Nuclear Physics Group Meeting 6/14

Week 3 Recap

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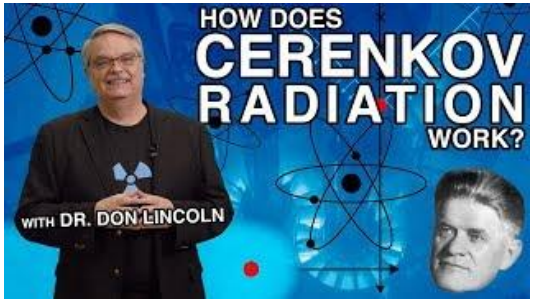
What has been done … (This Week)

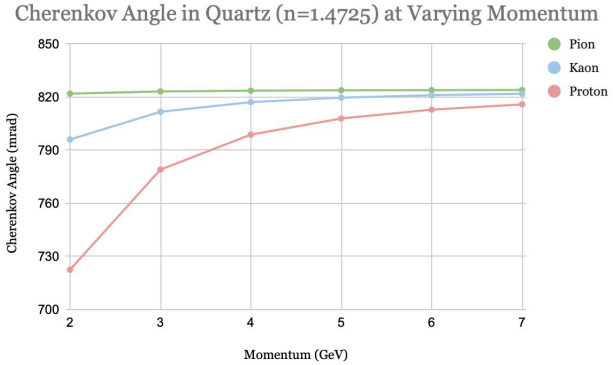
- Revisited Cherenkov Angle calculations from last week to include electrons and updated the graphs accordingly
- Used the simulation software to develop a baseline understanding of the visual results for varying polar angles and sensor configurations
- Identified issues in the simulation code that are relevant to my sensor study

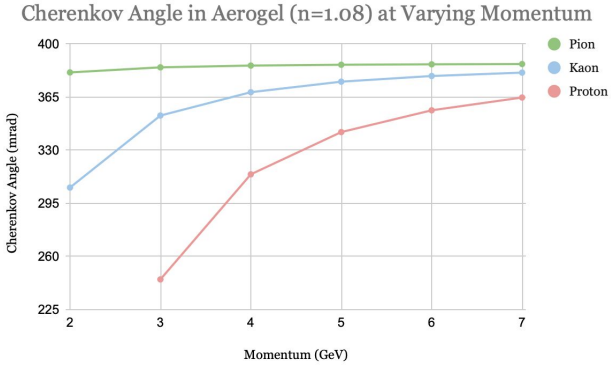
Cherenkov Angle Calculation Practice

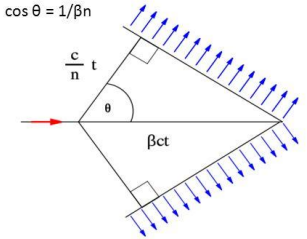
- Derived formula for Cherenkov Angle using provided momentum, particle mass, and refractive index
- Relativistic momentum, natural units, and some algebra



$$\theta = cos^{-1}\left(\frac{c}{nv_p}\right) \quad \Rightarrow \quad \theta = cos^{-1}\left(\frac{\sqrt{p^2+m^2}}{np}\right)$$



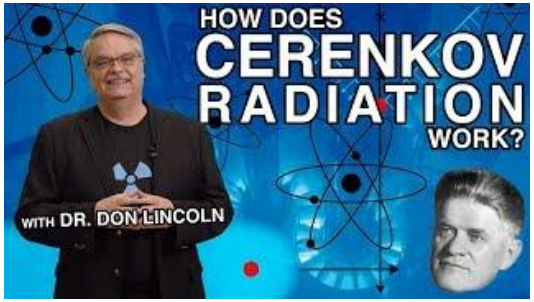


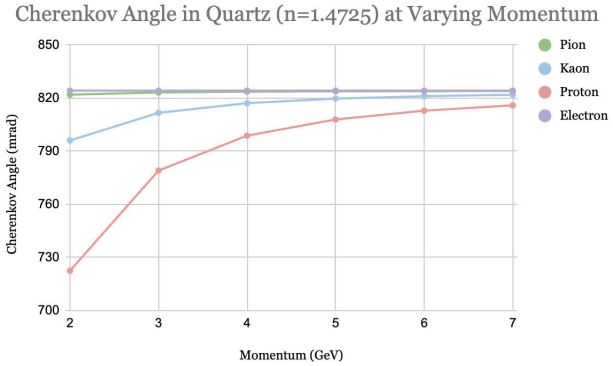


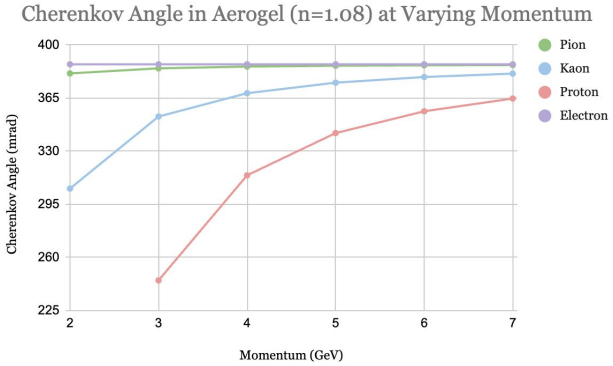
$$p_v = \frac{m_0 v}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}}$$

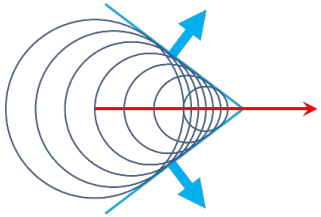
Cherenkov Angle Calculation Practice (Updated)

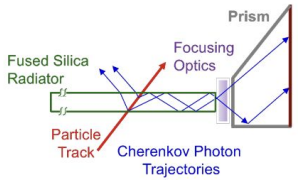
- Note the nearly horizontal line for the Cherenkov Angle of the electron in both cases
- Related to the mass of the electron and calculation of velocity from momentum and mass
- At 2 GeV, v_e is 99.99999675% of c. At 7 GeV, v_e is 99.9999997% of c. Only 2.95 x 10^{-6} % difference.
- ≈ 9.479% difference for protons at same momenta





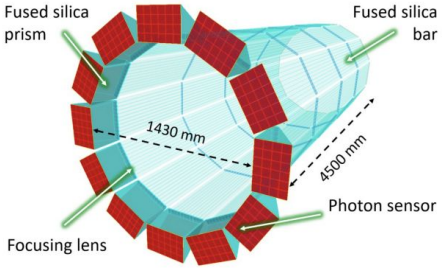


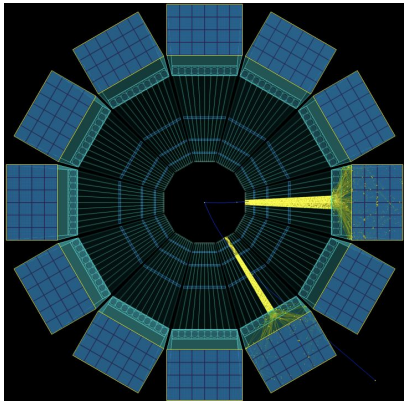




Simulation Parameters

-r	Run Type	0	Simulation
-o	Output File Name		
-theta	Polar Angle		
-x	Particle Type	“mix_pik”	1 pion / 1 kaon mix
-p	Momentum	6	6 GeV/c
-w	Physical List	0	Standard EM
-g	Geometry	1	ePIC One Barbox
-c	MCP Layout		
-l	Focusing System	3	3 Layer Spherical Lens
-trackingres	Tracking Resolution (rad)	0.0005	
-e	Events	2000	
-b	Batch Mode	1	Run Silent (w/o GUI)





```
-c    MCP layout
                0    4x6 standard MCPs (pixel size == mcp size)
                1    4x6 standard MCPs (6.4x6.4 pixels)
                3    one MCP cover all FD plain (custom pixel size)
                4    2x3 LAPD
                2031    4x6 MCPs with compact packing and 32x32 pixels (2 mm x 2 mm)
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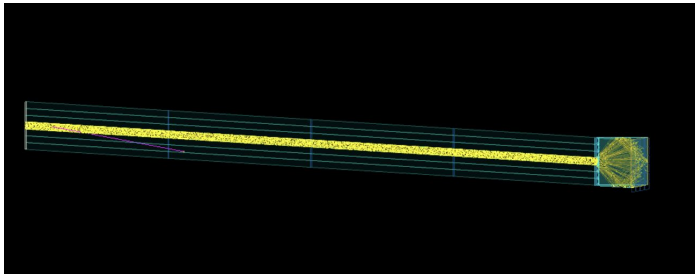
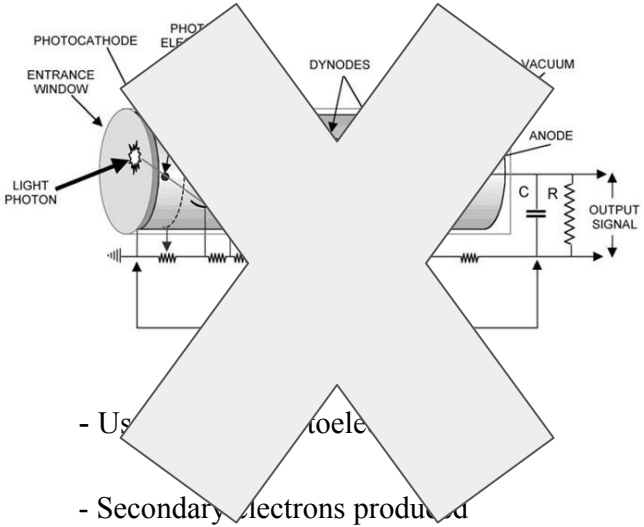


Review of the Sensors

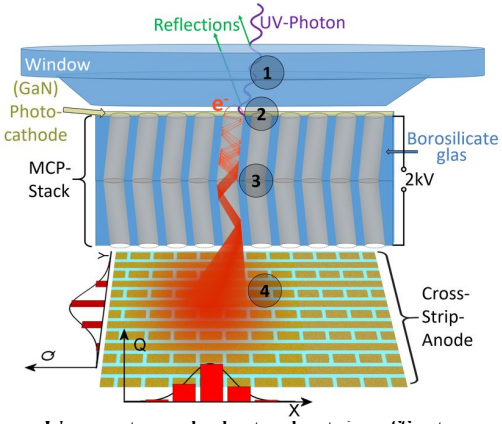
MA-PMTs



- Us toele

- Secondary lectrons produ d through interactions with dynodes

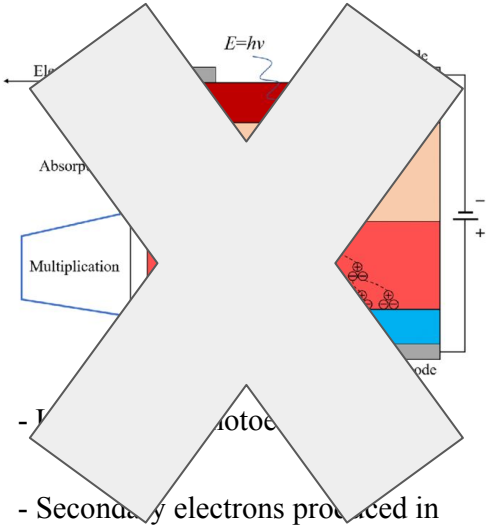
MCP-PMTs



- Use external photoelectric effect

- Secondary electrons produced through interactions with microchannels

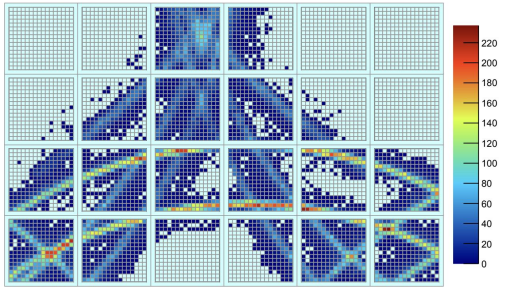
SiPMs



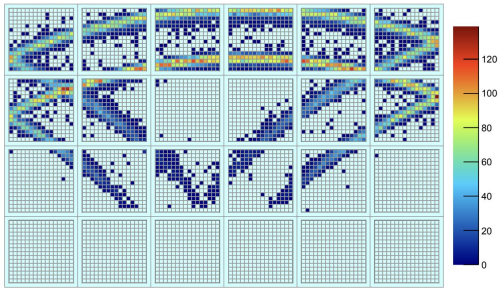
- I otoe

- Second y electrons pro ced in electron-hole pairs by impact ionization of atoms in the semiconductor lattice

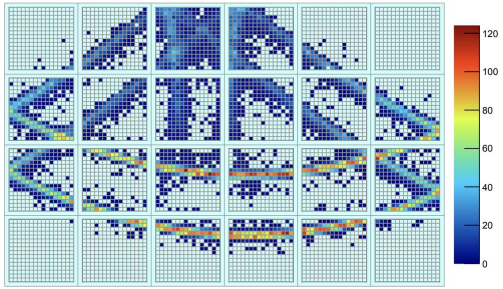
c2031 - 4 x 6 MCPs with Compact Packing and 16 x 16 pixels



Polar Angle = 30°

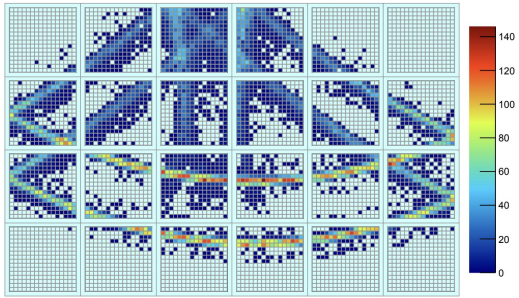


Polar Angle = 90°

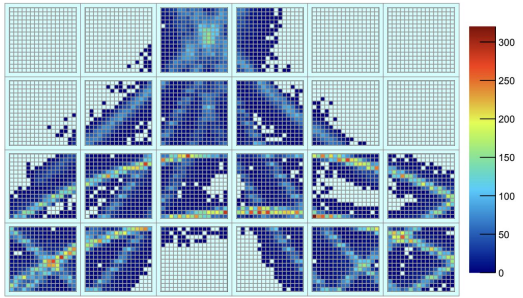


Polar Angle = 60°

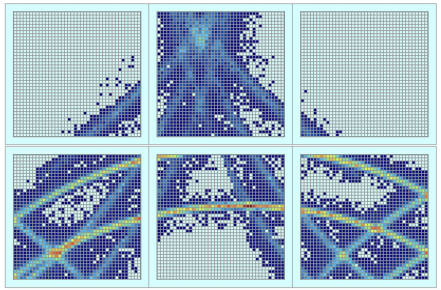
Polar Angle = 120°



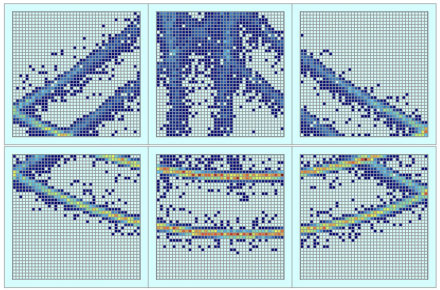
Polar Angle = 150°



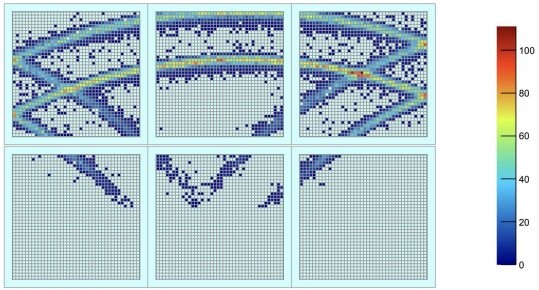
c4 - 2 x 3 LAPD



Polar Angle = 30°

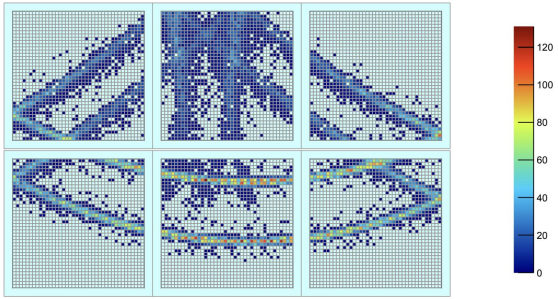


Polar Angle = 60°

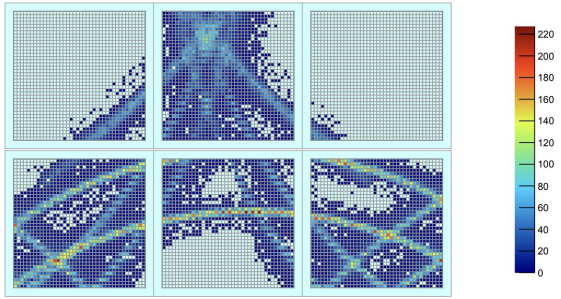


Polar Angle = 90°

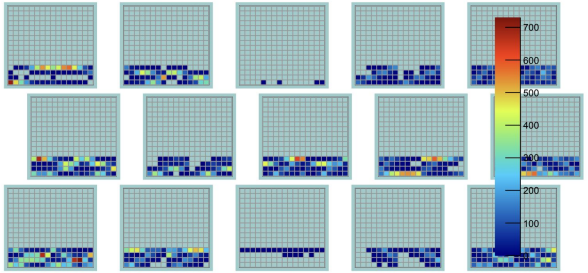
Polar Angle = 120°



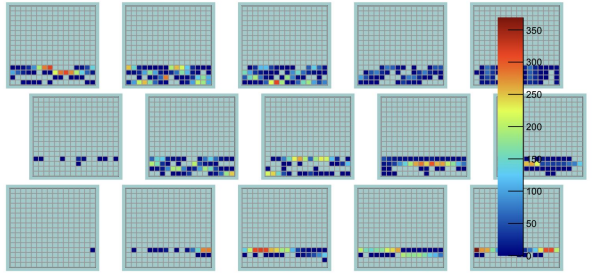
Polar Angle = 150°



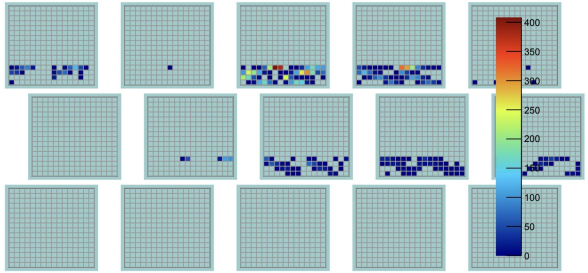
c1 - 4 x 6 MCPs (Pixel Size = 6.4 x 6.4)



Polar Angle = 30°

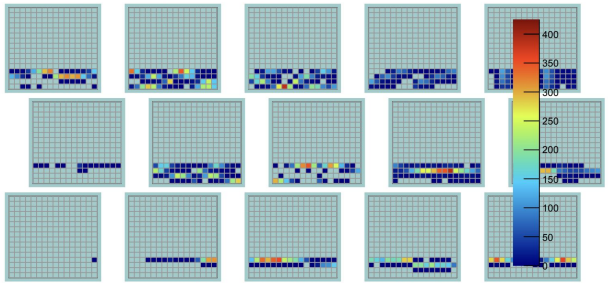


Polar Angle = 60°

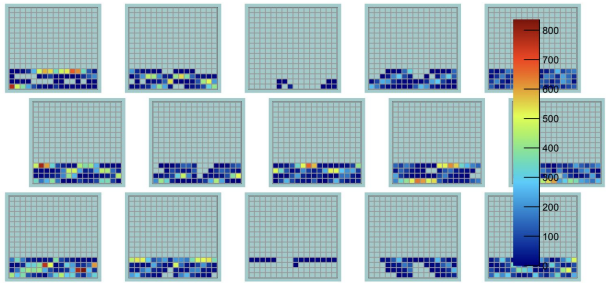


Polar Angle = 90°

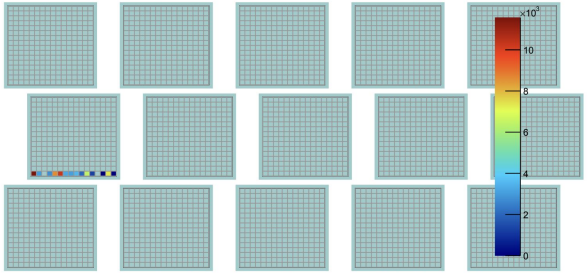
Polar Angle = 120°



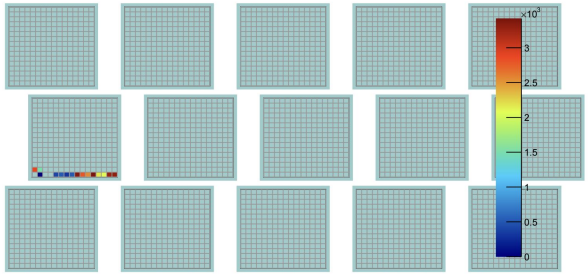
Polar Angle = 150°



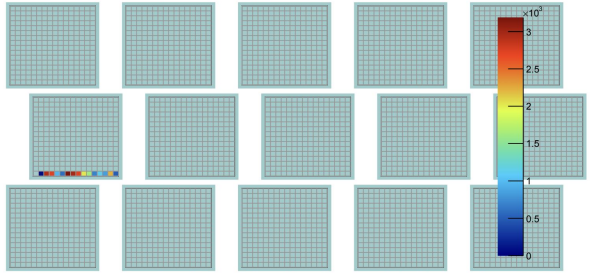
c0 - 4 x 6 MCPs (Pixel Size = MCP Size)



Polar Angle = 30°

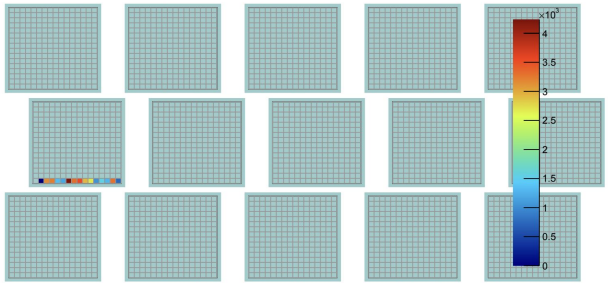


Polar Angle = 90°

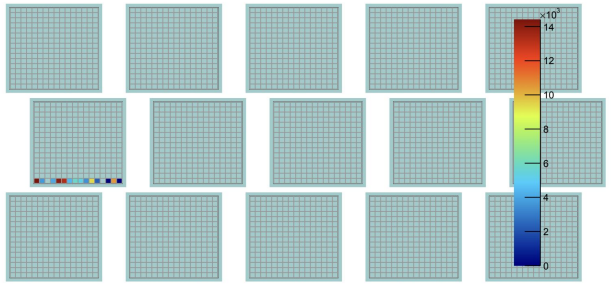


Polar Angle = 60°

Polar Angle = 120°

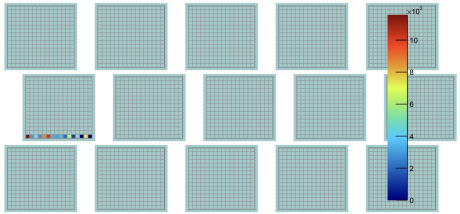


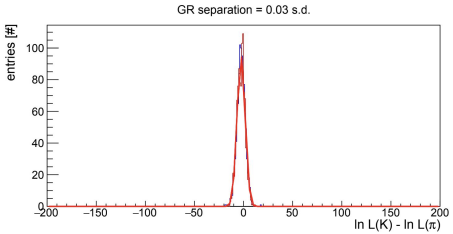
Polar Angle = 150°



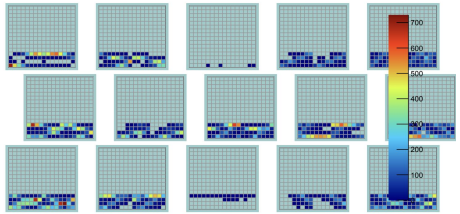
Various MCP Layouts at 30°

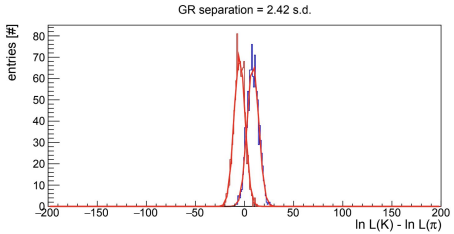
-c 0



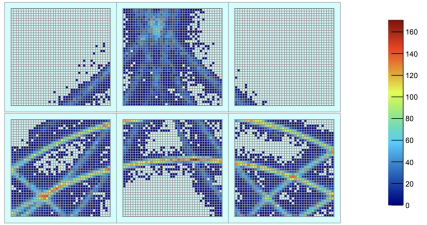


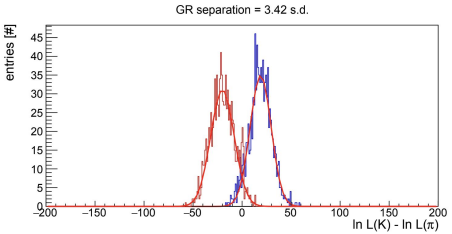
-c 1



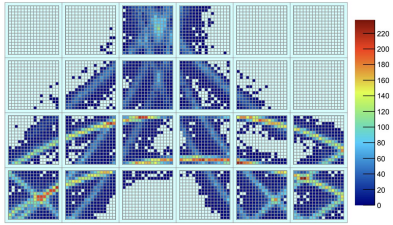


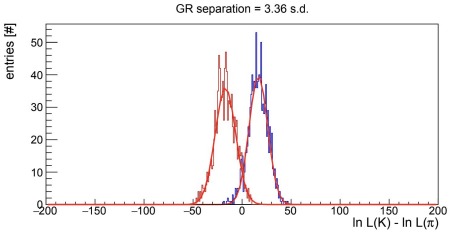
-c 4



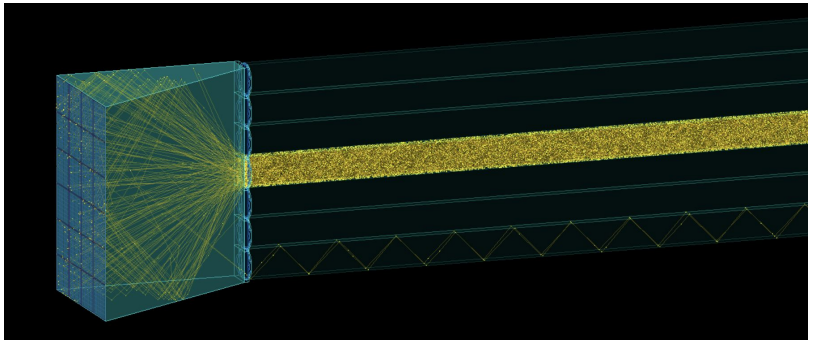


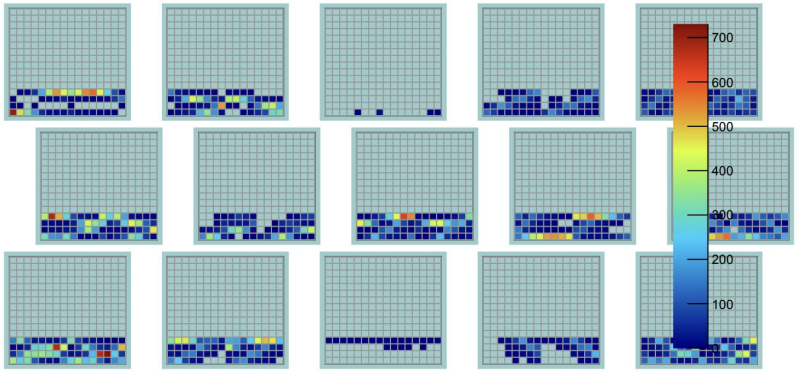
-c 2031

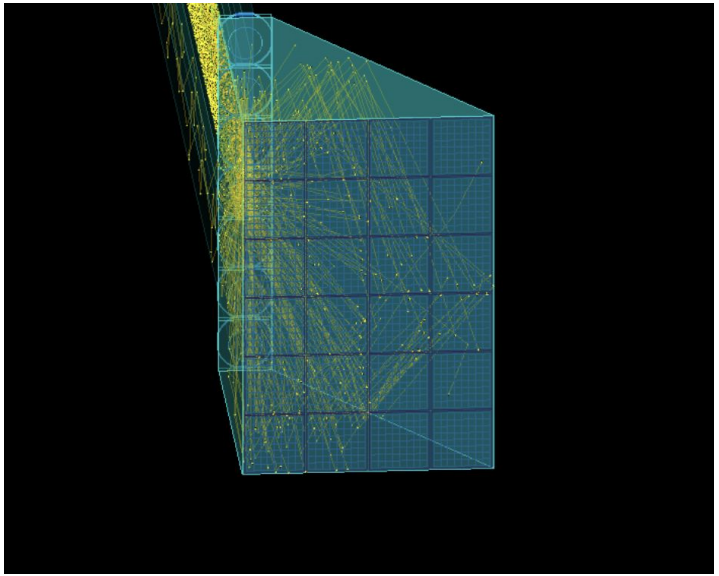




Another Discrepancy in c1







What needs to be done … (Next Week)

- Meetings to discuss the physics behind the simulation images and what they are telling us

- Continue investigating the code and begin editing the code instead of only using command line arguments

- Work on resolving the issues with MCP Configurations 0, 1, and 3