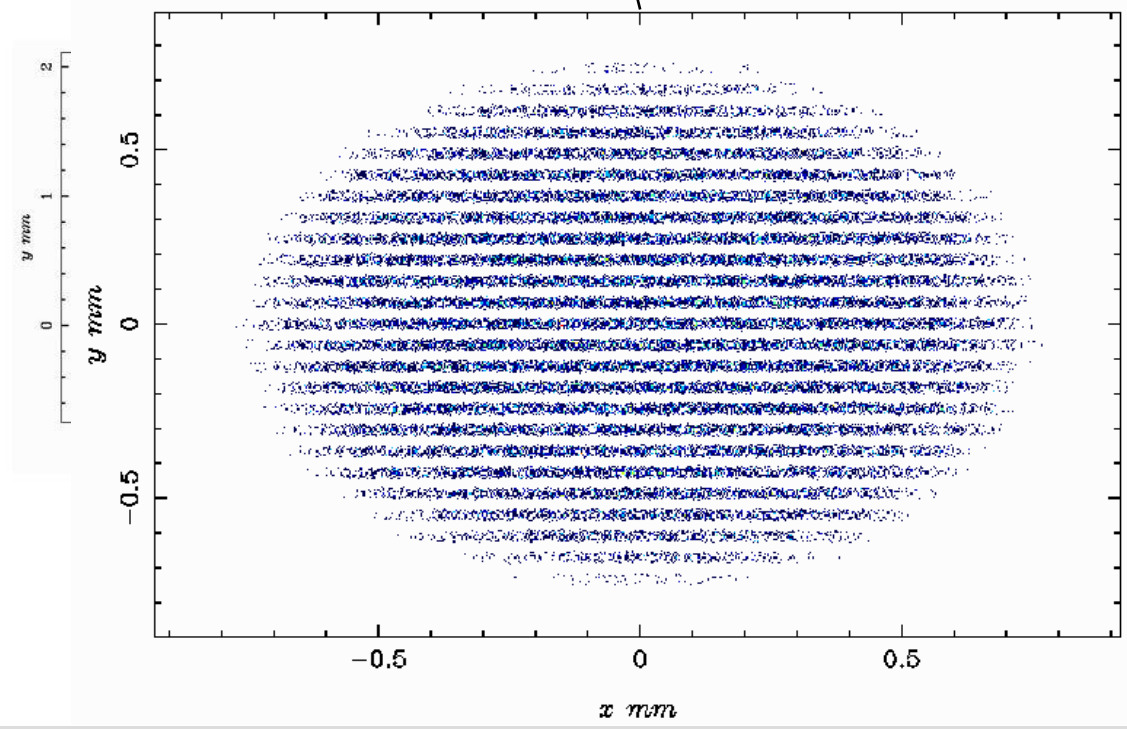
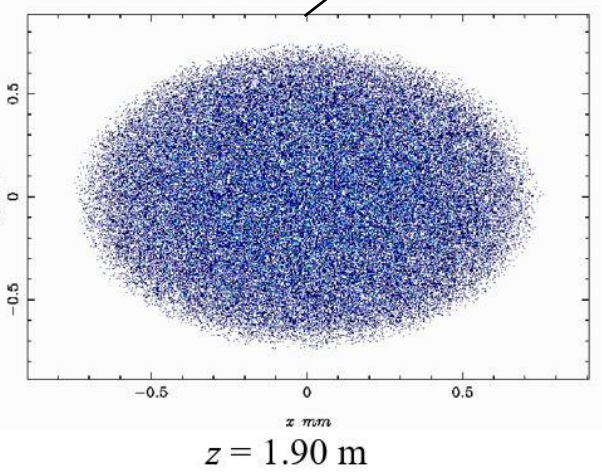
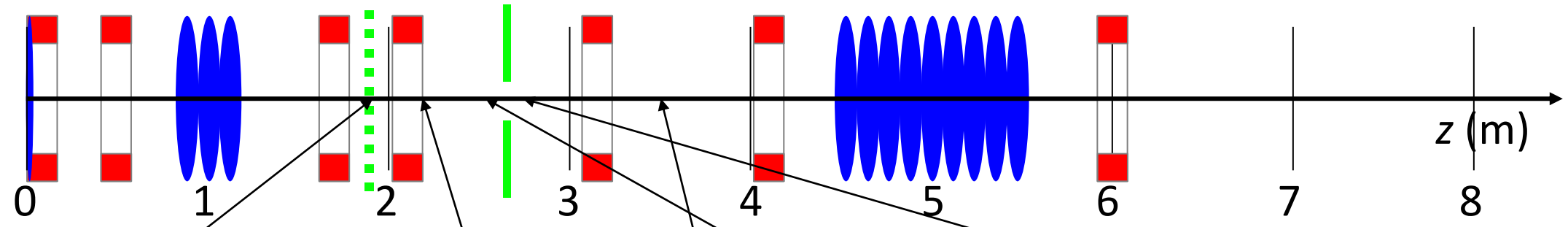
Peter Salen



Textbook: Fundamentals of Photonics - B.E.A. Saleh & M.C. Teich

## Simulation

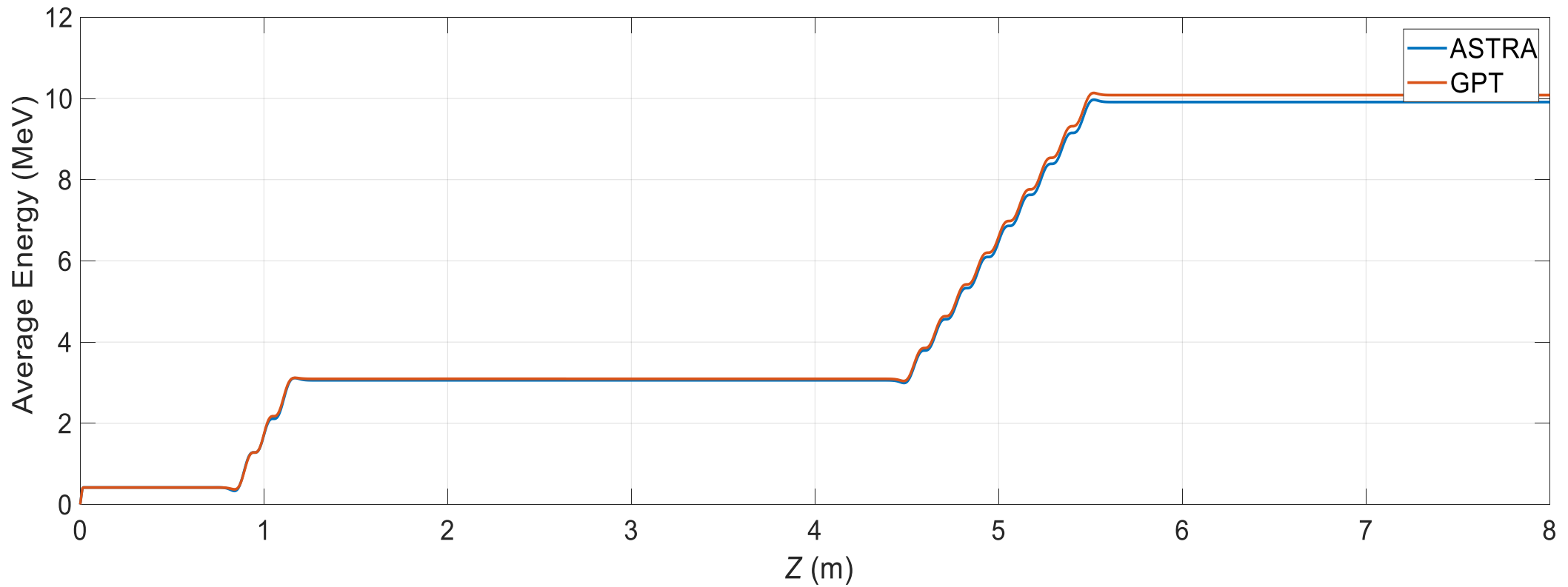
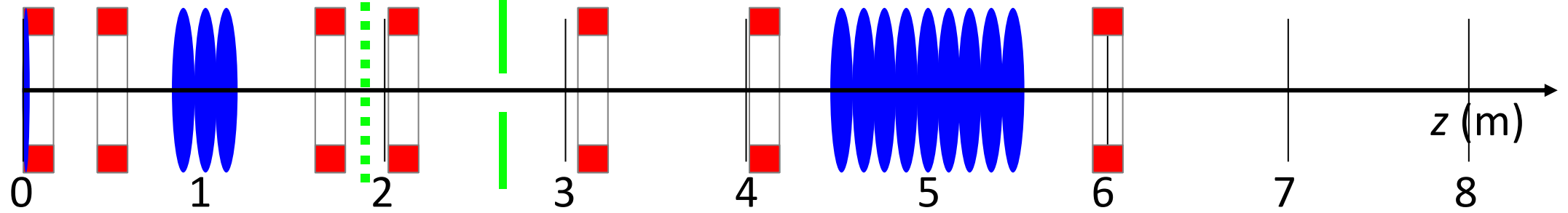


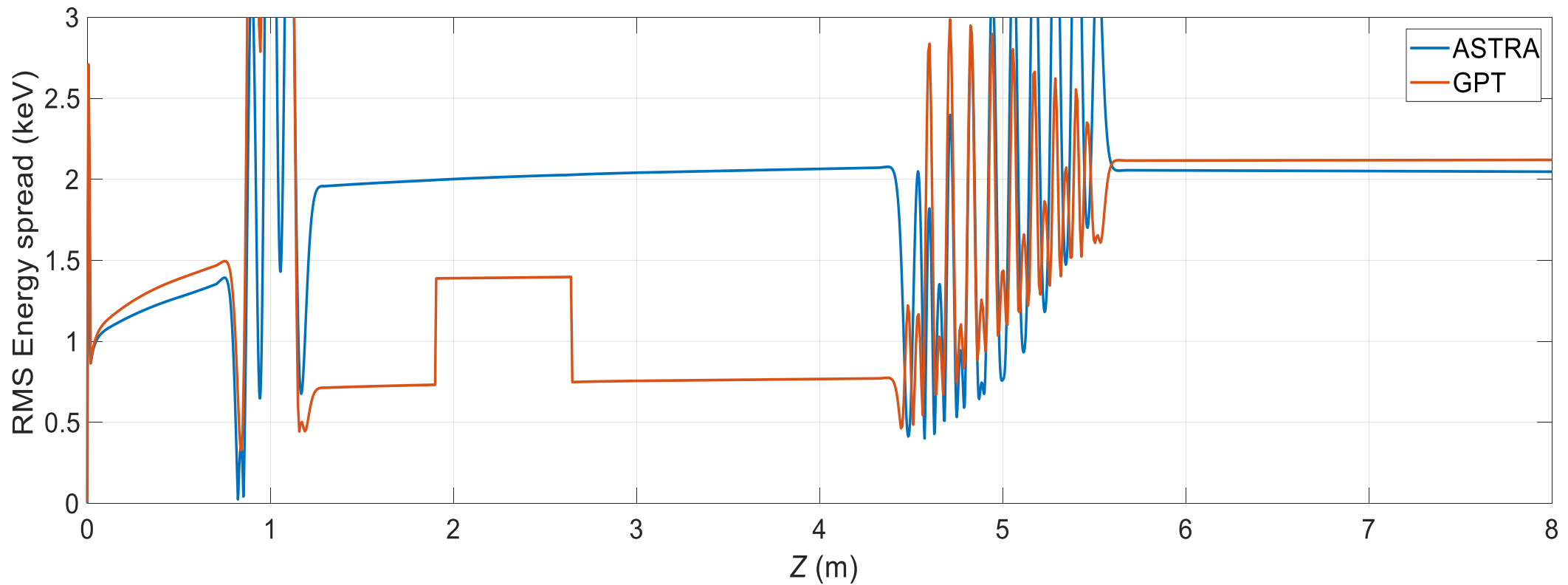
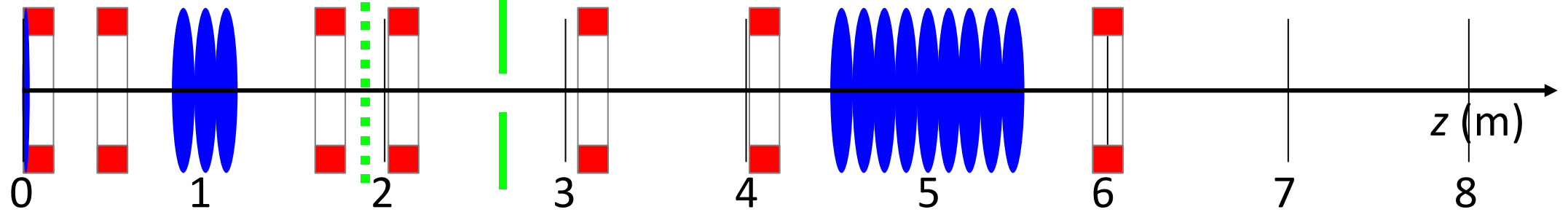




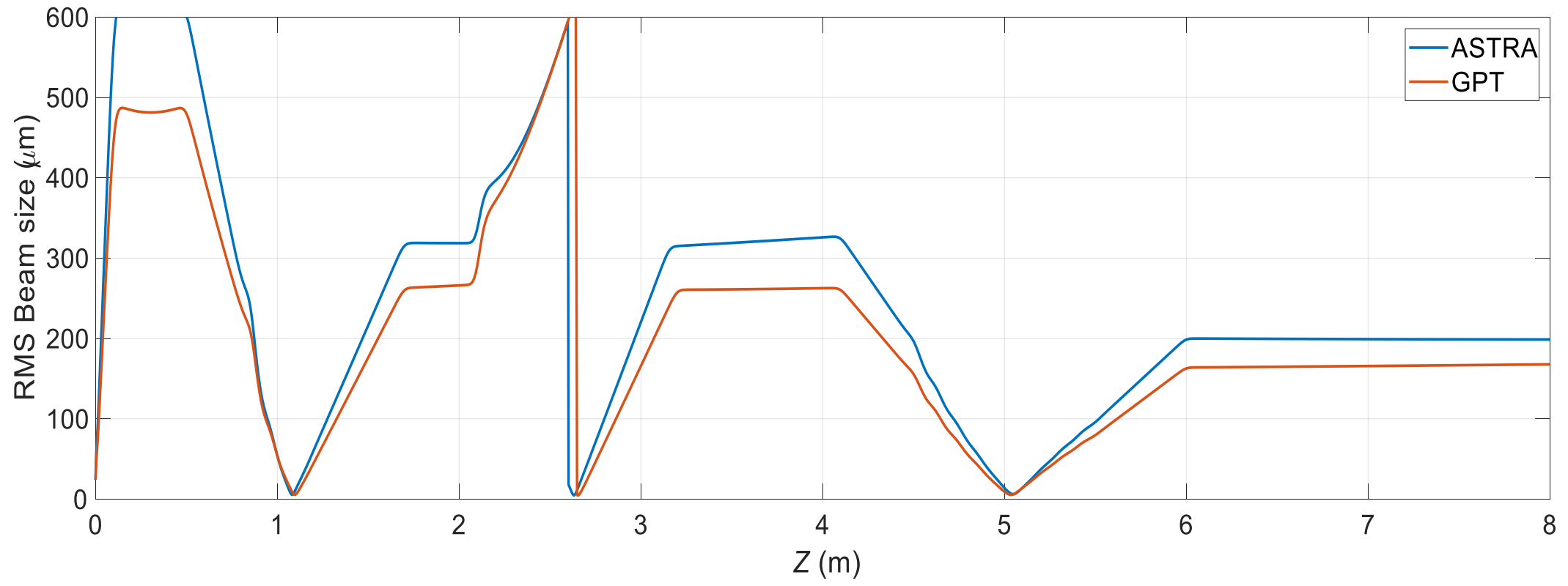
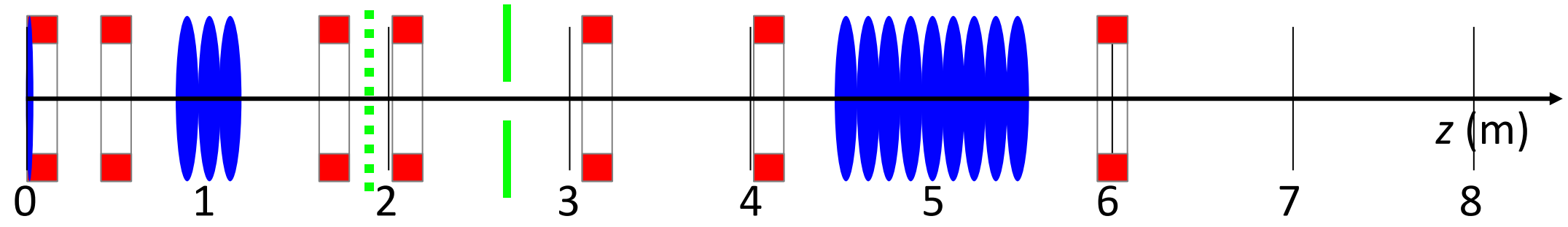
# GPT and ASTRA simulation results

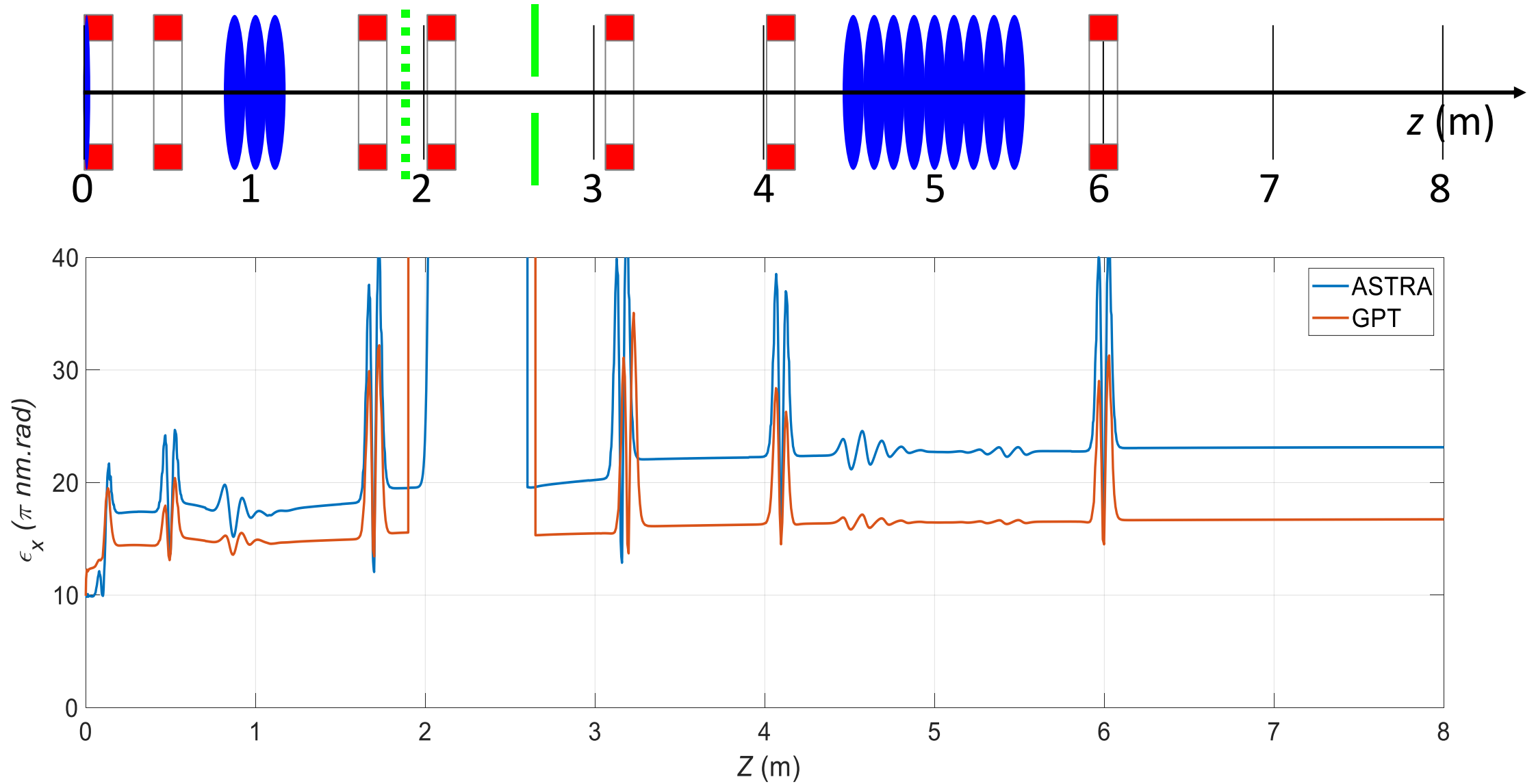




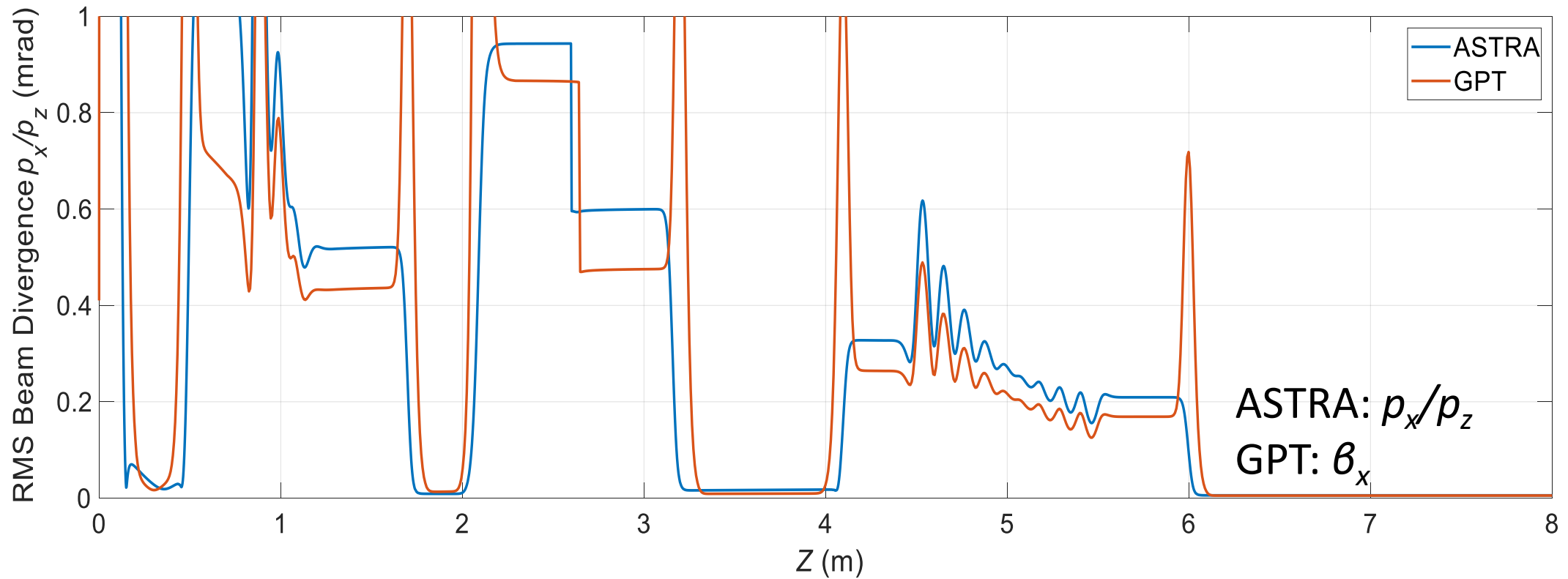
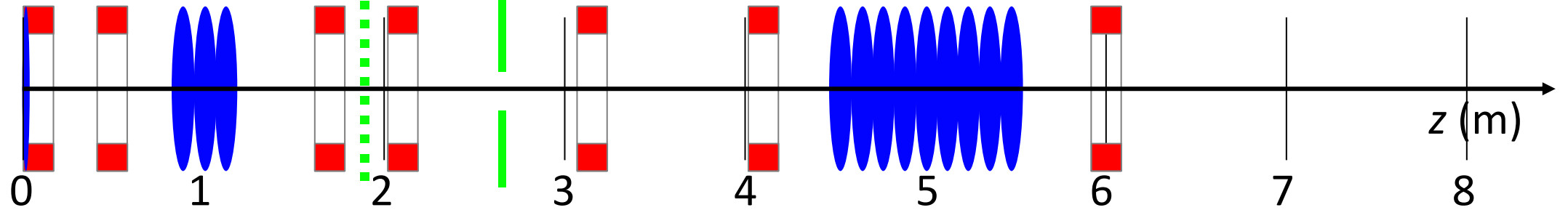


# Simulations – beam size





# Simulations – beam divergence





# Thank you for your attention