WCSim Status

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4th Open HK Meeting

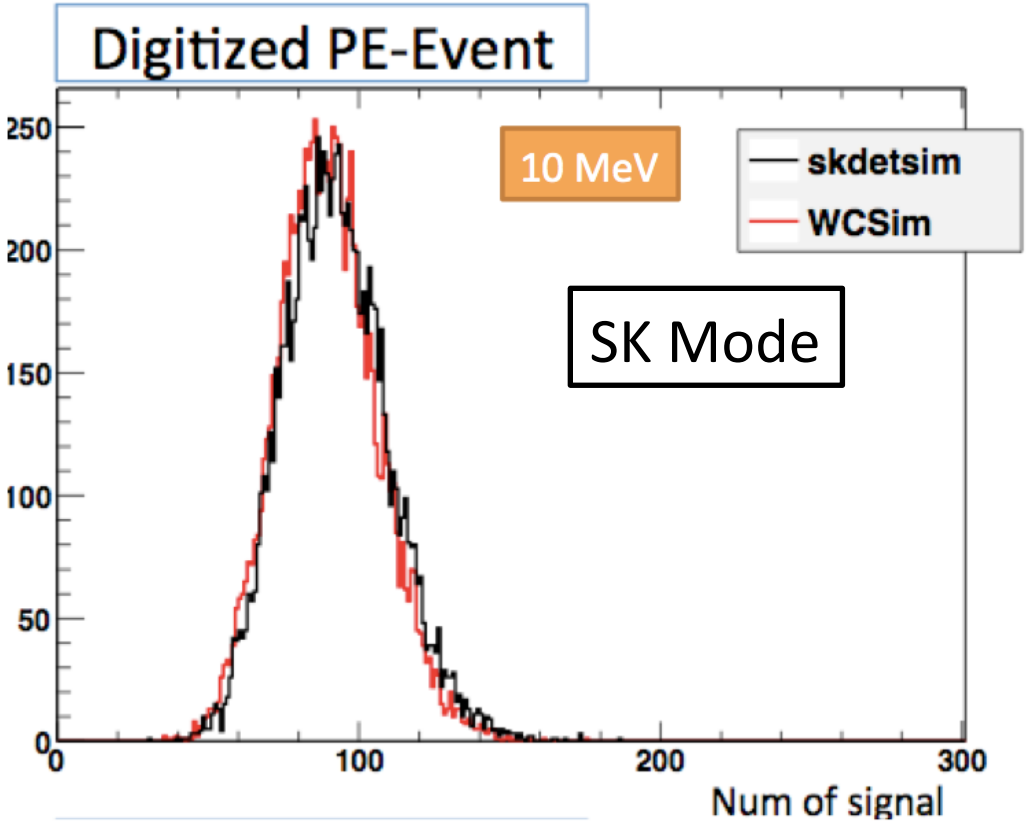
January 28th, 2014

Introduction

- WCSim: a flexible Geant4 simulation that can simulate *different* detector geometries with the *same* physics models
- Hyper-K is now one of those geometries.
- New for this meeting:
  - Event display developed by Alex Finch from Lancaster U.
  - Fixed a bug invisible to us before
  - Dark noise – next talk from Okajima
  - Working towards new PMTs – next talk

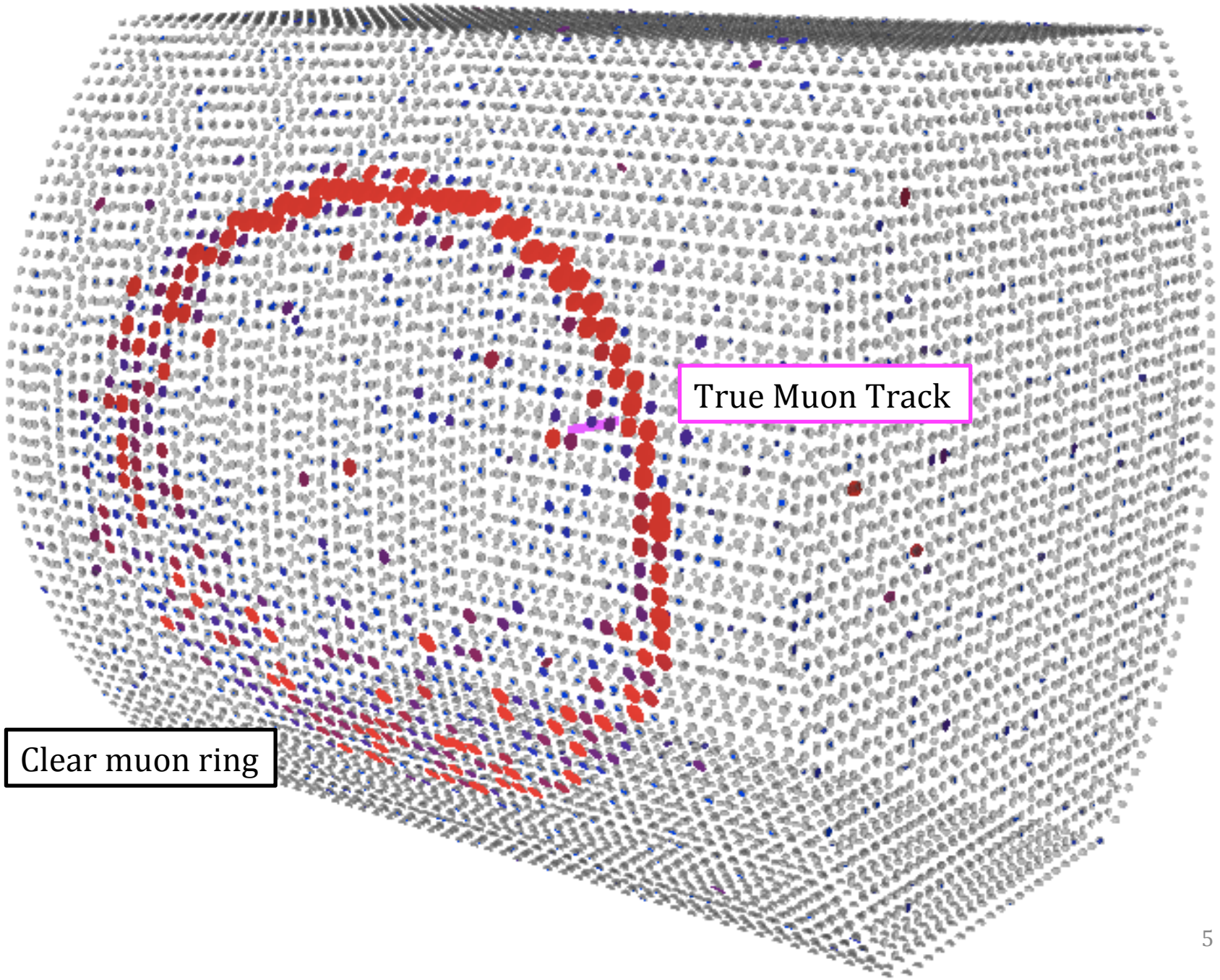
WCSim Validation

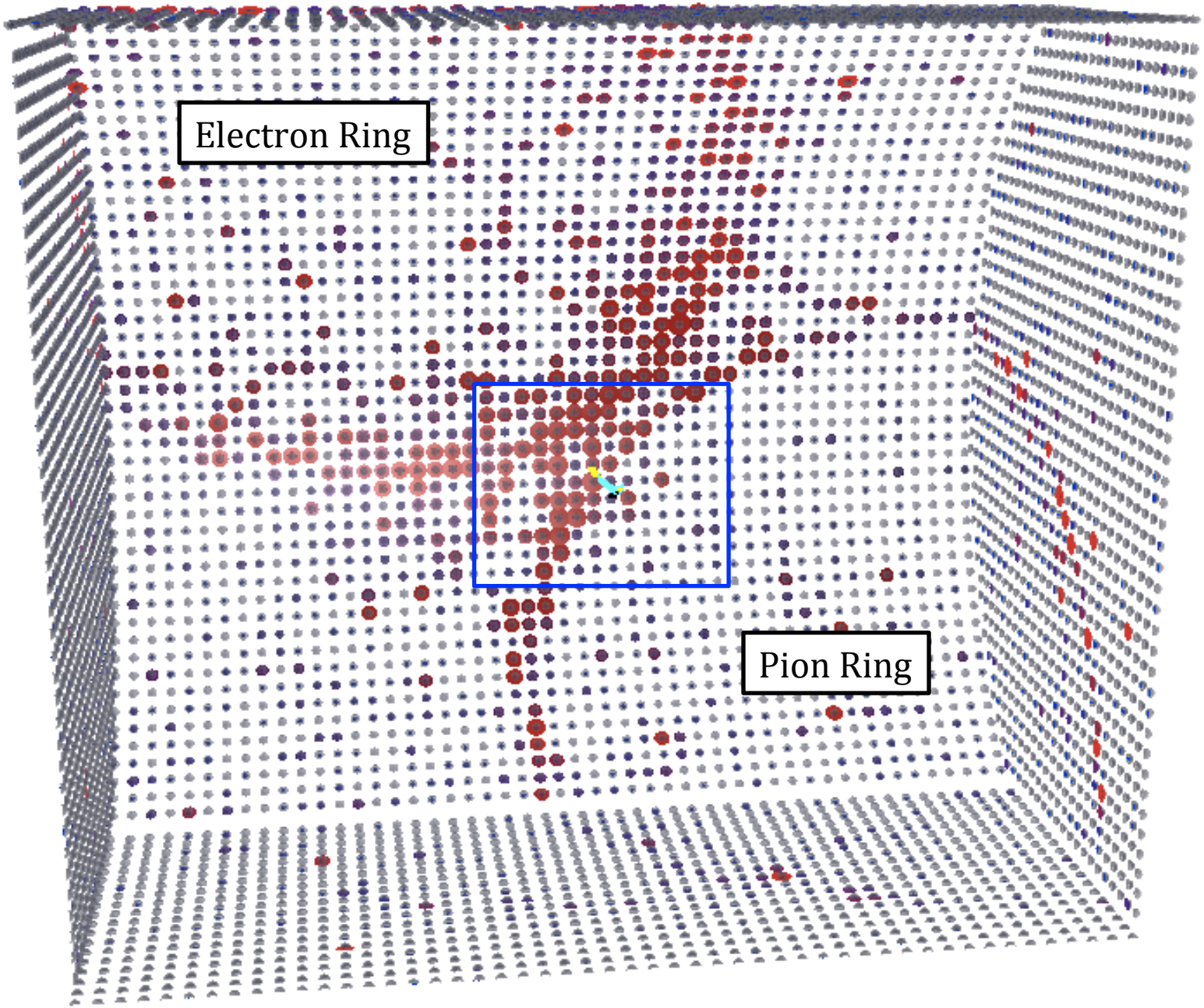
- Extensive validation of WCSim against SKDetSim has been presented at the last few meetings
- Have been working with WCSim in HK mode since then, and we think its ready to try
  - One issue was found and sorted out, as I'll show next
  - May be some more subtle issues, but best way to find them is to start putting it to use!

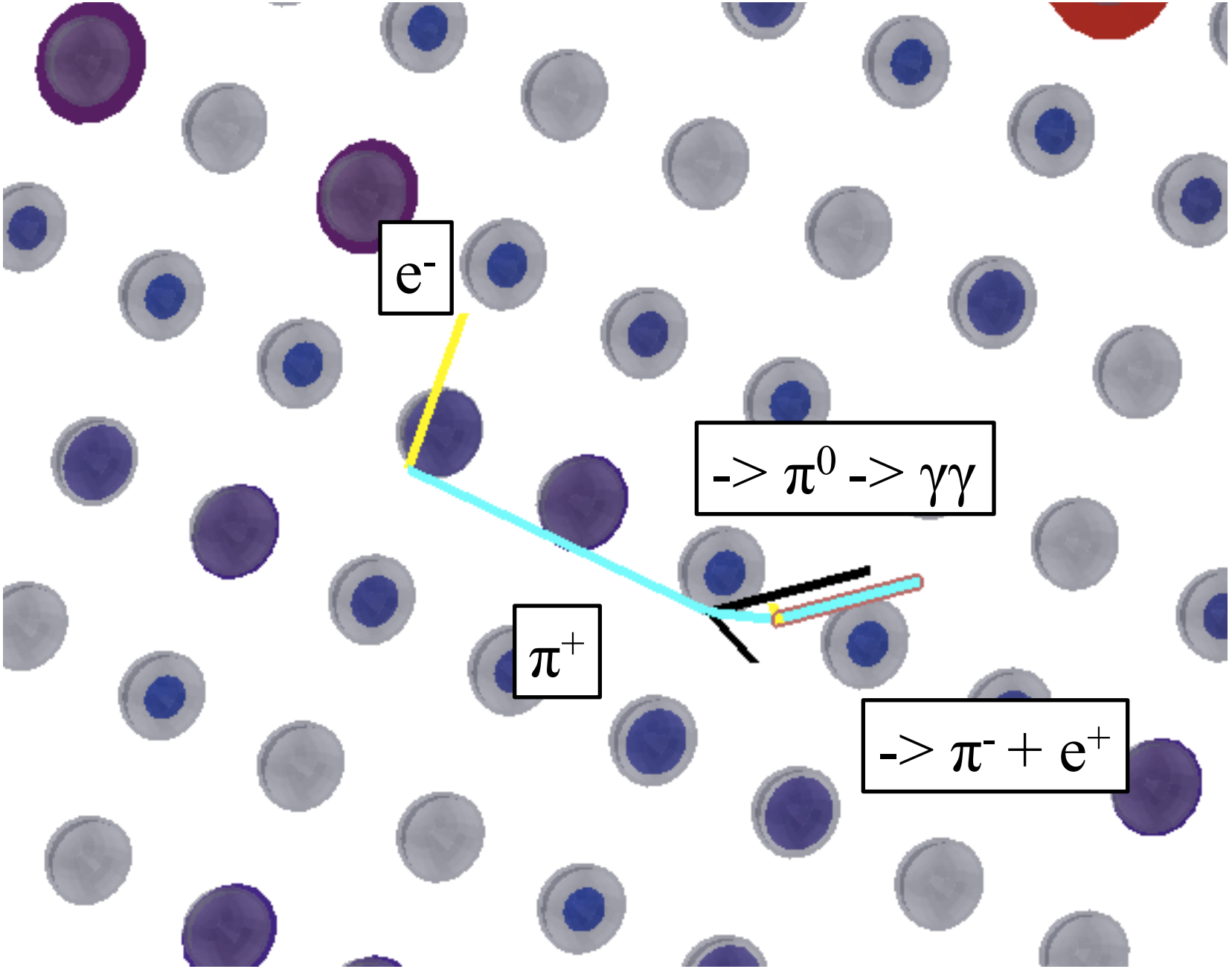


Event Display

- Getting the event display:
  - https://wiki.hyperk.org/Software/Release
- Based on eve
  - Depends only on ROOT and WCSim root library (*not* GEANT4)
- `root -l -x hyperk_display.C`
- *live demo*
  - Wish I could, but the projector resolution is too low
  - It is running on my laptop, so find me later if you want to play with it


True Muon Track
Clear muon ring


Electron Ring
Pion Ring

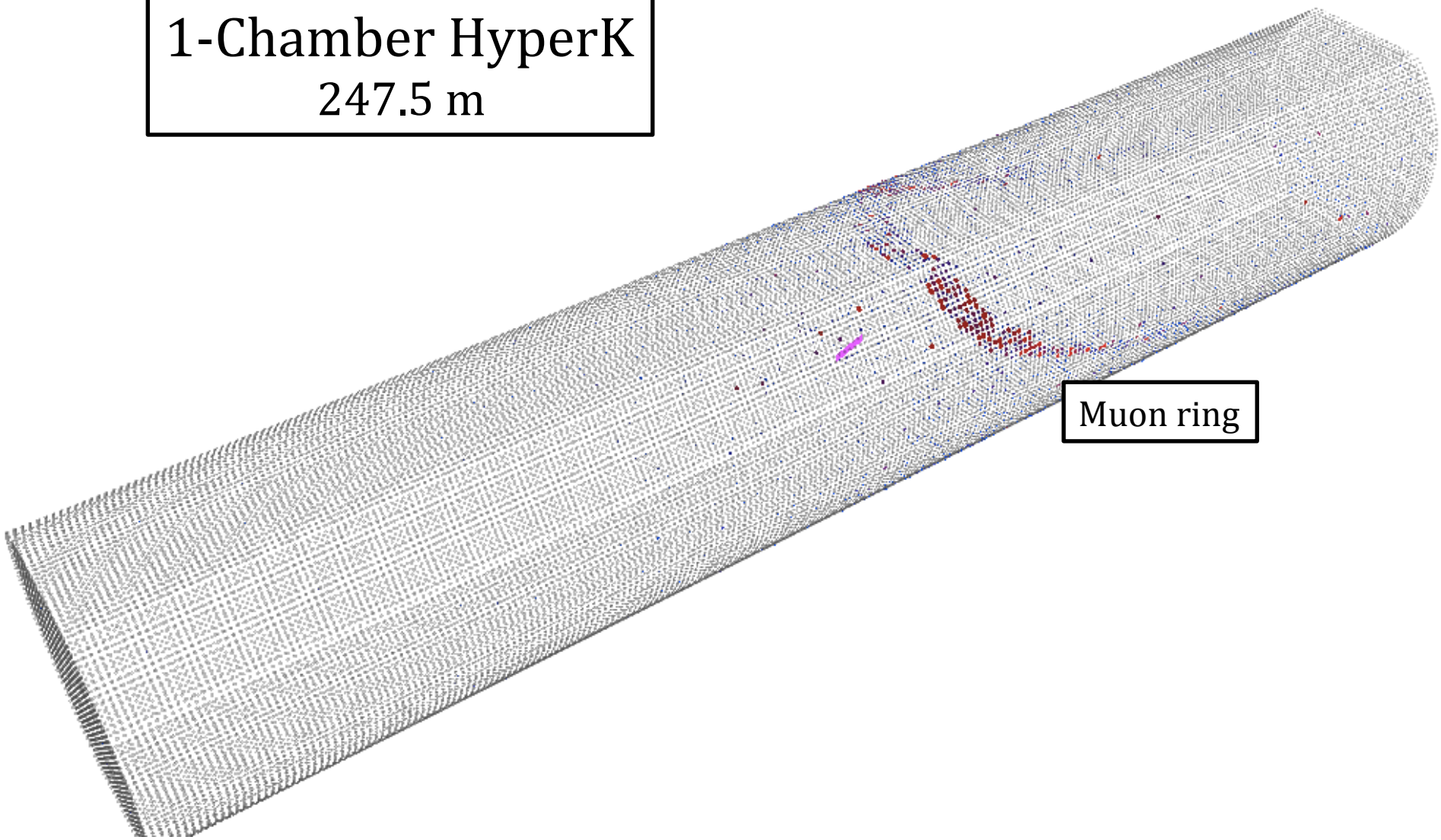

e^-
-> π^0 -> $\gamma\gamma$
π^+
-> π^- + e^+

HyperK Event Display Summary Table

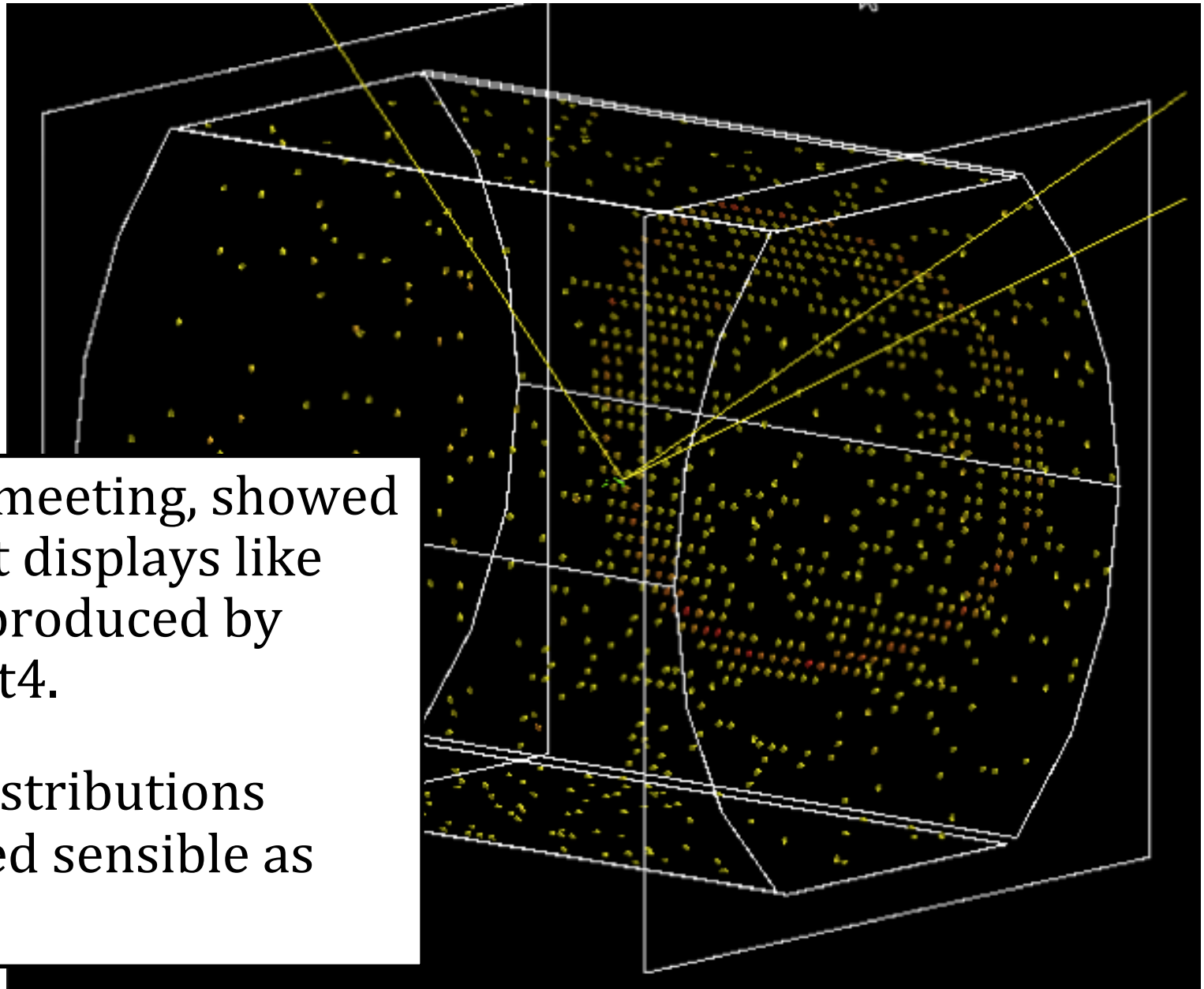
Tracks — *Size = 16*

Type	Start X	Start Y	Start Z	Stop X	Stop Y	Stop Z	Mass	Momentum	Energy	Pdir X	Pdir Y	Pdir Z
#0 (12) electron neutrino	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1566.53	1566.53	1049.20	-1162.65	37.94
#1 (2212) proton	0.00	0.00	0.00	0.00	0.00	0.00	175.72	0.00	175.72	-0.00	0.00	-0.00
#2 (2212) proton	0.00	0.00	0.00	0.00	0.00	0.00	938.27	0.00	938.27	0.00	0.00	0.00
#3 (11) electron	0.00	0.00	0.00	65.86	35.04	-23.47	0.51	1747.80	1747.80	1470.83	826.69	-456.12
#4 (211) pi+	0.00	0.00	0.00	93.63	-86.72	91.66	139.57	1750.78	1756.34	997.67	-1007.12	1027.43
#5 (111) pi0	93.63	-86.72	91.66	93.63	-86.72	91.66	134.98	413.48	434.95	294.90	-289.81	-0.93
#6 (22) gamma	93.63	-86.72	91.66	185.97	-109.26	107.37	0.00	107.64	107.64	103.17	-25.19	17.55
#7 (22) gamma	93.63	-86.72	91.66	130.21	-137.20	88.14	0.00	327.31	327.31	191.74	-264.63	-18.48
#8 (211) pi+	93.63	-86.72	91.66	115.94	-94.32	110.70	139.57	784.08	796.40	567.76	-212.38	497.31
#9 (211) pi+	115.94	-94.32	110.70	116.40	-95.94	112.69	139.57	85.01	163.42	13.12	-60.81	57.94
#10 (-13) anti-muon	116.40	-95.94	112.69	116.38	-96.03	112.80	105.66	29.79	109.78	-2.71	-16.15	24.89
#11 (14) muon neutrino	116.40	-95.94	112.69	936.31	4796.25	-7425.00	0.00	29.79	29.79	2.71	16.15	-24.89
#12 (12) electron neutrino	116.38	-96.03	112.80	-2291.71	677.64	-7425.00	0.00	9.74	9.74	-2.95	0.95	-9.23
#13 (-14) muon anti-neutrino	116.38	-96.03	112.80	2974.62	-7425.00	894.96	0.00	48.41	48.41	17.50	-44.88	4.79
#14 (-11) positron	116.38	-96.03	112.80	105.95	-76.66	116.13	0.51	47.00	47.00	-14.71	44.41	4.49
#15 (-211) pi-	115.94	-94.32	110.70	166.38	-83.91	149.72	139.57	290.69	322.46	210.79	48.23	194.27

1-Chamber HyperK
247.5 m

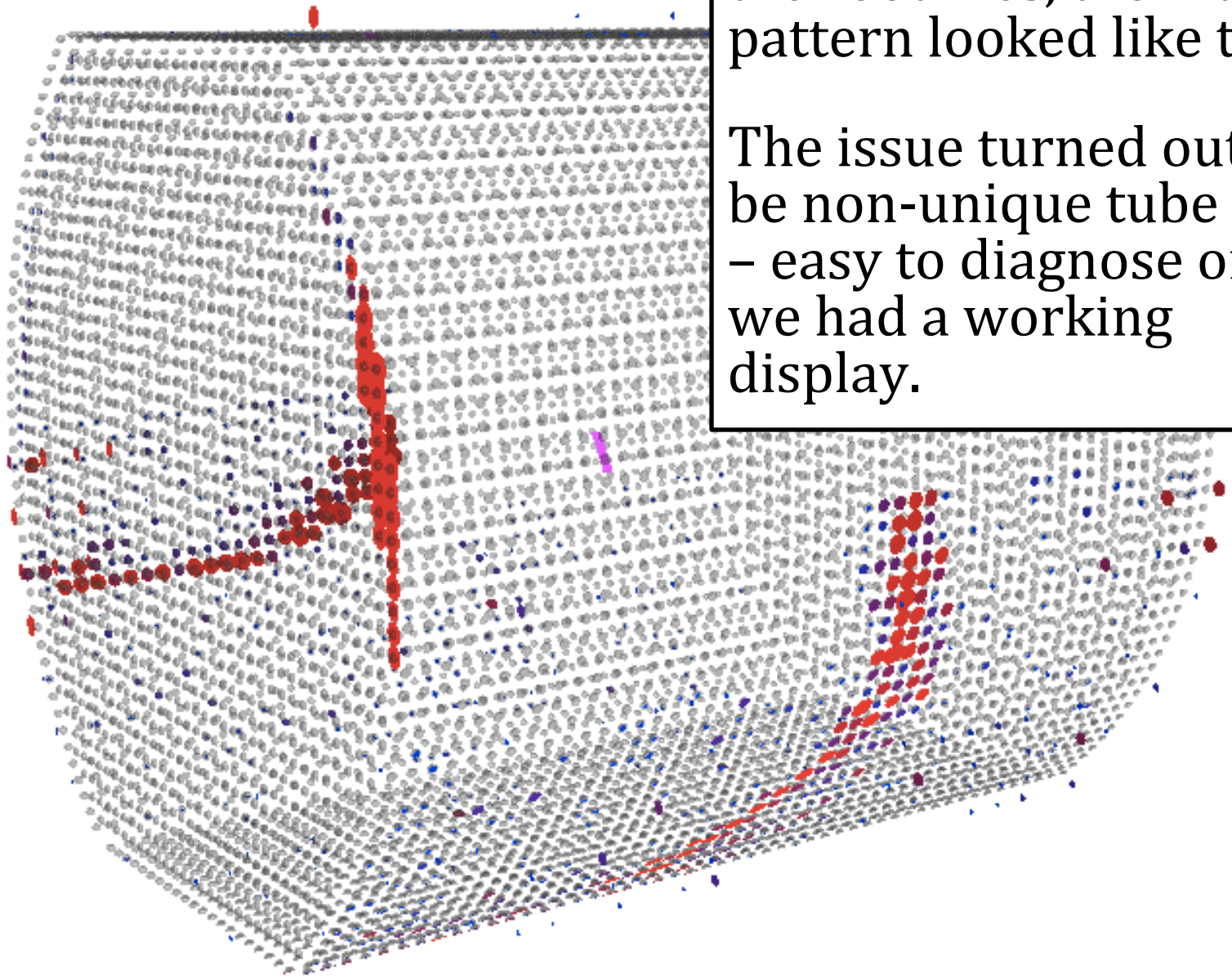


An Example Use



Last meeting, showed event displays like this produced by Geant4.

PE distributions looked sensible as well.

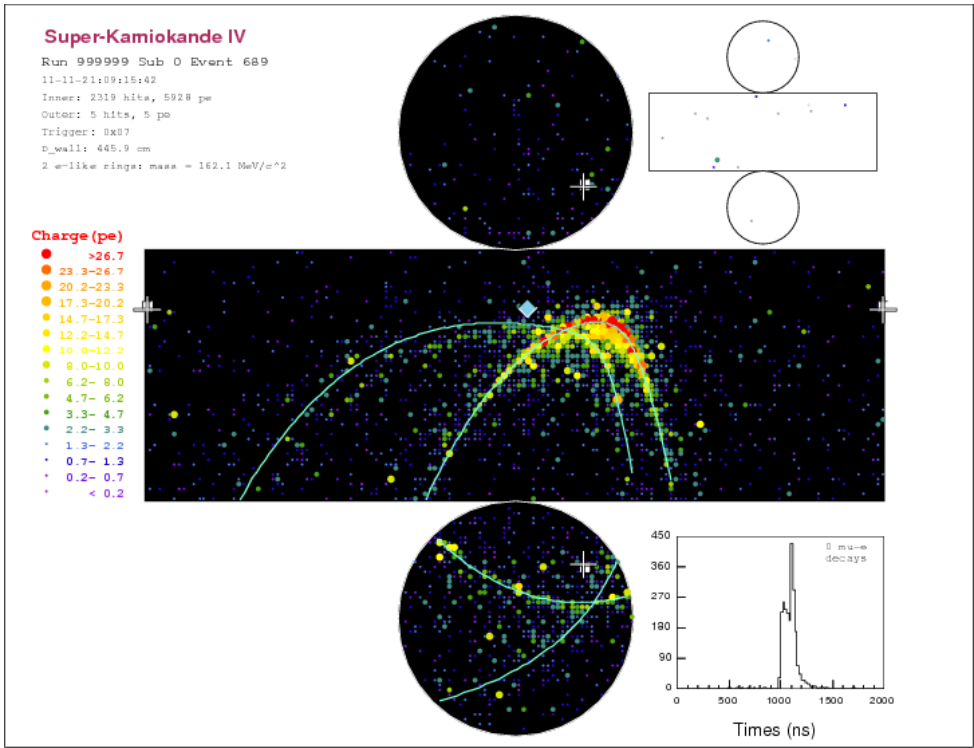


However, looking inside the root files, the hit pattern looked like this.

The issue turned out to be non-unique tube ID's – easy to diagnose once we had a working display.

Planned Improvements

- Right now, only displaying hits and MC information
- Plan to include reco. information from fiTQun
- Thinking about how to display an "unfolded" detector view as in superscan



WCSim Plans

- The next important step is to get the simulation files to the physics groups
  - Francesca later will discuss the production and file access
- Planned optimization studies
  - Compartment length
  - Alternate photodetectors
    - Okajima will tell more in the next talk
- Future upgrades:
  - Outer detector, multiple compartments, separate digitizer from phototube
  - Many opportunities