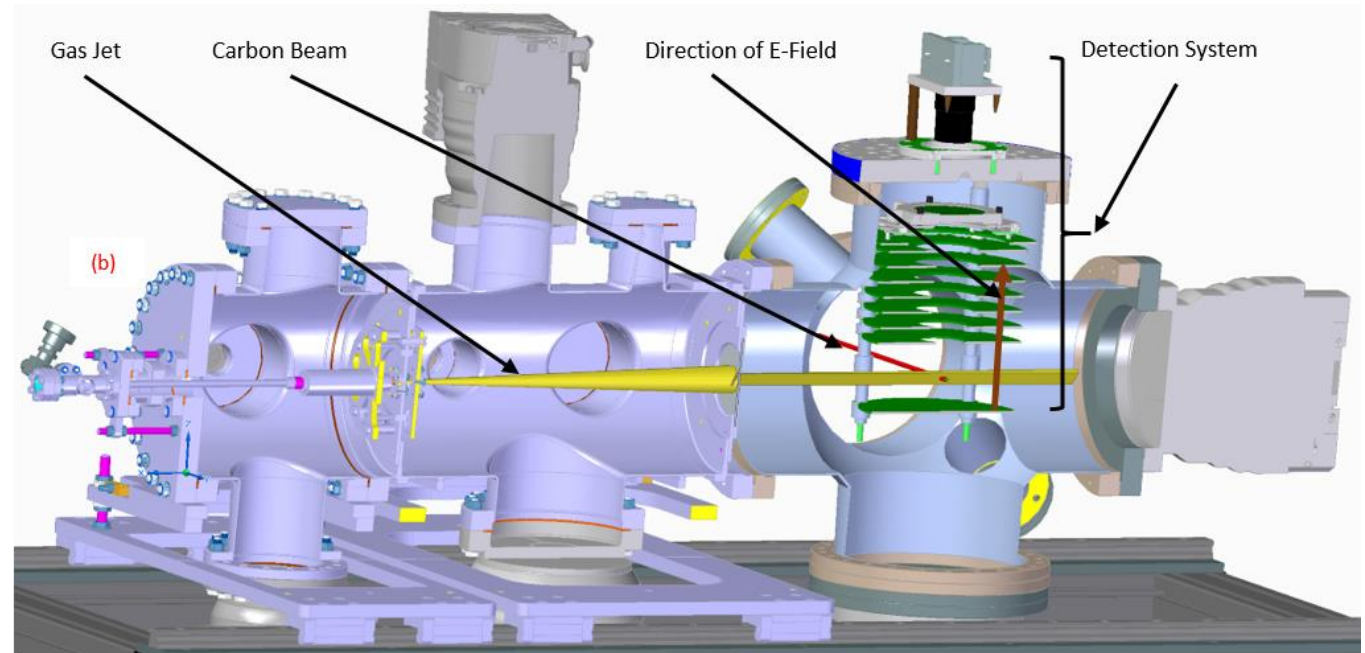
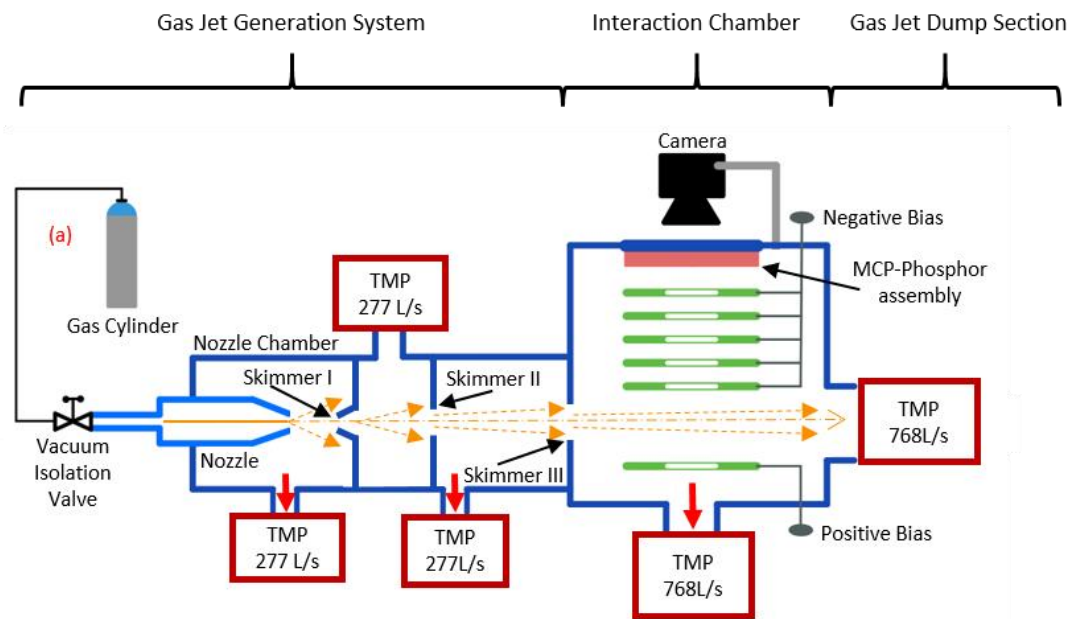


Progress Update on gas jet monitor

Simulation works on the new Ionization profile monitor
New MCP Detector installation
Preparations for Birmingham experiments (5-21 August)

Gas curtain beam profiler



Current Design 200 CF

Summary from the DCF experiments

	Detection Limit : Carbon 28MeV C6+	
Argon	$\sim 5.0 \times 10^7$	ions/ sq.mm
Nitrogen	$\sim 1 \times 10^8$	

Detection Limit: Total number of ions per unit area, required to register a single detectable count on a detector. (~5 counts for S/N>1)

	P+ MeV			C6+ MeV/u	
	12	15	127	33.4	
ions per bunch (no.)	6.2×10^8	6.2×10^8	6.2×10^8	1.0×10^8	← Particles in single bunch
square 3.5×3.5 cm	5.1×10^5	5.1×10^5	5.1×10^5	8.5×10^4	
round 3 cm	8.8×10^5	8.8×10^5	8.8×10^5	1.5×10^5	← Particles/mm ² in single bunch
pencil 1 mm	7.9×10^8	7.9×10^8	7.9×10^8	1.3×10^8	
	Insufficient Data			707	6558
				408	3784
				0.5	4.20
				Ar	N2

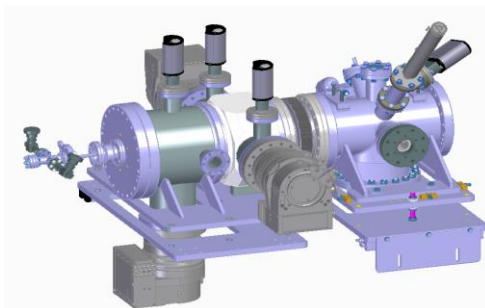
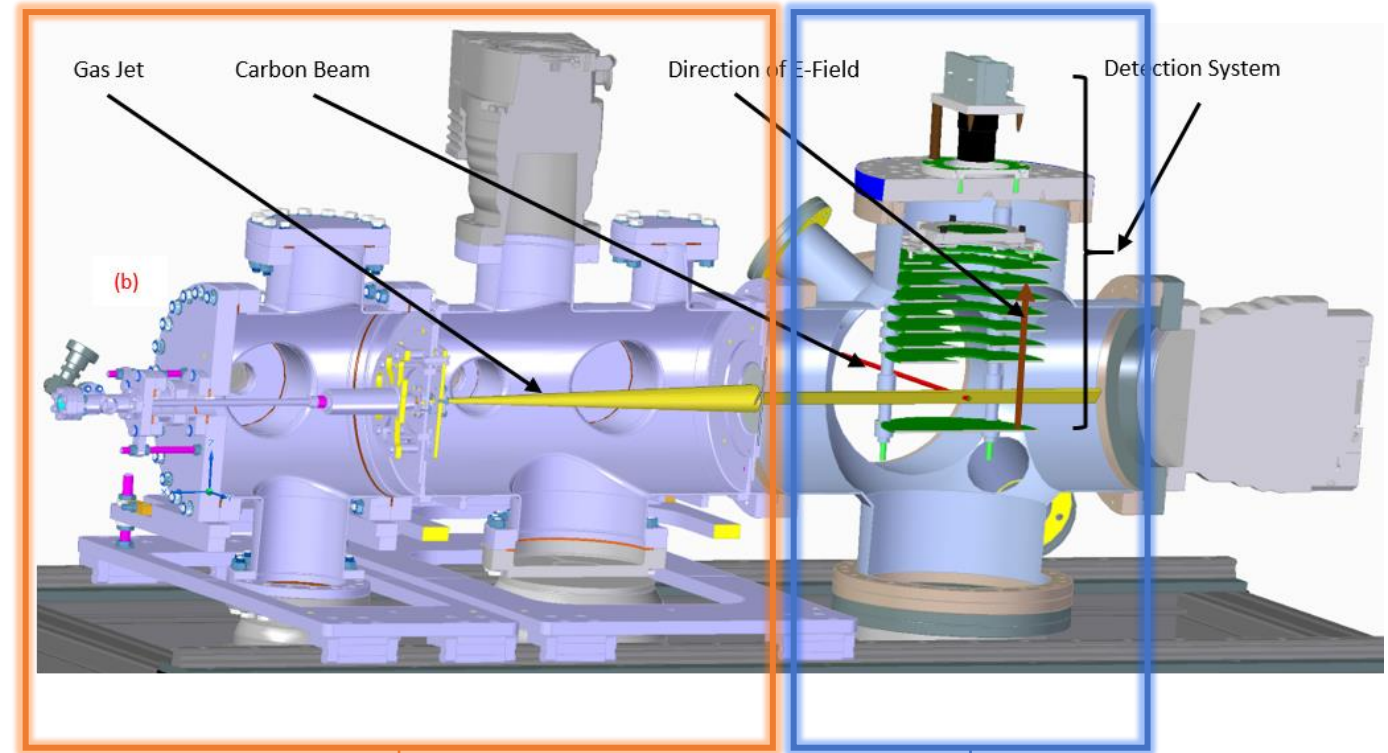
Additional gain required

Theoretical gain	pessimistic	optimistic	
QE P43	1.2	1.4	← Installed (Mostly engineering task)
MCP Double chevron	100	1000	
Effective ions extraction	1	1-4	← extraction system design
curtain thickness	2	5	
curtain density	2	5 (10)	← Gas jet section
	480	49700	

Considerations for IPM design

Need compact size for to account for

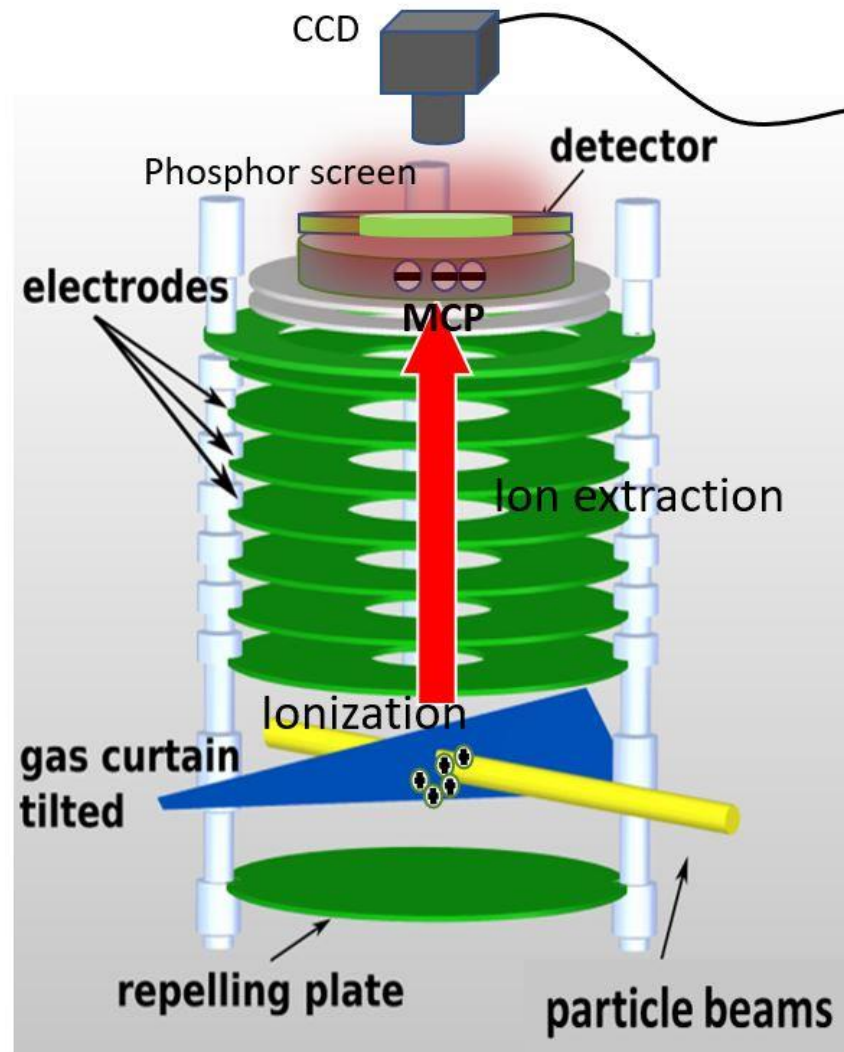
- Additional accessories for gas jet control and diagnostics.
- Camera and cabling for IPM.
- Accessing the alignment unit.
- Significant progress in gas jet generation system
- IPM needs attention



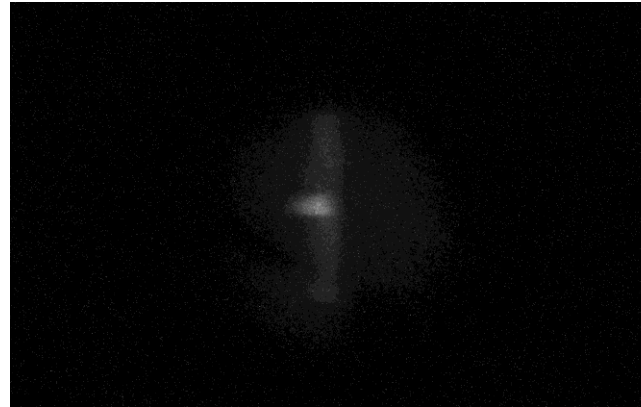
New design 150CF

Needs attention

Ionisation Profile Monitor: working



What camera sees

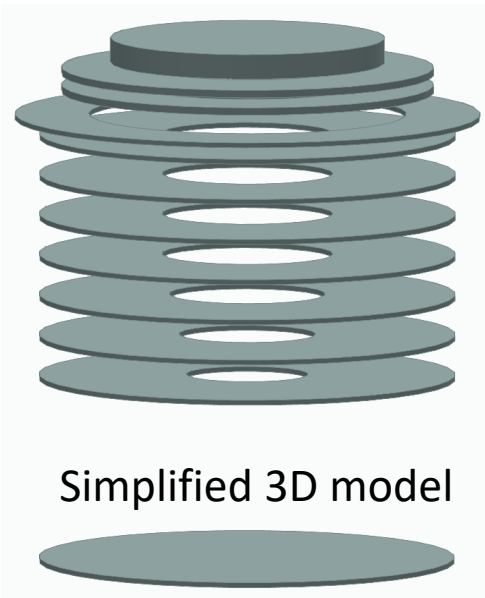


Simulations Considerations

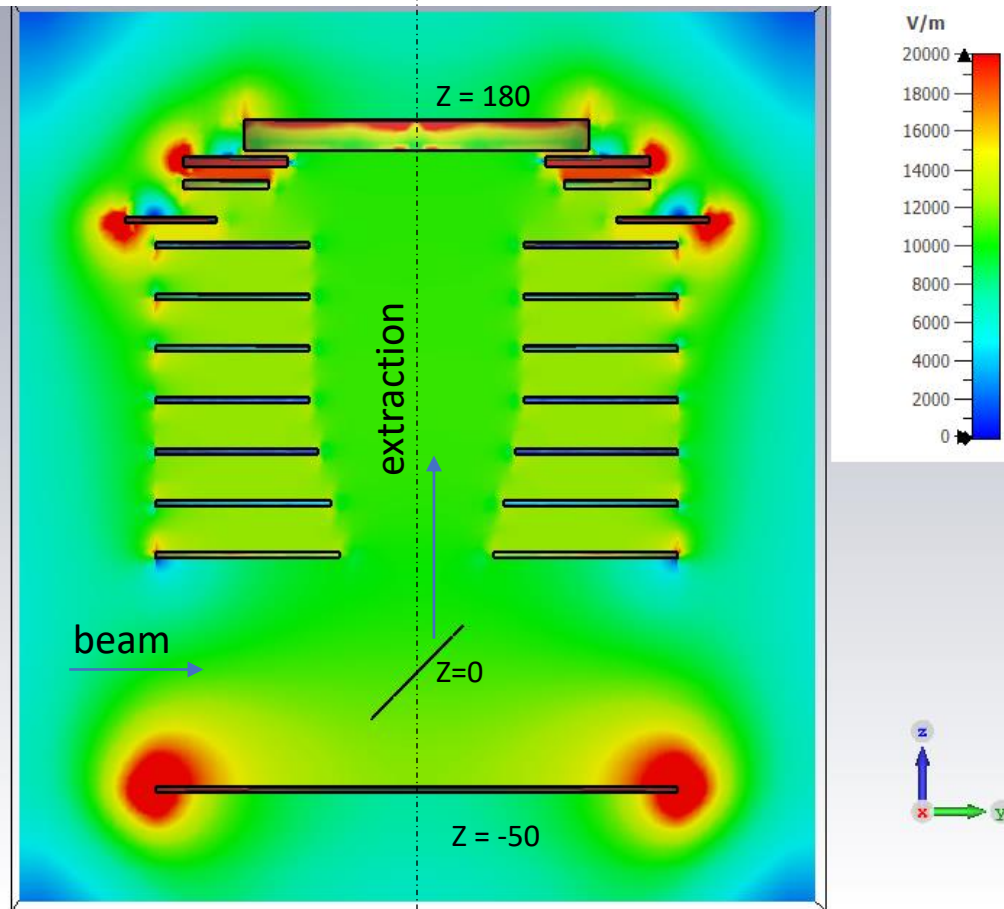
- reduce the size, -
- Particle energy $> 2\text{keV}$ particle energy.
- Quantify the contribution of surroundings.



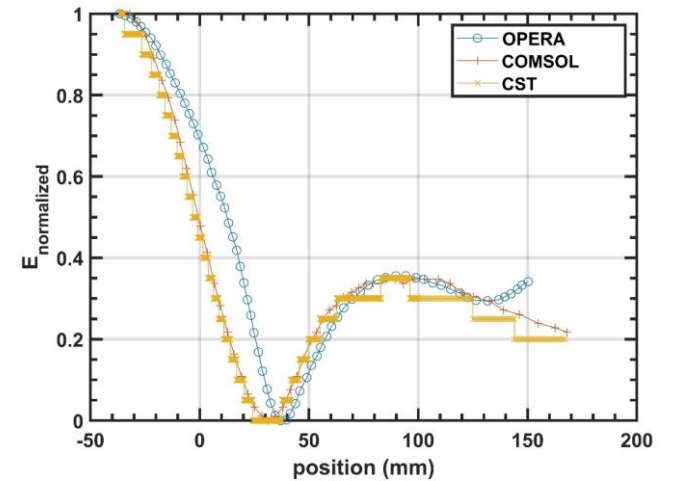
Benchmark: E-field distribution



Simulated electric field along the IPM axis



E-Field	
Component	Abs
Cross section	A
Cutplane at X	0.000 mm
Maximum on Plane (Plot)	69807.8 V/m
Maximum (Solver)	93614.1 V/m

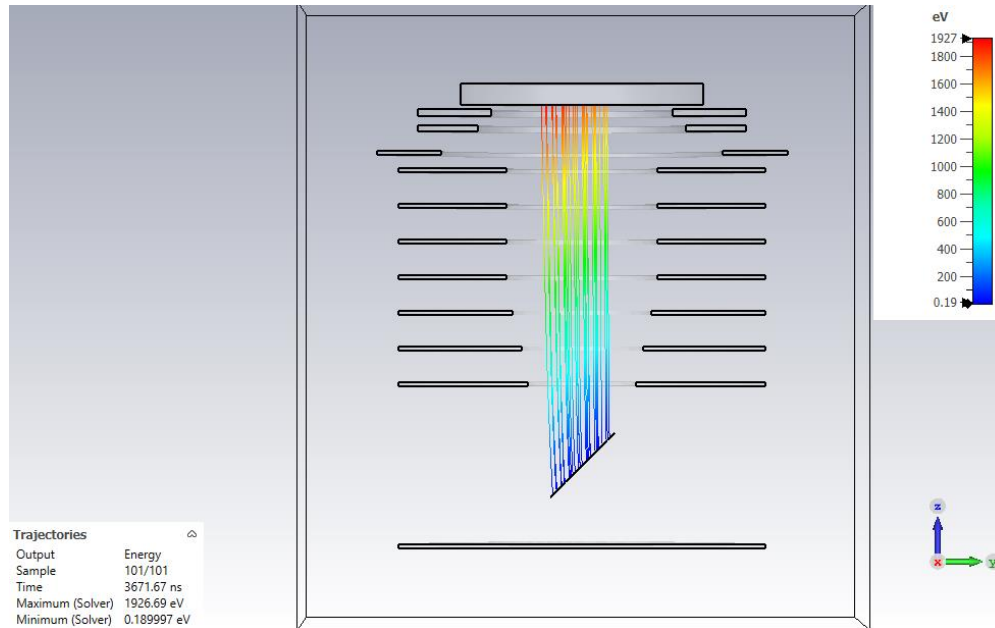


Comparison with previous data to check for inconsistencies in the boundary conditions

Benchmark: Ion trajectories and beam profile.

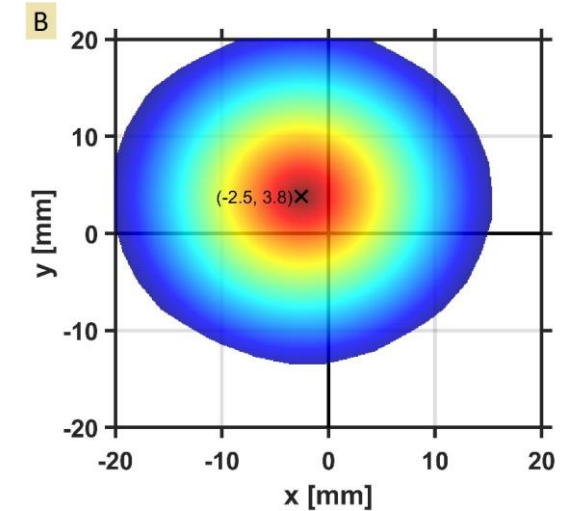
Particle trajectories simulations:

- Source is an elliptical projection 3cm of beam on the curtain.
- **Neutral velocity drift:** 0.1 eV due to neutral velocity of jet.
- **Recoil drift** of ions results in the 0.2 eV Drift.
- Recoil may have a distribution function. Need further study.
- Average Transfer time $12\mu\text{s}$.

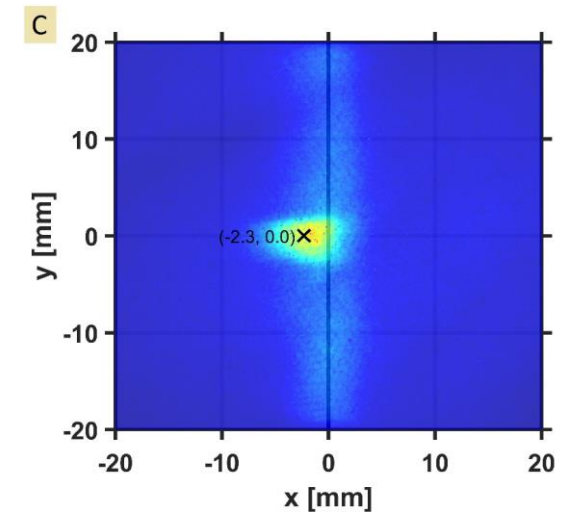


Simulations

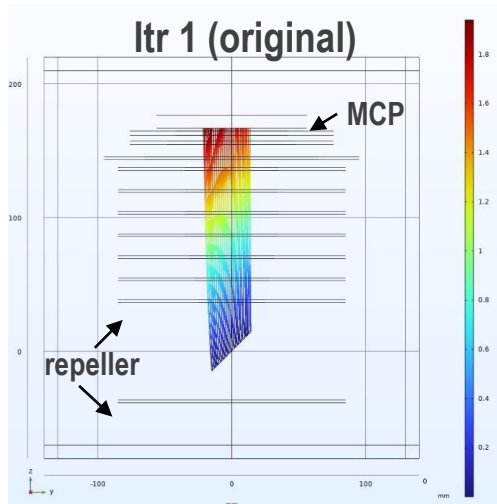
Beam profiles



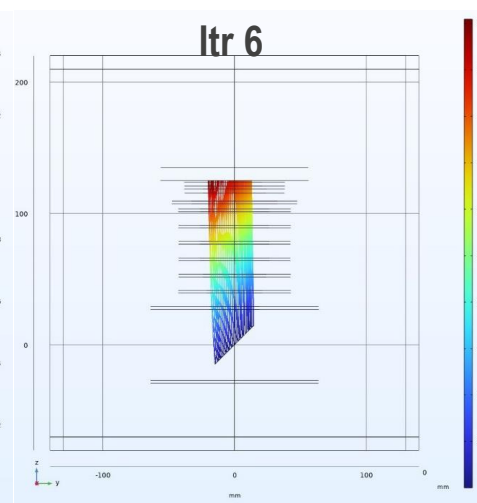
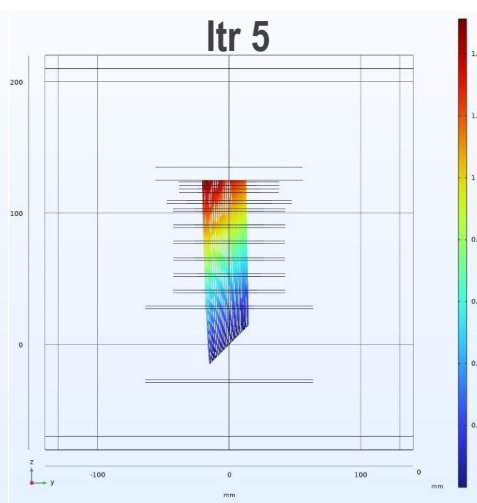
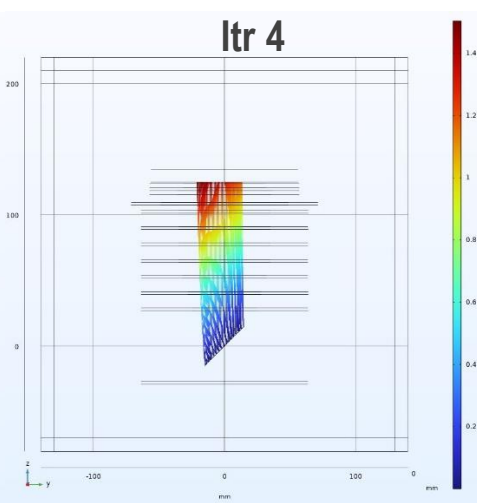
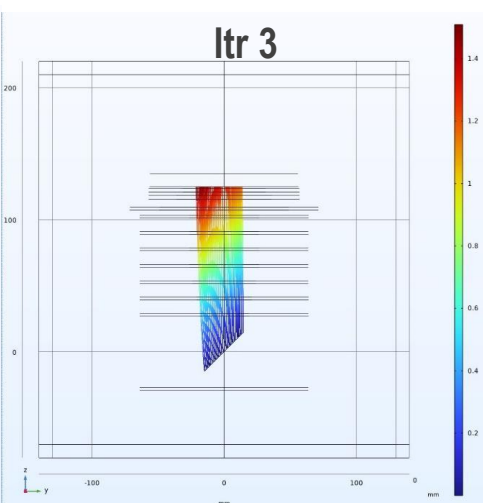
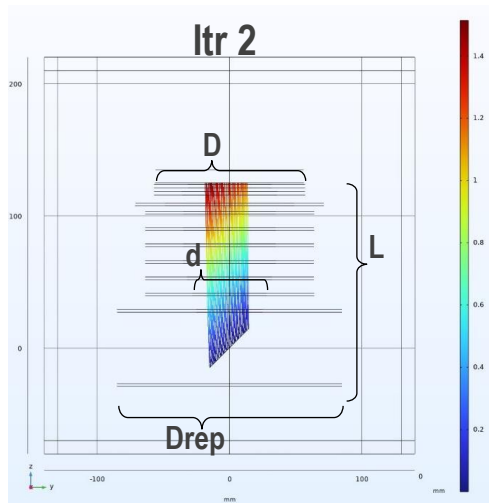
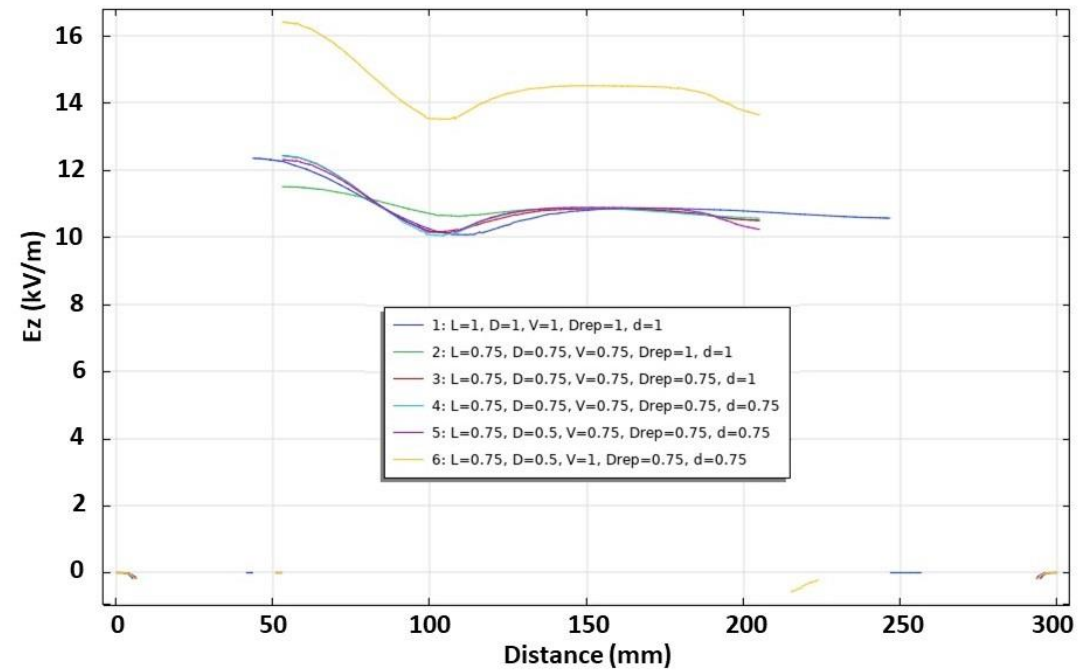
DCF
Experiments



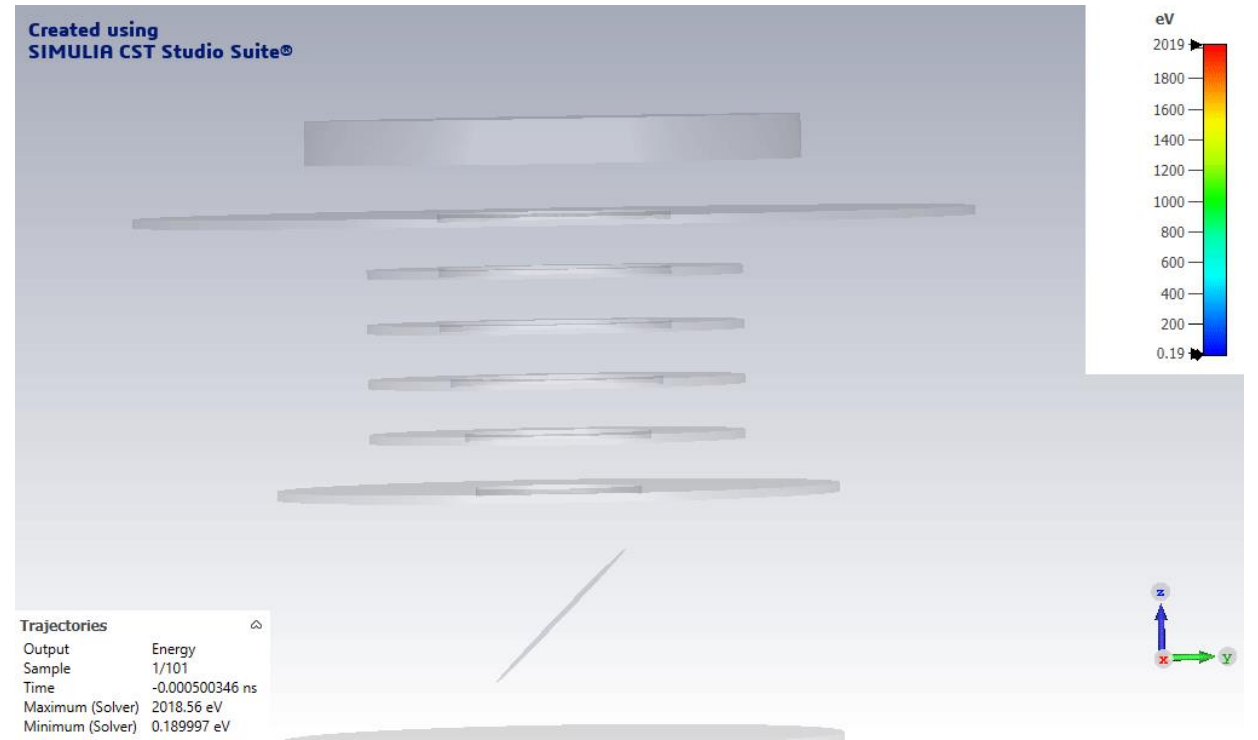
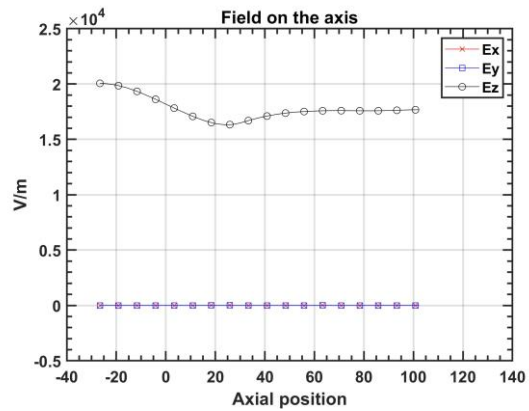
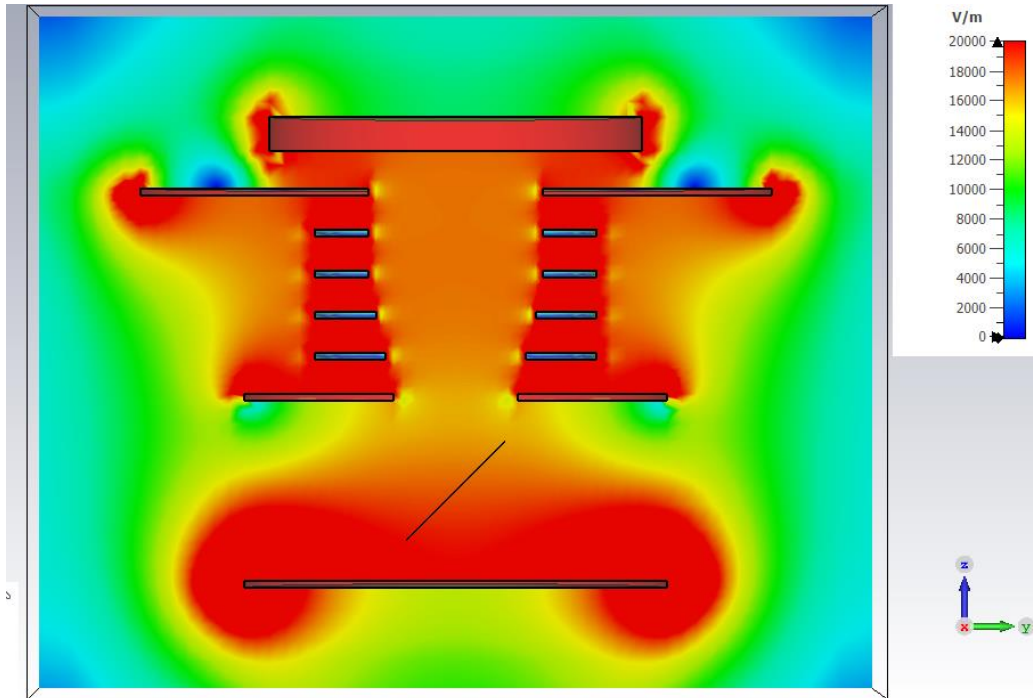
Optimizing size using parametric sweep



Parameter	itr1	itr2	itr3	itr4	itr5	itr6
L (plate sep.)	1	0.75	0.75	0.75	0.75	0.75
D (plate o.d.)	1	0.75	0.75	0.75	0.5	0.5
V (voltage)	1	0.75	0.75	0.75	0.75	1
Drep (repeller o.d.)	1	1	0.75	0.75	0.75	0.75
D (int. cutout dia.)	1	1	1	0.75	0.75	0.75

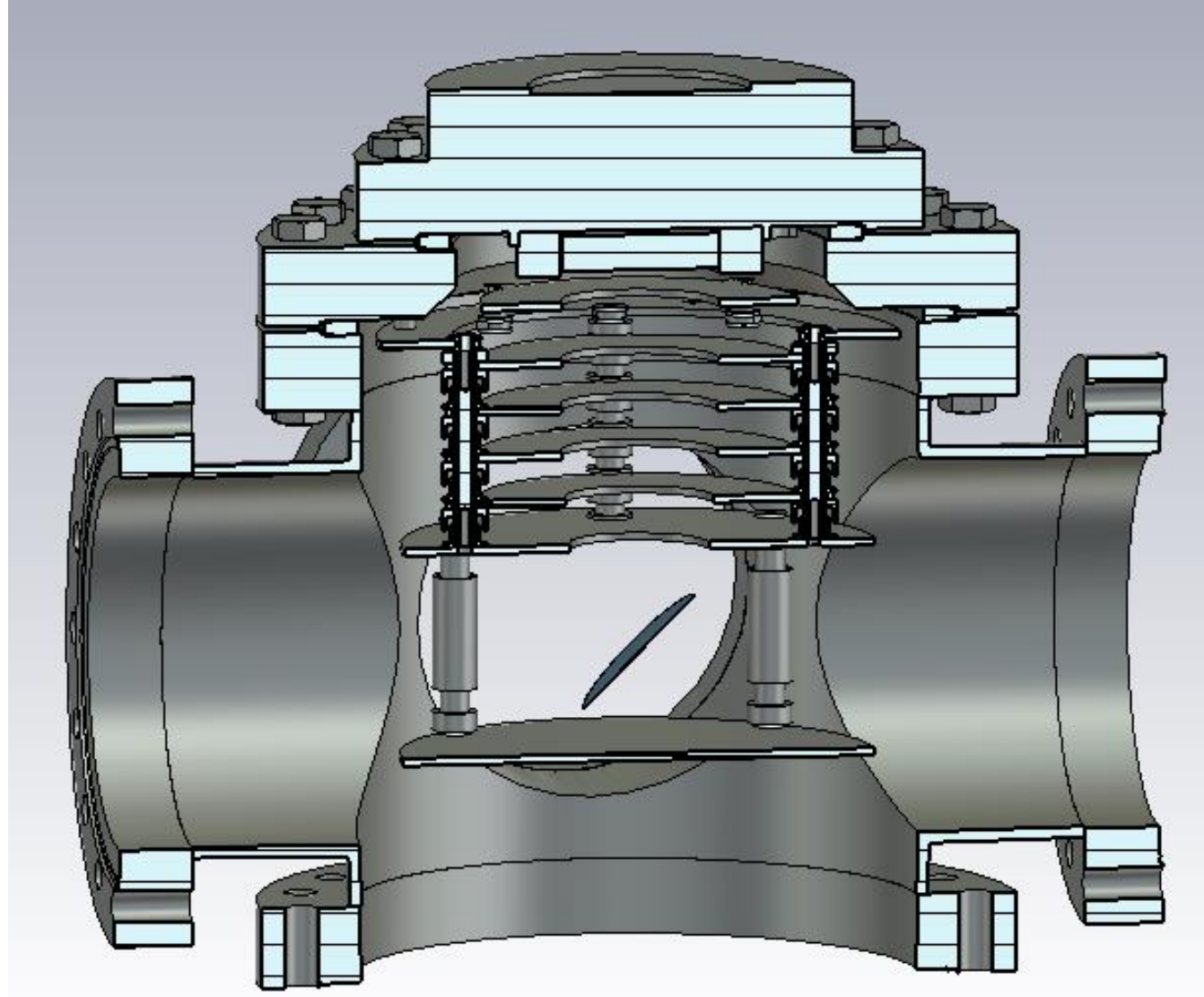


Extraction time

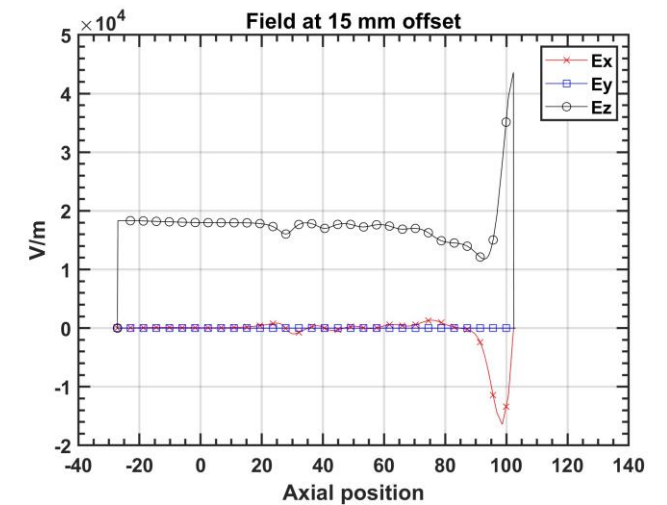
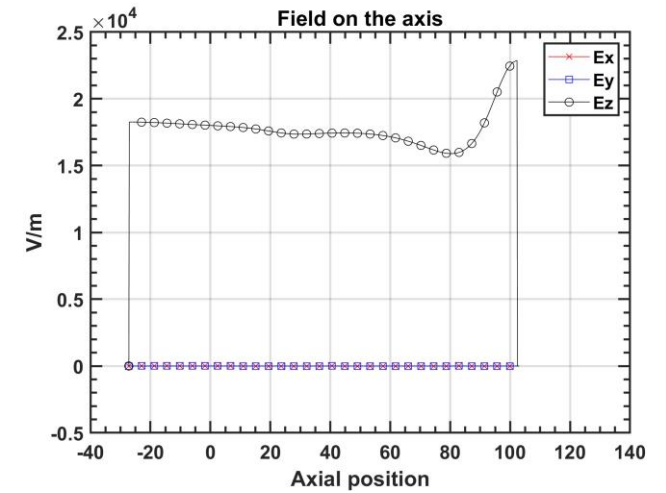
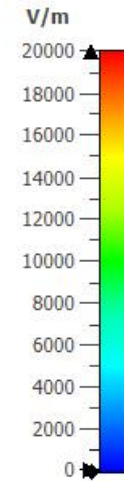
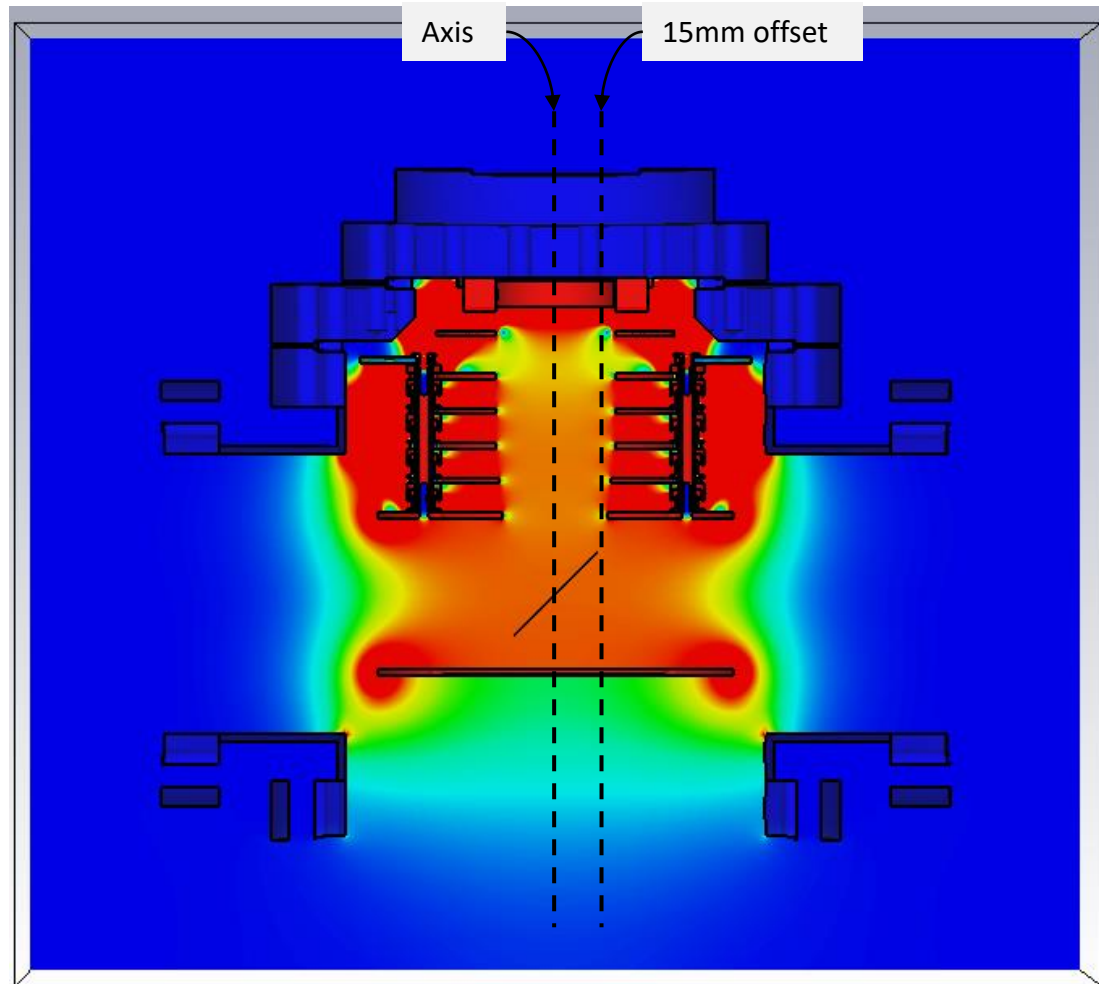


Transverse time 3us

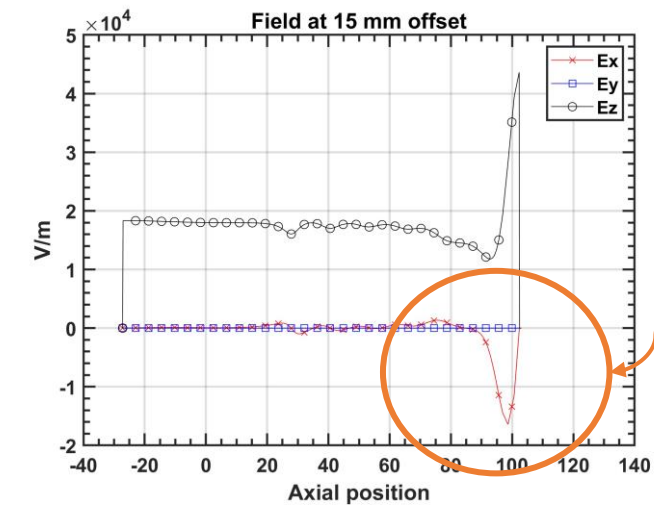
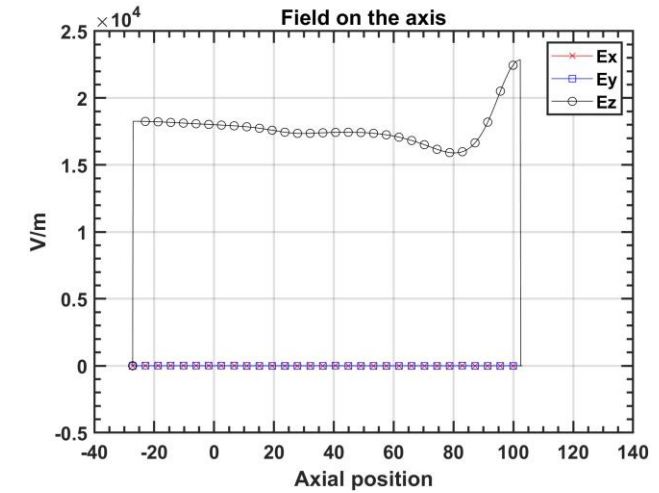
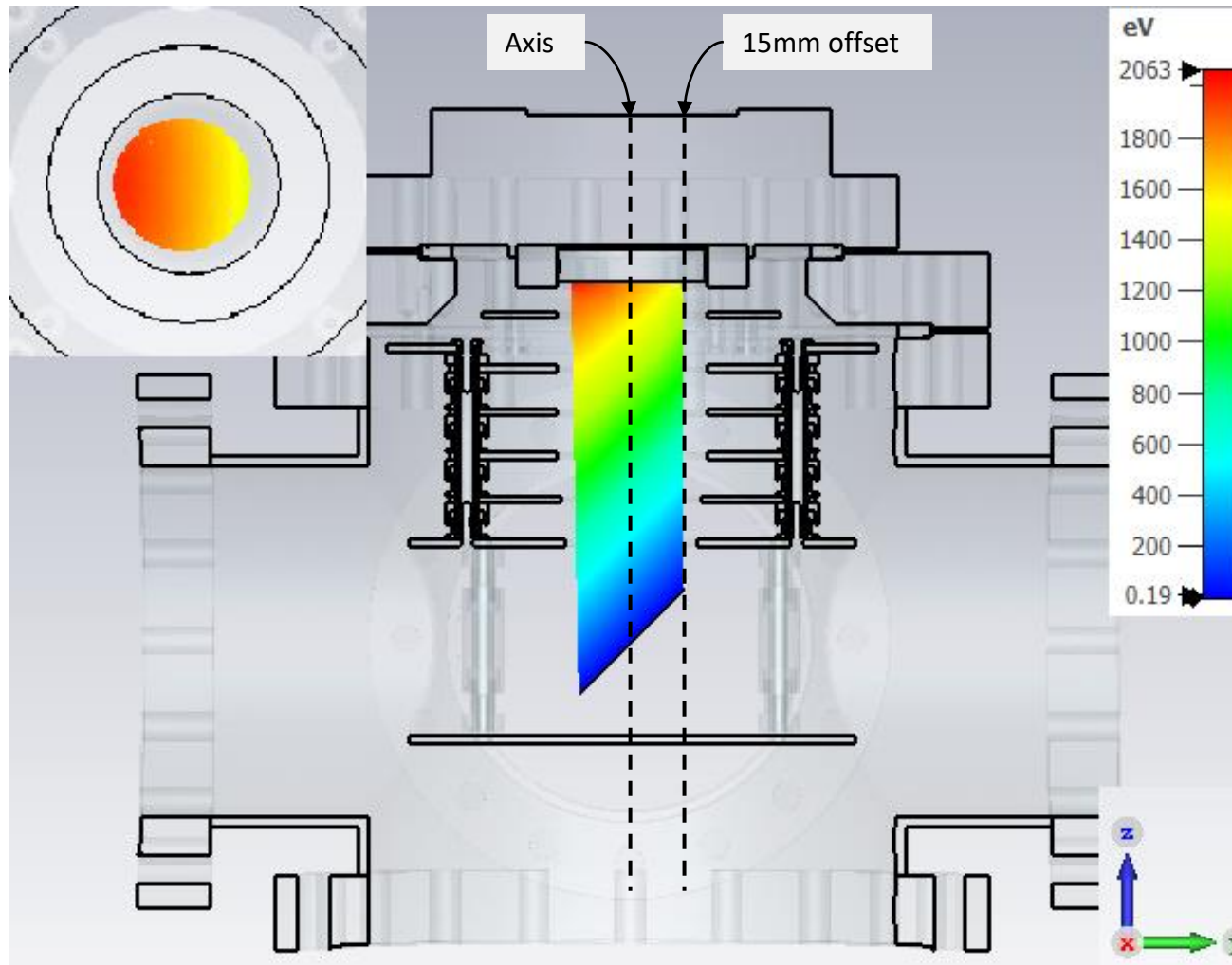
Full assemble of the new IPM



Assembly: Field distribution

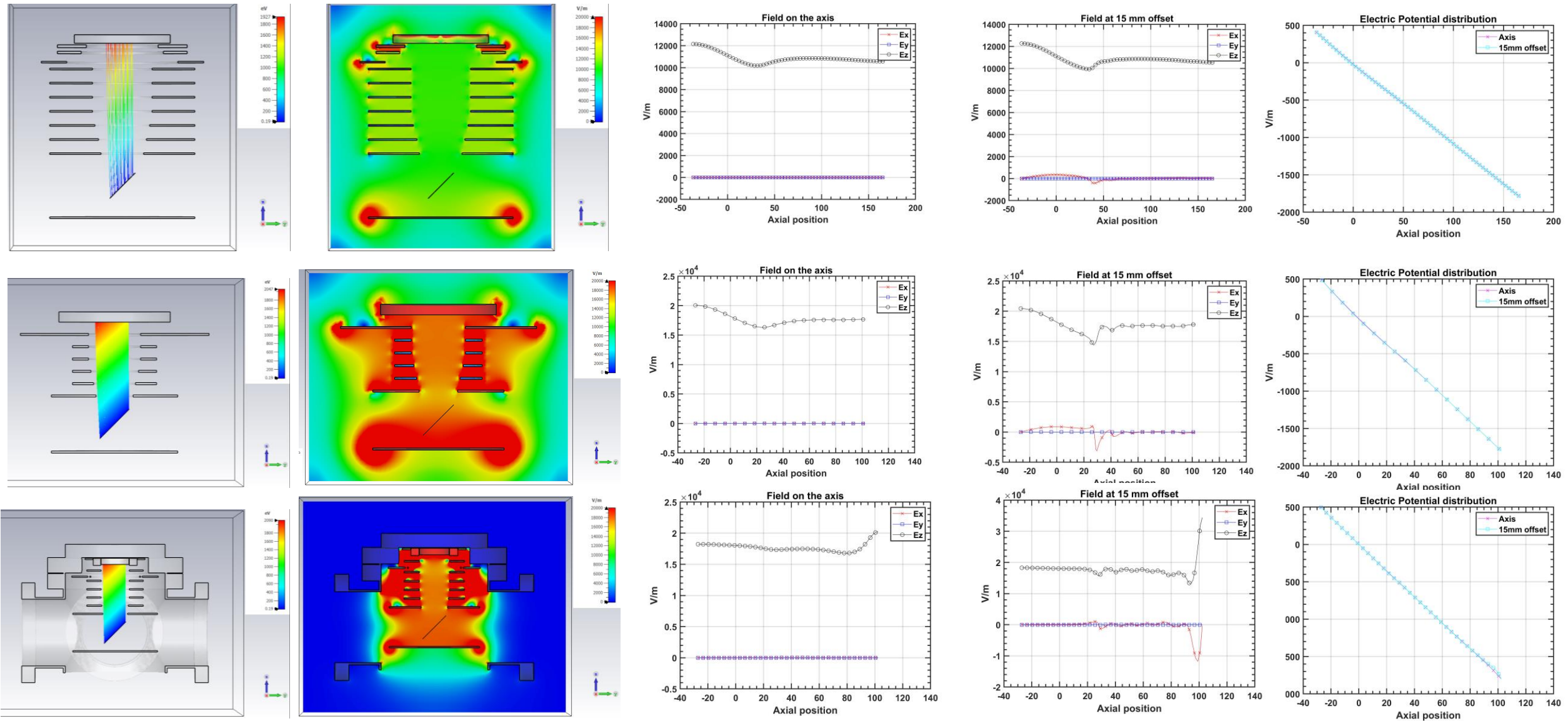


Assembly: Trajectory and profile plots



M. Patel et al., "Ionization Profile Monitor for in-vivo dosimetry in medical accelerators", in Proc. IPAC'24, Nashville, USA, May 2024, paper WEPG097.

Comparison with old design



Moving ahead

IPM challenges

- Remove the pinching radial field near MCP. Add suppressor?
- Recoil energy distribution and its affects.
- Estimation of total number of ionization events

Birmingham experiment campaign (5 to 21 -August):

- Data for proton beam to estimate detection limits at 15 MeV.
- Check for Repeatability of the data. Can be used to predict beam current distribution.

Thank you

Thanks to **Dr. Narender Kumar, Farahana Thesni** for their contribution.