(preliminary) design of Long DCH prototype @ LNF

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DCH R&D meeting
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Cell Layout

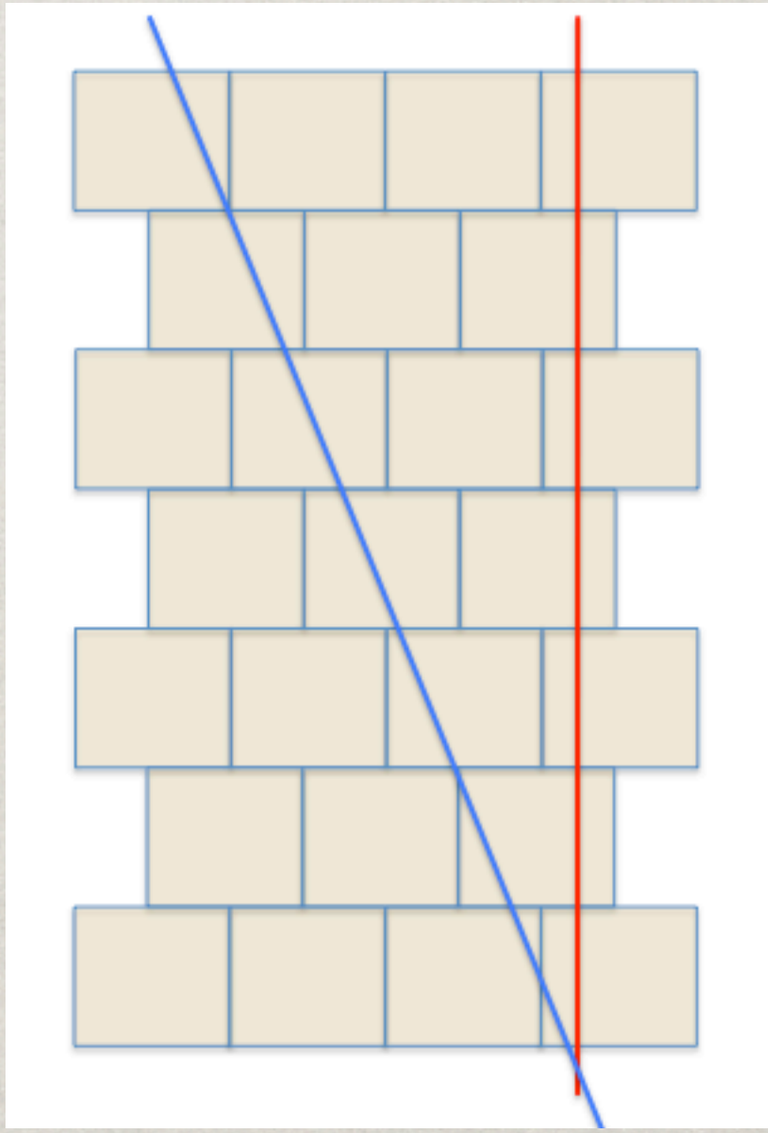
- Enough cell layers to allow track reconstruction inside the prototype

- Enough wires per layer to allow ±20° tracks

- Keep dimensions limited, such as to maximize use of off-the-shelf parts

- 7 layers of square cells, 15mm side (25 cells total)

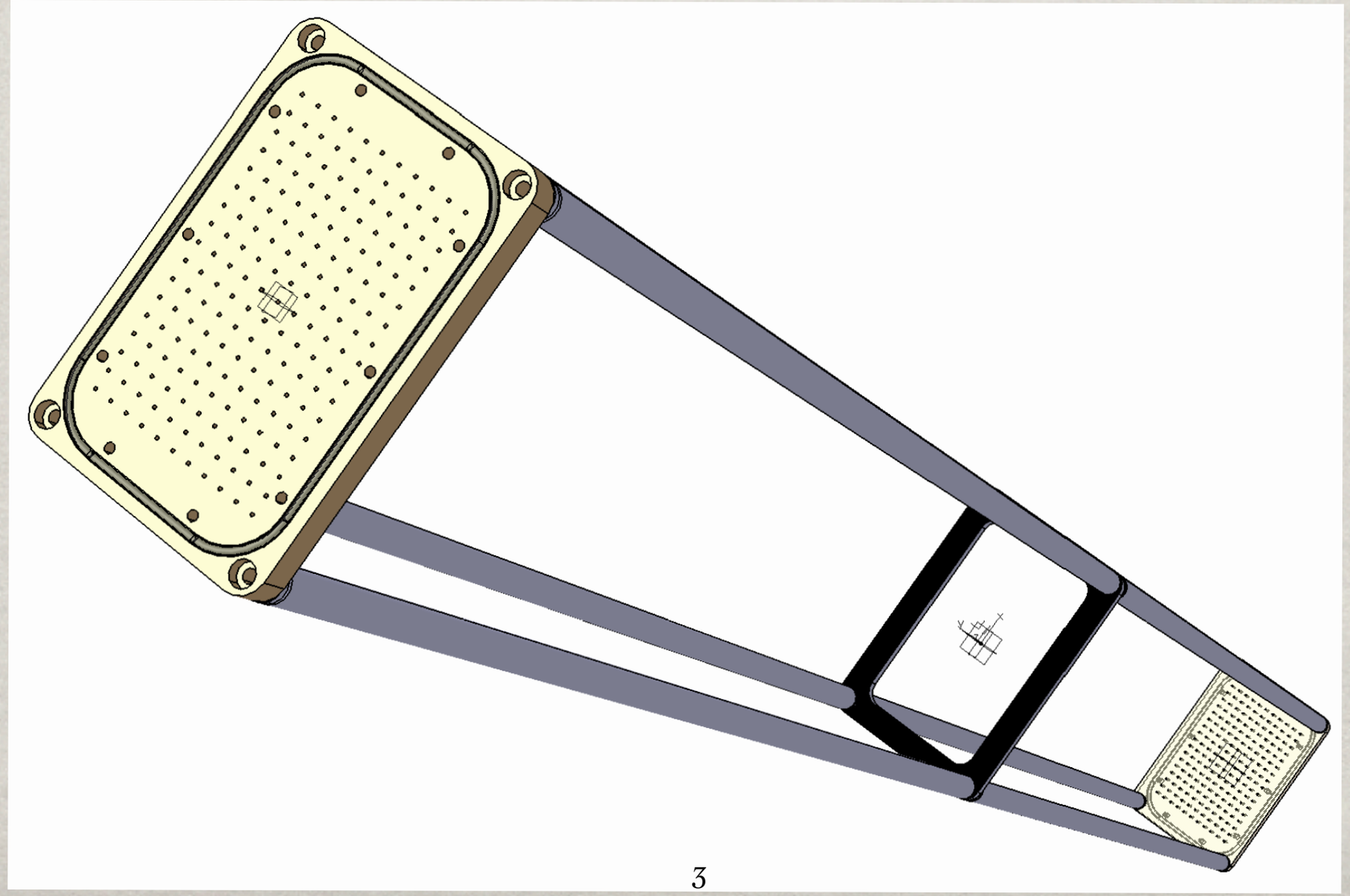
  ✓ Considering if possible/ useful to add 1 more layer



E. Capitolo
A. Cecchetti
LNF

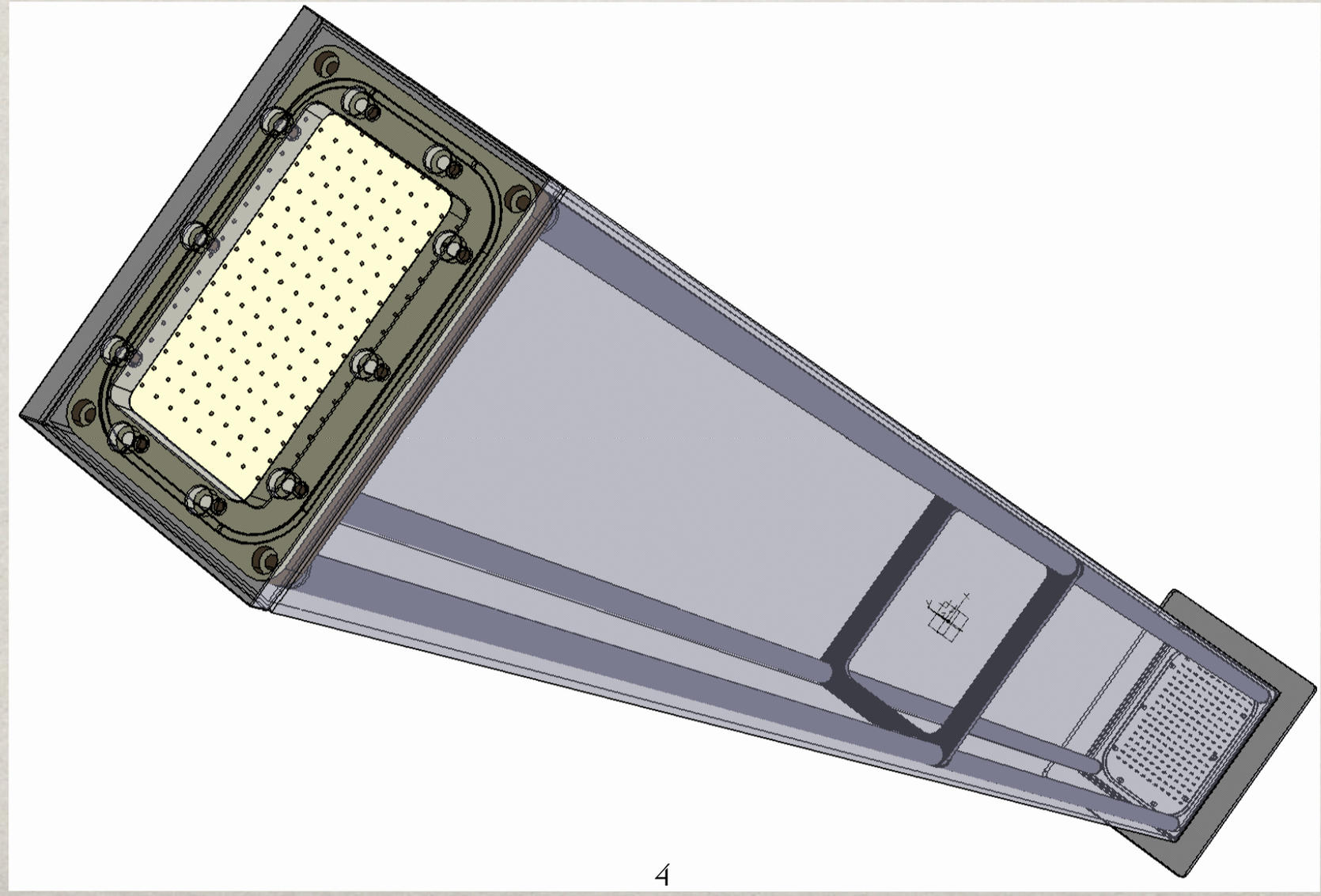
Technical Design

- 2.7m long, light structure with endplate frames separated by 4 Aluminum rod struts



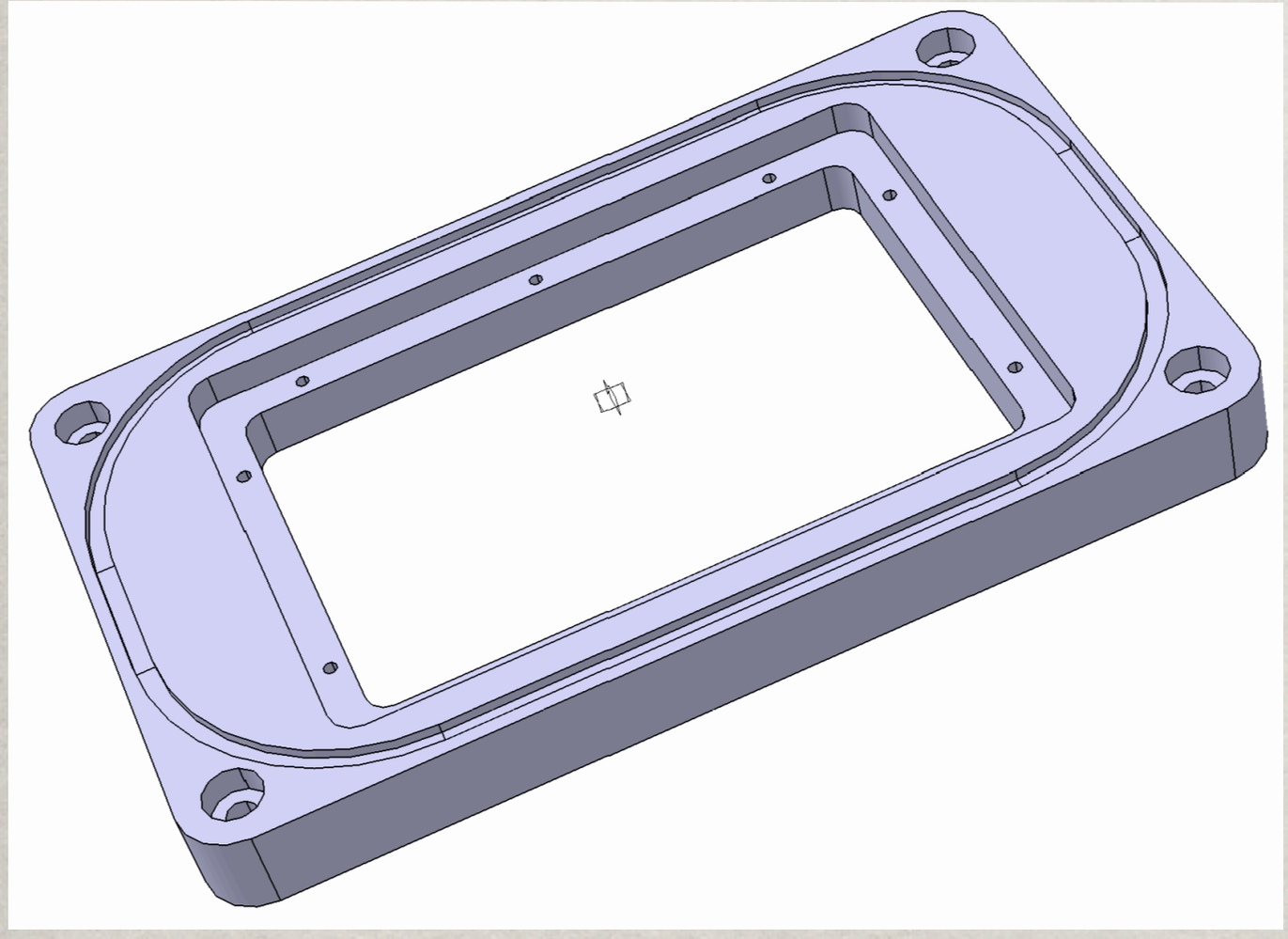
Technical Design

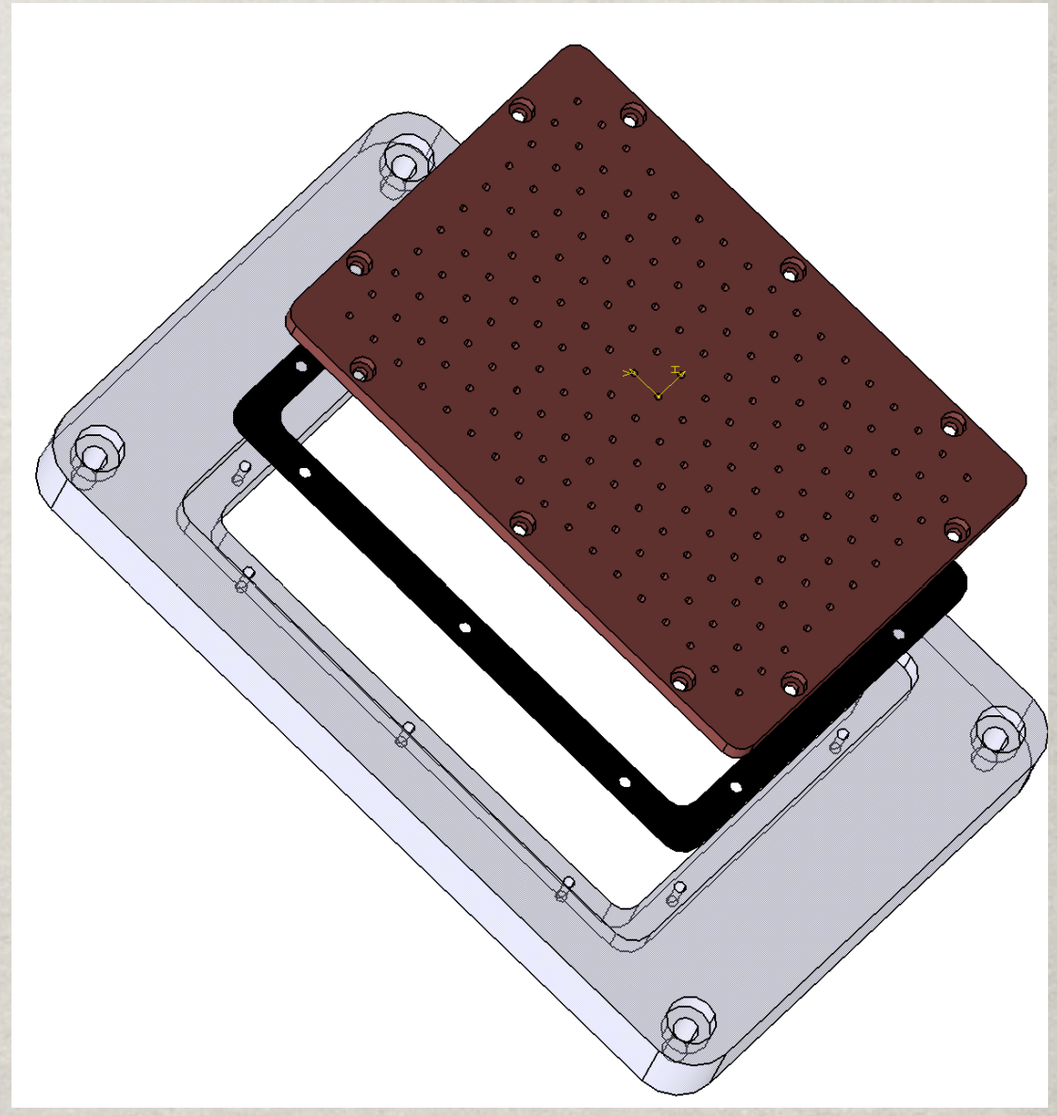
- After stringing, structure slid into a (~3mm thick) metal case for gas tightness
  - Aluminized mylar windows to minimize material seen by tracks at various longitudinal positions



Technical Design

- Details are being worked out





Sense Wires

- Gold-plated Tungsten-Rhenium (∅ 25µm) in hand
- Considering Gold-plated Molybdenum instead
  - ➡ Much Lower resistivity could be beneficial for cluster counting
  - ➡ purchasing a 400m spool (∅ 20µm)from Luma Metall for testing

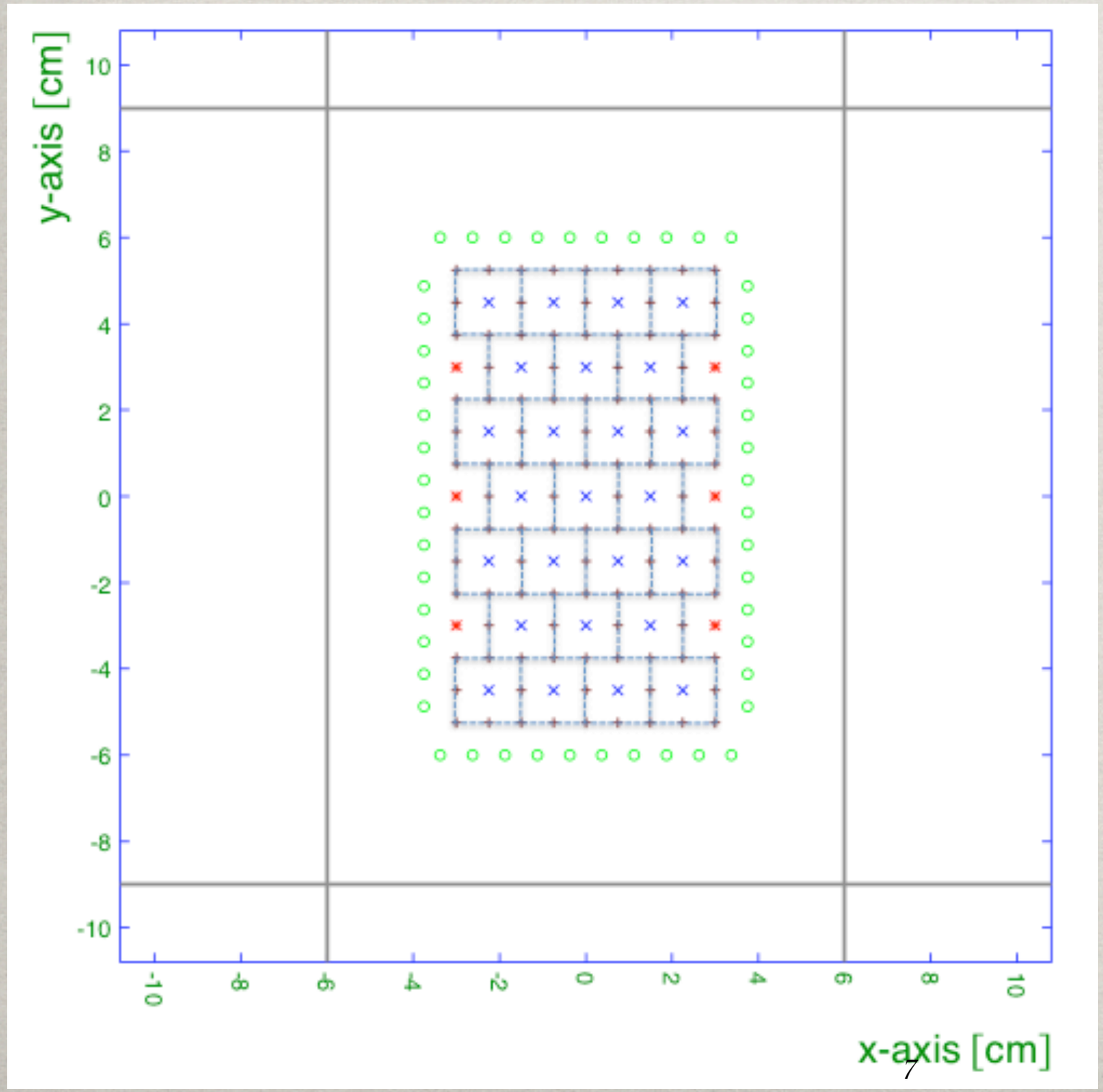
Properties of tungsten wire alloyed with 3% Rhenium

Purity of tungsten before rhenium addition	99.95% W
Melting point	3380 °C
Density	19.22 g/cm³
Specific electrical resistance at 20 °C	0.092 Ohm x mm²/m
Modulus of elasticity at 20 °C	430 kN/mm²

Properties of bare Molybdenum wire

Purity	99.9% Mo
Melting point	2620 °C
Density	10.14 g/cm³
Specific electrical resistance at 20 °C	0.052 Ohm x mm²/m
Modulus of elasticity at 20 °C	320 kN/mm²

Garfield studies - charge equalization



× Sense wires V=1900V
\+ Field wires V=0V
✶ Guard1 wires V=1650V
o Guard2 wires V=550/750V
\- Metal case V=0 V

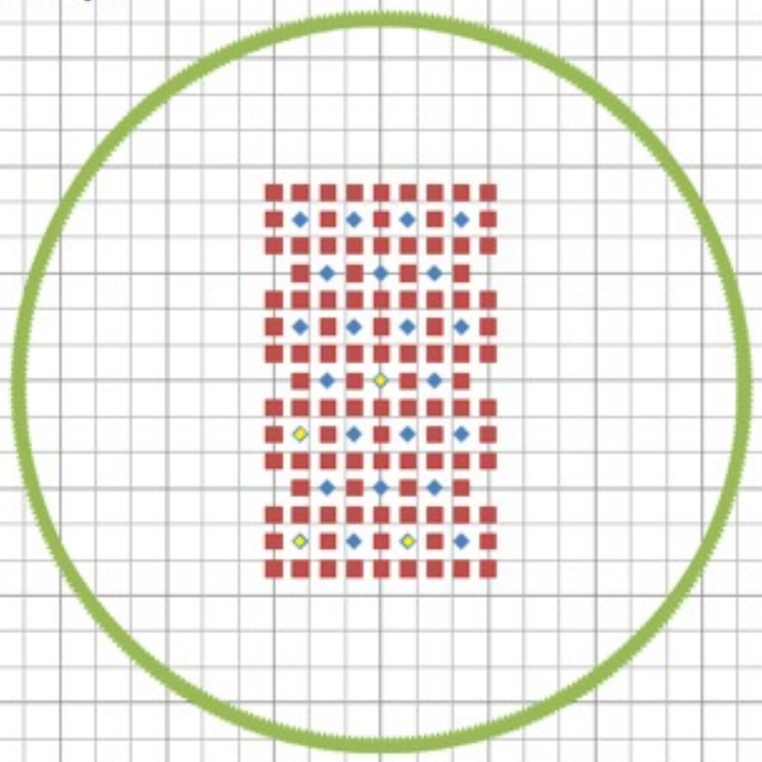
Garfield studies - charge equalization

Charge on sense wires [pC/cm]				$\Delta Q/Q_{max}$
139.15	138.79	138.79	139.15	0.26%
	138.52	138.83	138.52	0.22%
138.53	138.80	138.80	138.53	0.12%
	138.48	138.83	138.48	0.25%
138.53	138.80	138.80	138.53	0.12%
	138.52	138.83	138.52	0.22%
139.15	138.79	138.79	139.15	0.26%

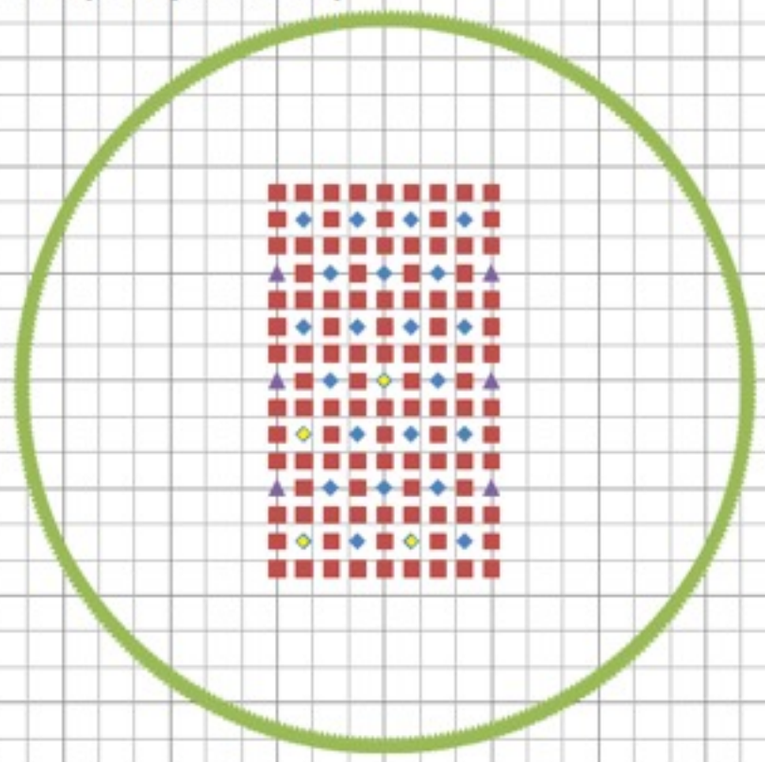
Garfield studies of the LNF prototype - Chris Hearty, Philip Lu

- Philip looked at five different layouts, all with 25 sense wires. 15 mm square cells.
- Select an arrangement of guard and bias wires that makes the electric field in the corner and edge cells look like that in the center cell.
- Quantify by looking at the reconstruction error arising from applying the time-to-distance from the center cell to the corner or edge cells.

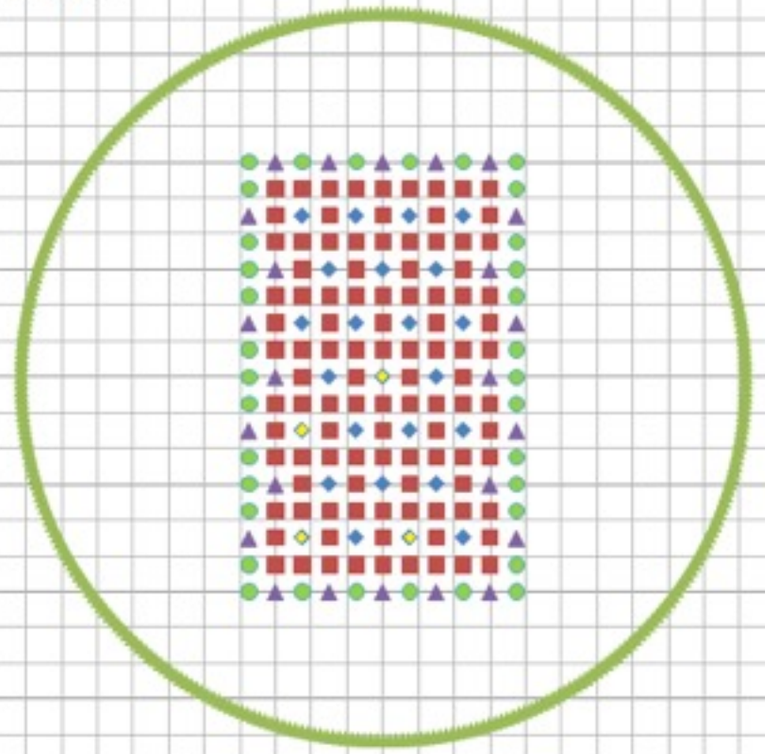
Base Layout



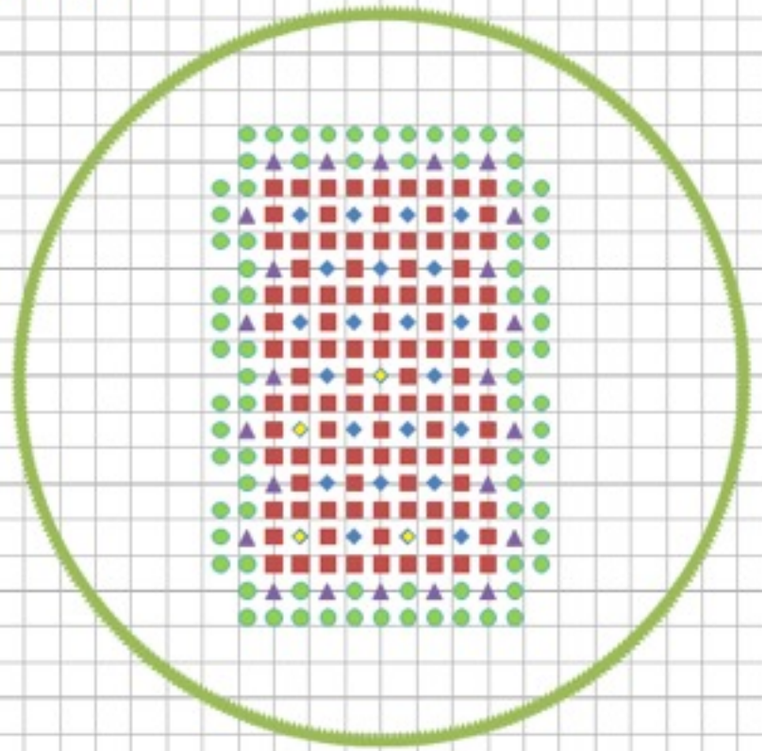
Base Layout (Modified)



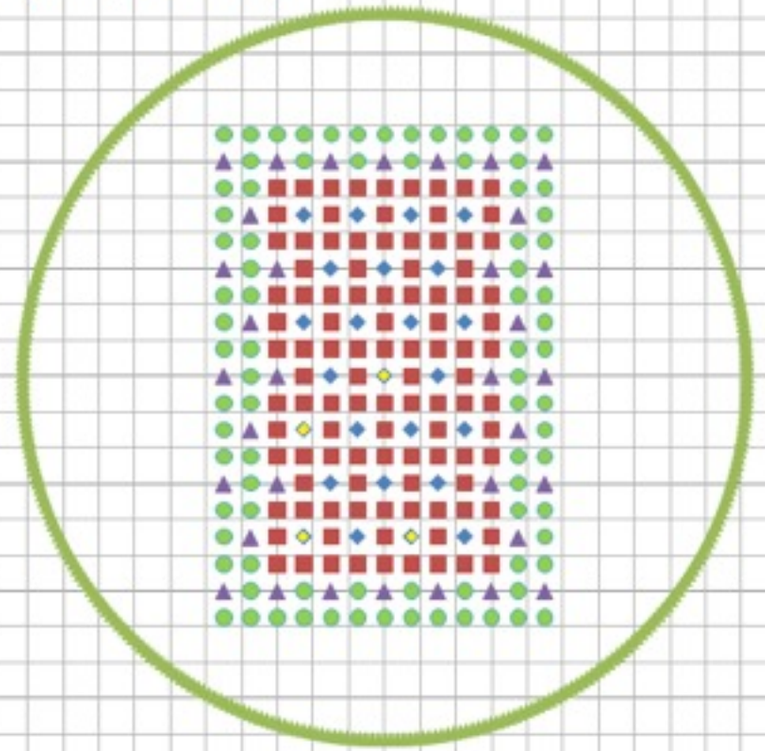
One Layer

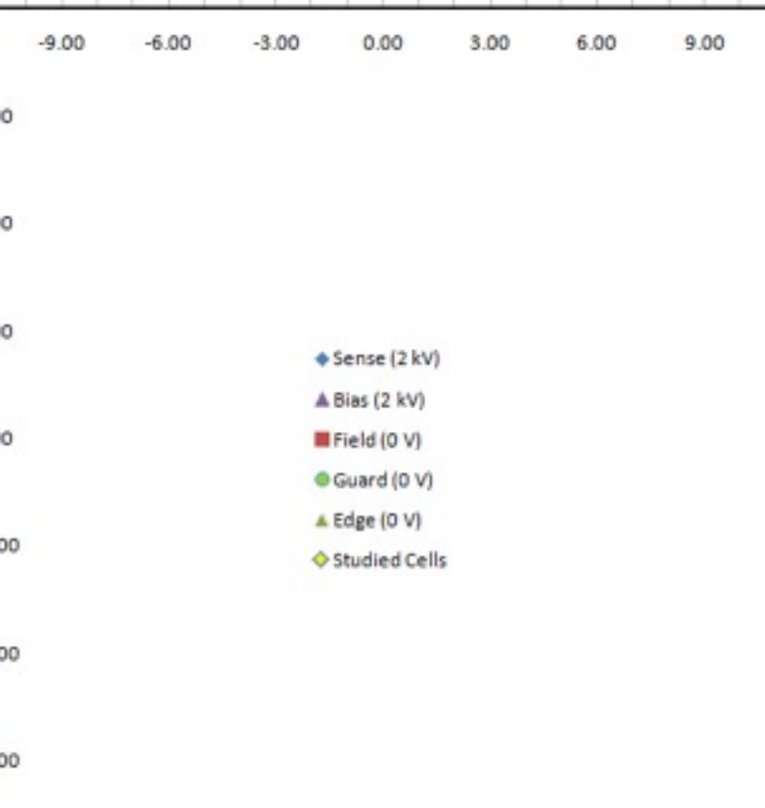


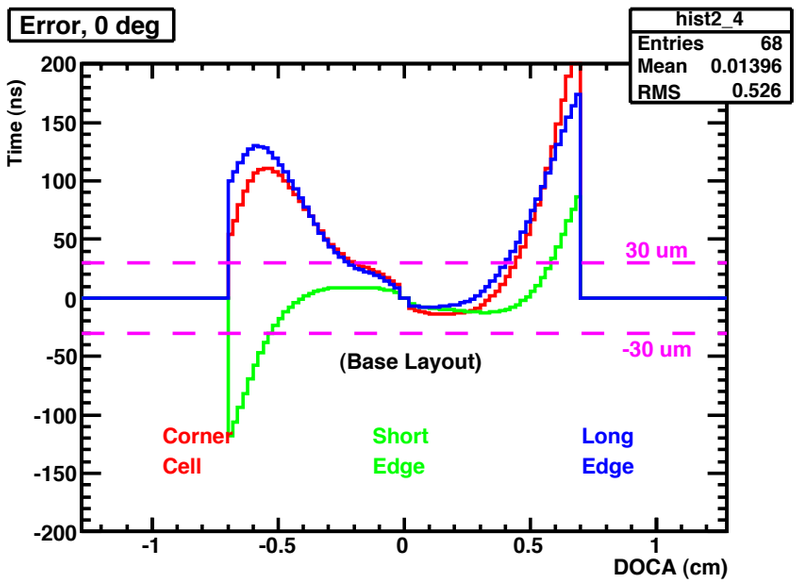
Two Layers



2 Layers (Modified)



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hist2_4
Entries 68
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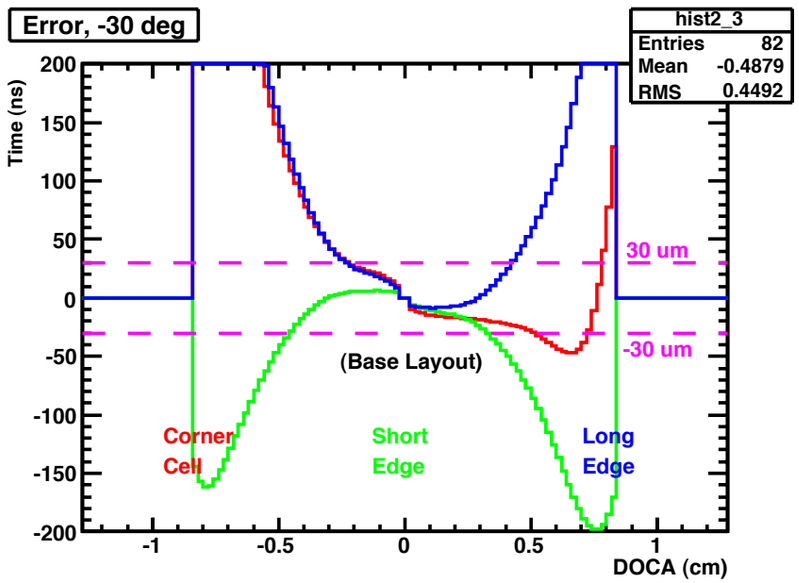
RMS 0.526
Time (ns)
DOCA (cm)
30 um
-30 um
(Base Layout)
Corner Cell
Short Edge
Long Edge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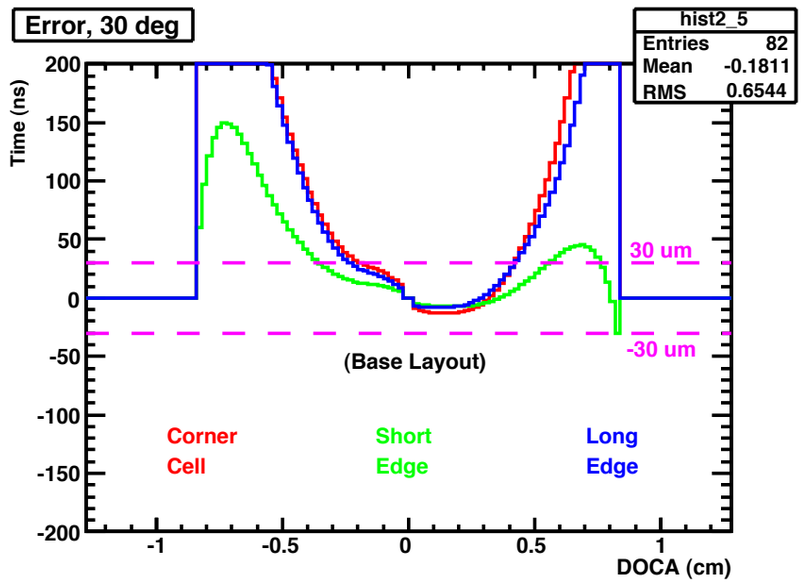
(Base Layout)
Corner Cell
Short Edge
Long Edge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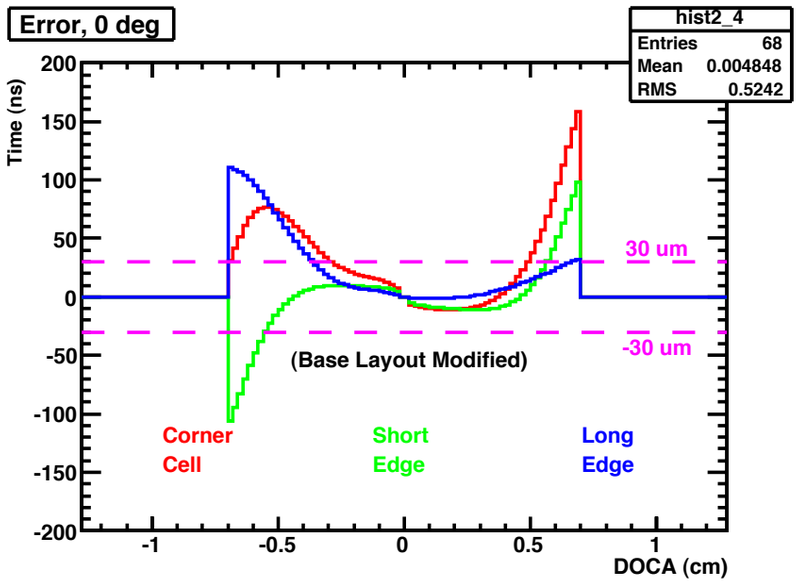
(Base Layout)
Corner Cell
Short Edge
Long Edge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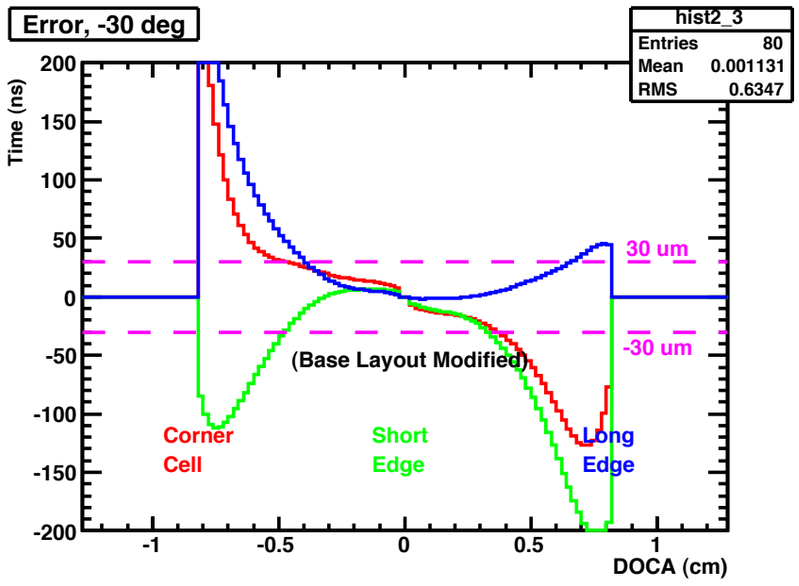
(Base Layout Modified)
Corner Cell
Short Edge
Long Edge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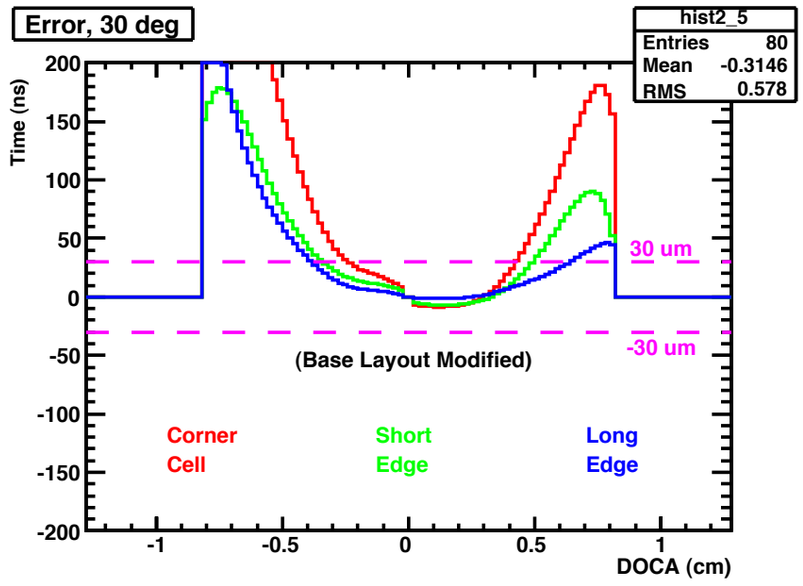
(Base Layout Modified)
Corner Cell
Short Edge
Long Edge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RMS 0.578
Time (ns)
DOCA (cm)
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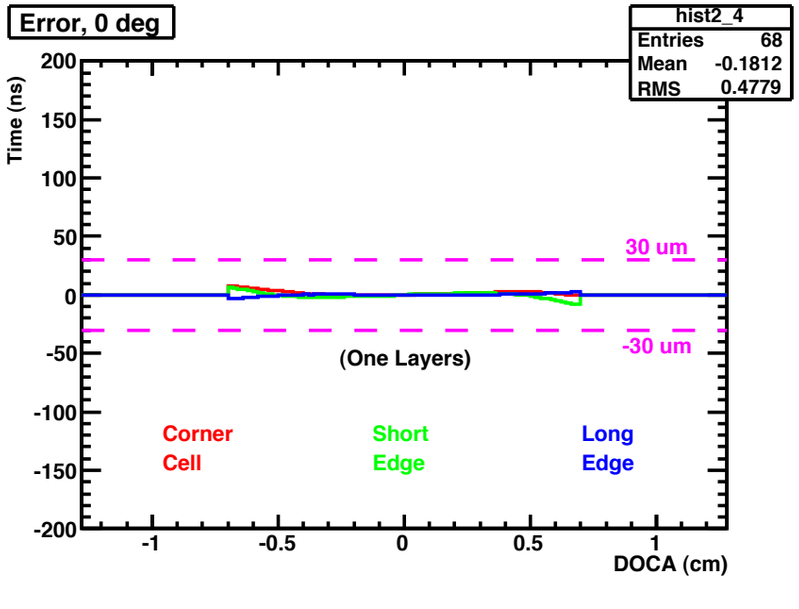
-30 um
(Base Layout Modified)
Corner Cell
Short Edge
Long Edge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DOCA (cm)
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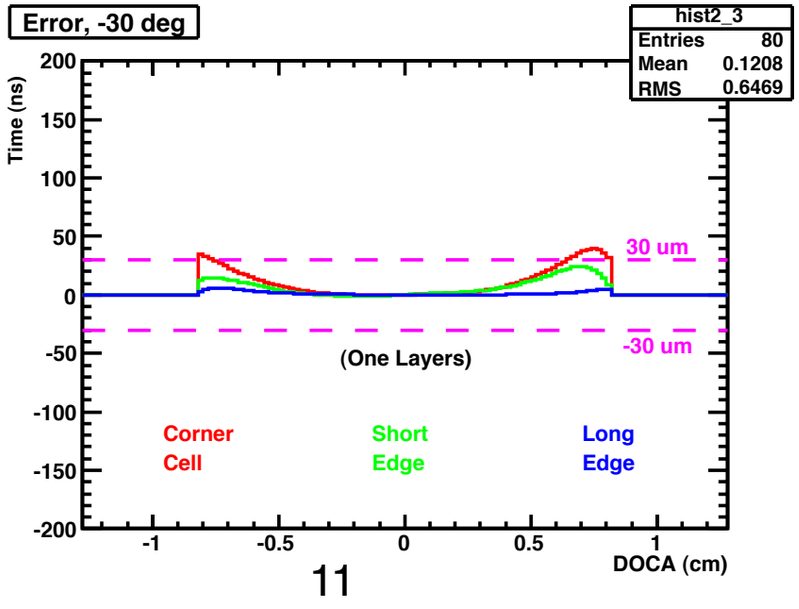
-30 um
(One Layers)
Corner Cell
Short Edge
Long Edge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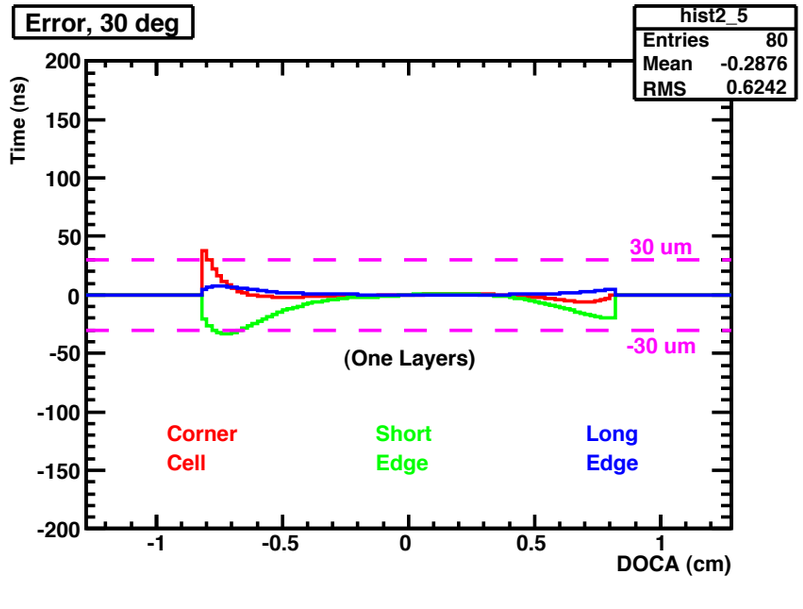
Time (ns)
DOCA (cm)
30 um
-30 um
(One Layers)
Corner Cell
Short Edge
Long Edge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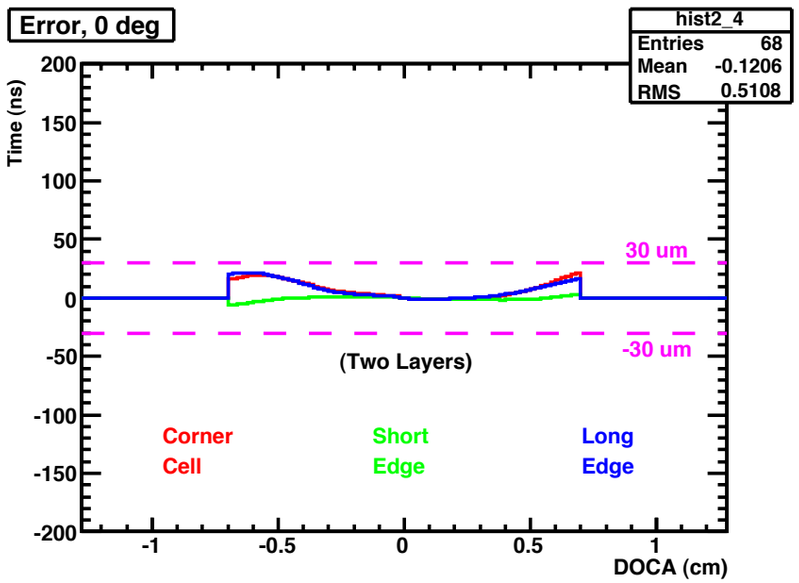
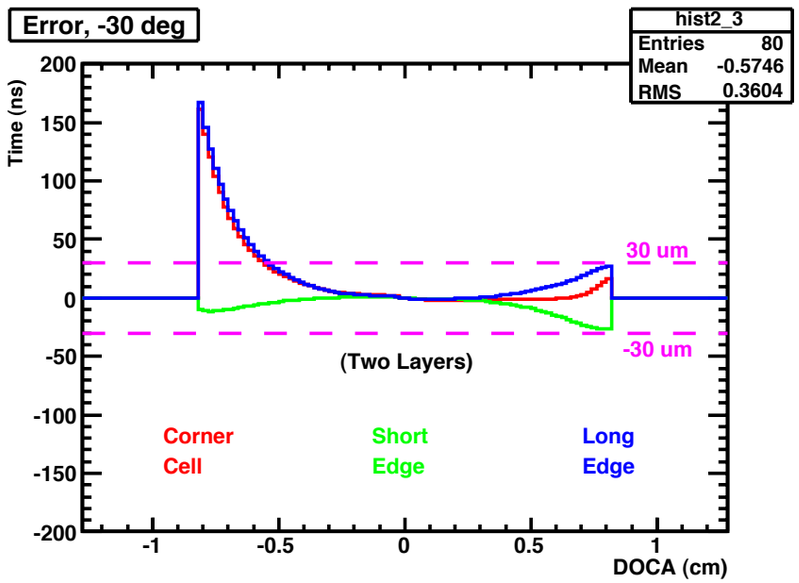
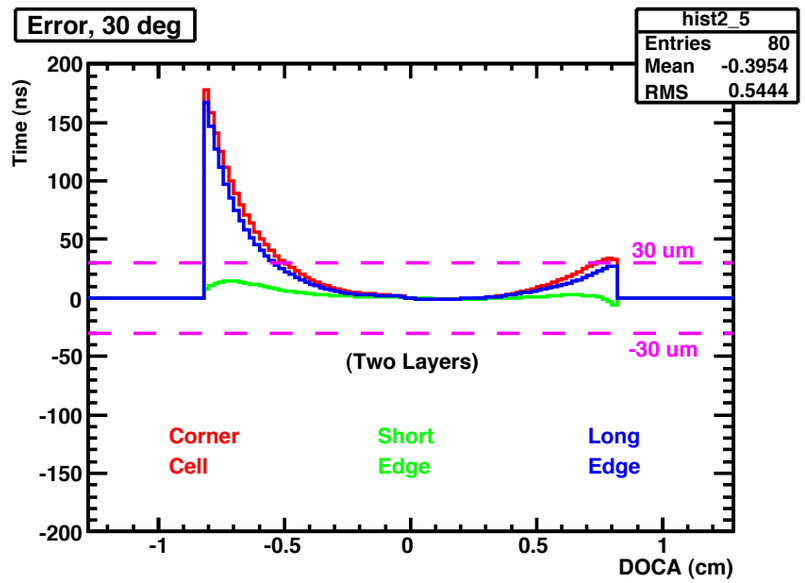
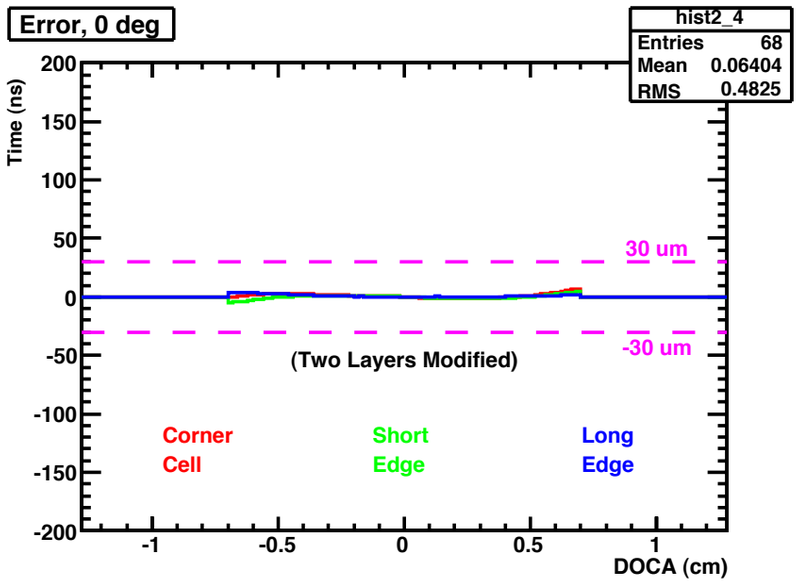
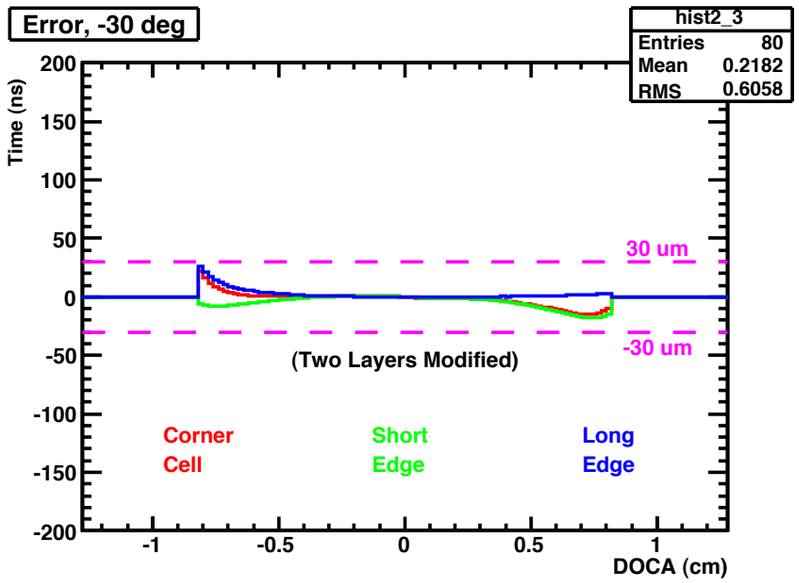
-30 um
(One Layers)
Corner Cell
Short Edge
Long Edge

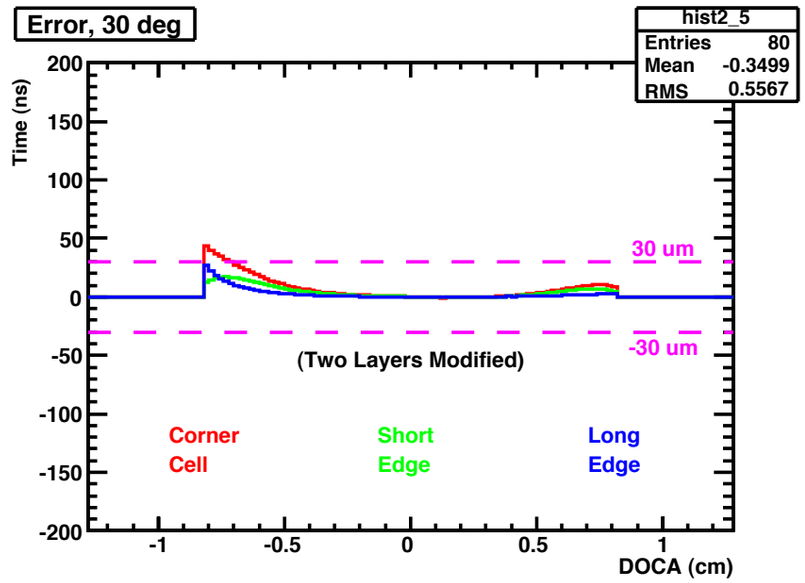




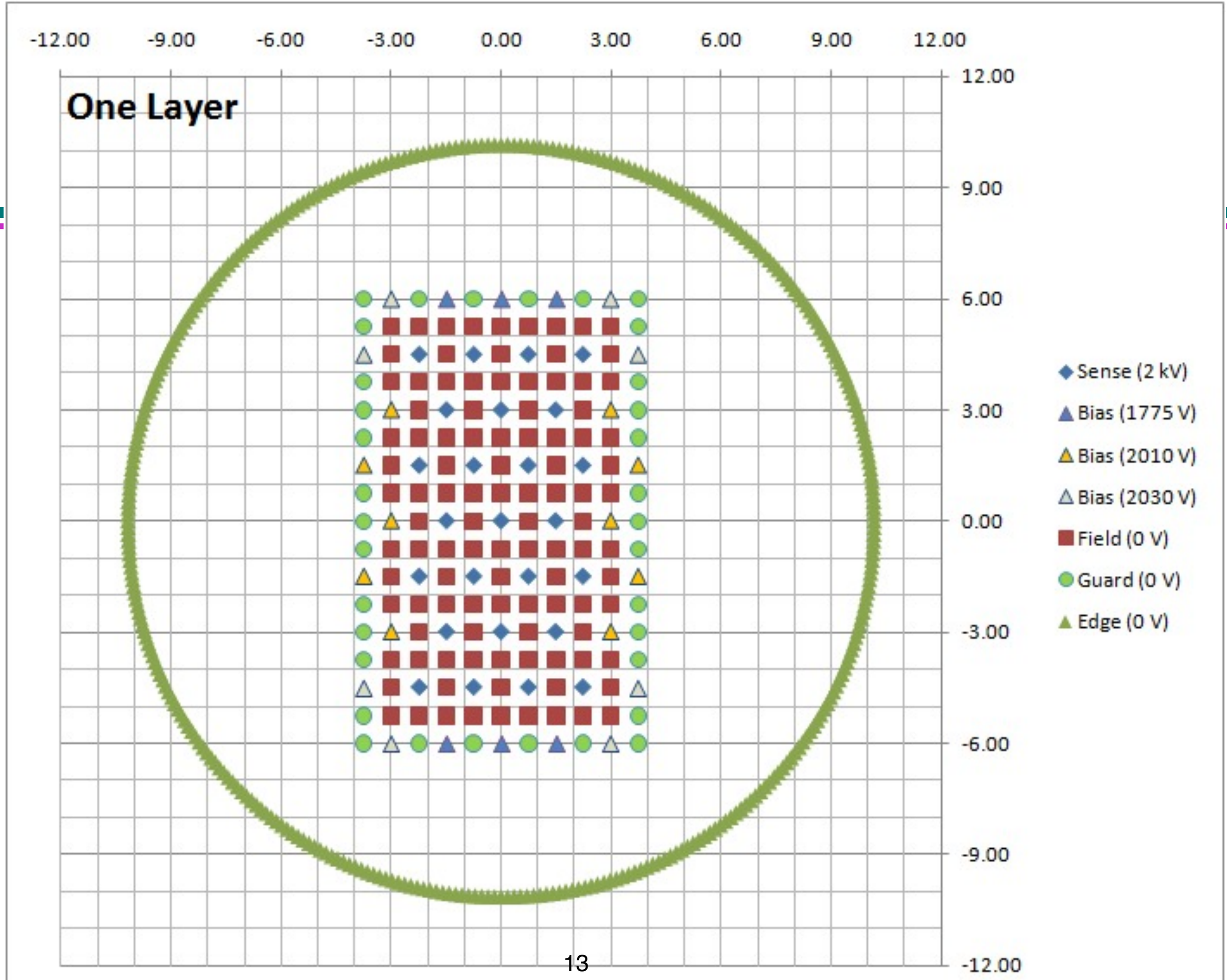




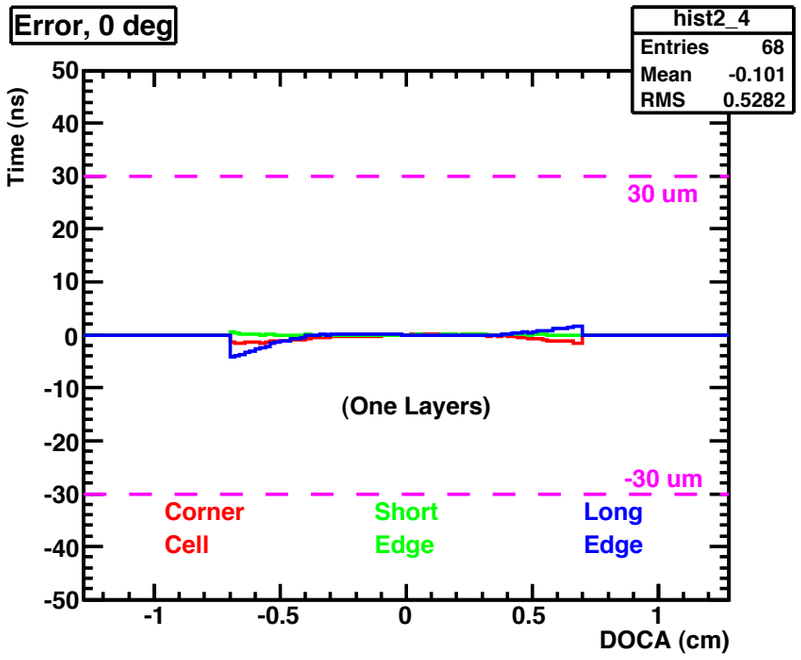


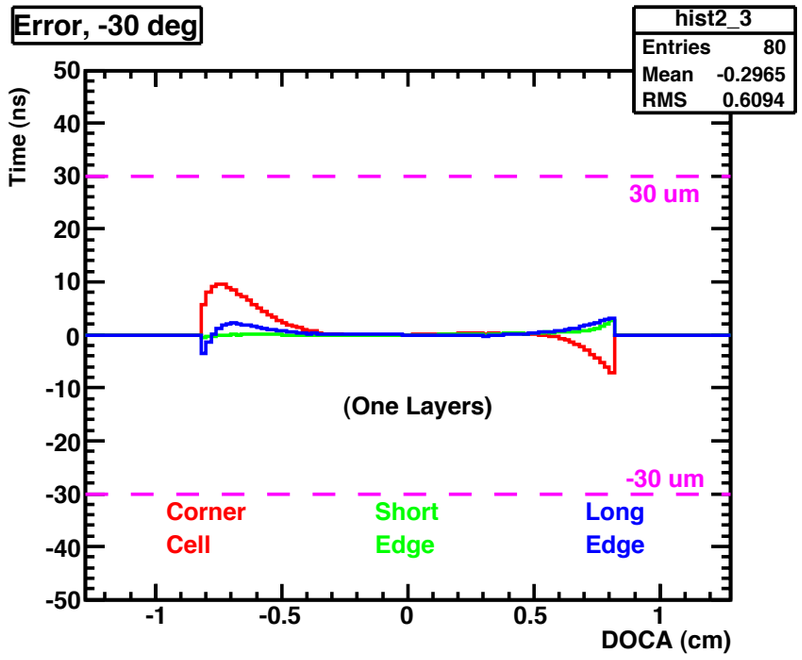


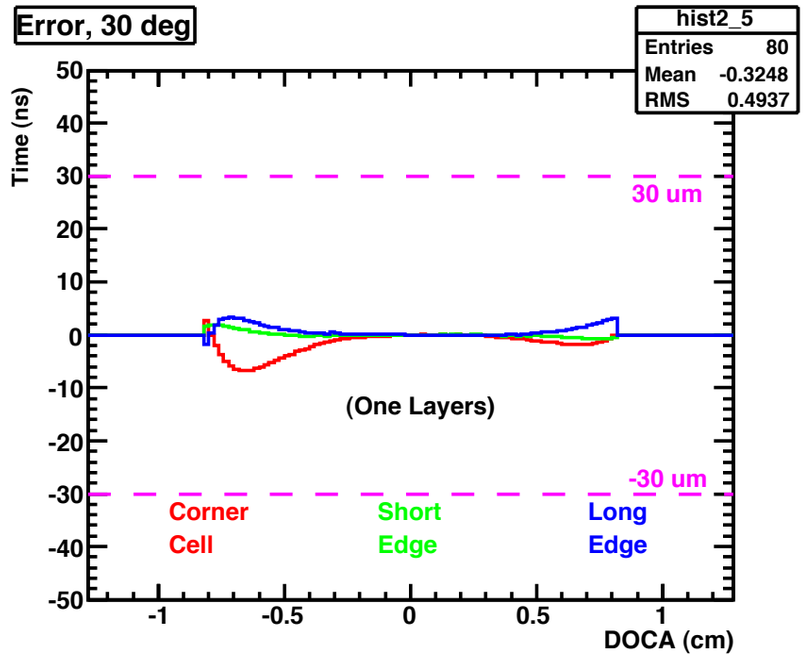
- One guard/bias layer gives adequate performance. Bias wires at nominal voltage (2 kV)
- Try to improve uniformity by varying bias voltage from nominal 2000 V.
- These results may depend on the details of the mechanical structure (i.e. ground), but this study demonstrates that improvement is possible.


One Layer
-12.00
-9.00
-6.00
-3.00
0.00
3.00
6.00
9.00
12.00
Sense (2 kV)
Bias (1775 V)
Bias (2010 V)
Bias (2030 V)
Field (0 V)
Guard (0 V)
Edge (0 V)

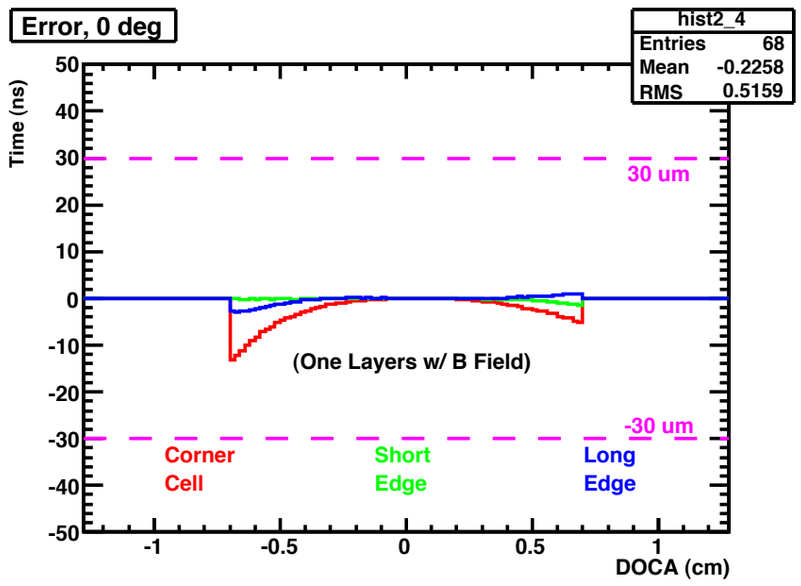
Results with different bias voltages, single guard layer. Note change in vertical scale with respect to previous plots.

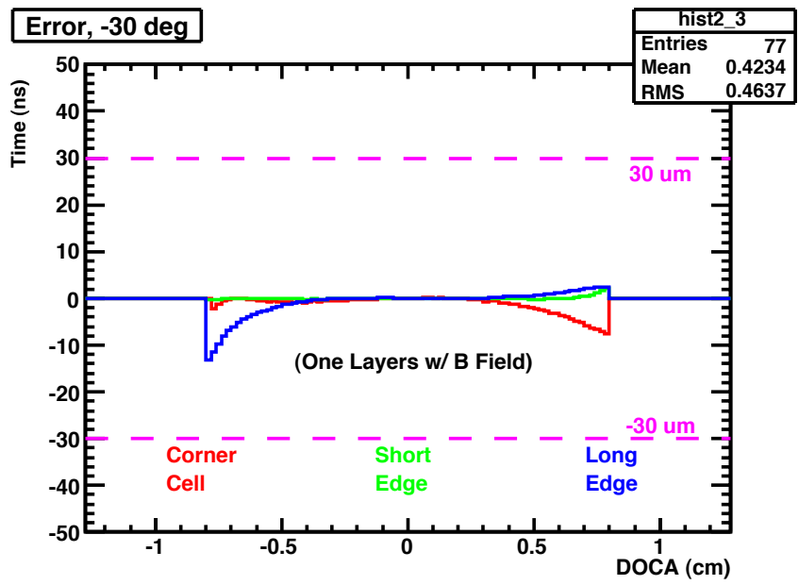


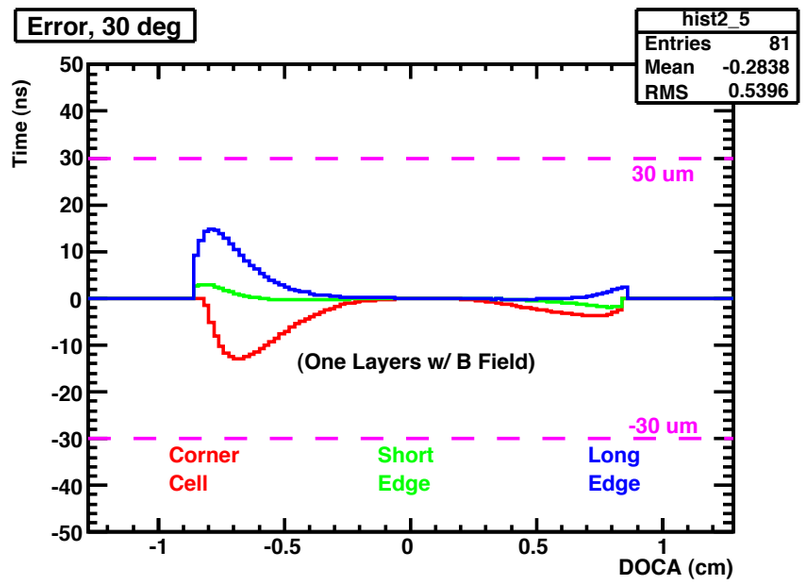




B = 0.9 T (Strovink solenoid)







In Summary...

- ✓ Aim to define last design details by the end of November
- ✓ Possibly start construction in December
- ✓ Wire tests, stringing and commissioning early 2011