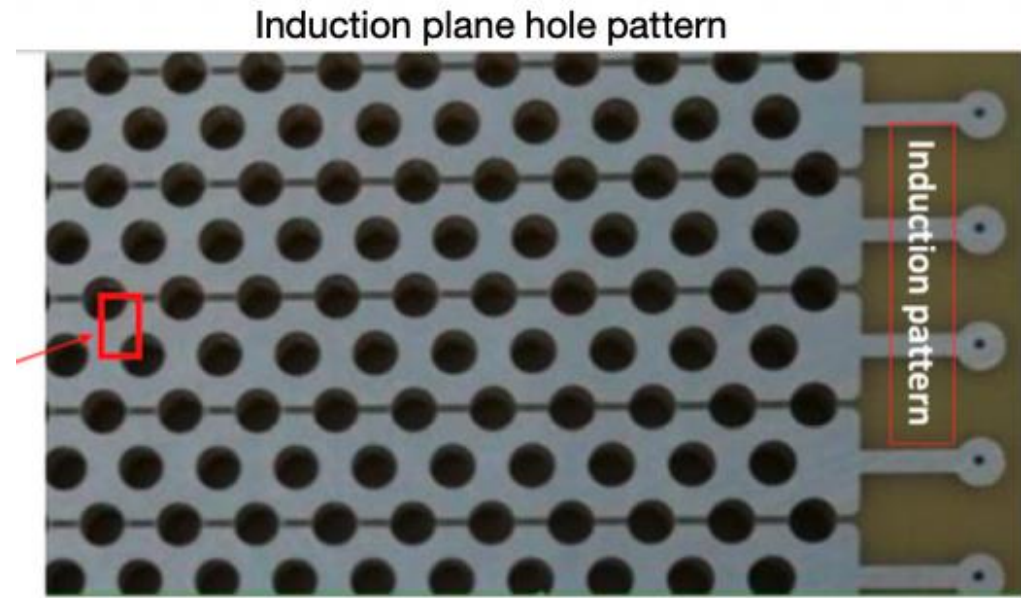
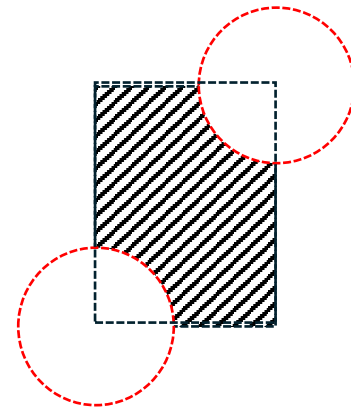
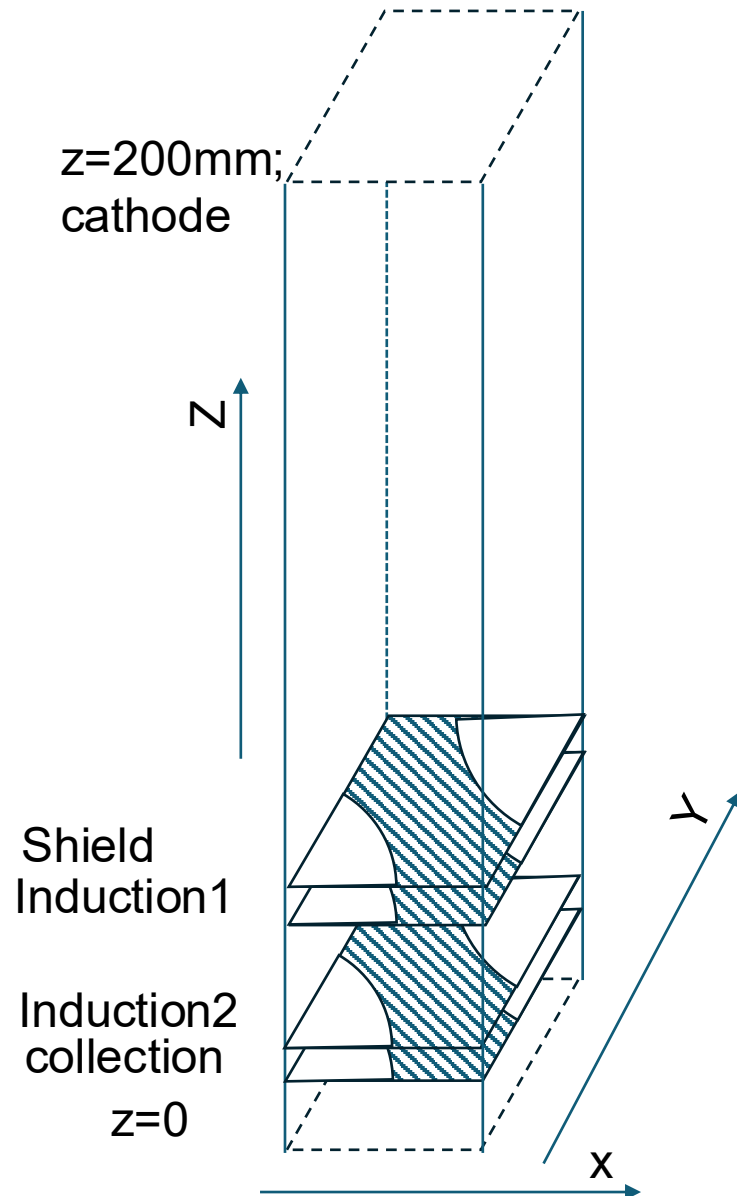


Field response check in PDVD

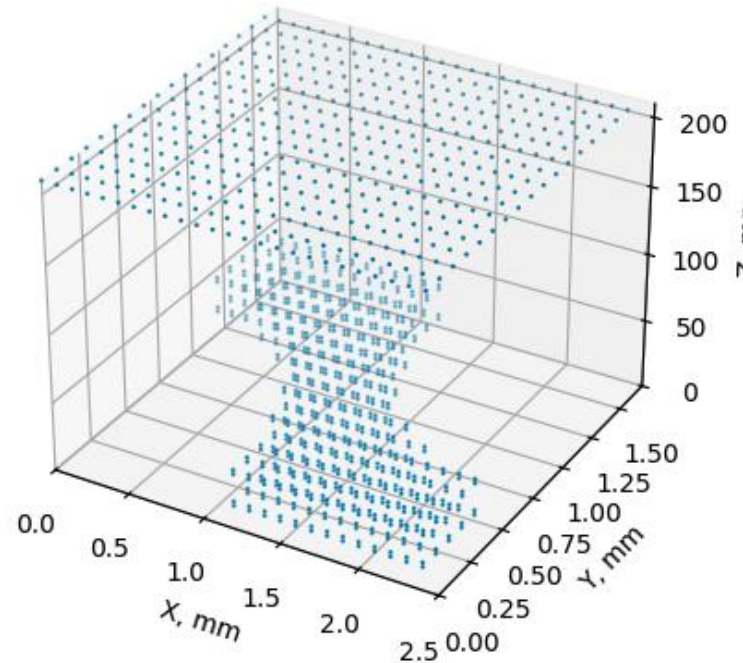
Xuyang Ning

3D Drift field

Minimal symmetry for Drift Field



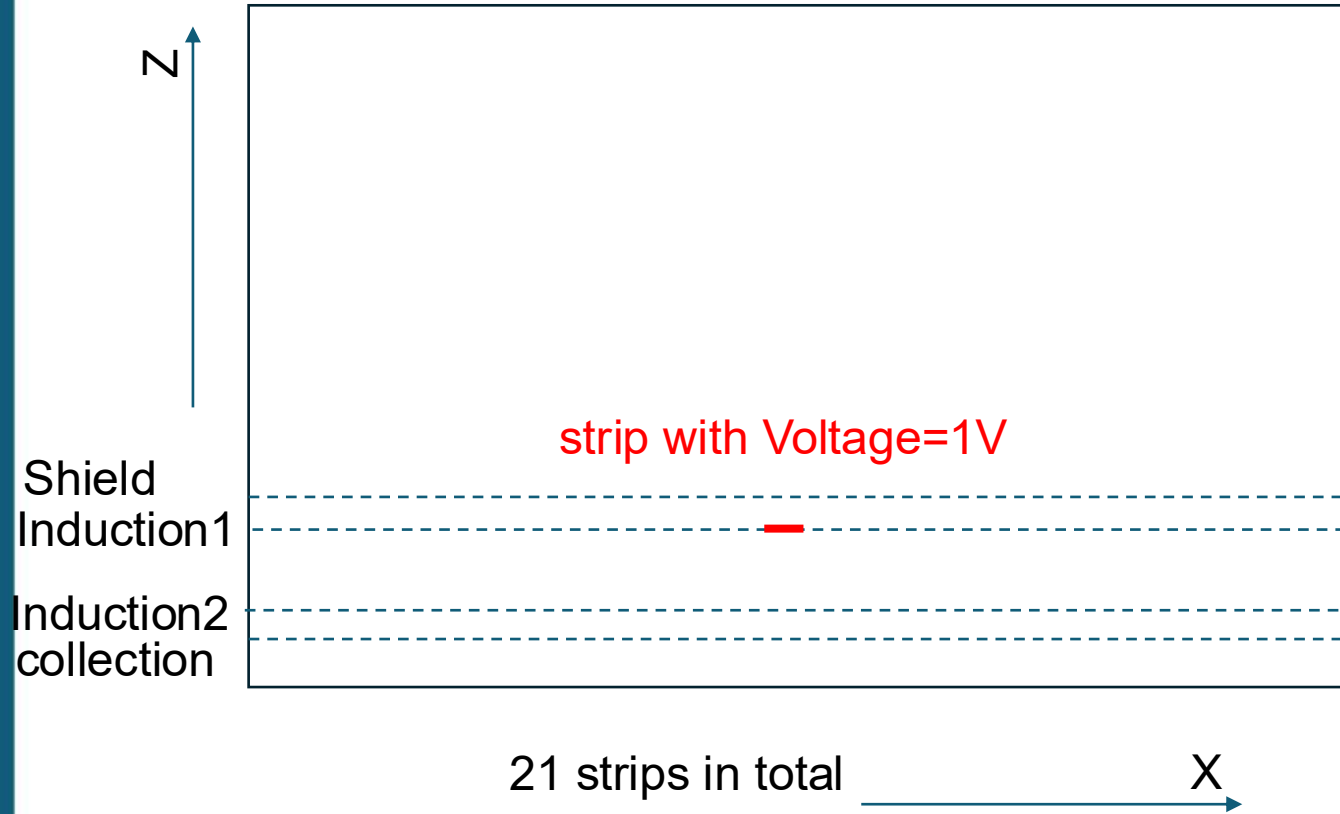
PCB Quarter 30deg - Boundary



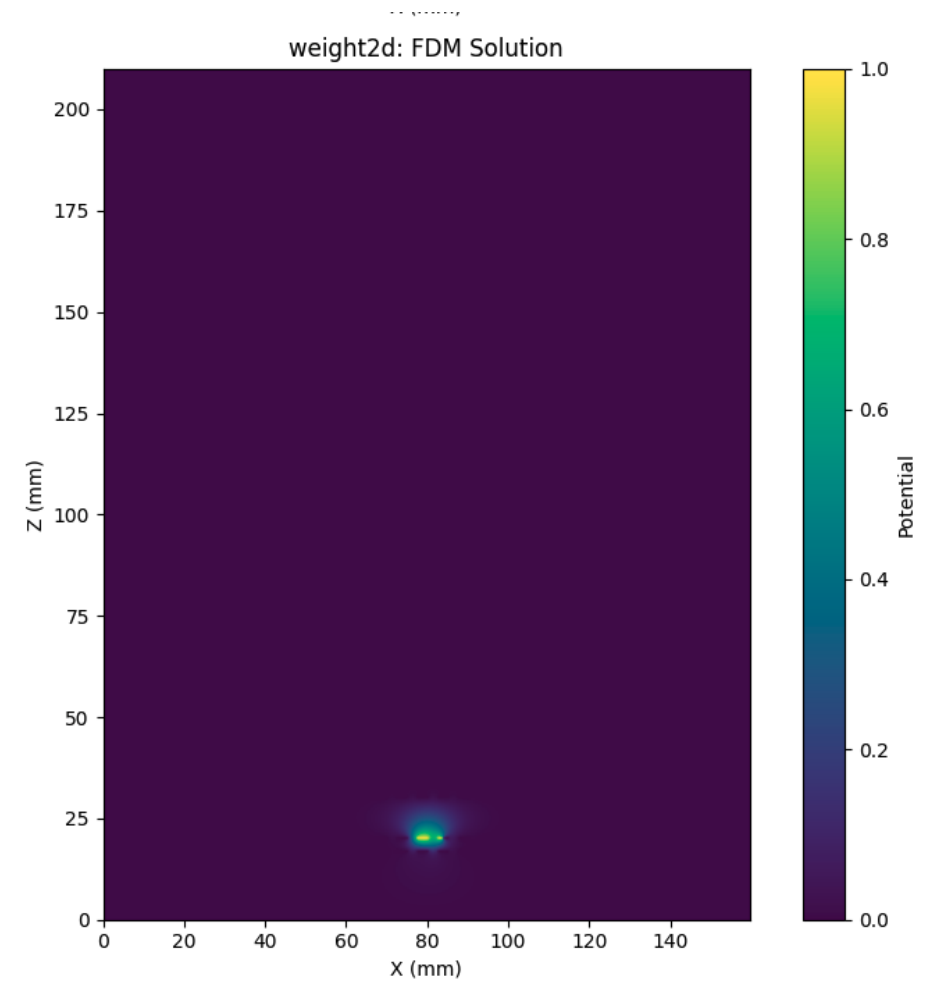
2 arrays to describe:
one for boundary;
one for voltage.

Then solved by FDM.

2D weighting field

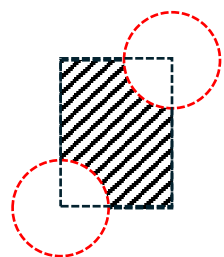


⊗, strip direction

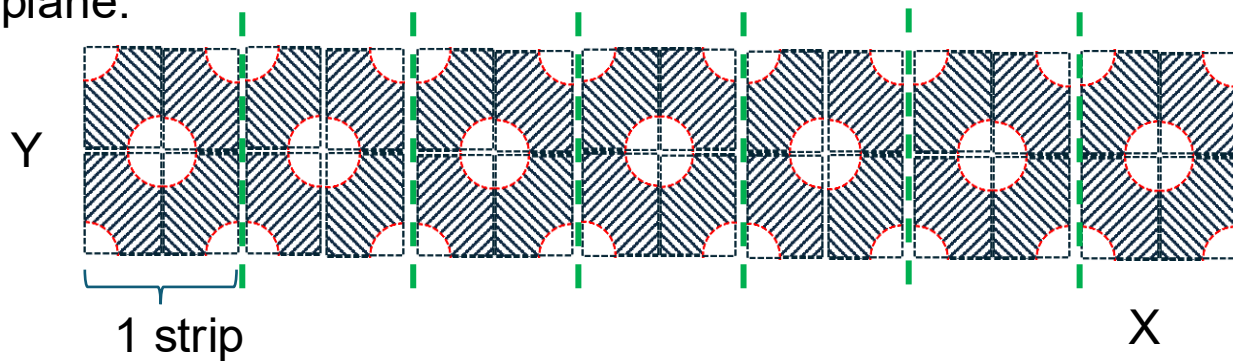


3D weighting field

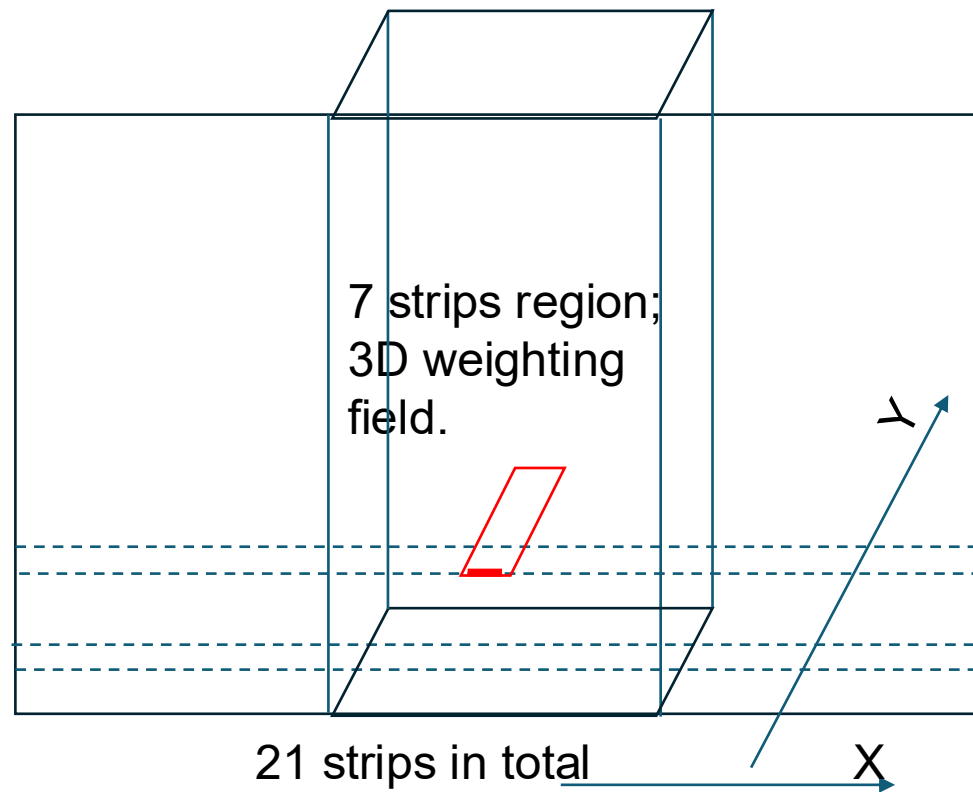
⊗, strip direction



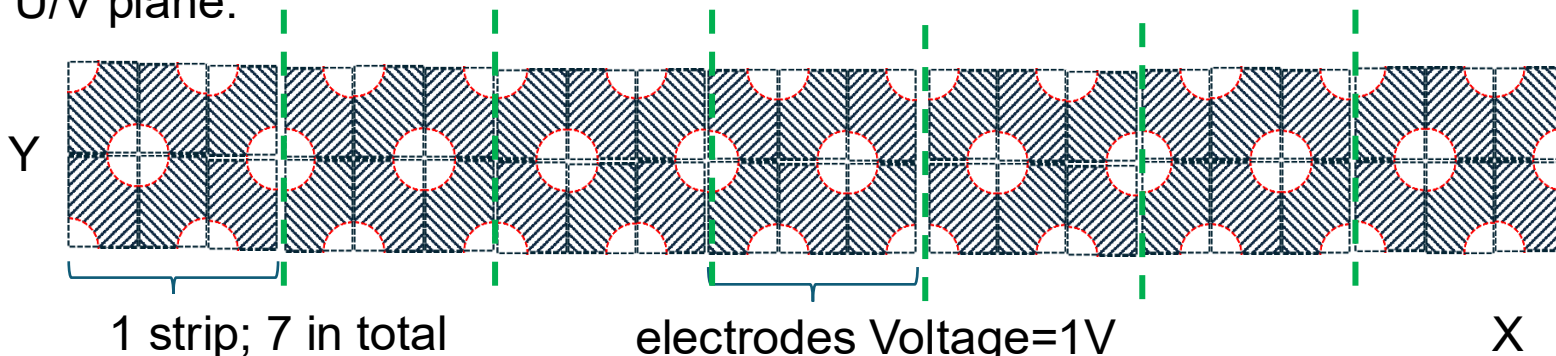
W plane:



Z

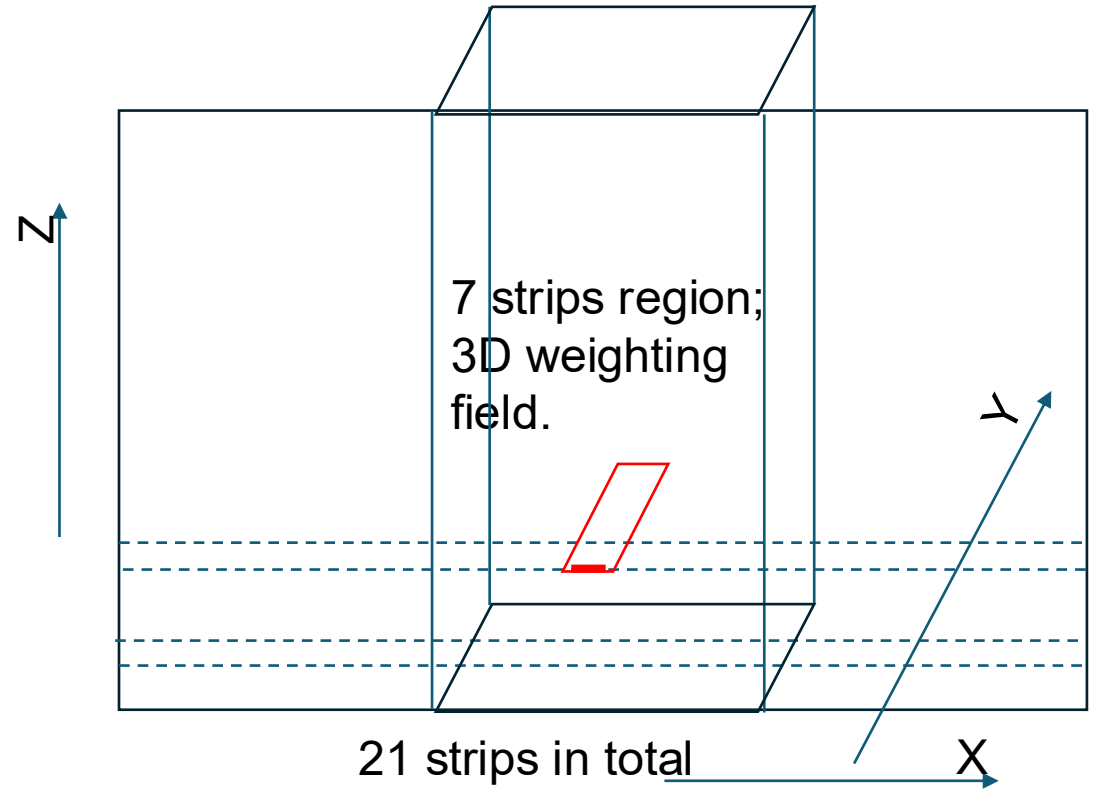


U/V plane:

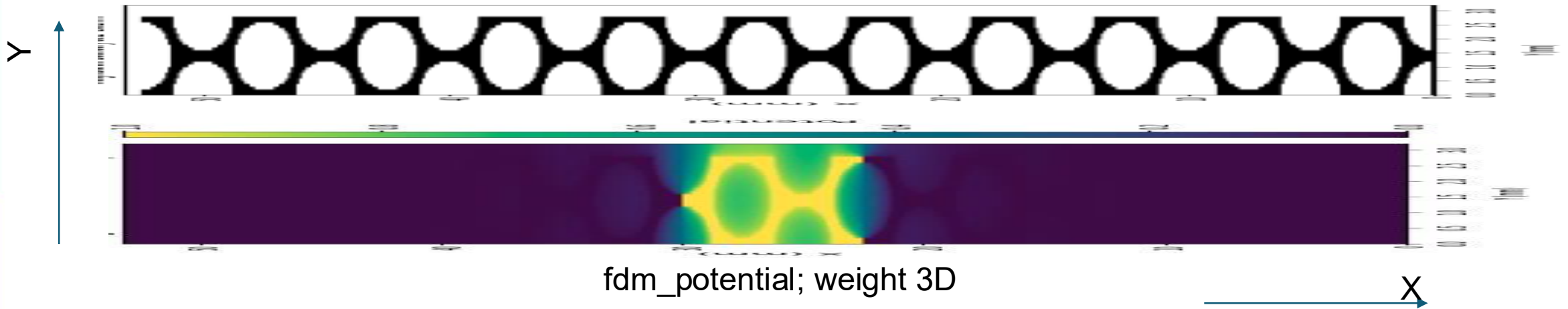


3D weighting field

initial value on boundary is got from
2D weighting field solution.

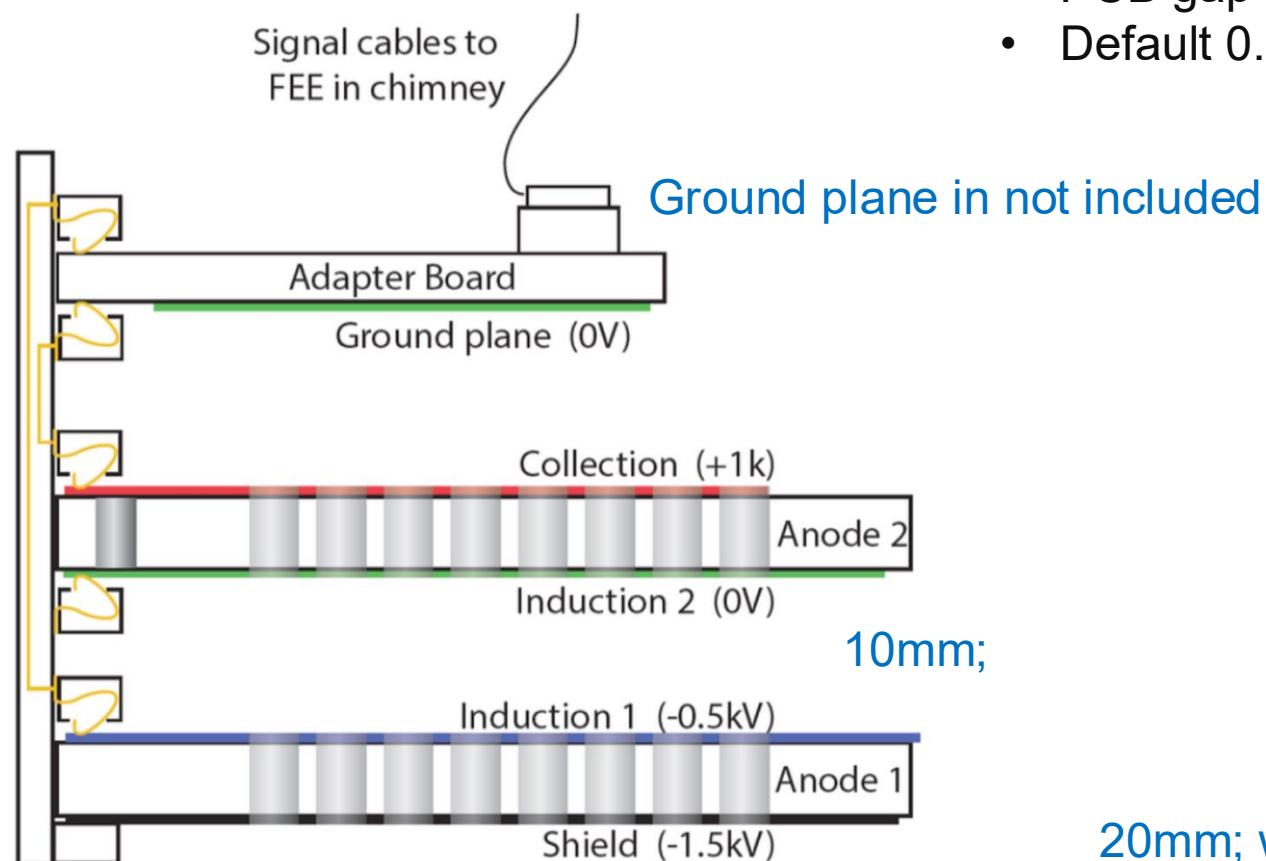


boundary

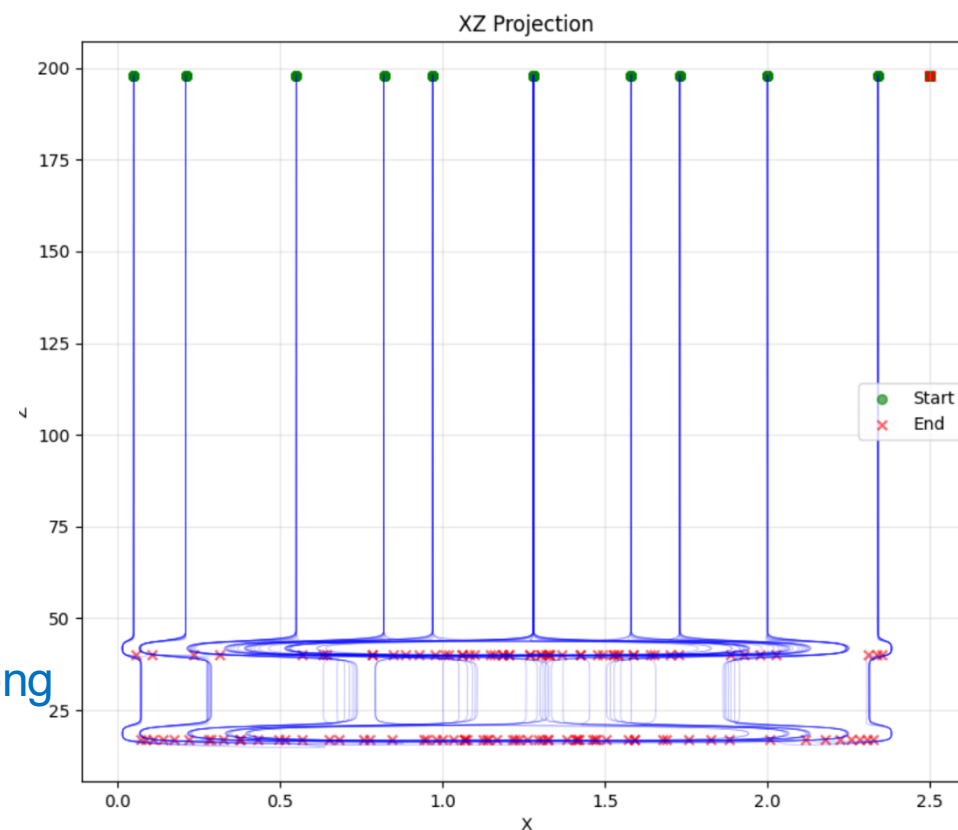


Check geometry in detail

- **Previous issues:**
- Hard-coded values in drift and 3D weighting fields
- PCB gap set to 200 (no unit)
- Default 0.1 mm grid spacing → incorrect 20 mm distance

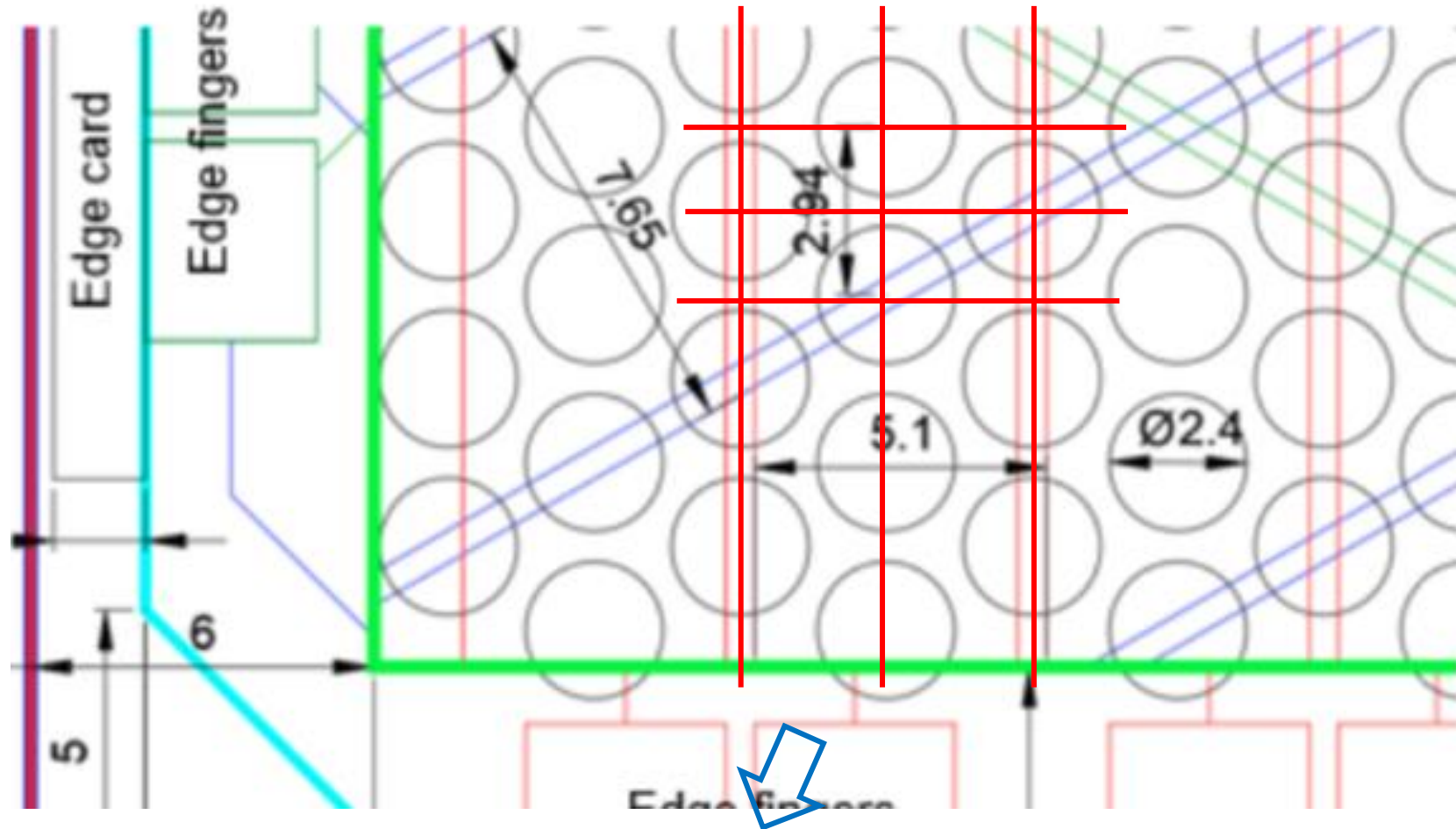


20mm; wrong

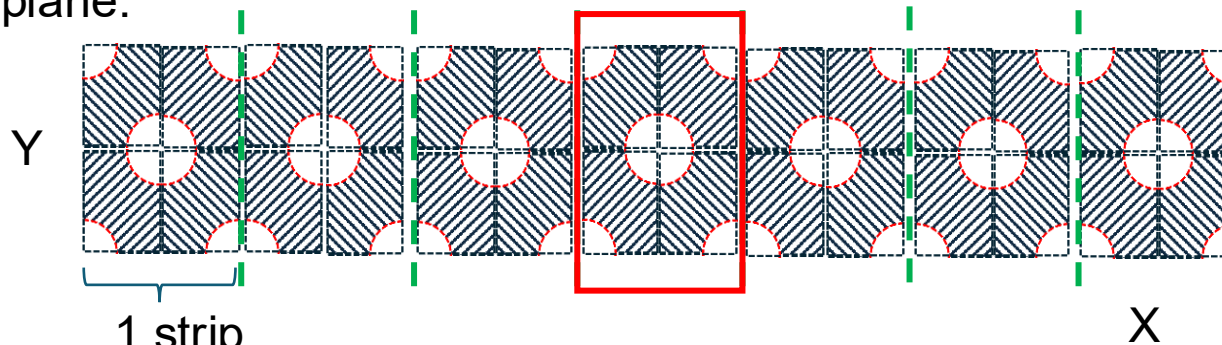


Due to the wrong gap, some electrons are collected at u plane;

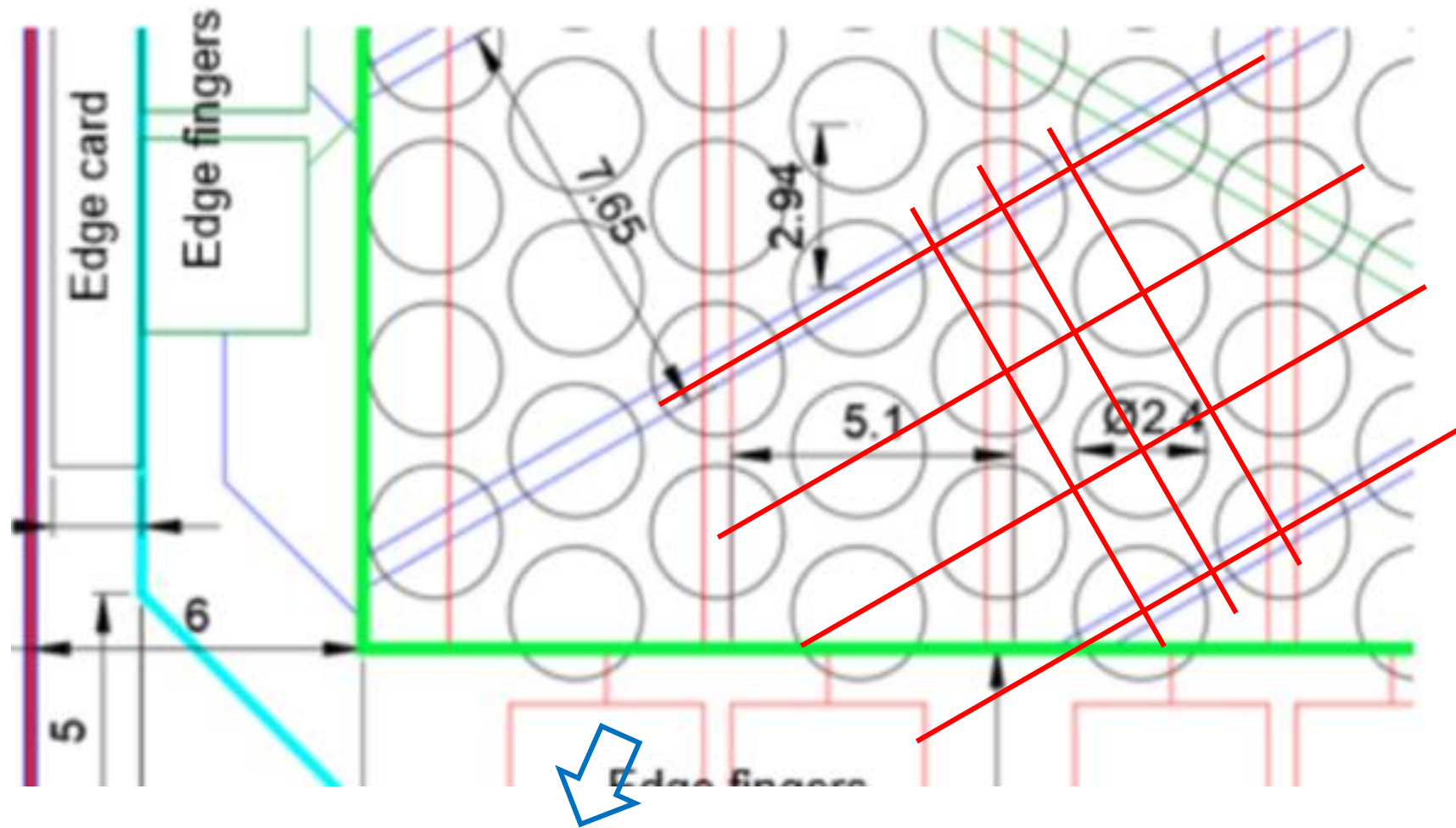
w strip



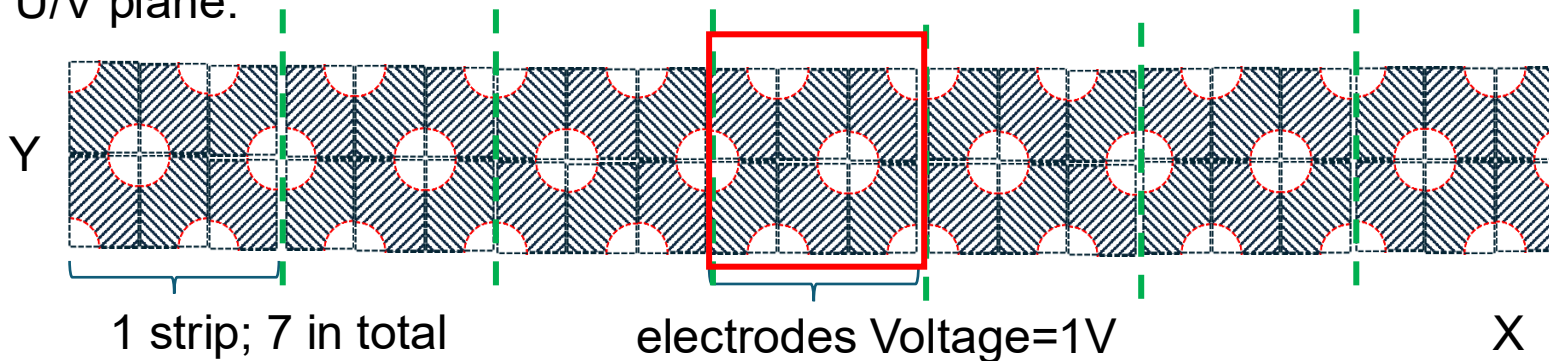
W plane:



u&v strip

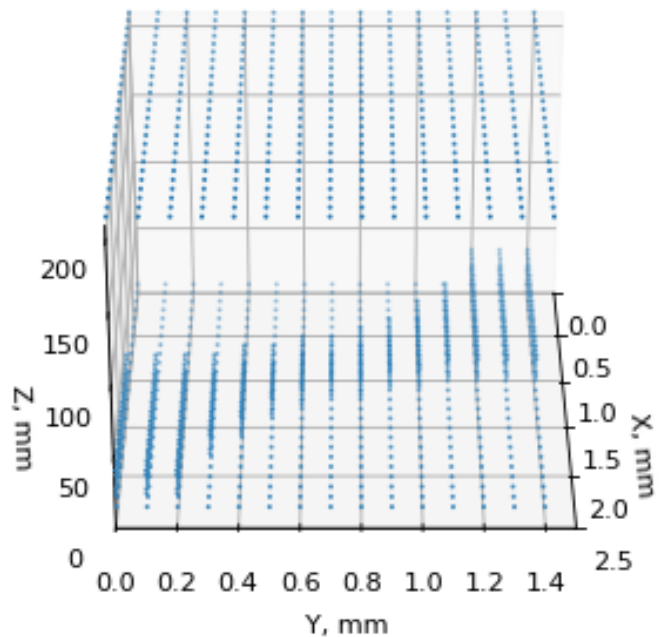


U/V plane:

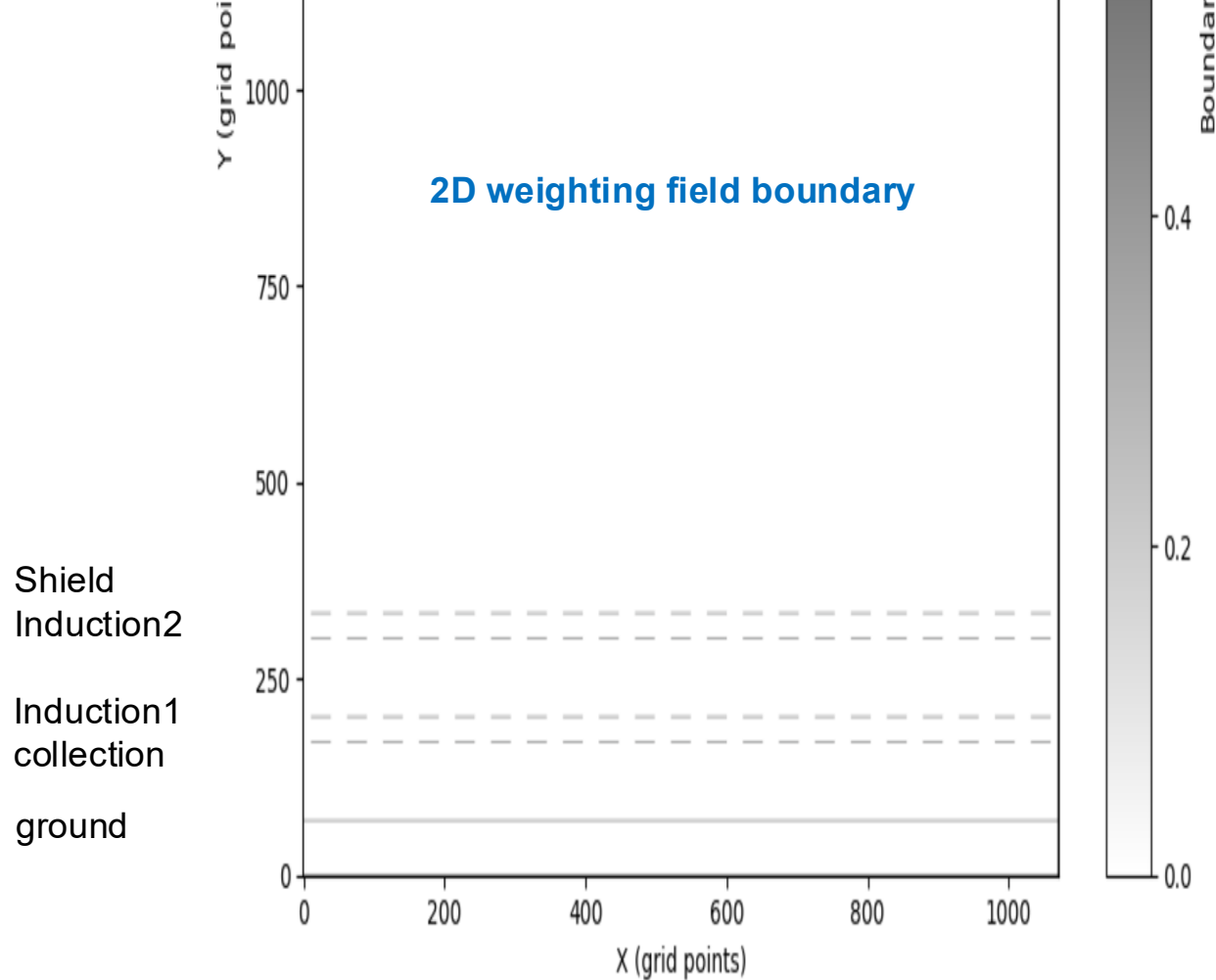


Updated geometry

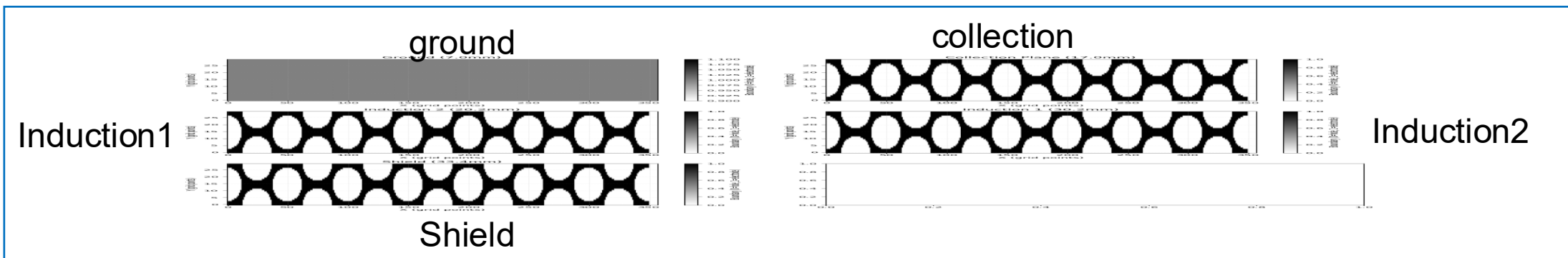
3D drift field



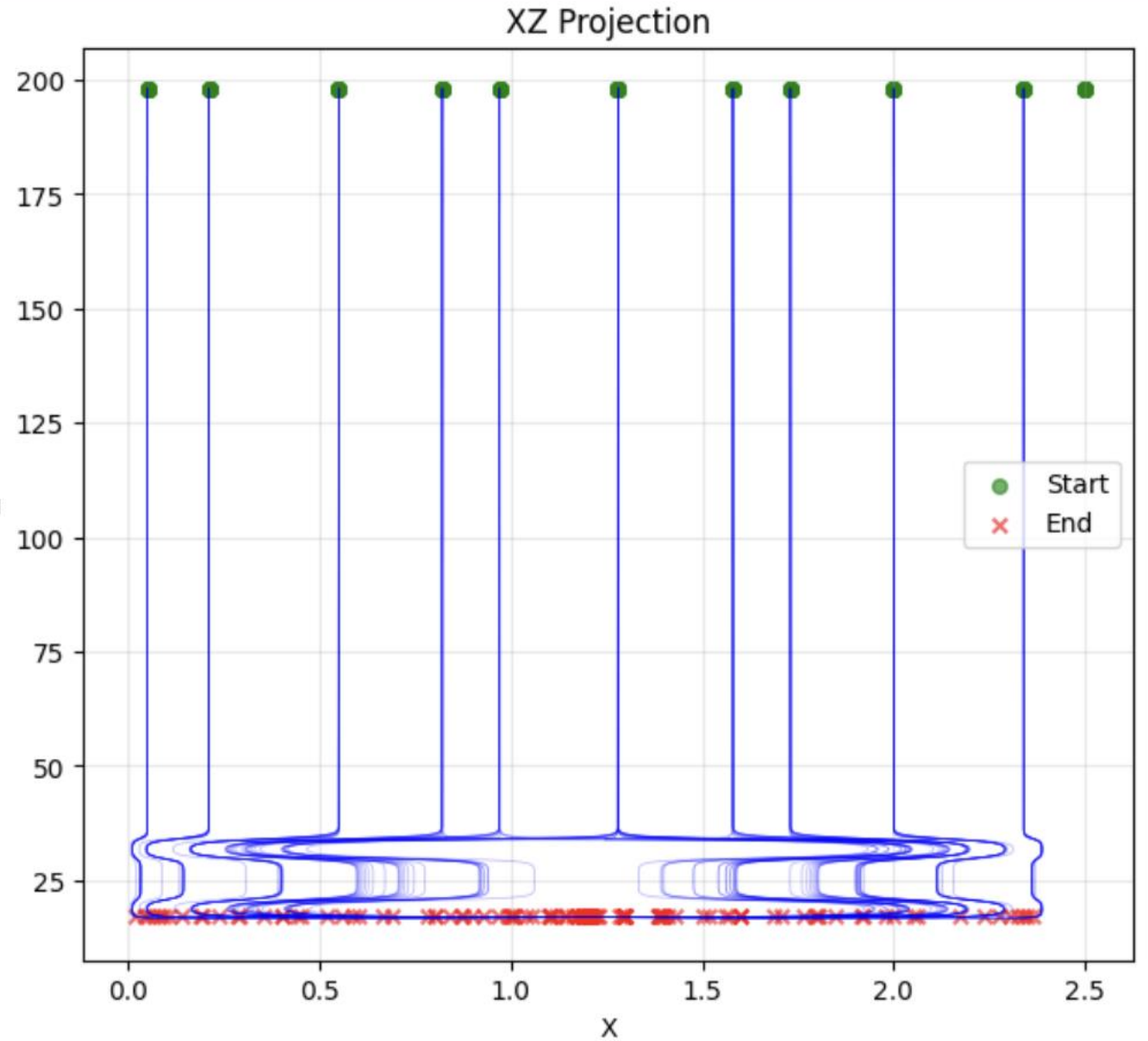
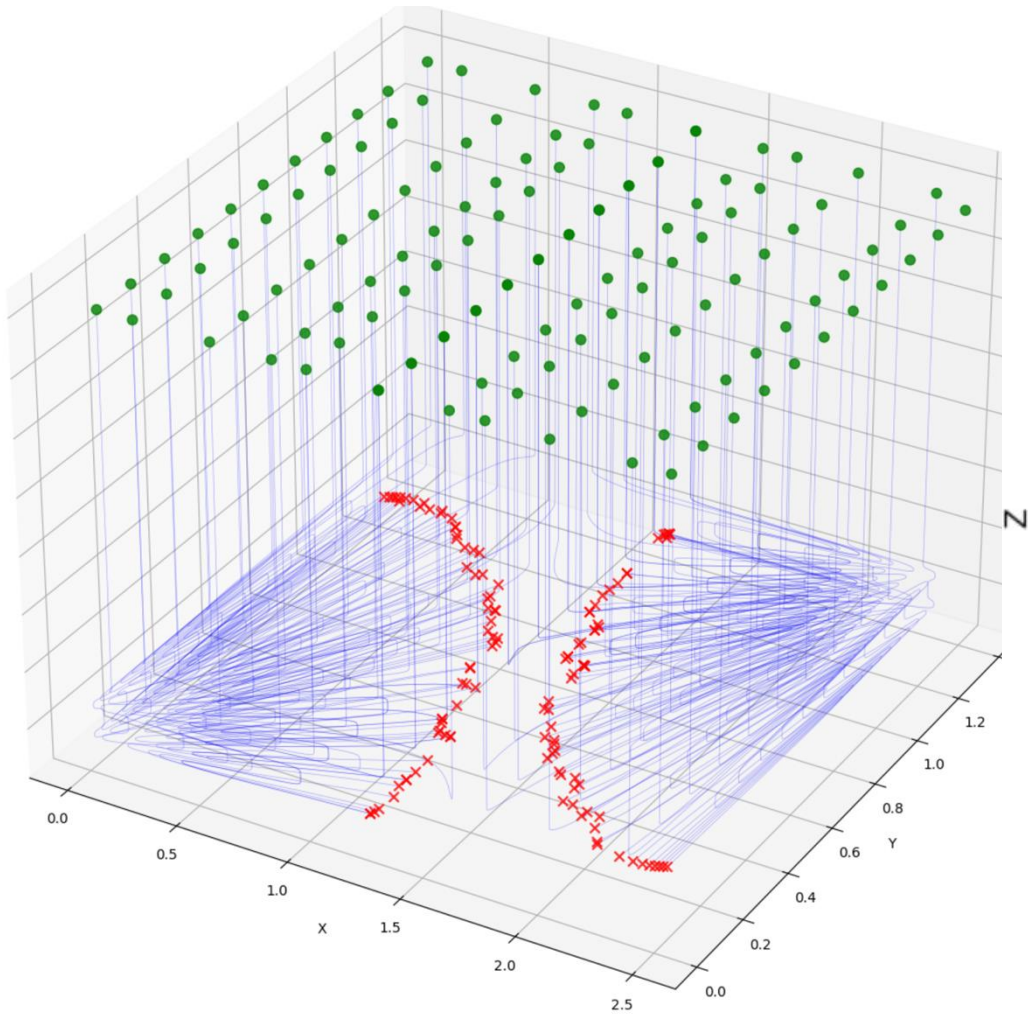
2D weighting field boundary



3D weighting field

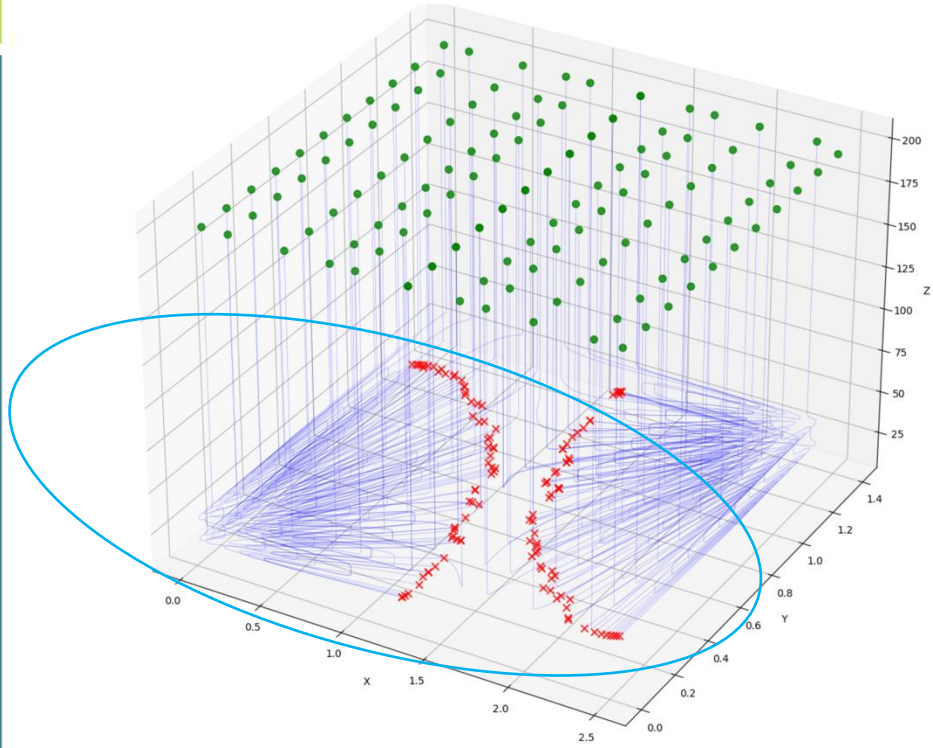


electron paths

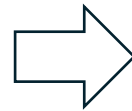


All electrons are collected at collection plane

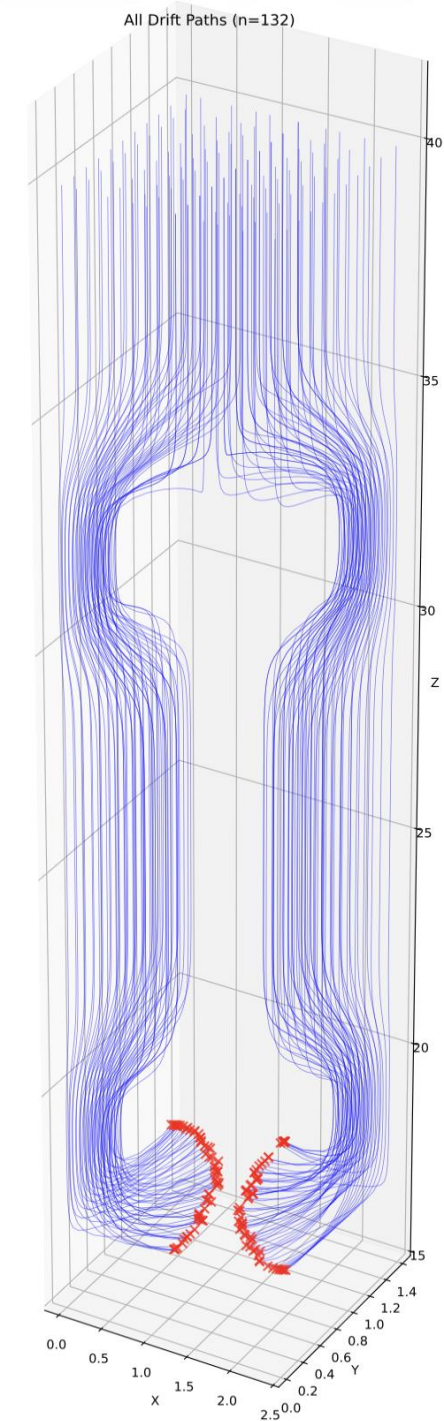
Check Drift paths



rescale this area in a more reasonable scale:

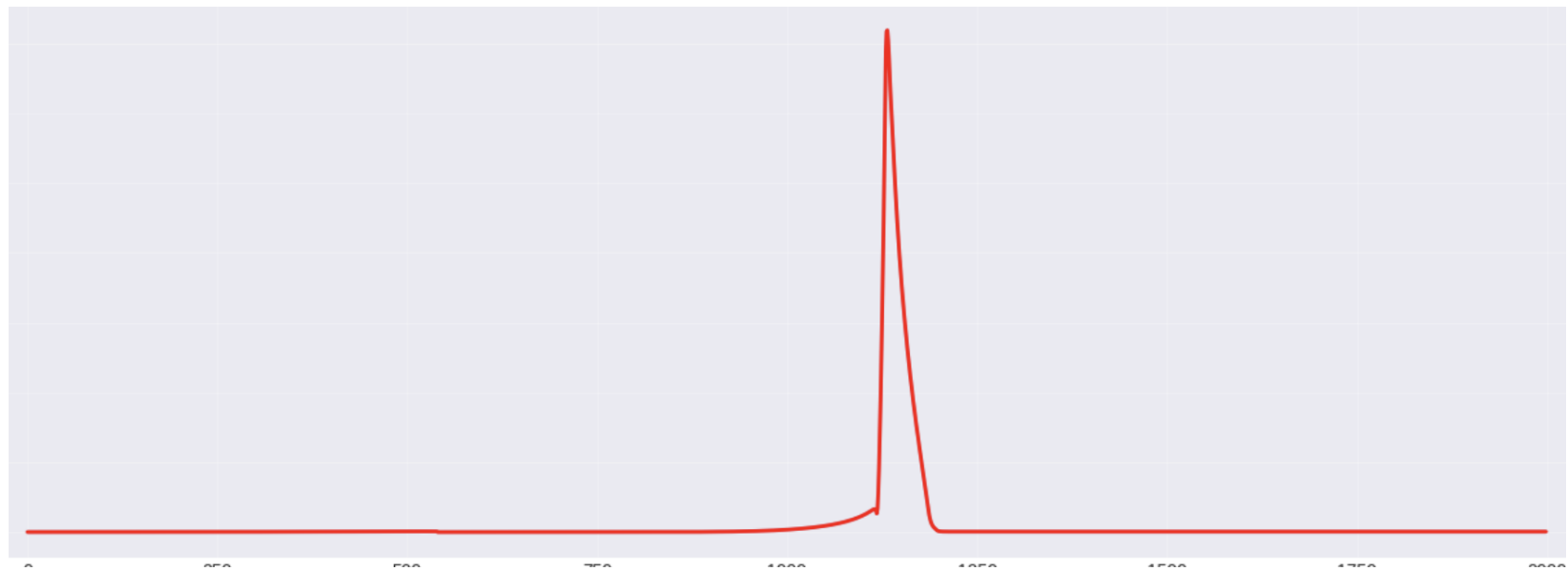
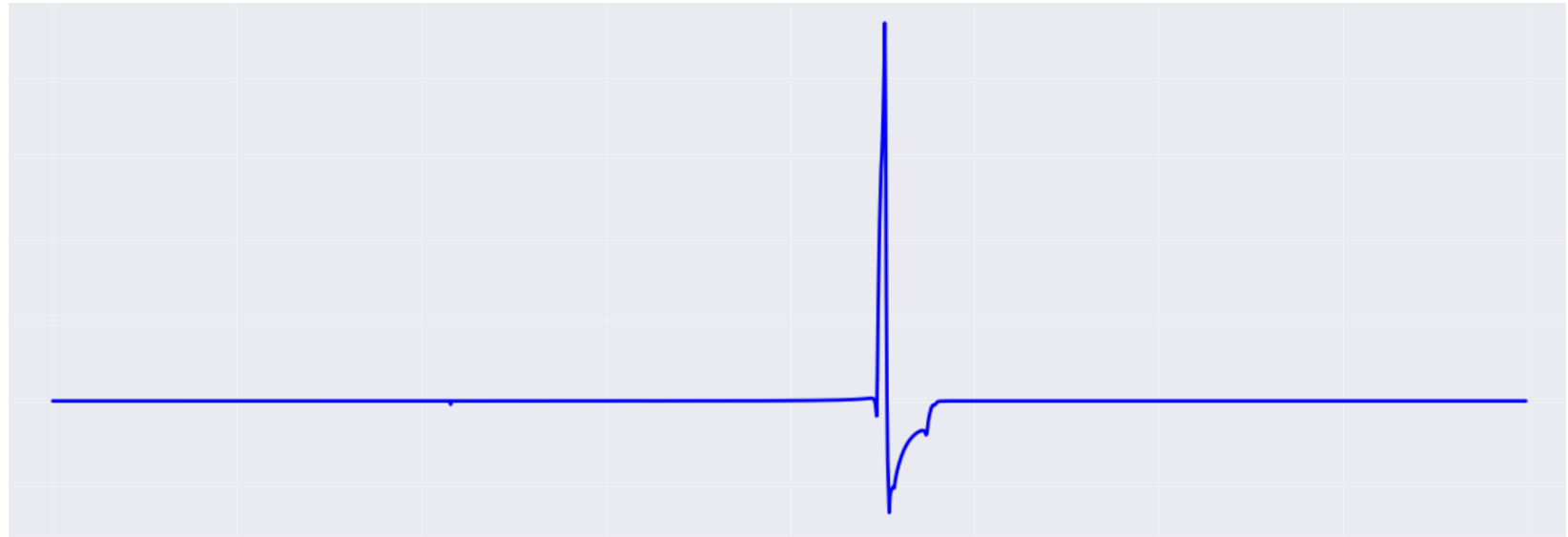


Drift field seems fine.

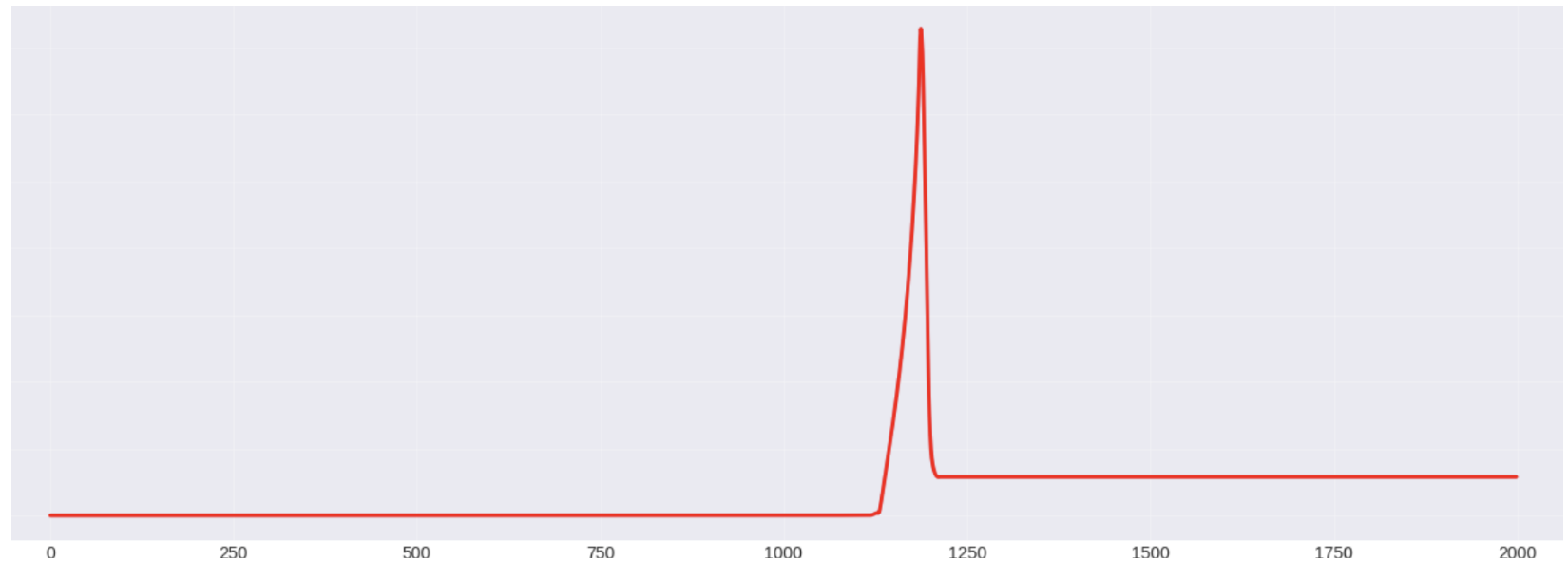
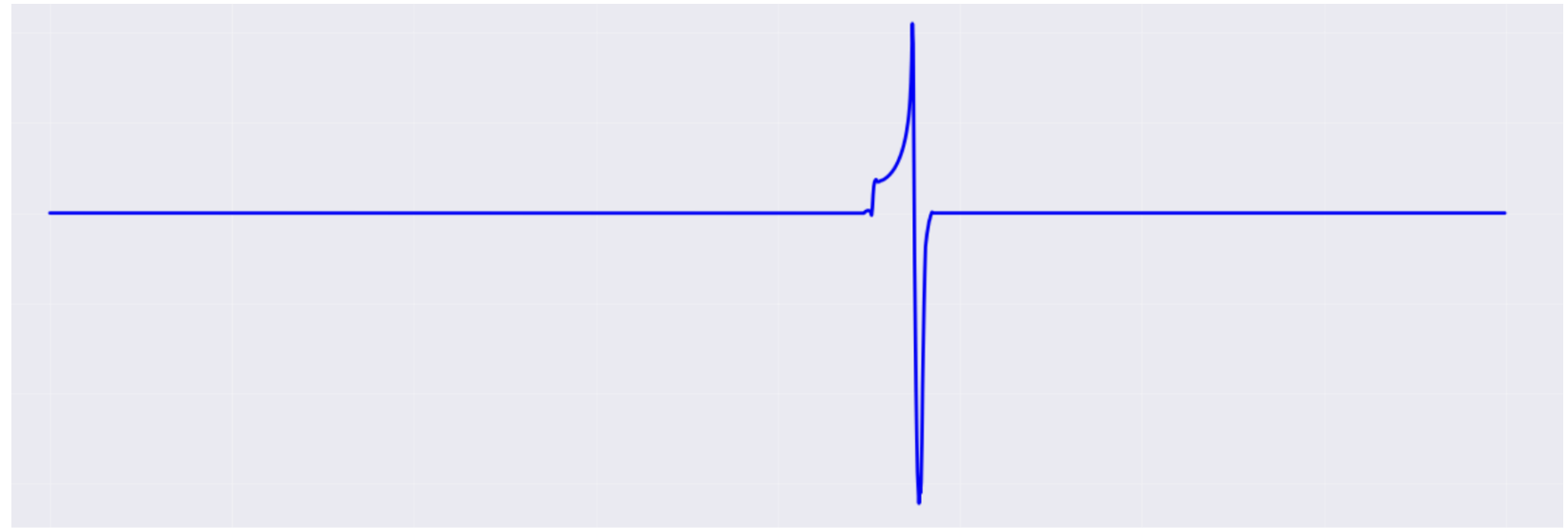


Averaged Current; u ;

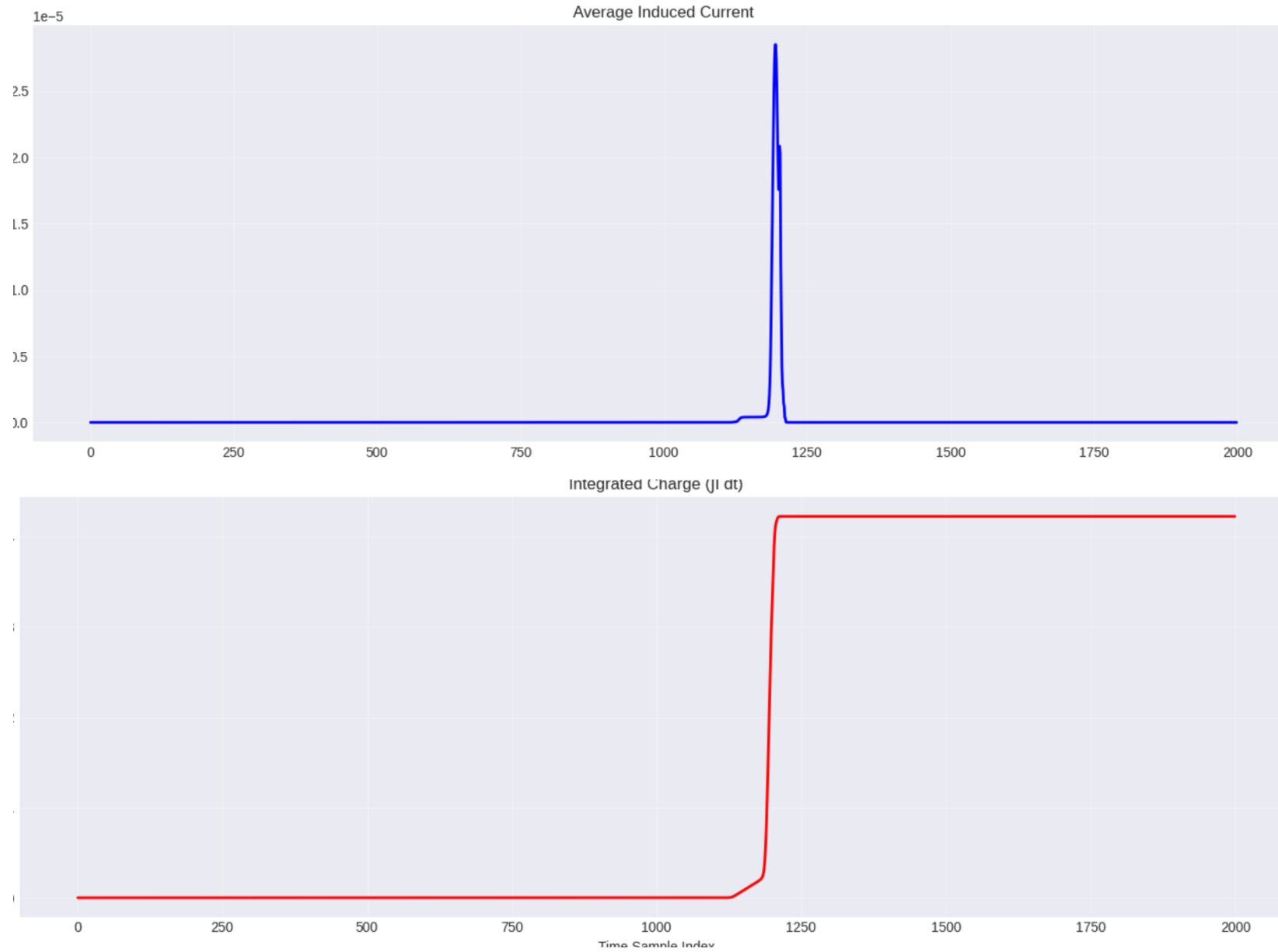
Averaged current for
132 paths inside
small drift volume



Averaged Current; v

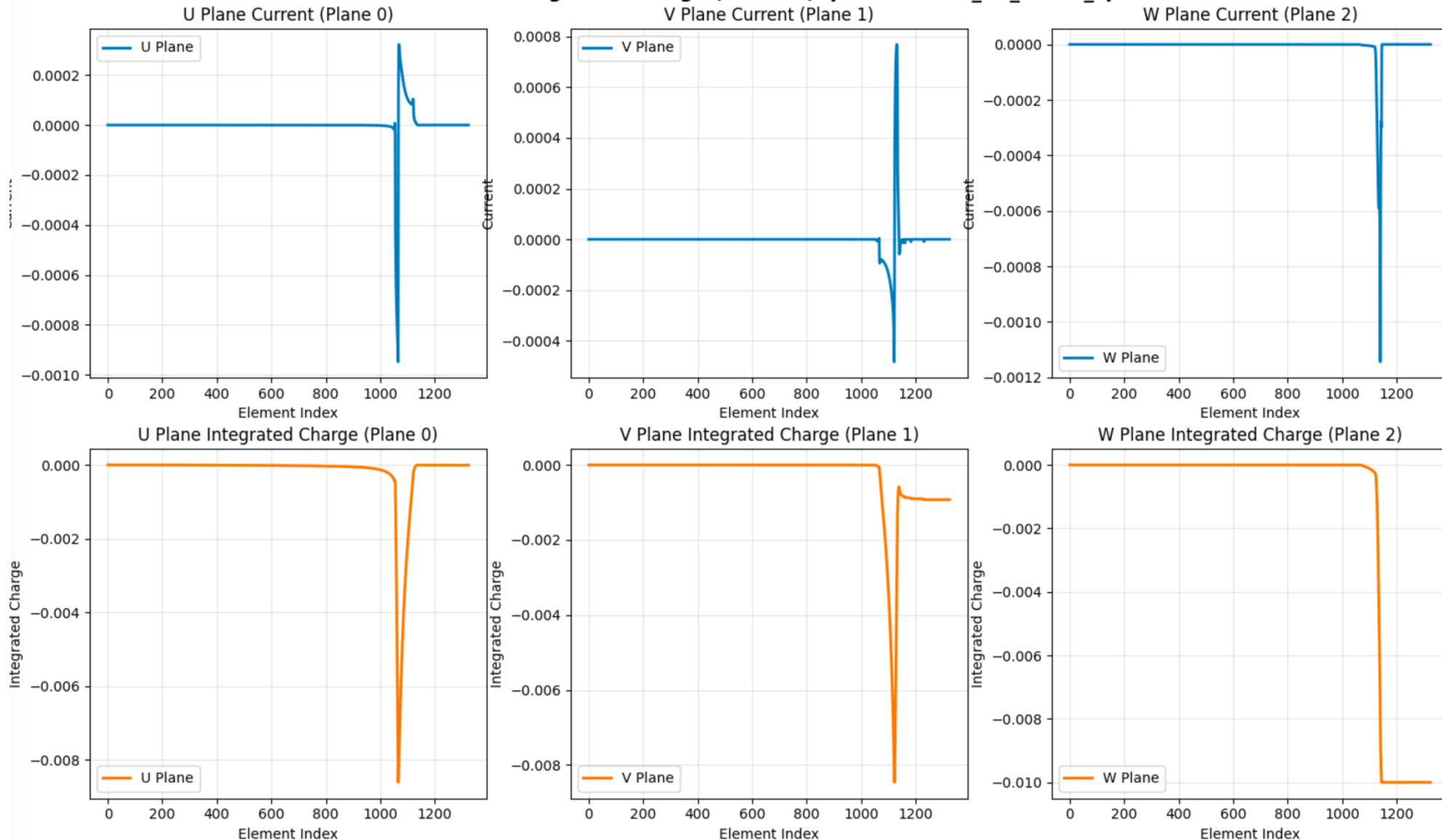


Averaged Current; w



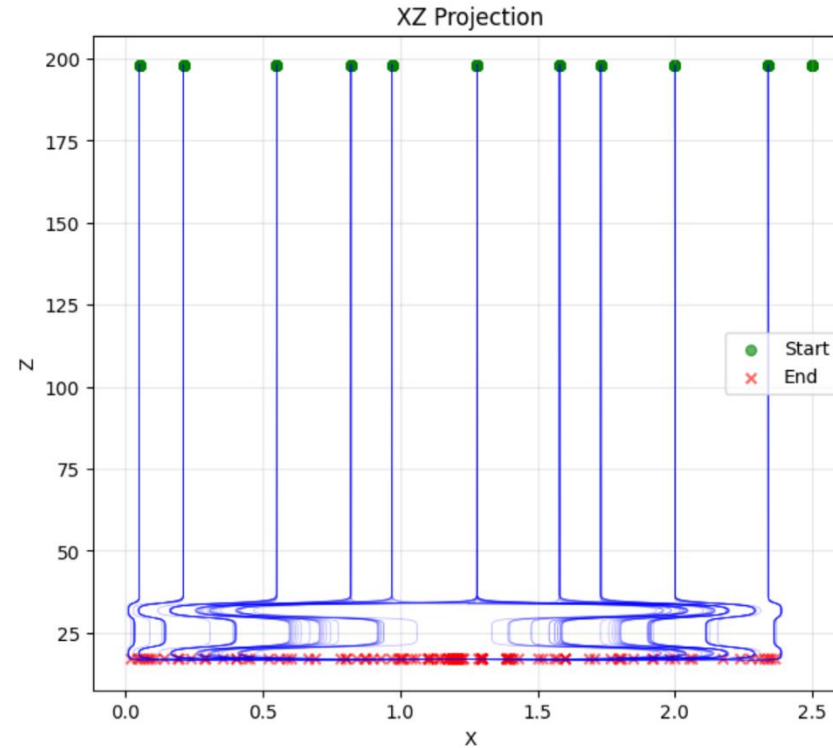
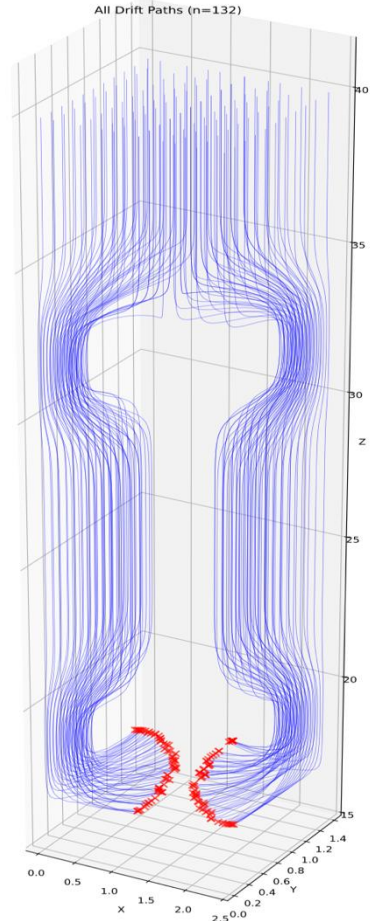
From Sergey's original FR

Middle Path Current & Integrated Charge (Path 63): protodunevd_FR_3view_speed1d55

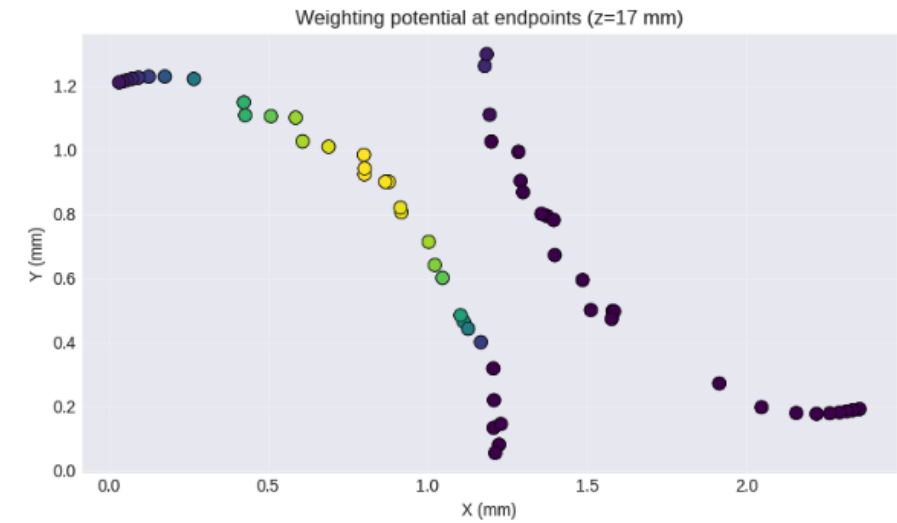


Why v plane has charge:

If any electron is collected on v?



XY projection at collection place



All the drift electrons are collected on w

Why v plane has charge:

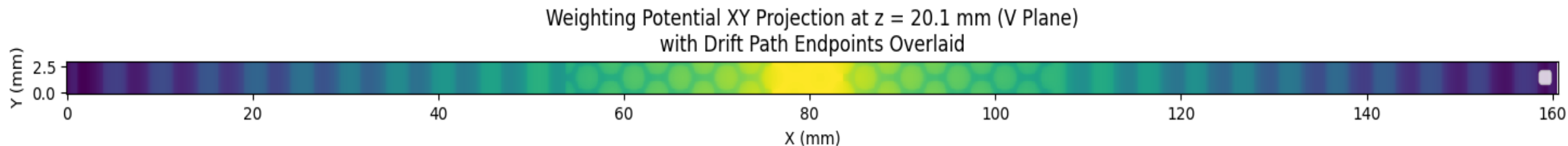
1. Anything wrong about the weighting field?

middle v strip set to 1V,
x-y projection of weighting field at v plane;

Total integrated induced charge:

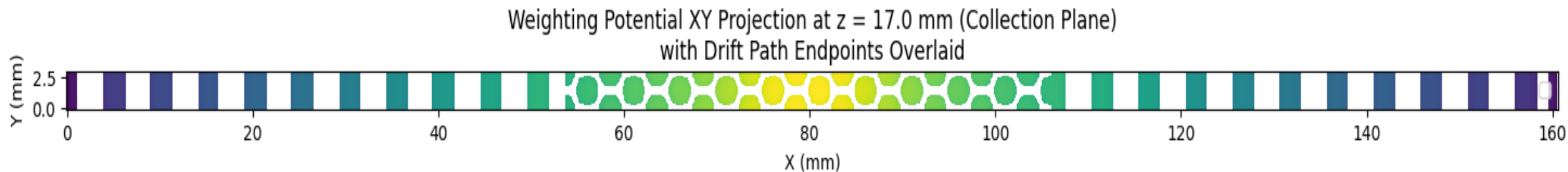
$$Q_{\text{induced}} = q * [W(r_{\text{final}}) - W(r_{\text{initial}})]$$

- Collecting electrode: $W(r_{\text{final}}) = 1$, so $Q = q * [1 - W(r_{\text{start}})]$
- Non-collecting electrode: $W(r_{\text{final}})$ should be 0, so $Q \sim 0$



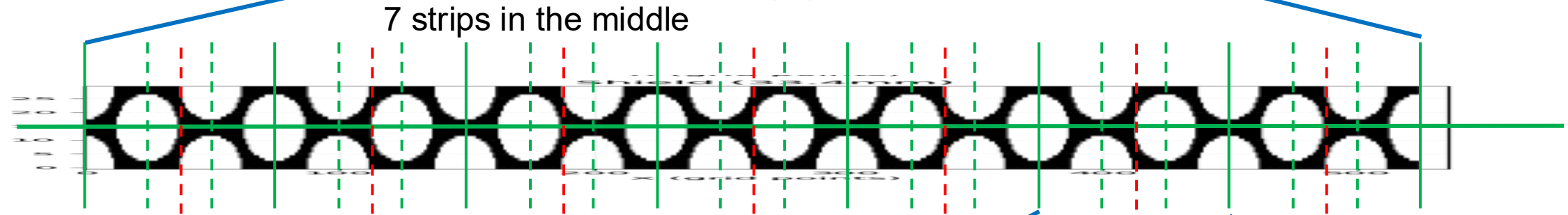
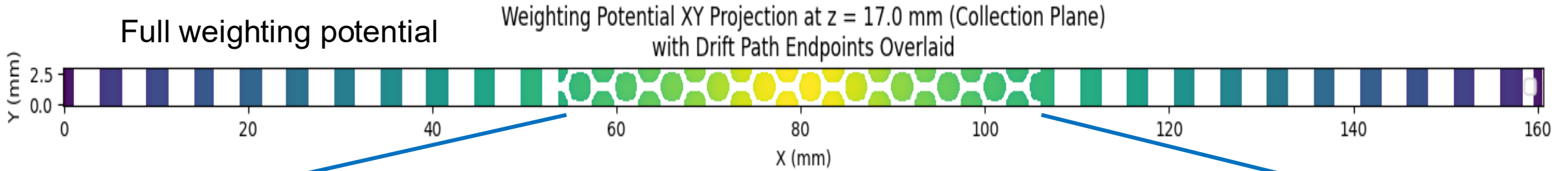
color z represent potential;
log scale

x-y projection of weighting field at w plane

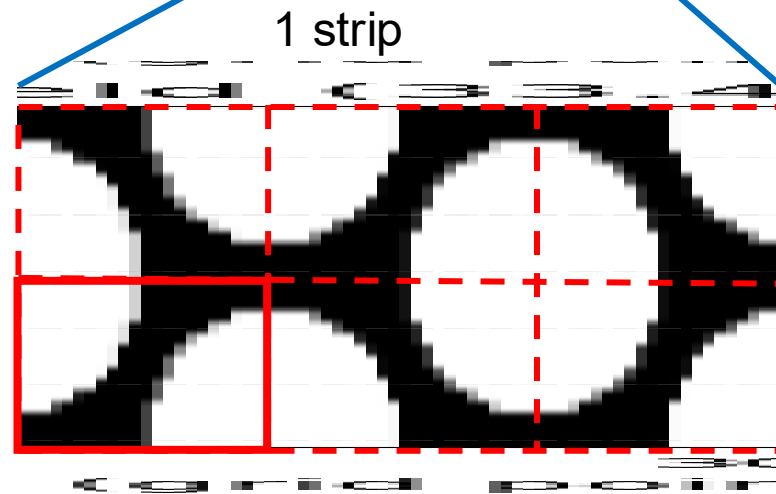
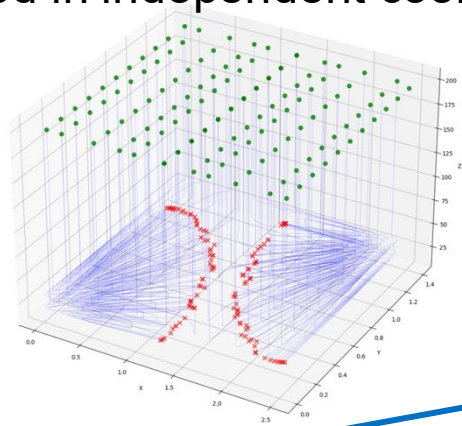


Map electron paths to weighting field

- In the view of x-y projection on w plane:

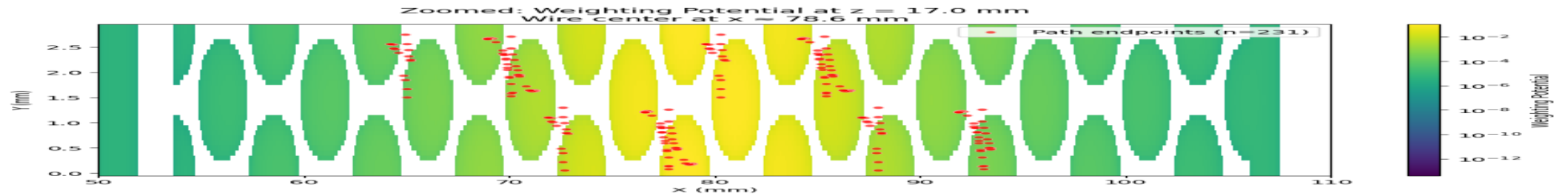
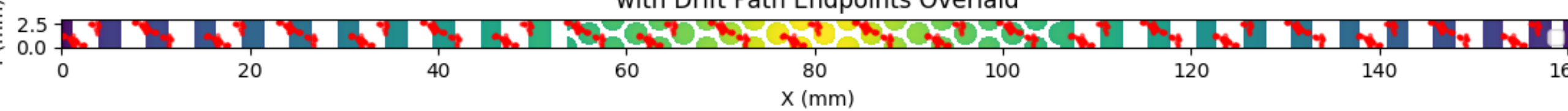


Drift electron paths
separate simulated in independent coordinate

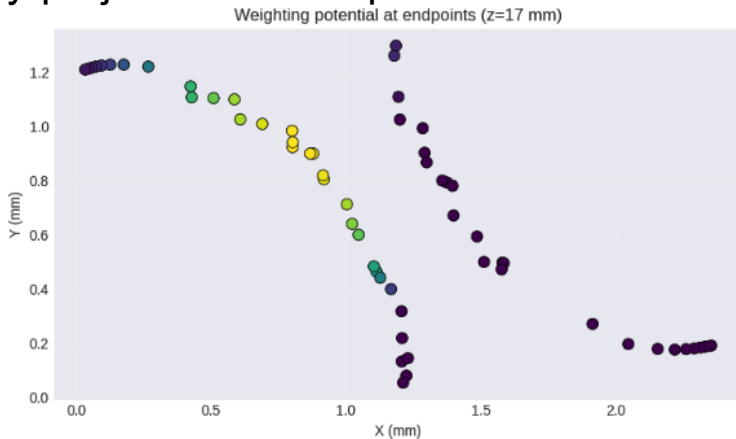


Drift electrons are placed wrong

Weighting Potential XY Projection at $z = 17.0$ mm (Collection Plane)
with Drift Path Endpoints Overlaid



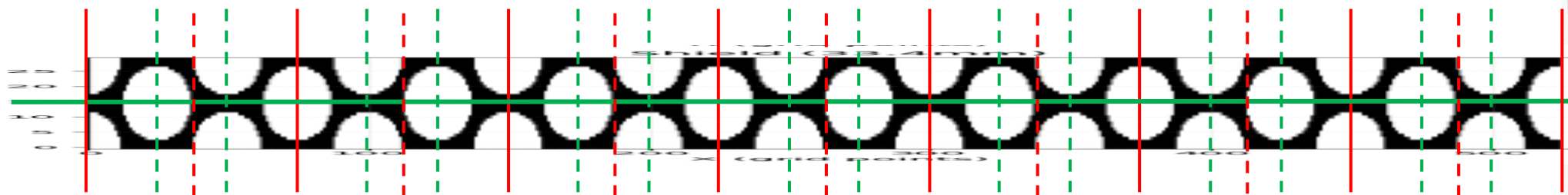
x y projection of end points of drift electron paths



Two geometry are not correctly placed.

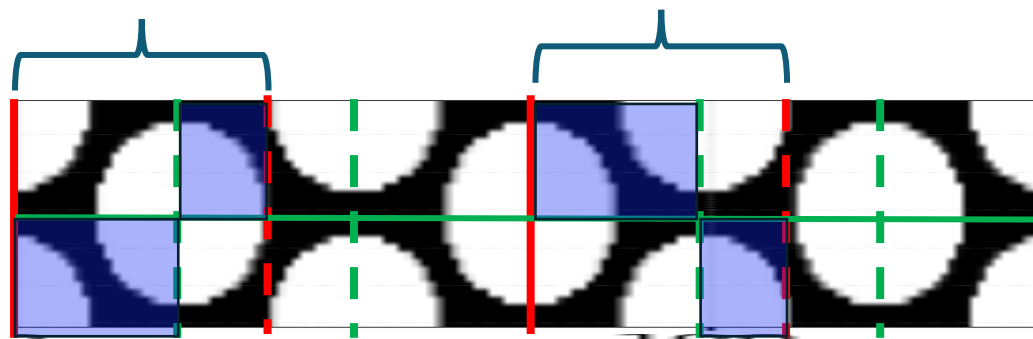
Align weighting field and drift paths

Induction plane



half strip 1

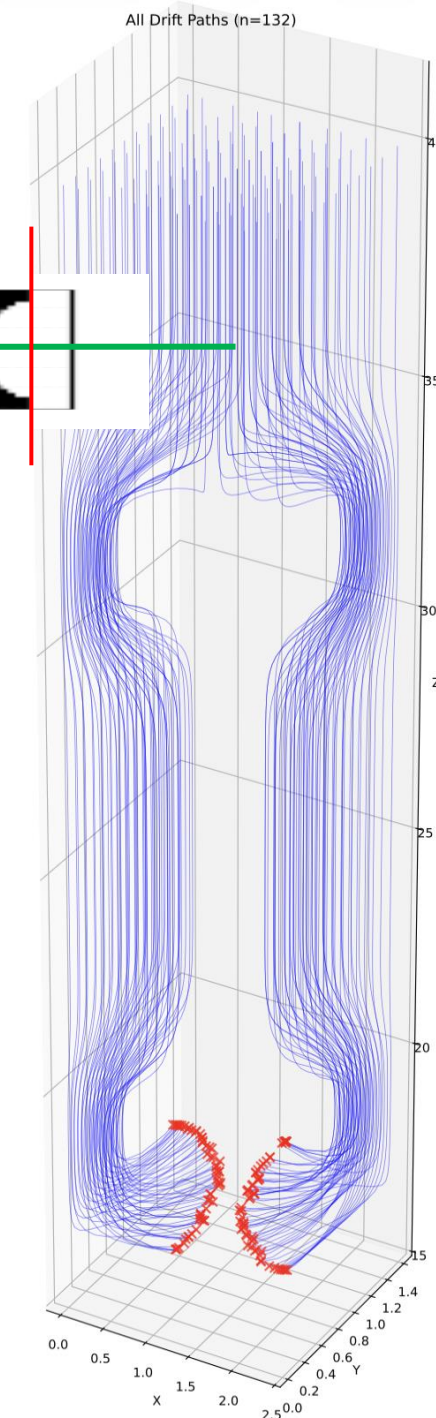
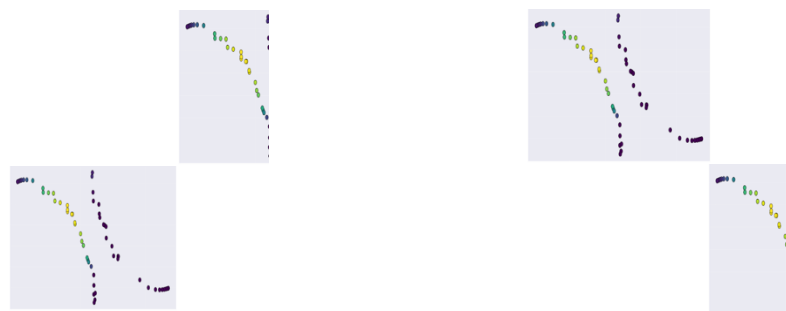
half strip 2



region that supposed to put drift paths in



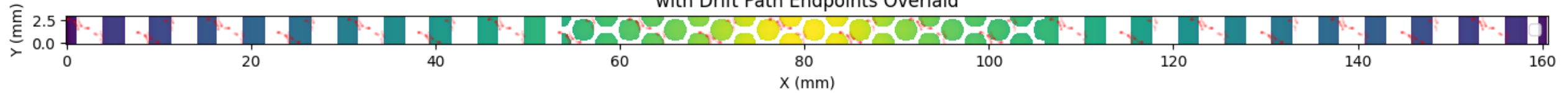
end points of drift paths on w plane projection



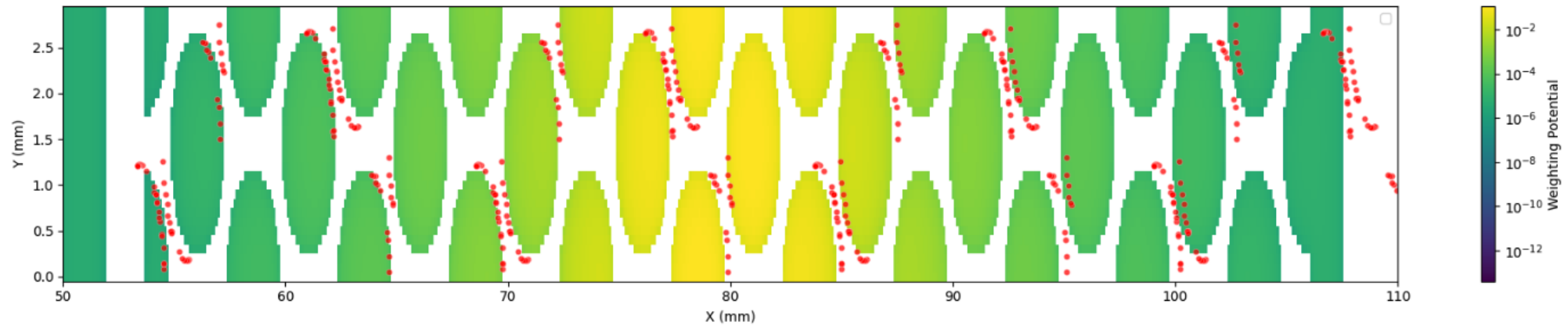
The bug is even strip and odd strip are treated reversed.

After correction; induction

Weighting Potential XY Projection at $z = 17.0$ mm (Collection Plane)
with Drift Path Endpoints Overlaid



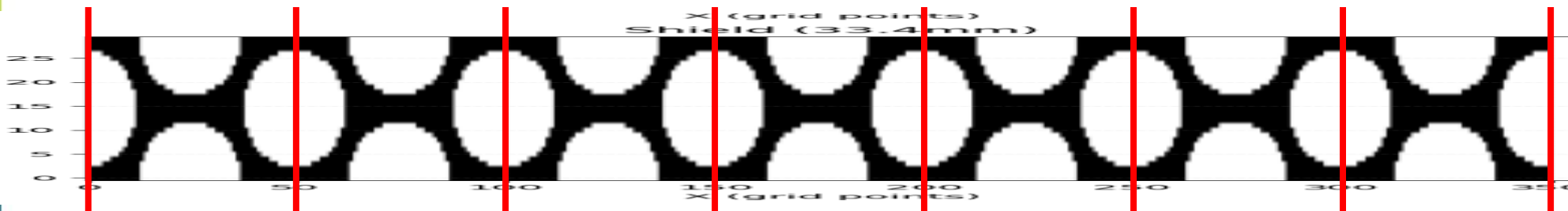
Zoomed: Weighting Potential at $z = 17.0$ mm
Wire center at $x \approx 78.6$ mm



Very difficult to placed perfectly aligned.
for the edge region, it has to have some weighting field non-zero.
tuned manually to make sure the center region is well aligned.

Align weighting field and drift paths

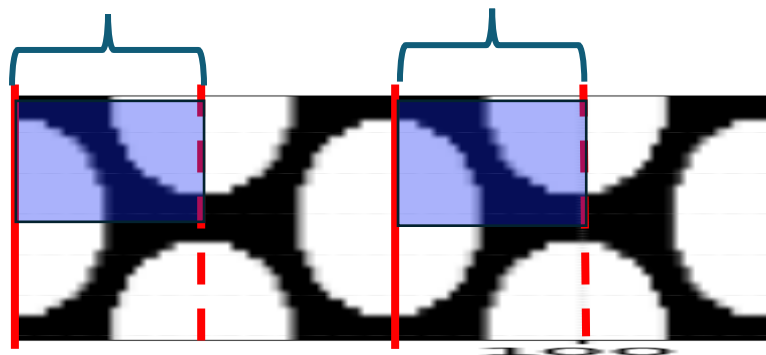
Collection plane:



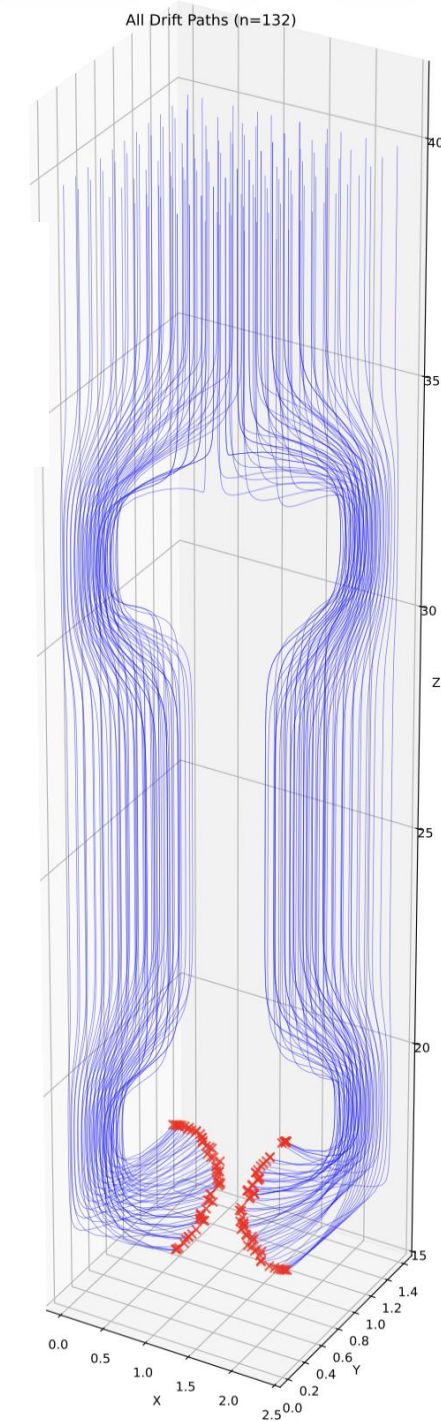
half strip 1

half strip 2

region that supposed to put drift paths in

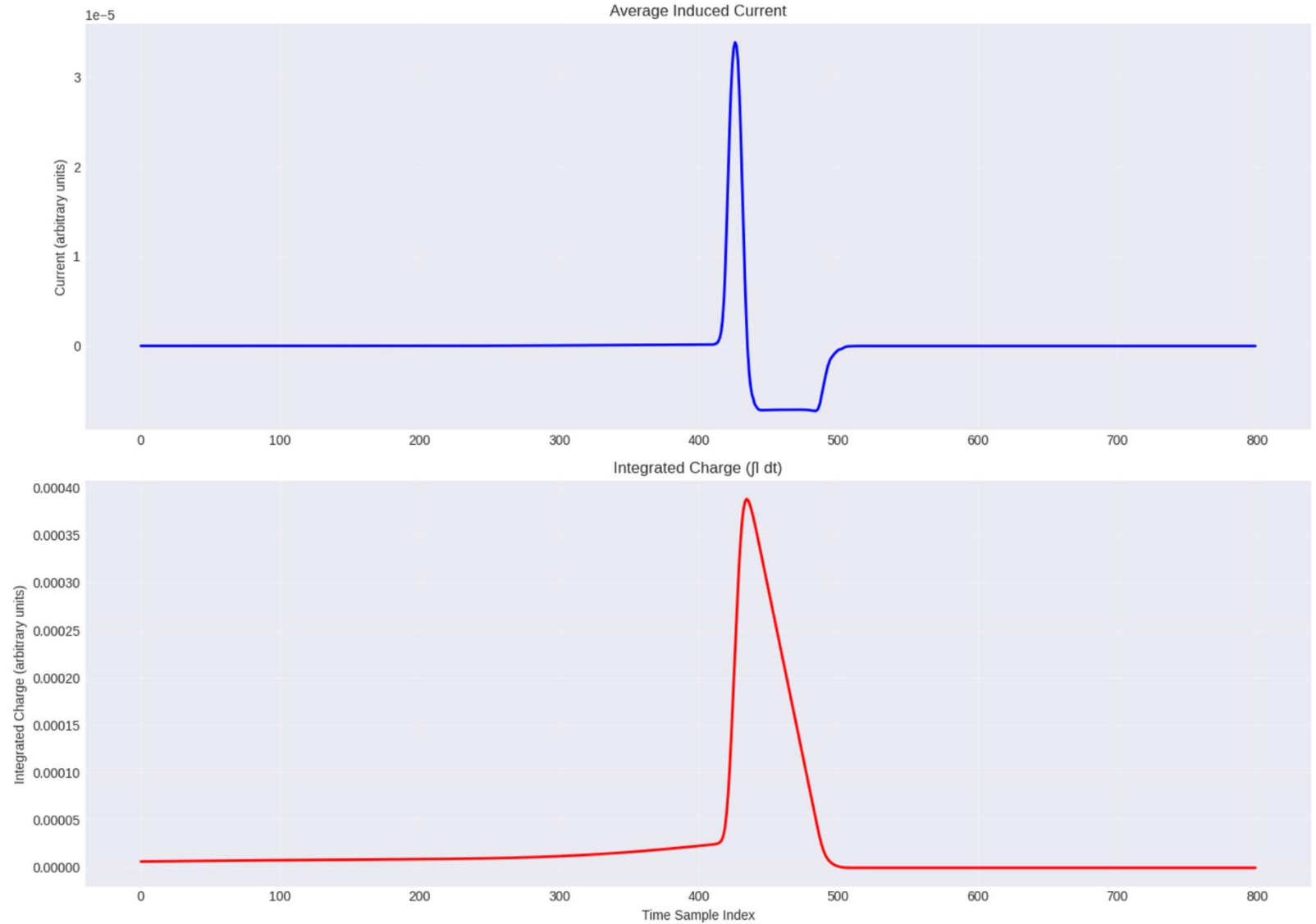


end points of drift paths on w plane projection



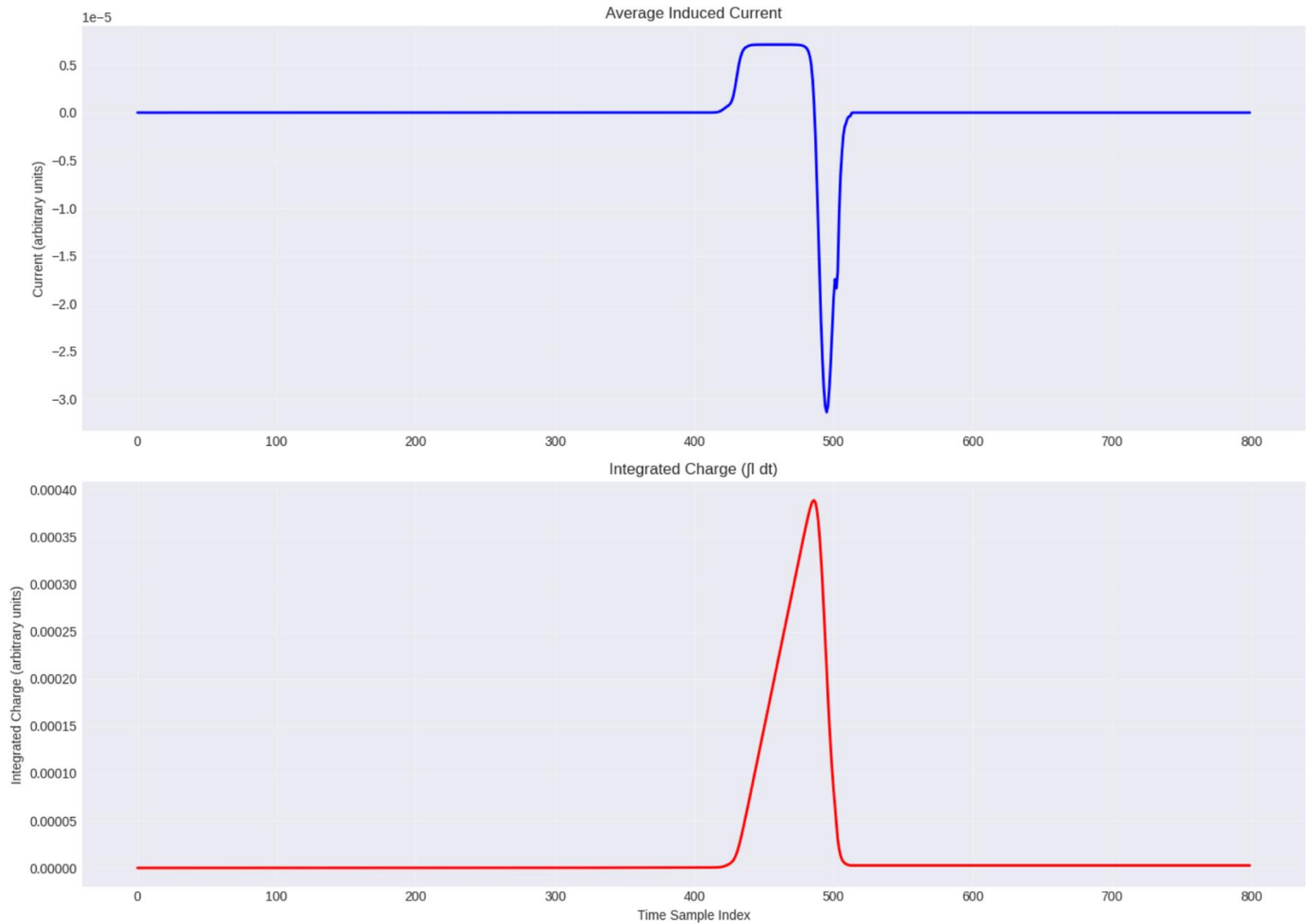
After correction: u plane

Averaged current for 120*21 paths



After correction: v plane

Averaged current for 120*21 paths



After correction: w plane

