A proposal to close the Grid Leak
“it will never die”

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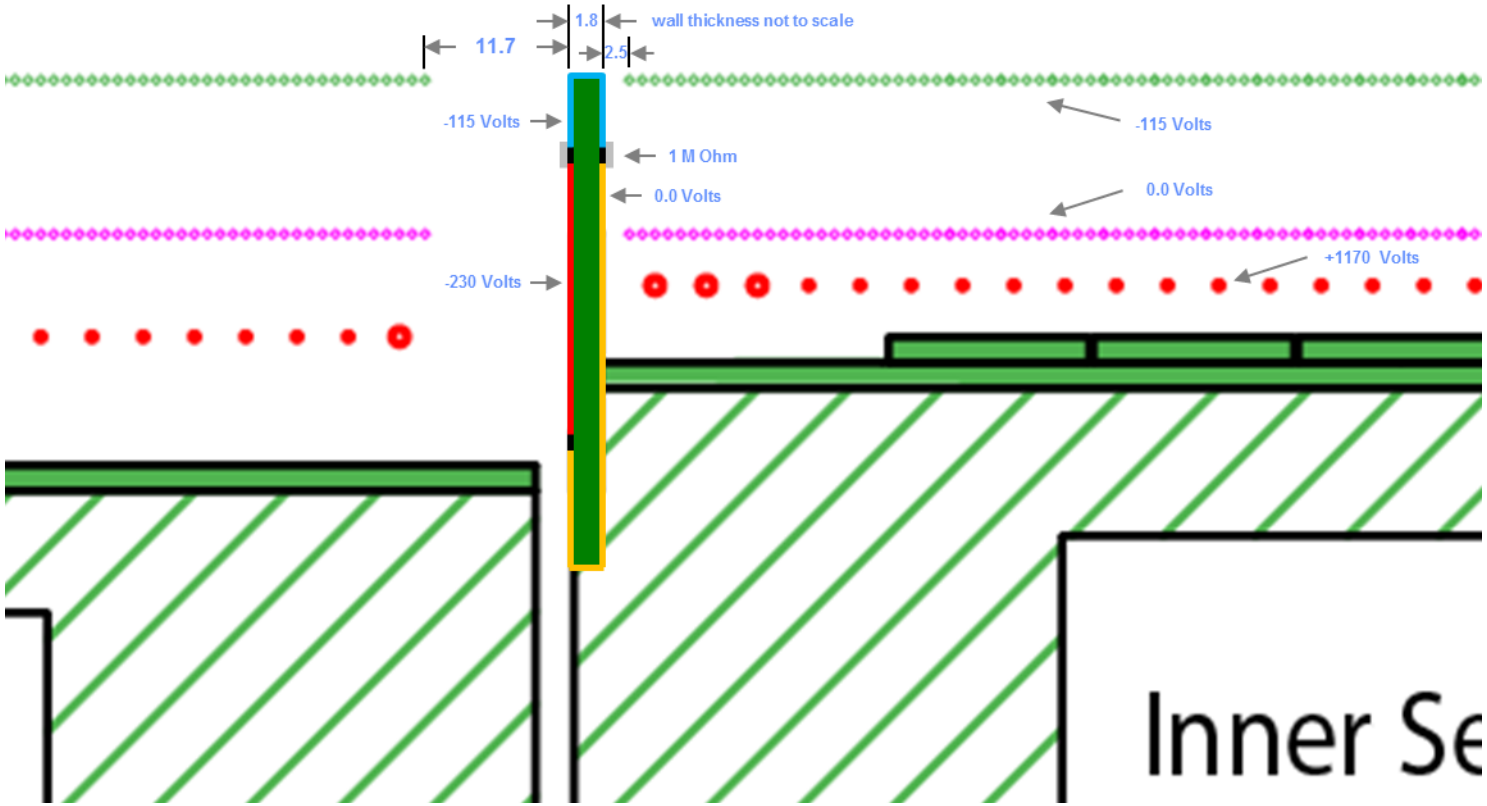
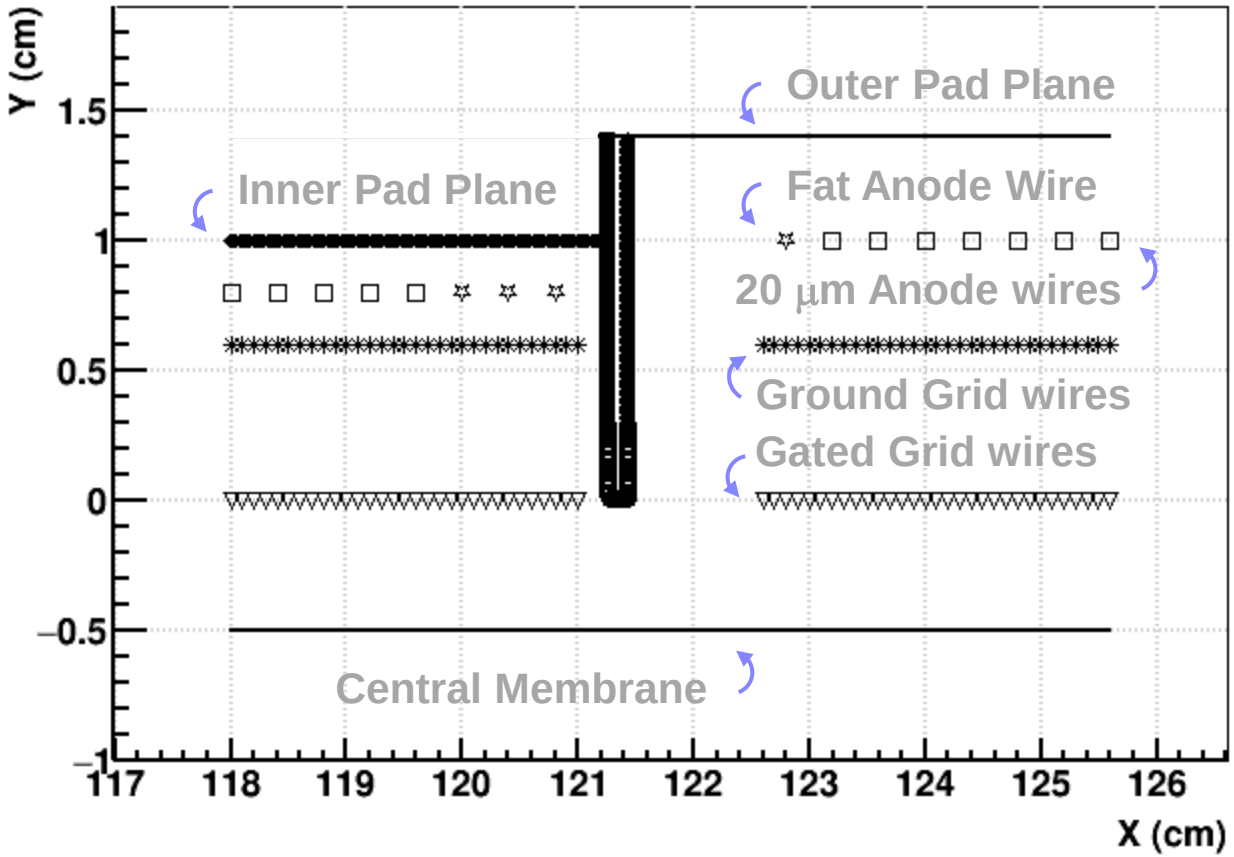
Proposal 1 to close the “Grid Leak”



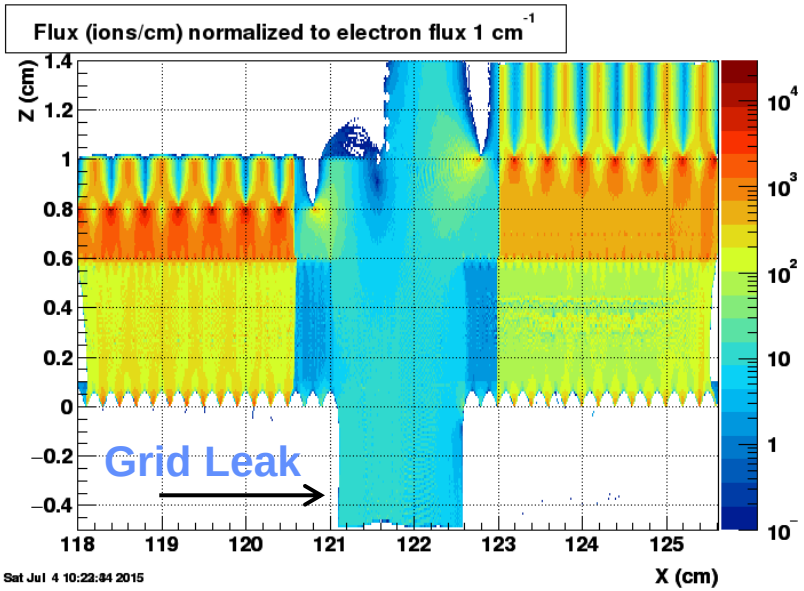
- **Wall is 1.8 mm thick Printed Circuit Board with Cu on both sides**
- **Grey bumps are 1 M Ohm type 603 surface mount resistors**
- **-115 Volts matches the GG voltage when it is “open”**
- **-230 Volts provided by external power supply, -115 V provided by resistors to 0 Volts**

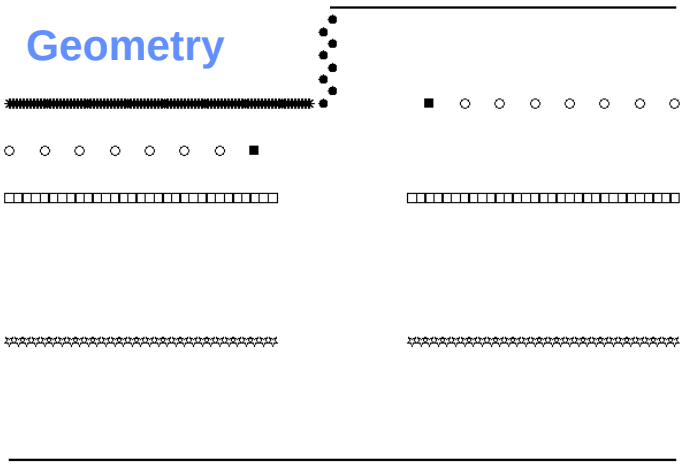
Yuri's Simulation Geometry

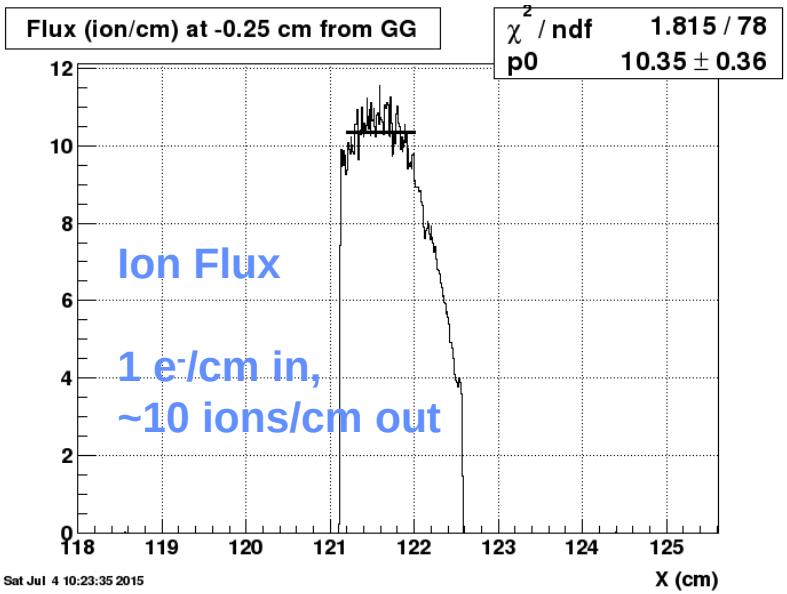


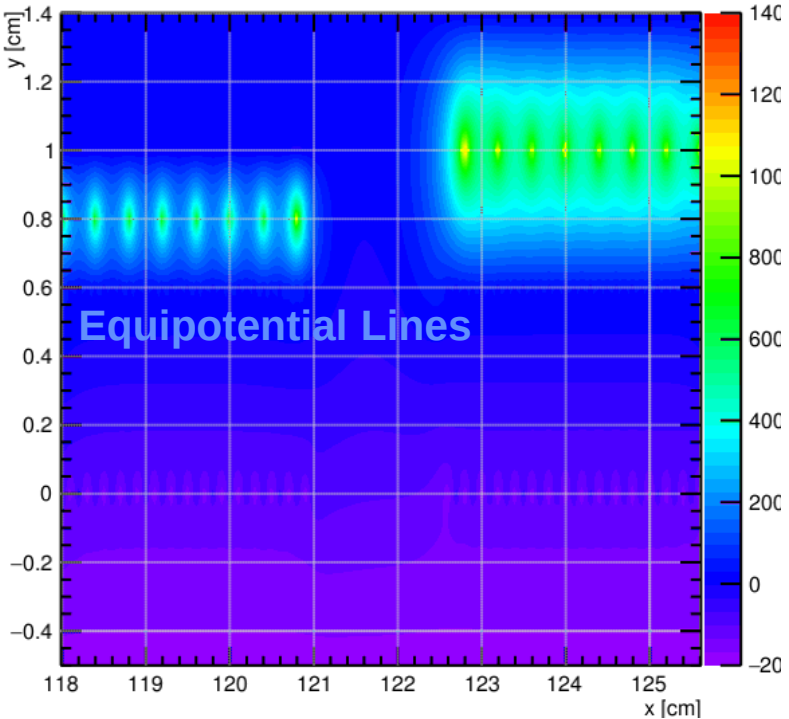
- Pad Plane on top, Central Membrane at bottom
- Rotate ME views 180° around an axis coming out of the page
- Electrons float up, Ions fall down
- Note that Central Membrane is only 5 mm from the GG

Normal Geometry: No Wall

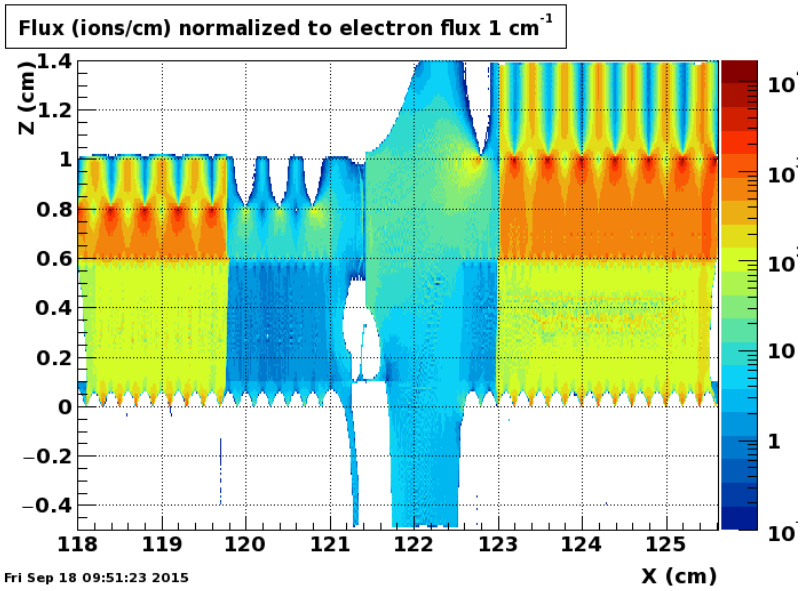


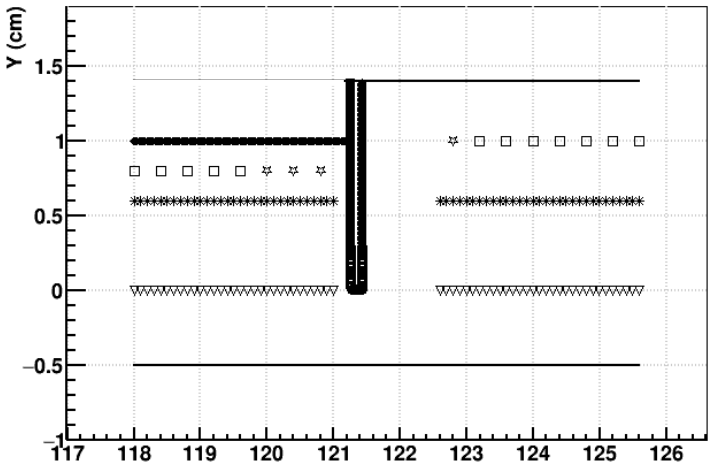


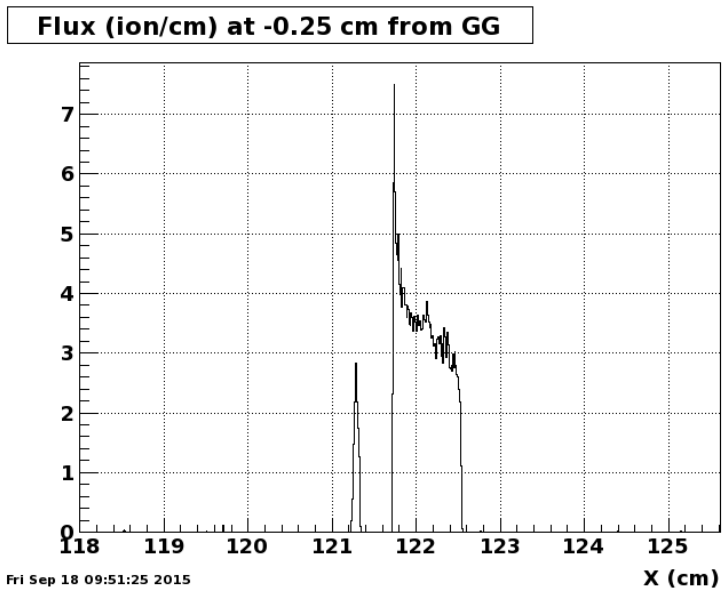


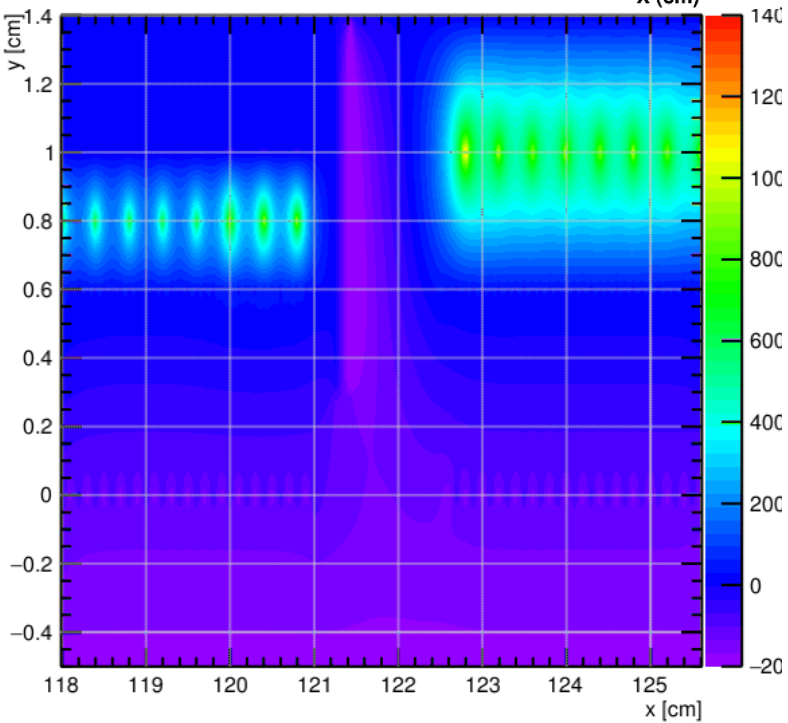


-230 volts on outside of wall

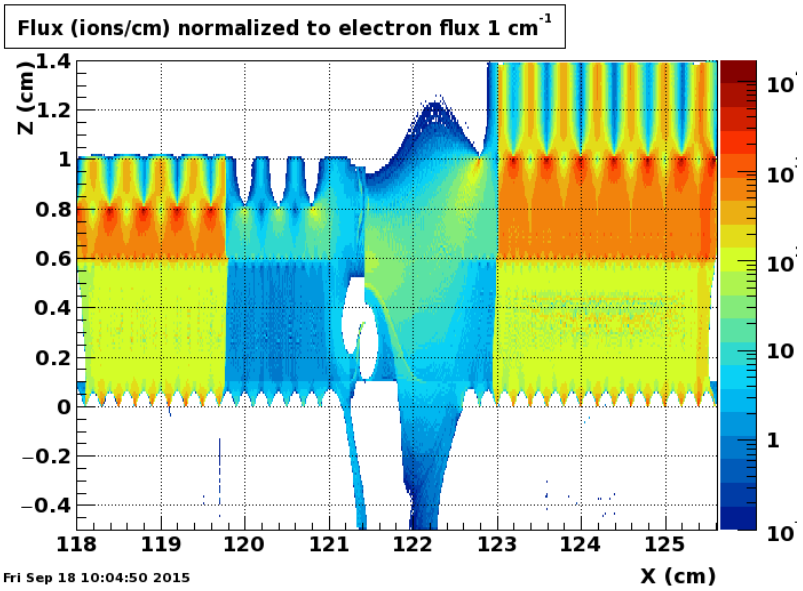


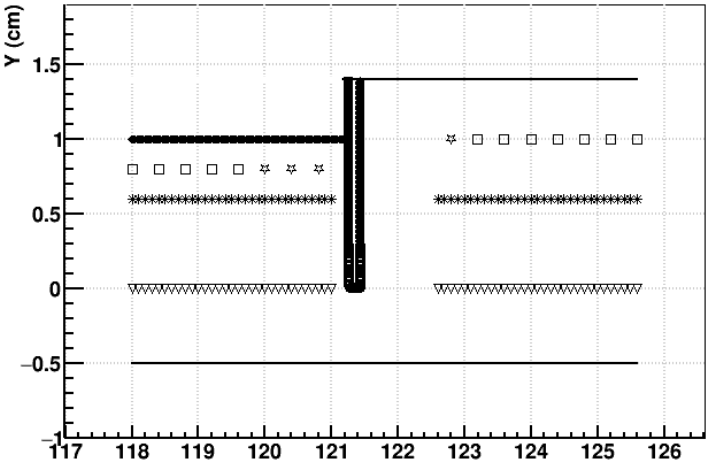


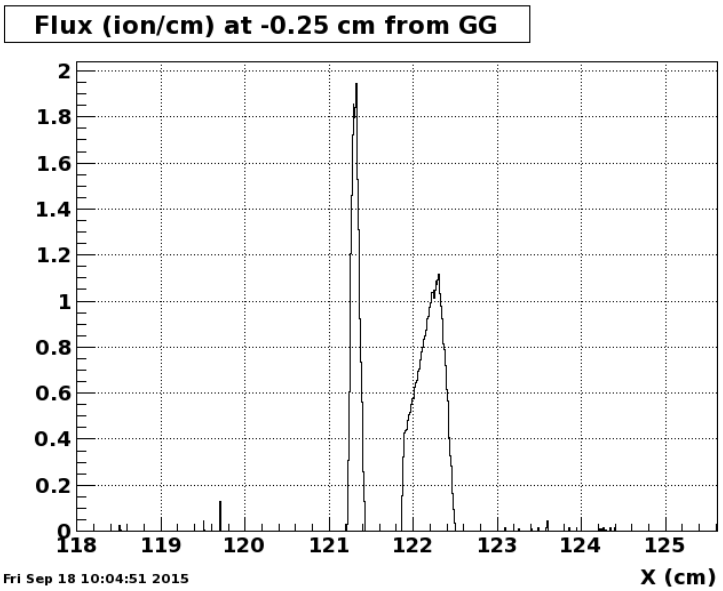


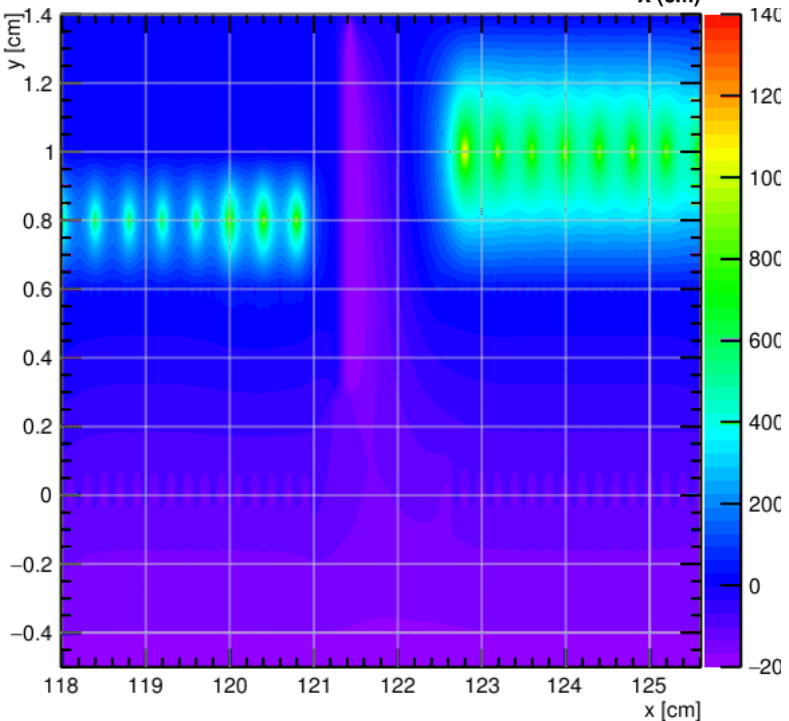


-690 Volts on outside of wall





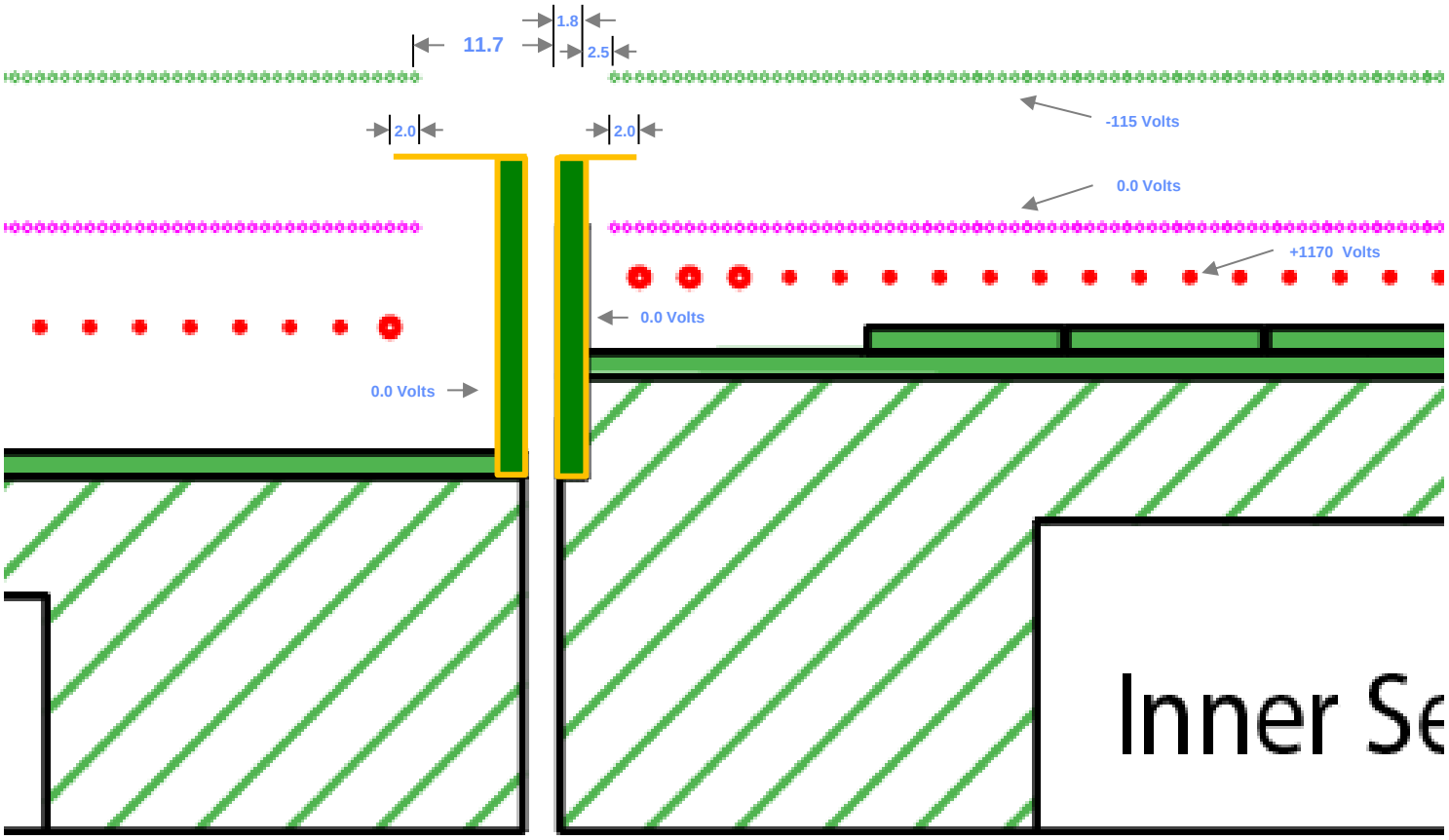




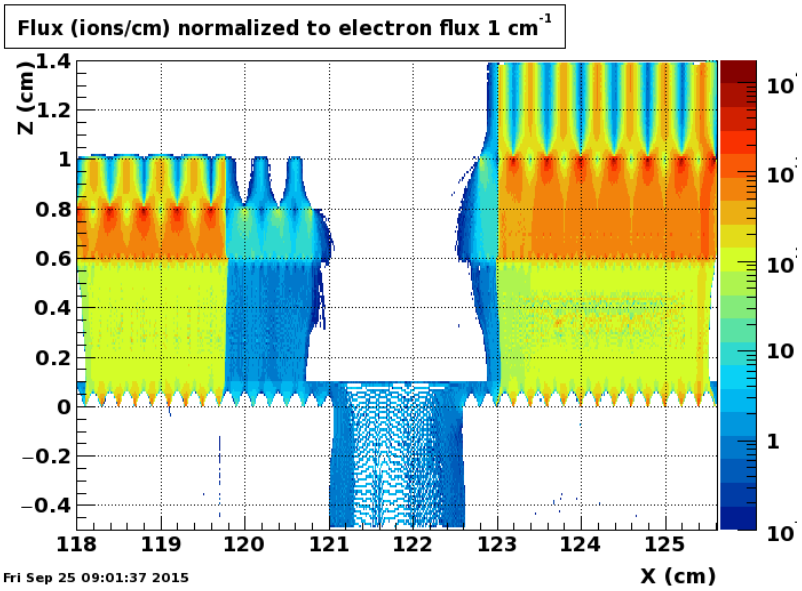
Proposal 1: Conclusions

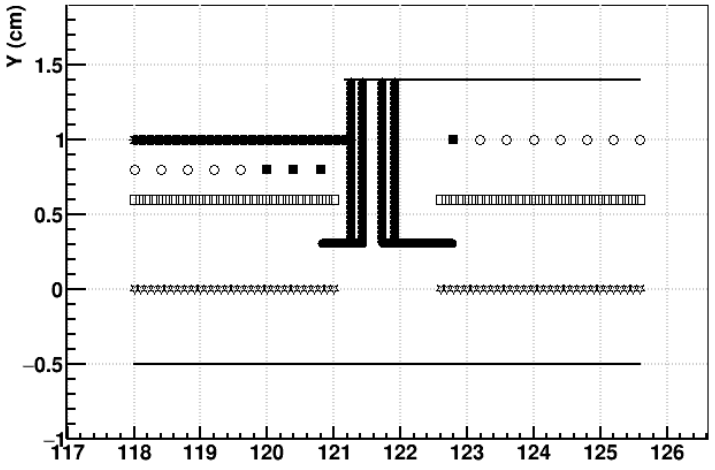
- A Biased wall will work
- Order of magnitude decrease of Ion Flux can be achieved
- ~700 volts required to do a good job
- Note that equipotential lines (lower right panels) guide the ions to the wall
- Mechanical Engineering is achievable
  - Requires 0.070” deep notch in top and bottom of inner sector so 1/16” G10 wall can be glued or screwed in place
  - Requires modest change in routing of Pad Plane, perhaps want to redesign ground plane on Pad Plane to reflect new routing pattern
  - One bias connector available on inner sector, have to run cable down existing groove on side (under pulser and GG boards)
  - Need to route bias cable around the corner of the sector to access wall
  - Want to do this on both top and bottom of Inner Sector (grid leak in both places)

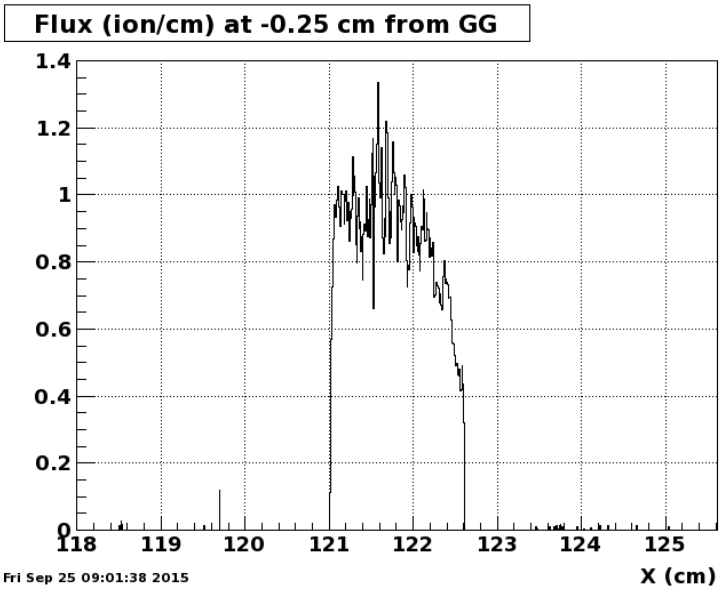
Proposal 2 to close the “Grid Leak”

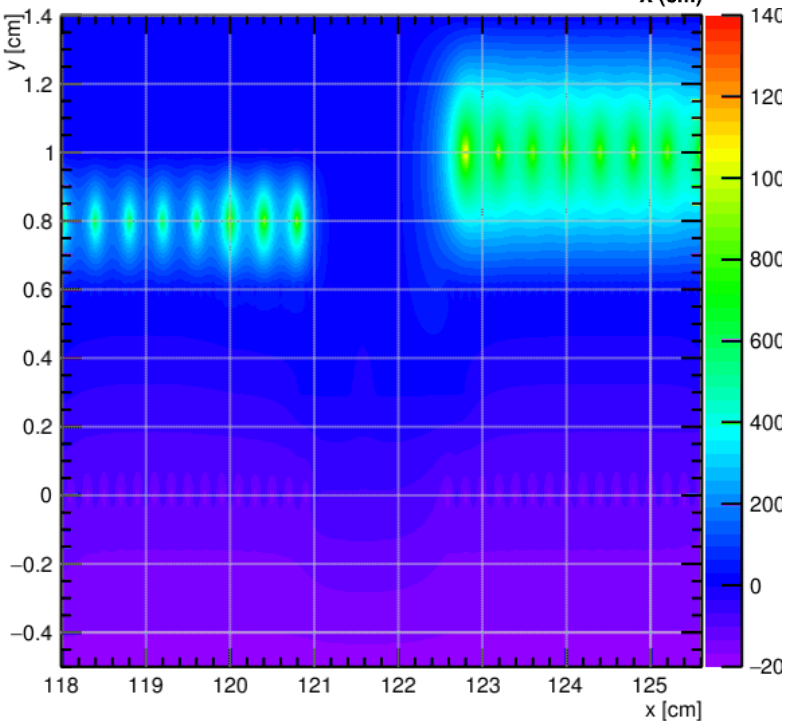


Grounded fingers between the grids: Inner & Outer Sectors!









Proposal 2: Conclusions

- Grounded Fingers will work – very simple conceptual design
- Order of magnitude decrease of Ion Flux can be achieved
- However, this solution requires changes to the outer sectors while still installed inside the TPC
  - Hands, heads, and tools inside the TPC! Epoxy, too.
  - Careful fixturing may make this solution possible
  - Engineering required, Risk analysis required
- Mechanical Engineering is achievable
  - Requires 0.070” deep notch in top and bottom of inner sector so 1/16” G10 wall can be glued or screwed in place
  - Requires modest change in routing of Pad Plane, perhaps want to redesign ground plane on Pad Plane to reflect new routing pattern
- A careful analysis of the equipotential lines (lower right panel) suggests that a river of ions flows very close to the GG and out the gap
  - The grid leak will never completely die … the river of ions will exist as long as there is a physical gap between the inner and outer gated grids

Grand Conclusion

- **Further work is needed before we can decide upon which solution is best: Biased Wall or Fingers between the grids**
  - **Is it reasonable to put ~700 volts on a wall near the wires?**
  - **Engineering design & Fixturing required for "Finger" solution**
  - **Risk analysis required for both proposals**

- **Both designs can/should be further optimized**
  - **But is seems unlikely that we can kill the grid leak substantially more than a factor of 10 below the current design**

- **The Mechanical Engineering design for the Strongback is the same for both of these solutions**
  - **We should add a 0.070" notch on the top and bottom sides of the inner sector to accommodate a 1/16" G10 (or Cu) Wall**
  - **Assume that we will run a cable to bias the wall, but we may not use it**

I believe the Mechanical Engineering design of the strongback is complete. We can now proceed with final drawings and fabrication of prototypes (JT).

Backup Slides

Location of Wires and Pads

Radius (Y)	Description
0.00	Center of STAR Detector (vtx)
498.80	Bottom of Full size PC Board
512.70	Tertiary Fiducial L & R
519.05	Strongback Bottom Edge
530.00	Gated Grid Wire 1
531.00	Gated Grid Wire 2
532.00	Anode Wire 1 & GG W-3
536.00	Anode Wire 2 & GG W-7
540.00	Anode Wire 3 & GG W-11
540.25	Secondary Fiducial
544.00	Anode Wire 4 & GG W-15
548.00	Anode Wire 5 & GG W-19
558.00	Pad Row 1 - Center
574.00	Pad Row 2 - Center
1166.00	Pad Row 39 - Center
1179.45	Primary Fiducial
1182.00	Pad Row 40 - Center
1192.00	Anode Wire 166 & GG W-663
1196.00	Anode Wire 167 & GG W-667
1200.00	Anode Wire 168 & GG W-671
1204.00	Anode Wire 169 & GG W-675
1204.85	Alternate Primary Fiducial
1208.00	Anode Wire 170 & GG W-679
1209.00	Gated Grid Wire 680
1210.00	Gated Grid Wire 681
1214.32	Strongback Top Edge
1220.67	Tertiary Fiducial L & R
1235.42	Top of Full size PC Board

Repeat pad rows every 16 mm

GATED GRID WIRE
Ø.075mm BeCu , Au plated
spacing 1mm
OUTER : 689 Wires
INNER : 681 Wires
TOTAL : 1,370 Wires per Sector

SHIELD GRID WIRE
Ø.075mm BeCu , Au plated
spacing 1mm
OUTER : 689 Wires
INNER : 681 Wires
TOTAL : 1,370 Wires per Sector

ANODE GRID WIRE
Ø.020mm W, Au plated
spacing 4mm
OUTER : 170 Wires
INNER : 164 Wires (168 in old design)
TOTAL : 334 Wires per Sector (338 in old design)

LAST ANODE WIRE
Ø.125mm BeCu , Au plated
OUTER : 2 Wires
INNER : 6 Wires (2 in old design)
TOTAL : 8 Wires per Sector (4 in old design)

References:
LBL Drawings
24A055,
24A373,
24A374

Wire Locations are the same as before except for the replacement of 6 thin anode wires with larger diameter anode wires (0.020 mm ⇒ 0.125 mm)