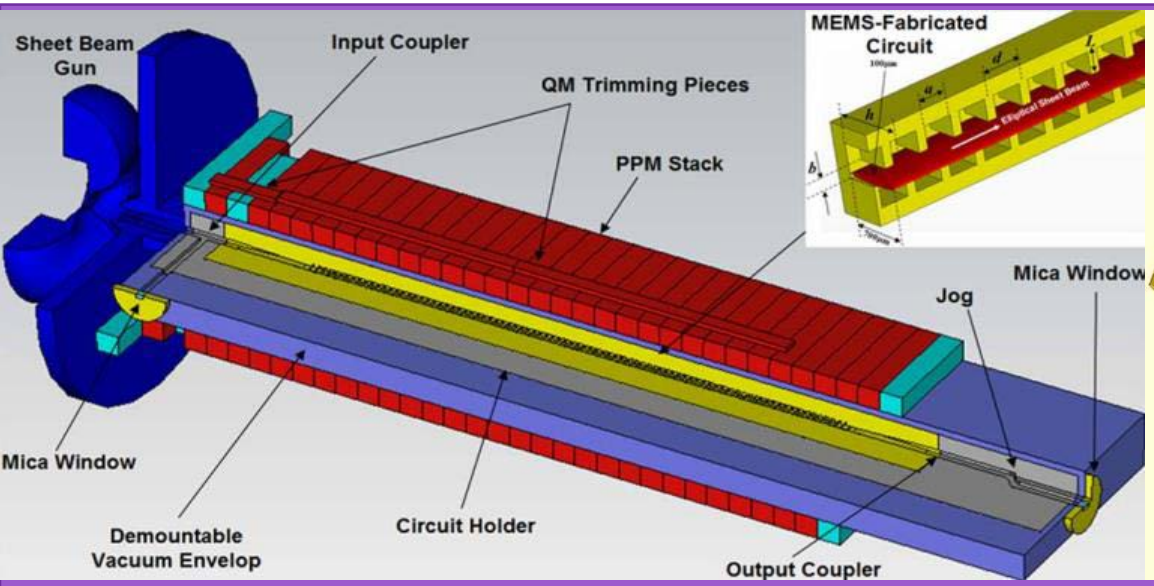
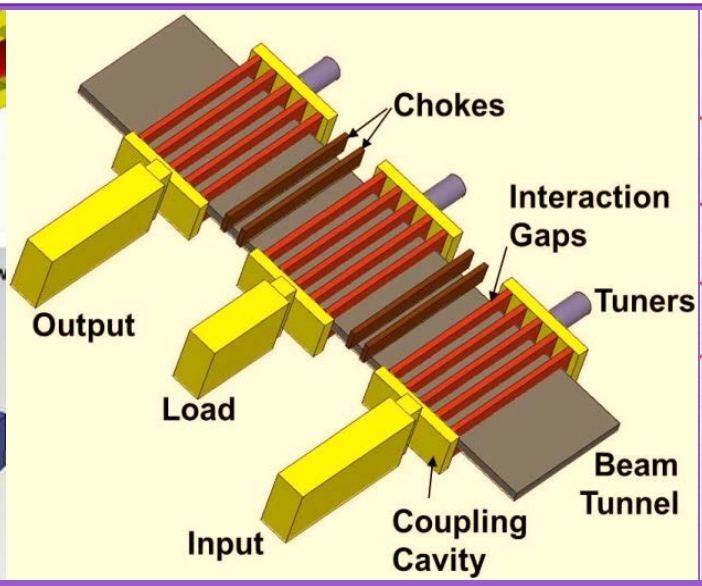
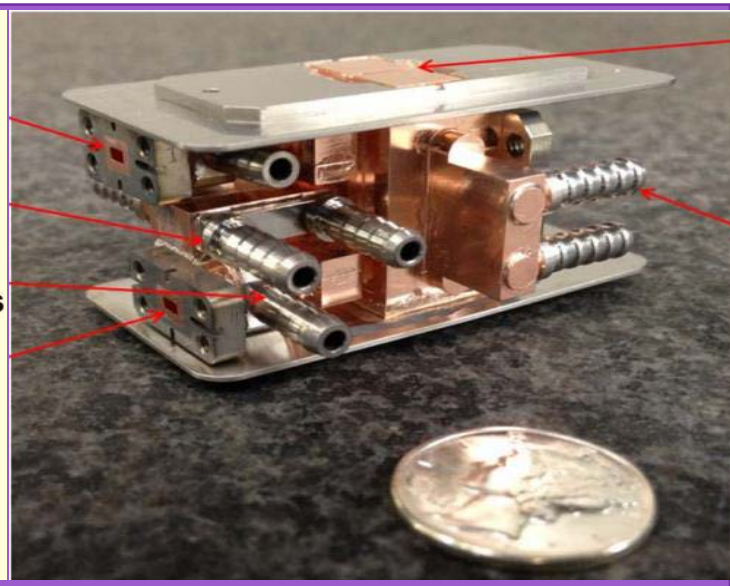
DESIGN OF SHEET BEAM ELECTRON GUN WITH PCM FOCUSING SYSTEM FOR G-BAND EIK







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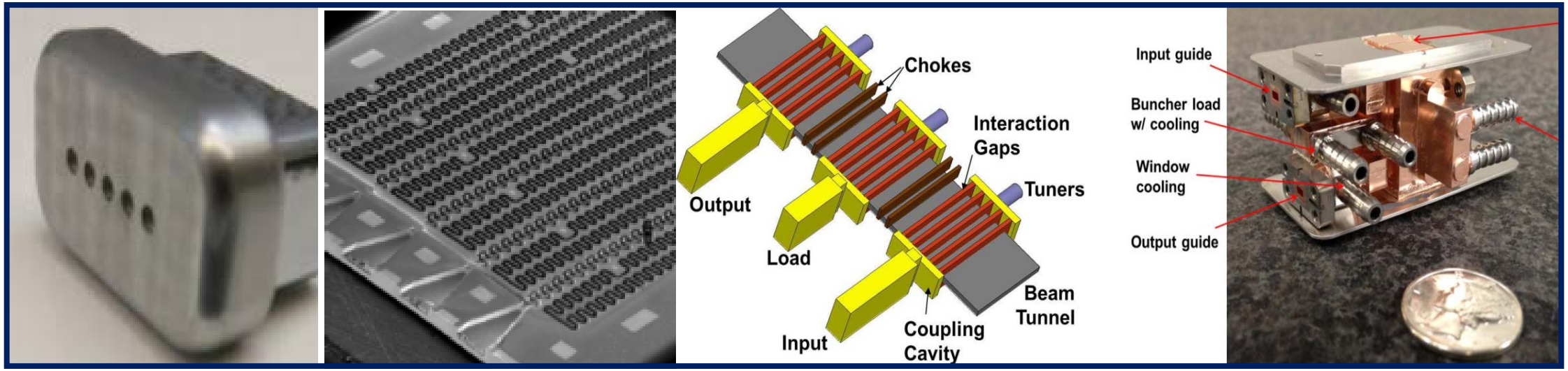
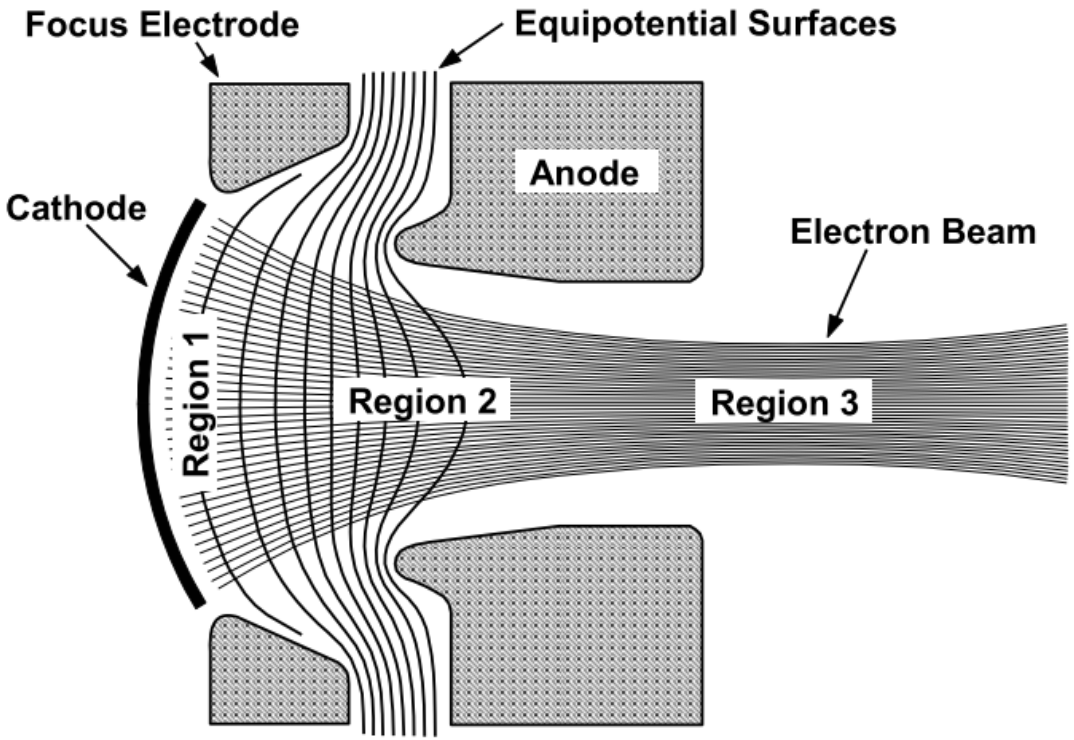
INTRODUCTION



- Lack of theoretical basis for the systematic design of planar multi-beam electron optical systems.
- The proper method to focus the sheet beam for a long-distance stable transportation had not been found.
- The circular microwave tubes can achieve high power output in microwave range for many requirements.

◆ Theory Design for the Sheet Beam Electron Gun

➢ Theoretical Design of the Pierce Electron Gun



Schematic of the simplified electron gun model

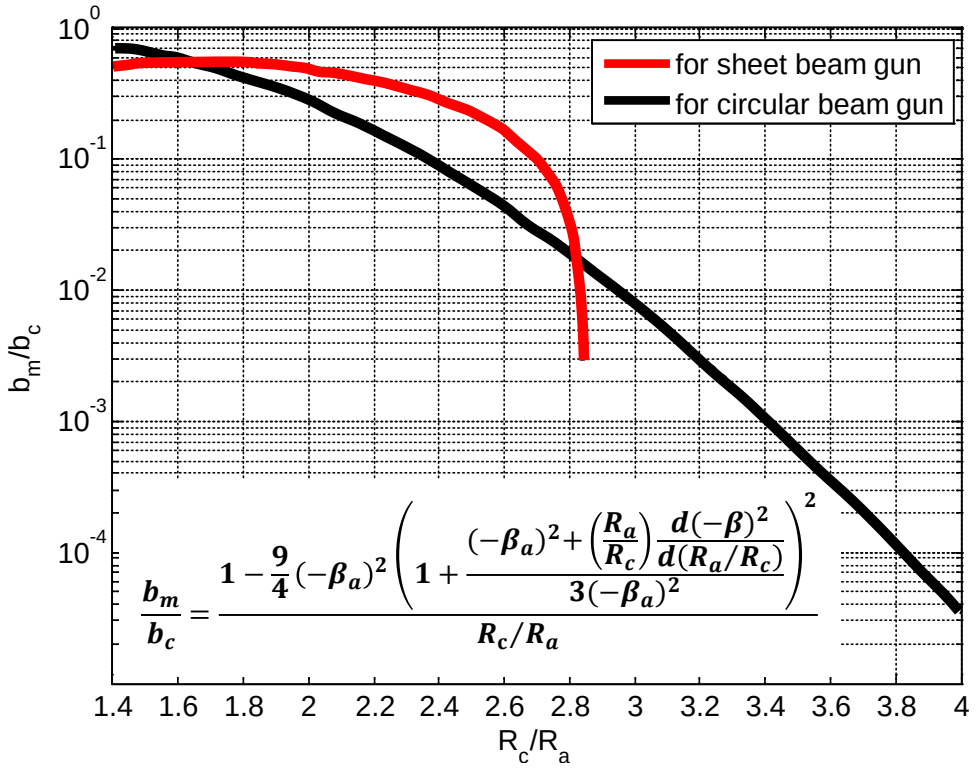
Perce Theory
- ◆ Compression factor curve
- ◆ Throw distance curve

Correction
- ◆ Anode aperture correction
- ◆ Cylinder aberration correction

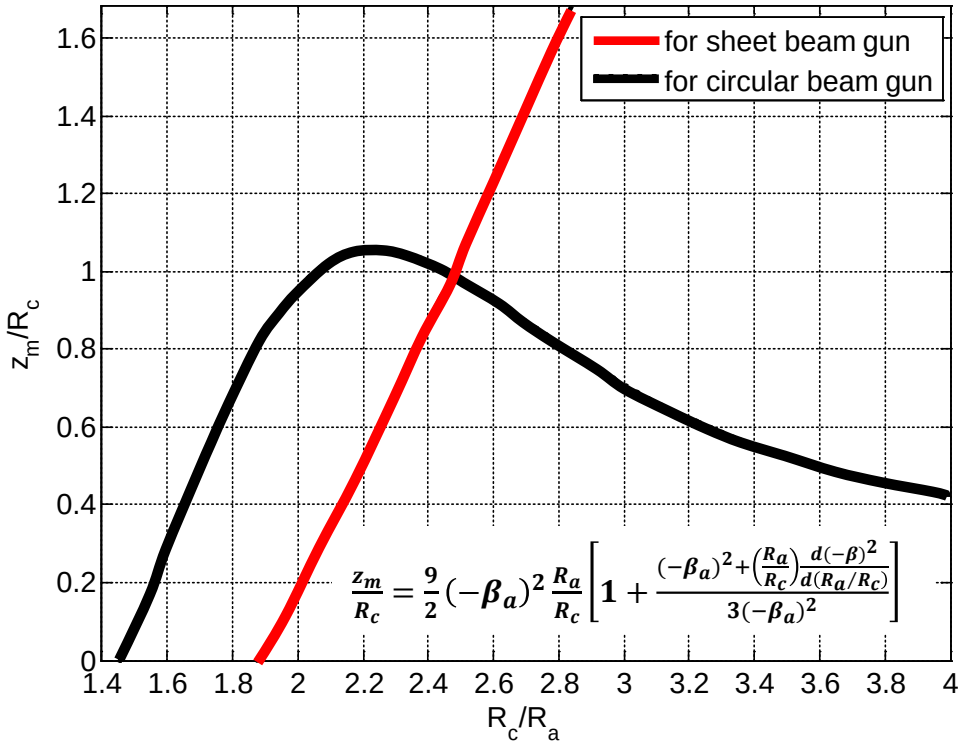
Simplification Optimization
- ◆ Sheet Beam gun

◆ Theory Design for the Sheet Beam Electron Gun

➢ Design curves of beam compression factor and throw distance



(a)



(b)

Figure 1. Design curves of beam (a) compression factor and (b) throw distance. Solid curve: sheet beam gun. Dot curve: circular beam gun.

◆ Theory Design for the Sheet Beam Electron Gun

➢ Theoretical Calculated Gun Parameters

Table 1. Theoretical Calculated Gun Parameters

Parameter	Value	Parameter	Value
cathode	0.3mm×0.52mm	z_m	1.9030mm
R_c/R_a	2.4665	θ'	0.0426rad
θ	0.1349rad	r_a	0.1984mm
R_c	1.9336mm	M	4
R_a	0.784mm	U	16.5kV
dKa	1.1392mm	I	0.30A

◆ Simulation and Verification for the Sheet Beam Electron Gun

- 3-D model of the sheet beam gun

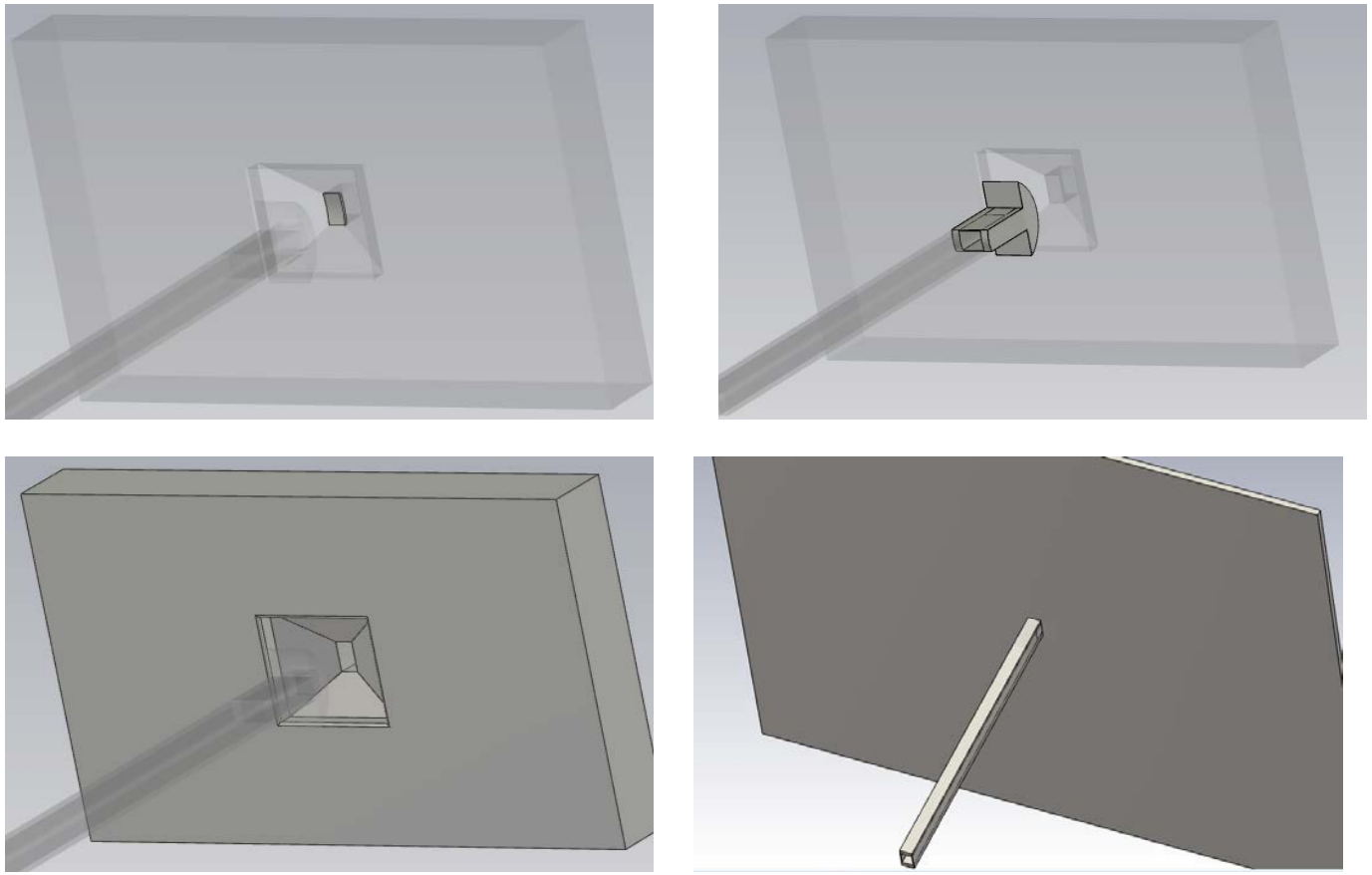
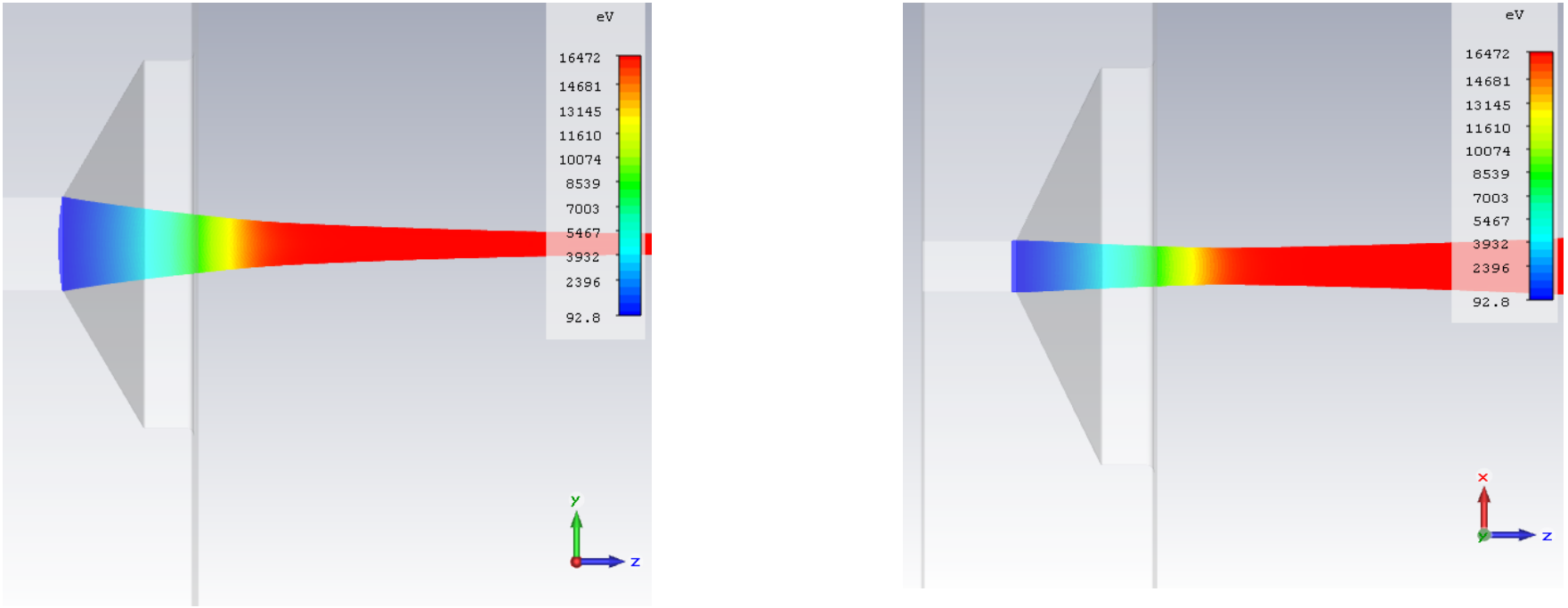


Figure 2. Typical 3-D model of the sheet beam gun

◆ Simulation and Verification for the Sheet Beam Electron Gun

➢ Beam trajectory for the sheet beam gun



(a) (b)

Figure 3. Beam trajectory for the sheet beam gun with a compression factor of 4. (a) Narrow direction. (b) Width direction.

◆ Simulation and Verification for the Sheet Beam Electron Gun

➢ Cross section of sheet beam

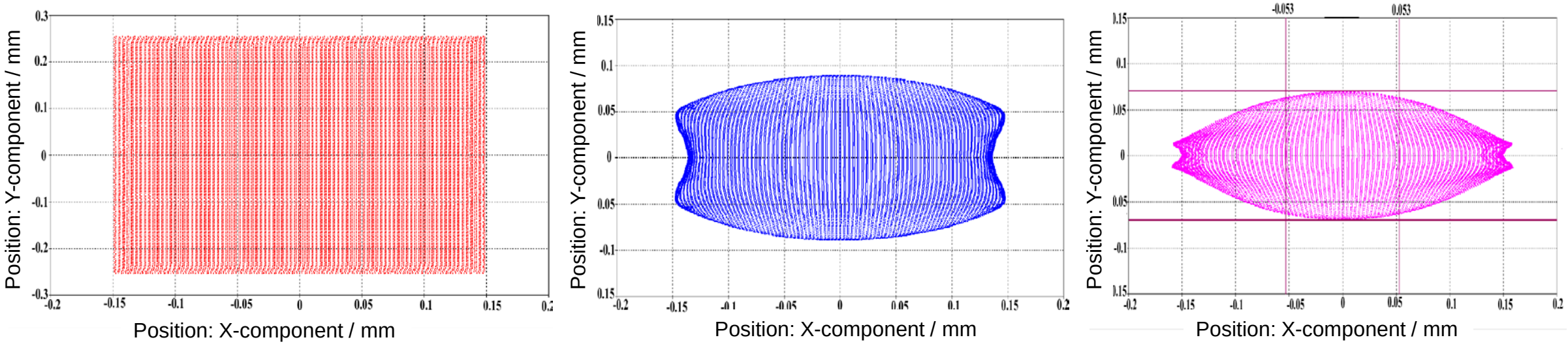


Figure 4. Cross section of sheet beam at the position of (a) *z* = 0.1 mm, (b) *z* = 1 mm, (c) *z* = 3 mm for the sheet beam gun with the compression factor of 4. (c) Cross section of beam waist.

◆ PCM Focusing Structure

➢ Sketch of the PCM focusing system and parameters

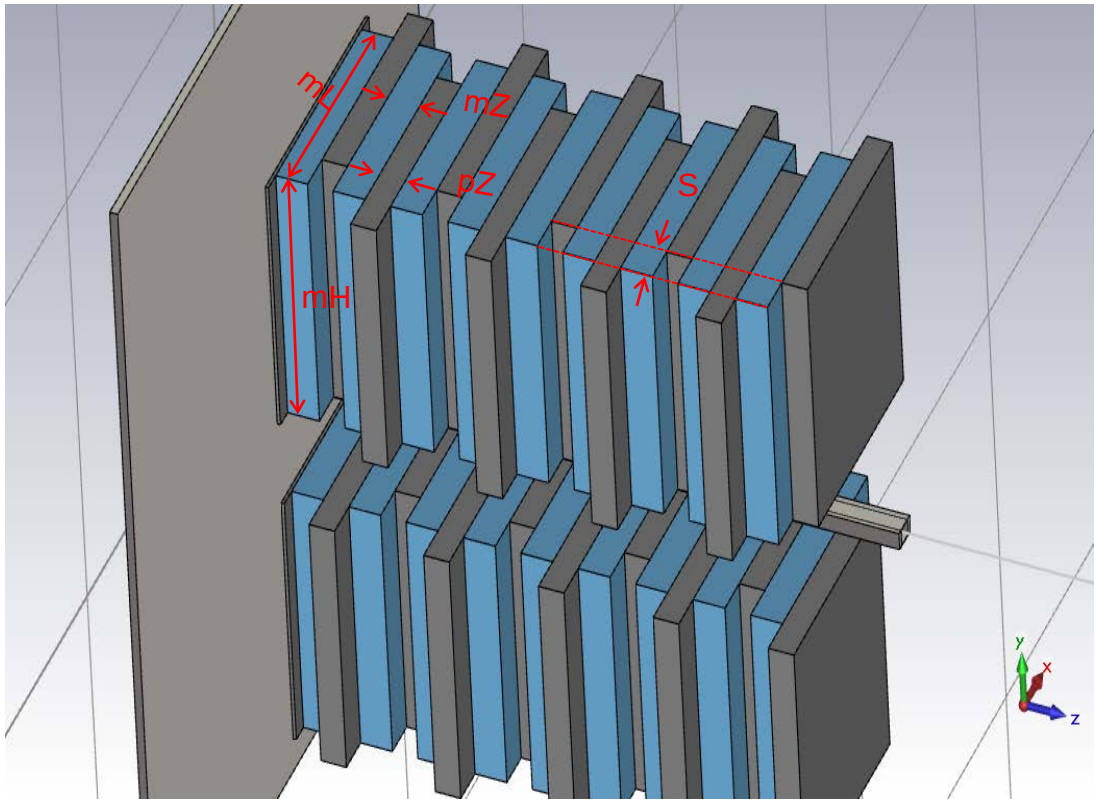


Figure 5. Sketch of the PCM focusing system.

Table 2. Dimension of the pcm magnet and pole piece

Parameter	Designed value
mL	36mm
mH	16mm
mZ	0.6mm
pZ	0.5mm
S	3mm

◆ PCM Focusing Structure

➢ Distributions of magnetic field B_z

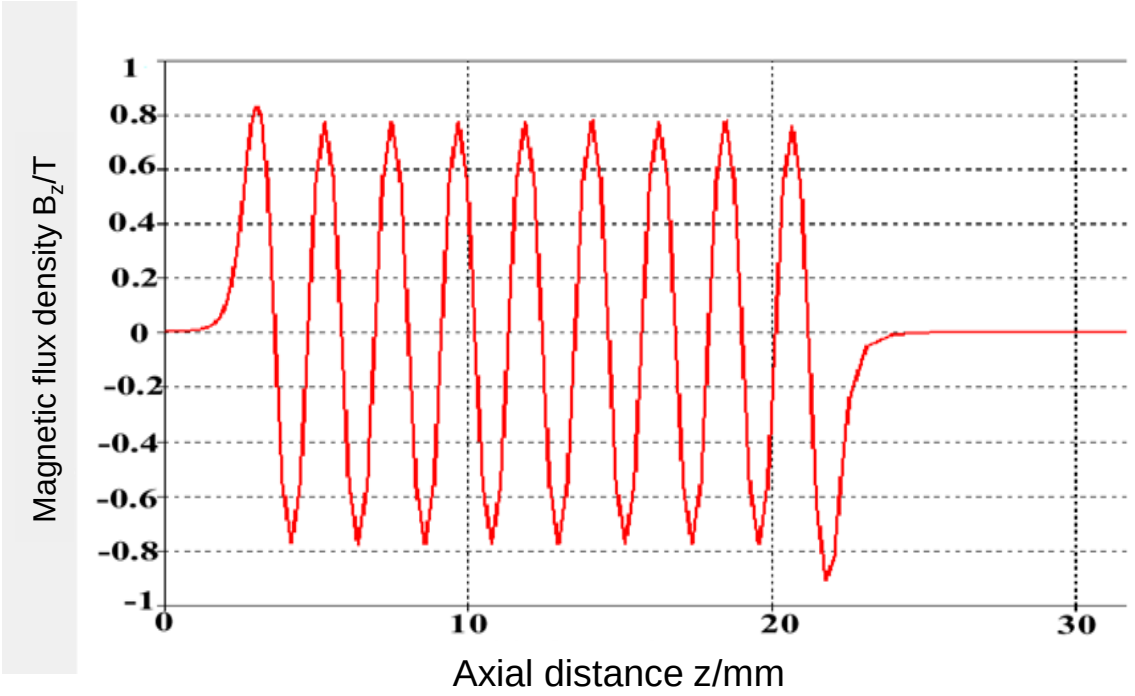
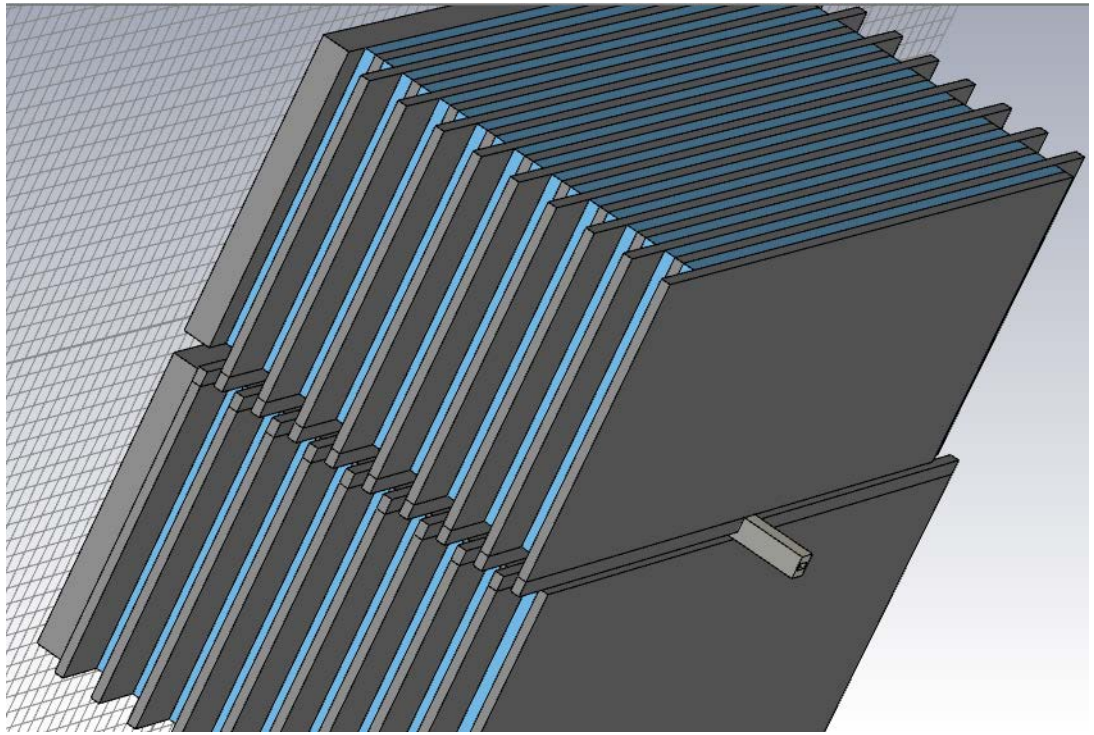


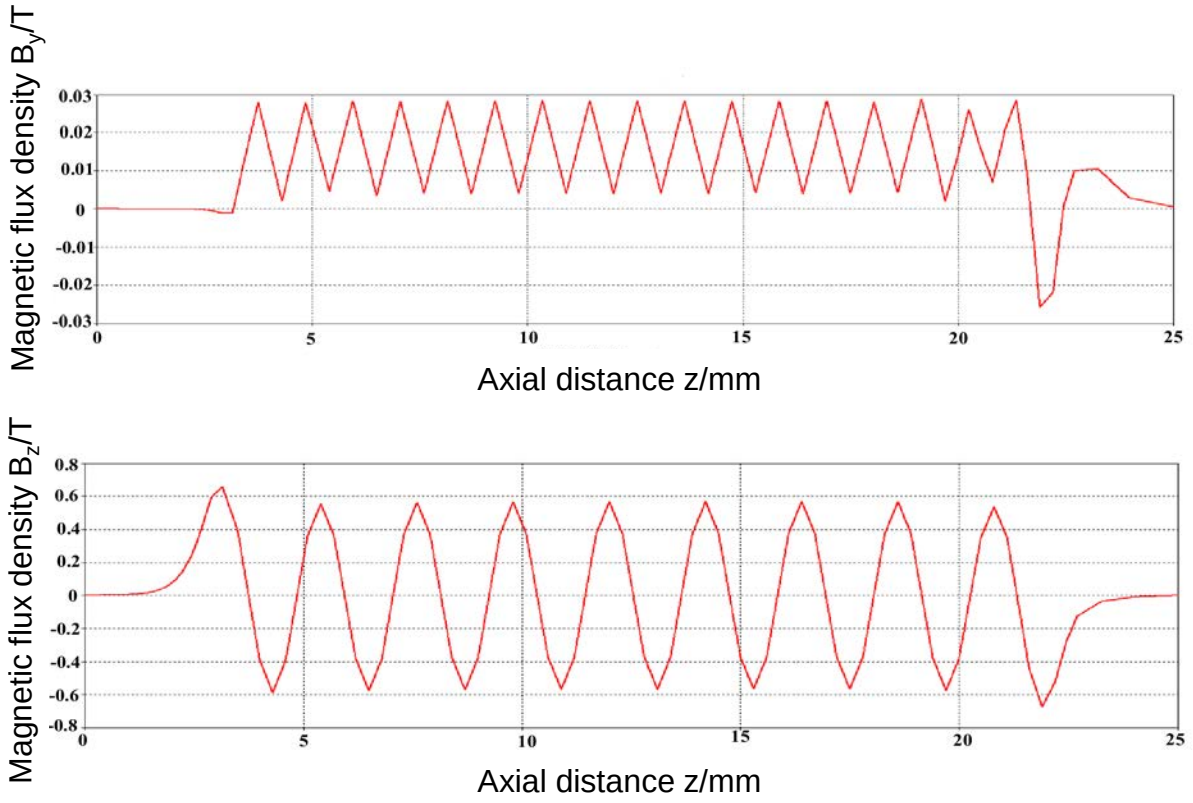
Figure 6. Distributions of magnetic field B_z

Figure 7. Beam trajectory. (a) Narrow side. (b) Wide side.

◆ PCM Focusing Structure

- Optimizing and matching stability analyses





◆ PCM Focusing Structure

➢ Electron distribution in XY-section

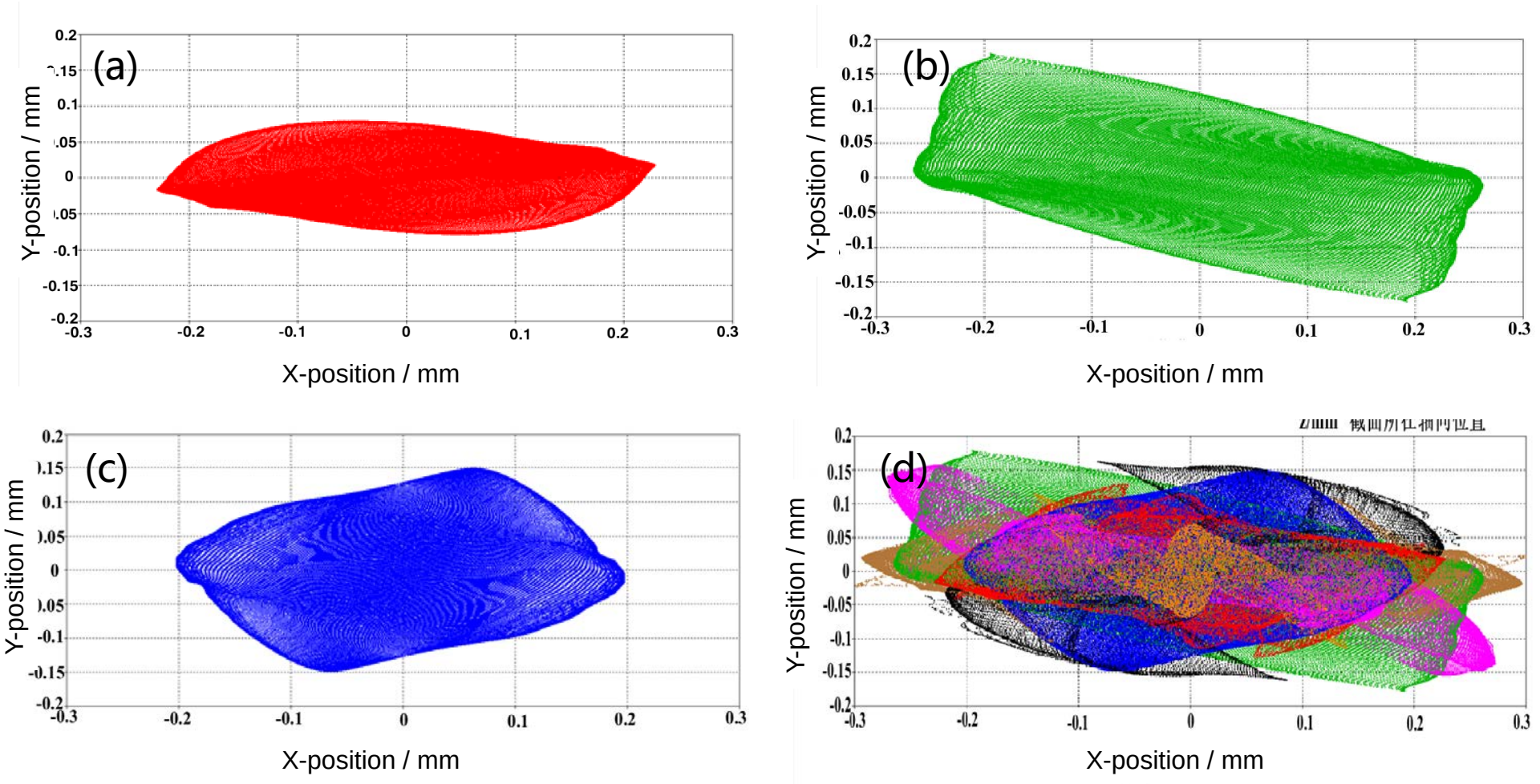


Figure 8. Electron distribution in XY-section at Z = 3.2 mm, Z = 6 mm, Z = 7.5 mm and all in XY-section


THANK YOU