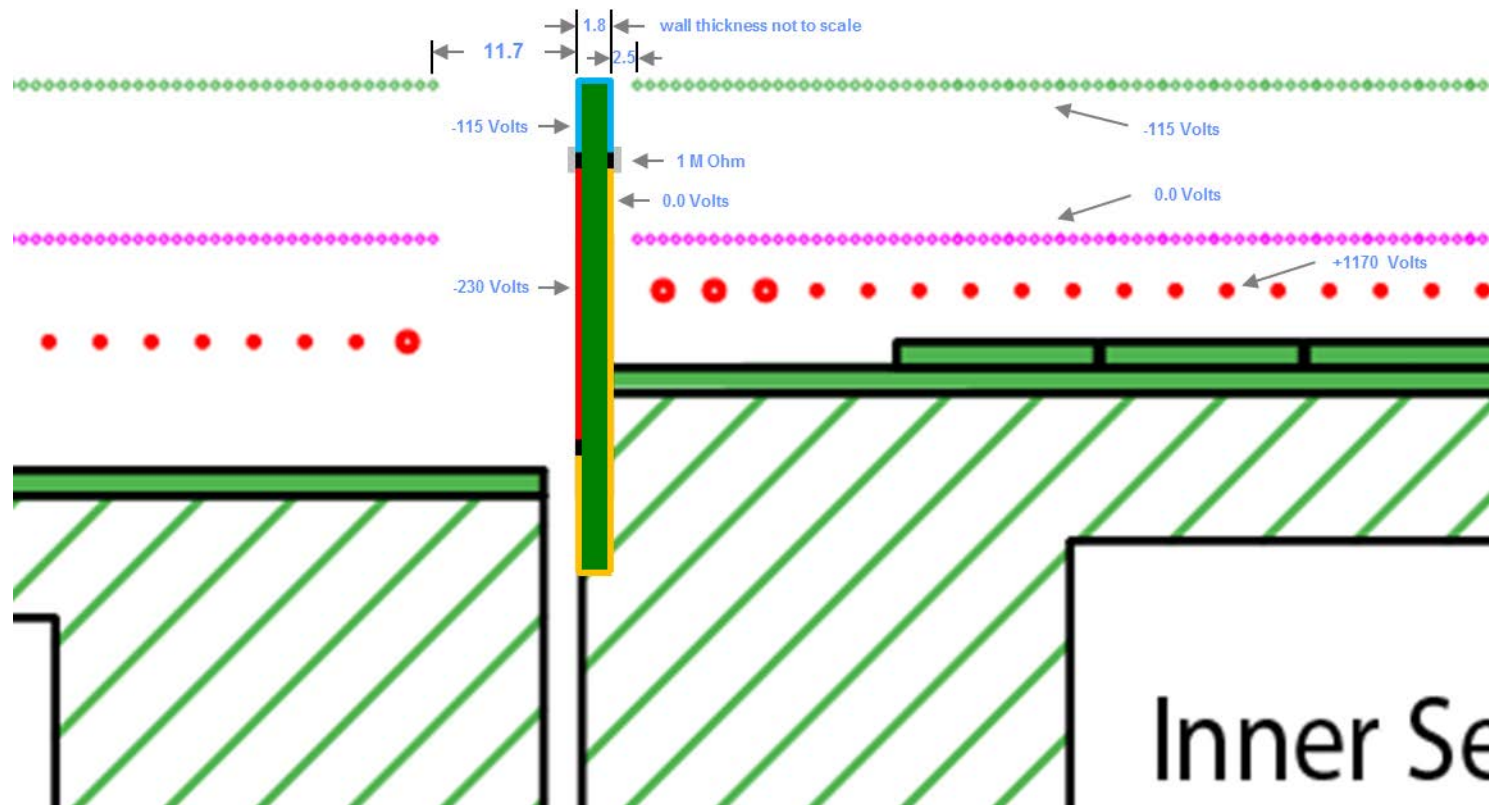


A proposal to close the Grid Leak “it will never die”

**Yuri Fysiak, Jim Thomas & Gene VanBuren
Eric Anderssen, Howard Wieman & Jon Wirth**

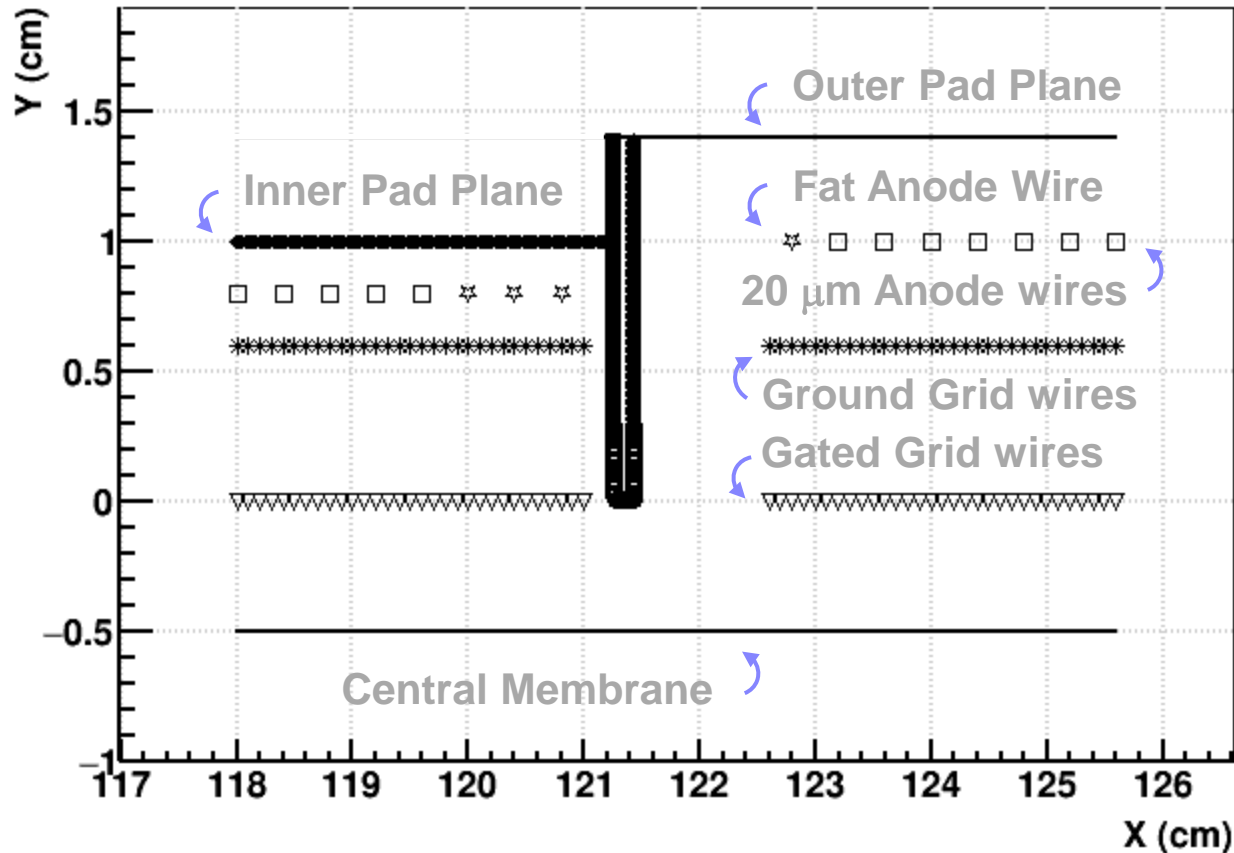
9/26/2015

Proposal 1 to close the "Grid Leak"



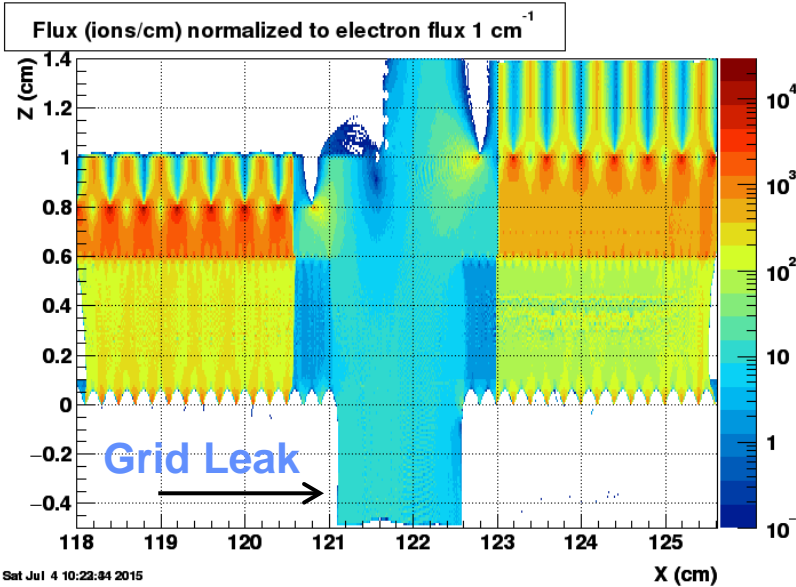
- Wall is 1.8 mm thick Printed Circuit Board with Cu on both sides
- Grey bumps are 1 M Ohm type 603 surface mount resistors
- -115 Volts matches the GG voltage when it is "open"
- -230 Volts provided by external power supply, -115 V provided by resistors to 0 Volts

Yuri's Simulation Geometry

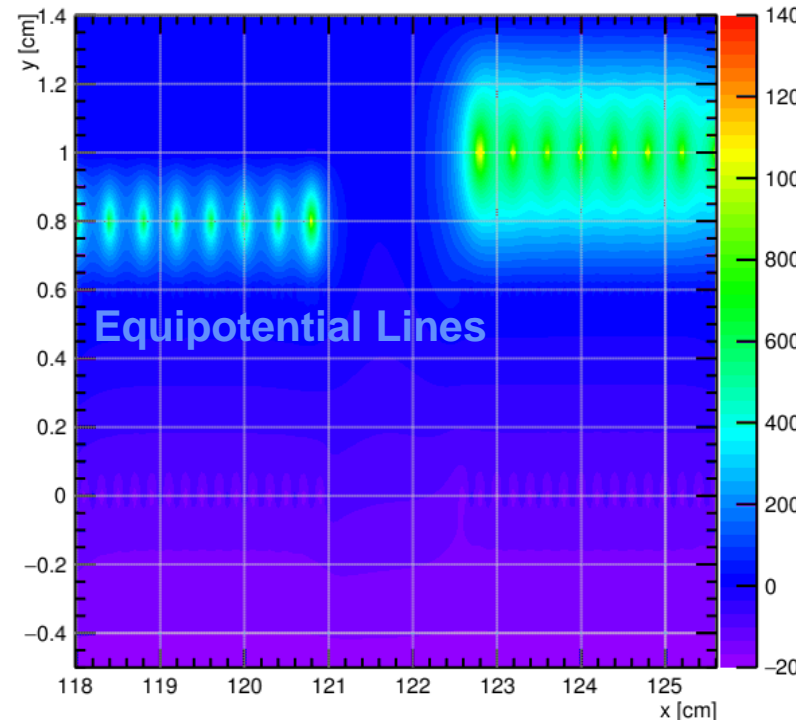
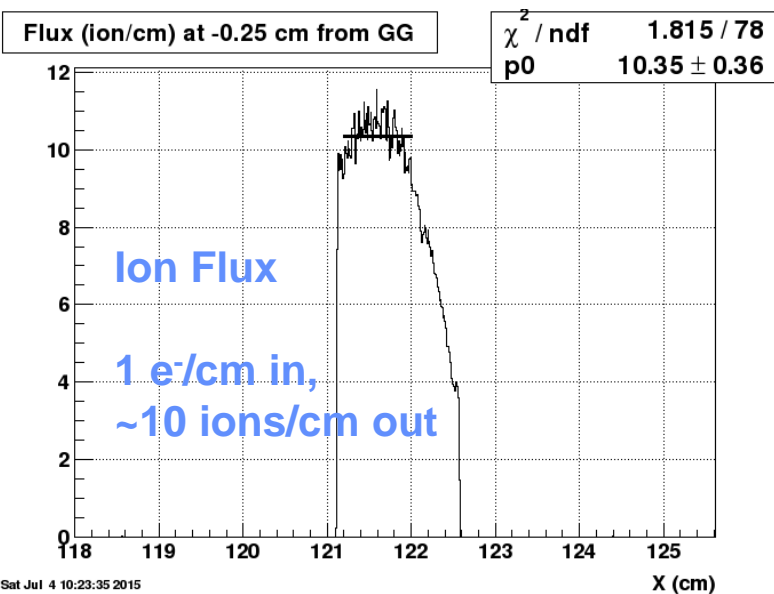
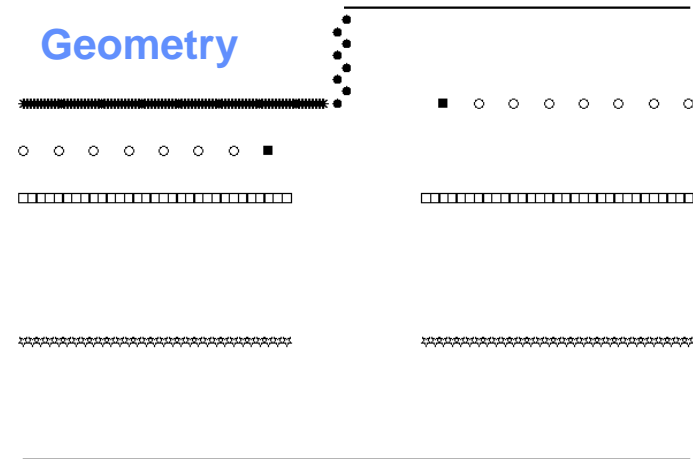


- Pad Plane on top, Central Membrane at bottom
- Rotate ME views 180° around an axis coming out of the page
- Electrons float up, Ions fall down
- Note that Central Membrane is only 5 mm from the GG

Normal Geometry: No Wall



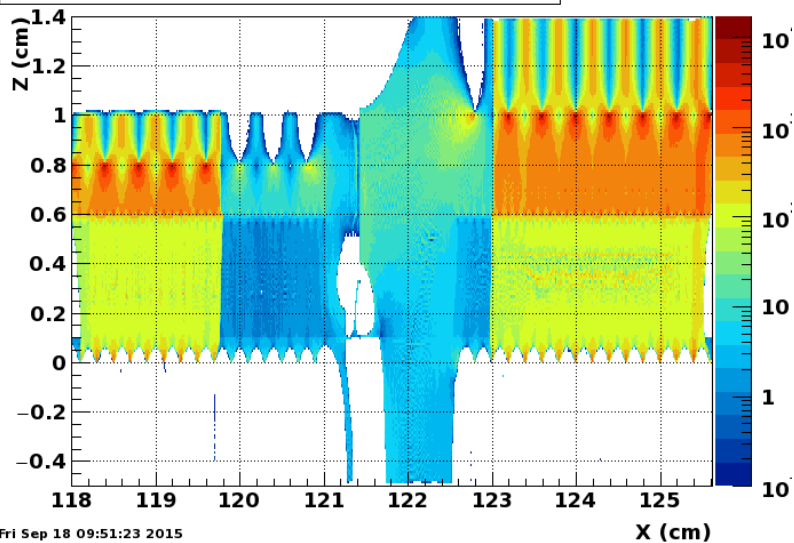
Geometry



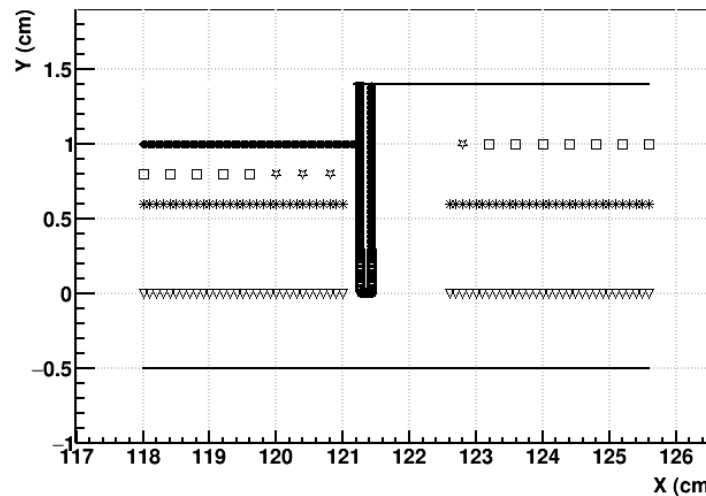
-230 volts on outside of wall



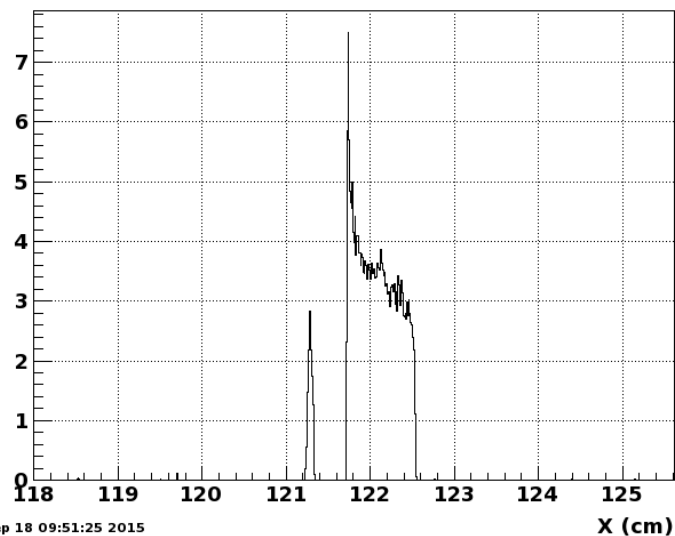
Flux (ions/cm) normalized to electron flux 1 cm^{-1}



Fri Sep 18 09:51:23 2015

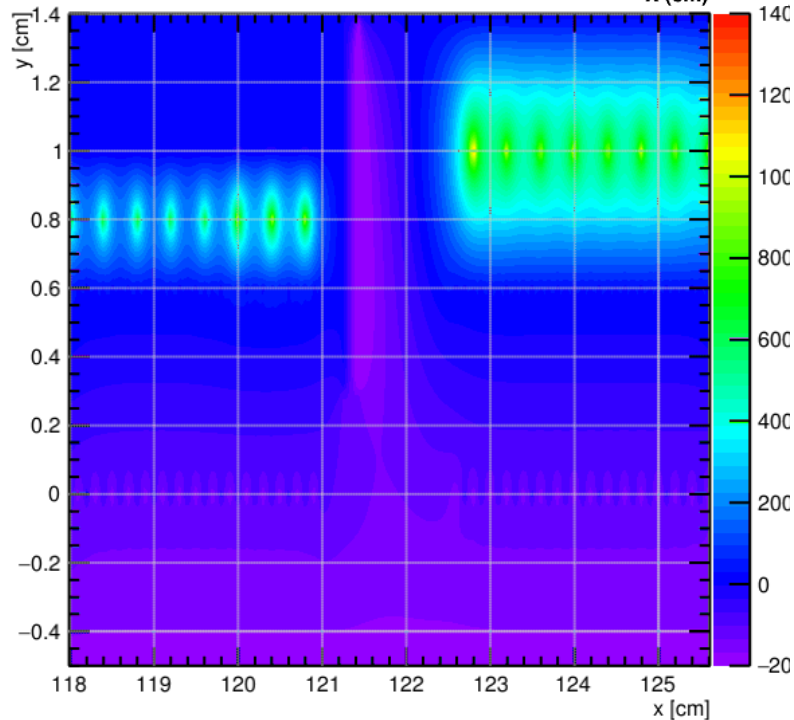


Flux (ion/cm) at -0.25 cm from GG



Fri Sep 18 09:51:25 2015

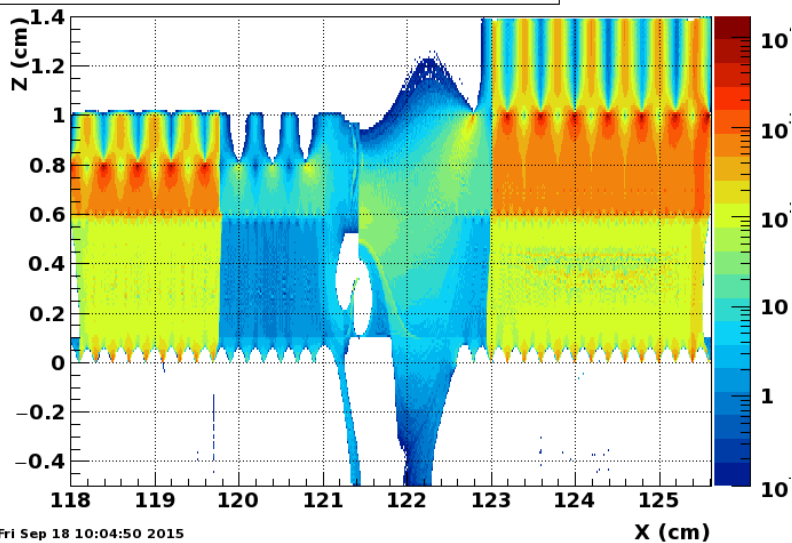
Jim Thomas - LBL



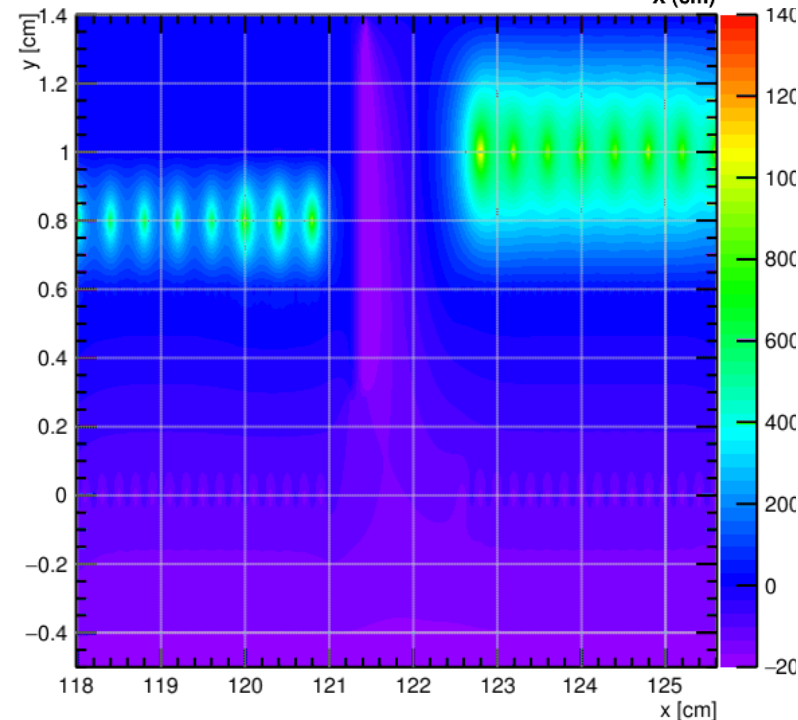
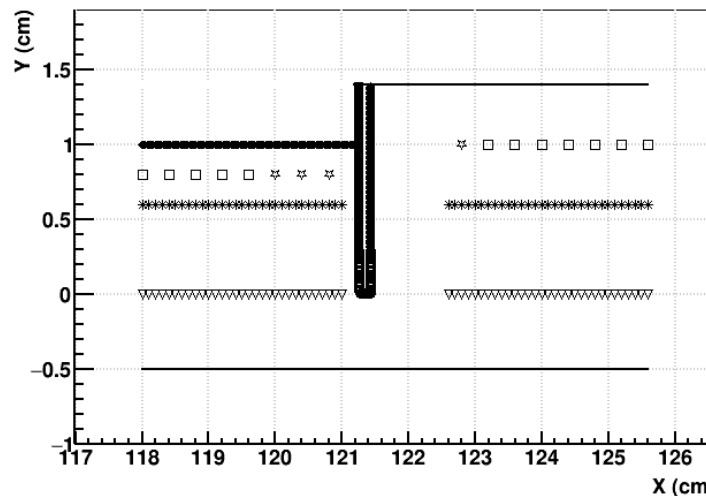
-690 Volts on outside of wall



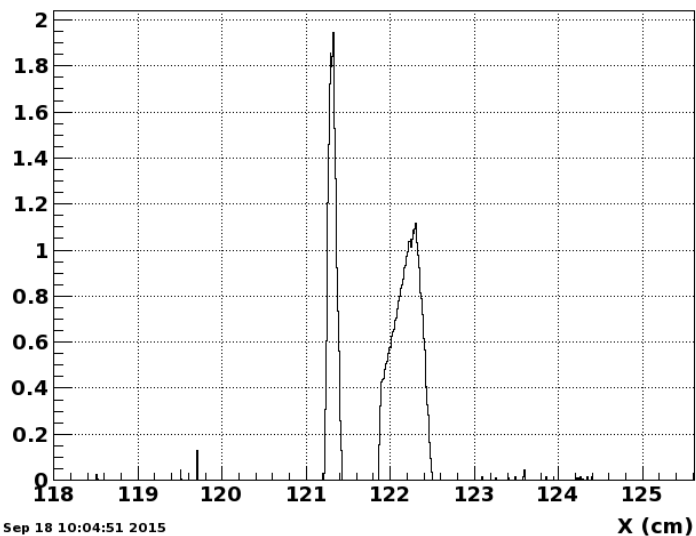
Flux (ions/cm) normalized to electron flux 1 cm^{-1}



Fri Sep 18 10:04:50 2015



Flux (ion/cm) at -0.25 cm from GG

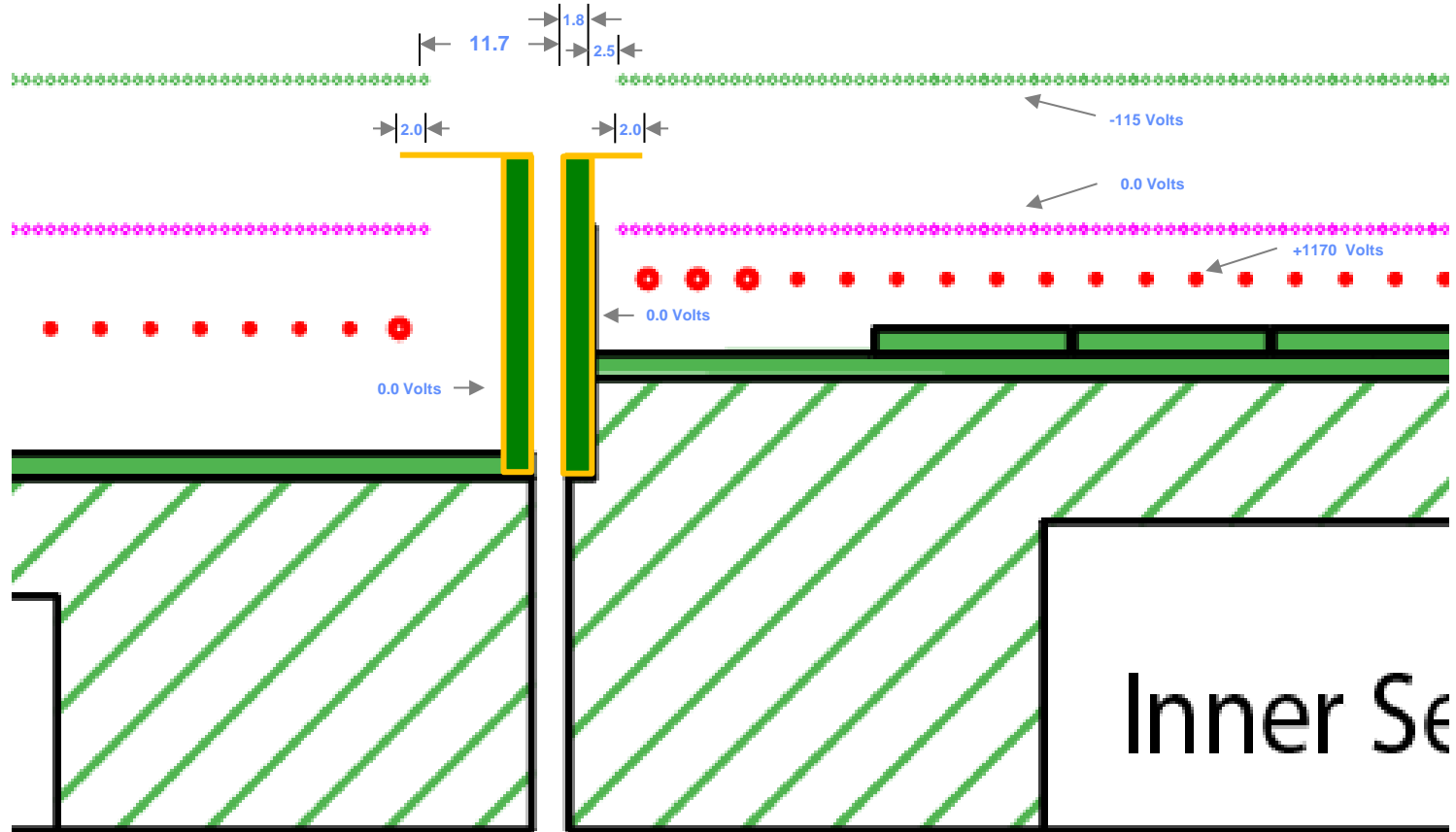


Fri Sep 18 10:04:51 2015

Jim Thomas - LBL

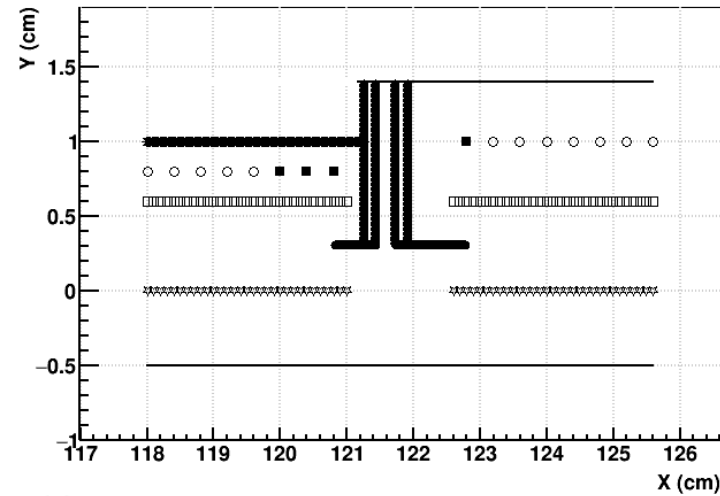
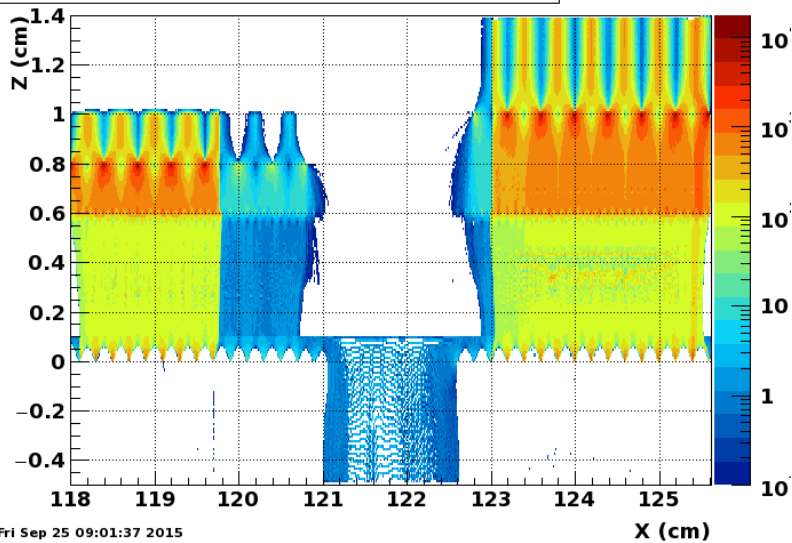
- **A Biased wall will work**
- **Order of magnitude decrease of Ion Flux can be achieved**
- **~700 volts required to do a good job**
- **Note that equipotential lines (lower right panels) guide the ions to the wall**
- **Mechanical Engineering is achievable**
 - **Requires 0.070” deep notch in top 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"

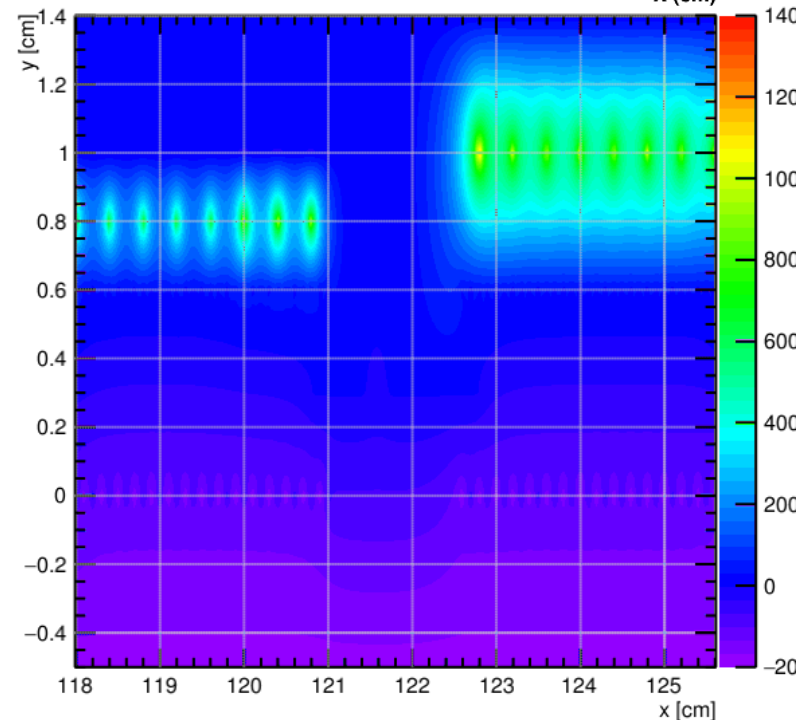
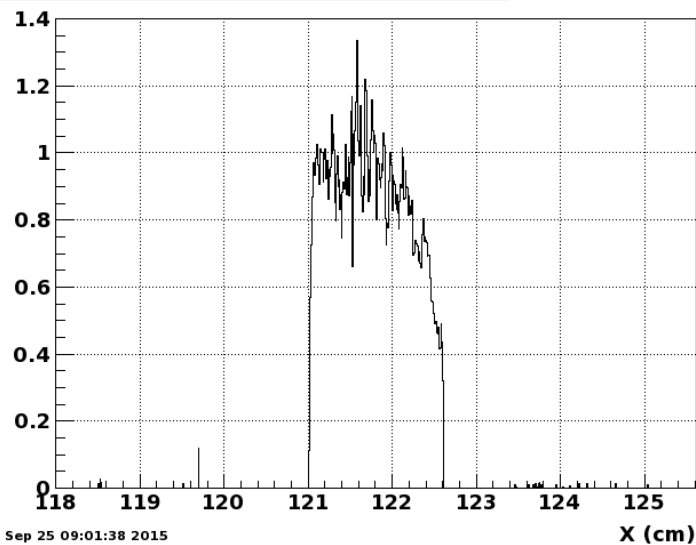


Grounded fingers between the grids: Inner & Outer Sectors!

Flux (ions/cm) normalized to electron flux 1 cm^{-1}



Flux (ion/cm) at -0.25 cm from GG



- **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

- **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 it 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



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

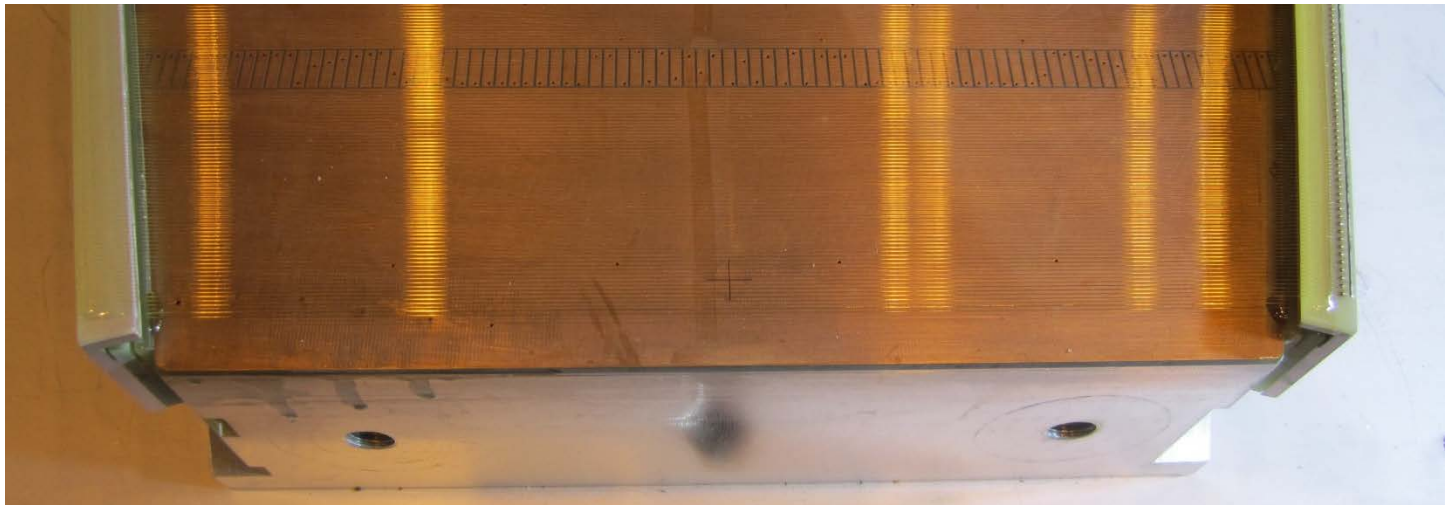
Radius (Y)	Description	
0.00	Center of STAR Detector (vtx)	GATED GRID WIRE
498.80	Bottom of Full size PC Board	Ø.075mm BeCu , Au plated
512.70	Tertiary Fiducial L & R	spacing 1mm
519.05	Strongback Bottom Edge	OUTER : 689 Wires
530.00	Gated Grid Wire 1	INNER : 681 Wires
531.00	Gated Grid Wire 2	TOTAL : 1,370 Wires per Sector
532.00	Anode Wire 1 & GG W-3	
536.00	Anode Wire 2 & GG W-7	SHIELD GRID WIRE
540.00	Anode Wire 3 & GG W-11	Ø.075mm BeCu , Au plated
540.25	Secondary Fiducial	spacing 1mm
544.00	Anode Wire 4 & GG W-15	OUTER : 689 Wires
548.00	Anode Wire 5 & GG W-19	INNER : 681 Wires
558.00	Pad Row 1 - Center	TOTAL : 1,370 Wires per Sector
574.00	Pad Row 2 - Center	
1166.00	Pad Row 39 - Center	Repeat pad rows every 16 mm
1179.45	Primary Fiducial	ANODE GRID WIRE
1182.00	Pad Row 40 - Center	Ø.020mm W, Au plated
1192.00	Anode Wire 166 & GG W-663	spacing 4mm
1196.00	Anode Wire 167 & GG W-667	OUTER : 170 Wires
1200.00	Anode Wire 168 & GG W-671	INNER : 164 Wires (168 in old design)
1204.00	Anode Wire 169 & GG W-675	TOTAL : 334 Wires per Sector (338 in old design)
1204.85	Alternate Primary Fiducial	
1208.00	Anode Wire 170 & GG W-679	LAST ANODE WIRE
1209.00	Gated Grid Wire 680	Ø.125mm BeCu , Au plated
1210.00	Gated Grid Wire 681	OUTER : 2 Wires
1214.32	Strongback Top Edge	INNER : 6 Wires (2 in old design)
1220.67	Tertiary Fiducial L & R	TOTAL : 8 Wires per Sector (4 in old design)
1235.42	Top of Full size PC Board	

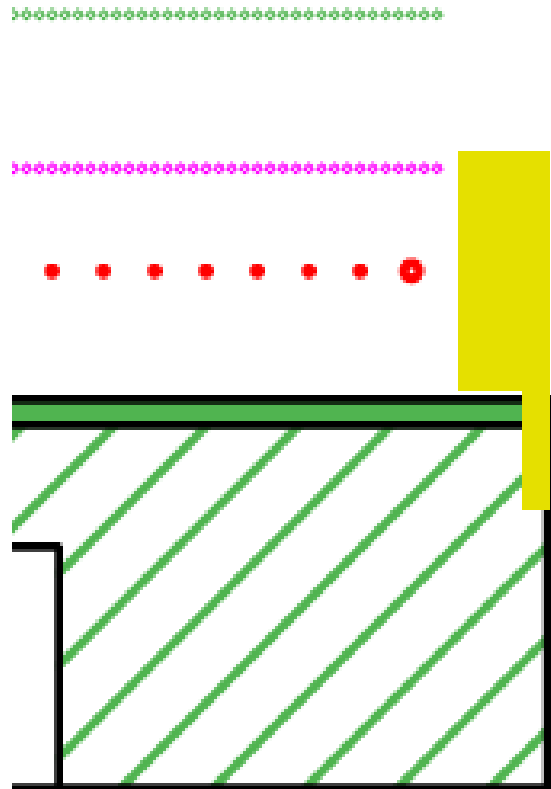
Wire Locations are the same as before except for the replacement of 6 thin anode wires with larger diameter anode wires (0.020 mm ⇒ 0.125 mm)

Inner Inner solution – first impressions



- Inner inner solution will be more complex because distance from edge of strongback to wires is greater. Perhaps use the outer solution, fingers between ground plane and GG, at 40 volts. Now we can use a notch and a fat wall (1/4") and or fingers between the grids.





- A metal wall at ground potential
- The main part of the wall is “fat”, but fastens to the strongback in the same way that the inner/outer grid leak walls attach
- “Free Machining” Brass
- Needs simulation to prove it works ... but very likely it will work if the wall is close enough to the wires.