CRT Simulation Preparation

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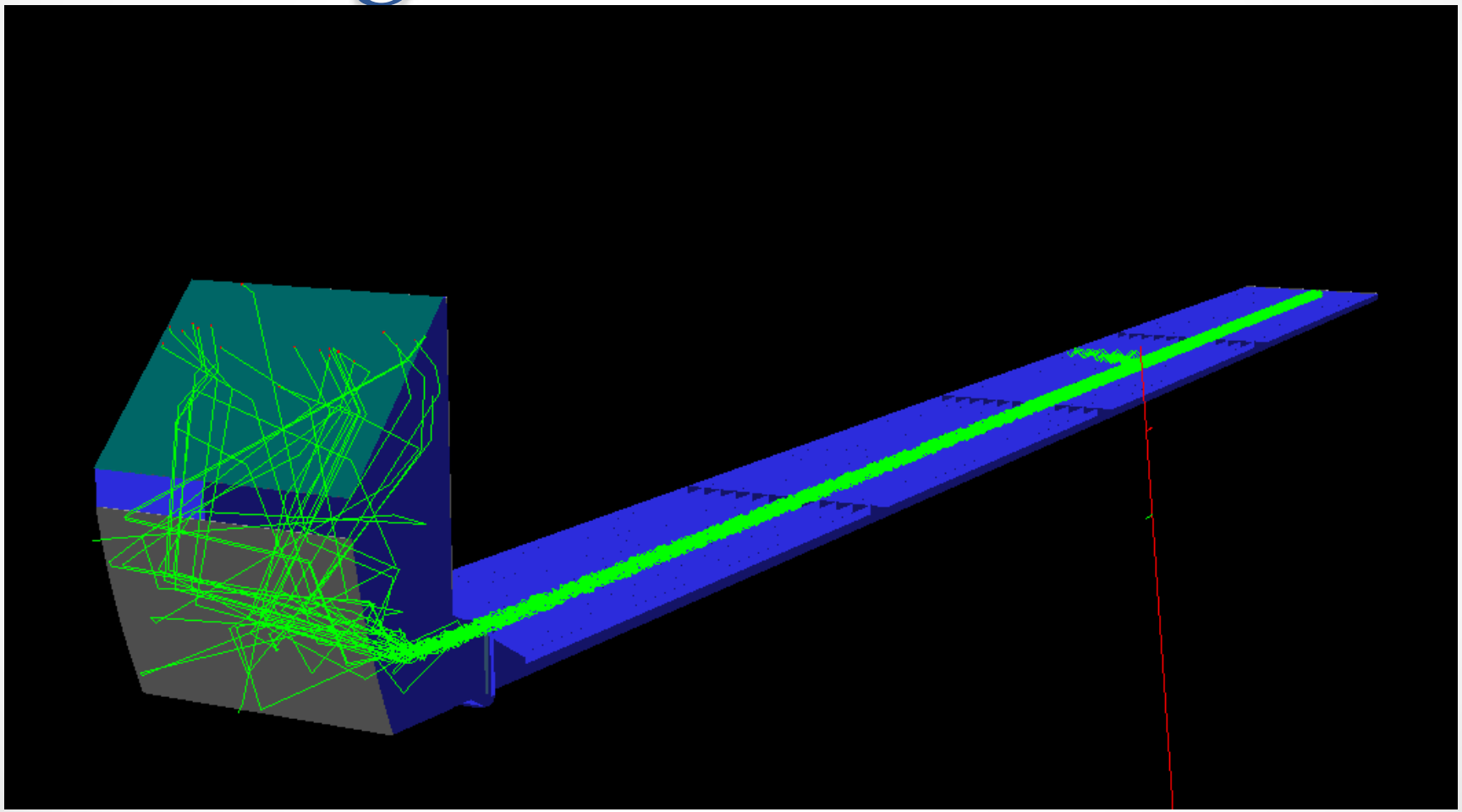
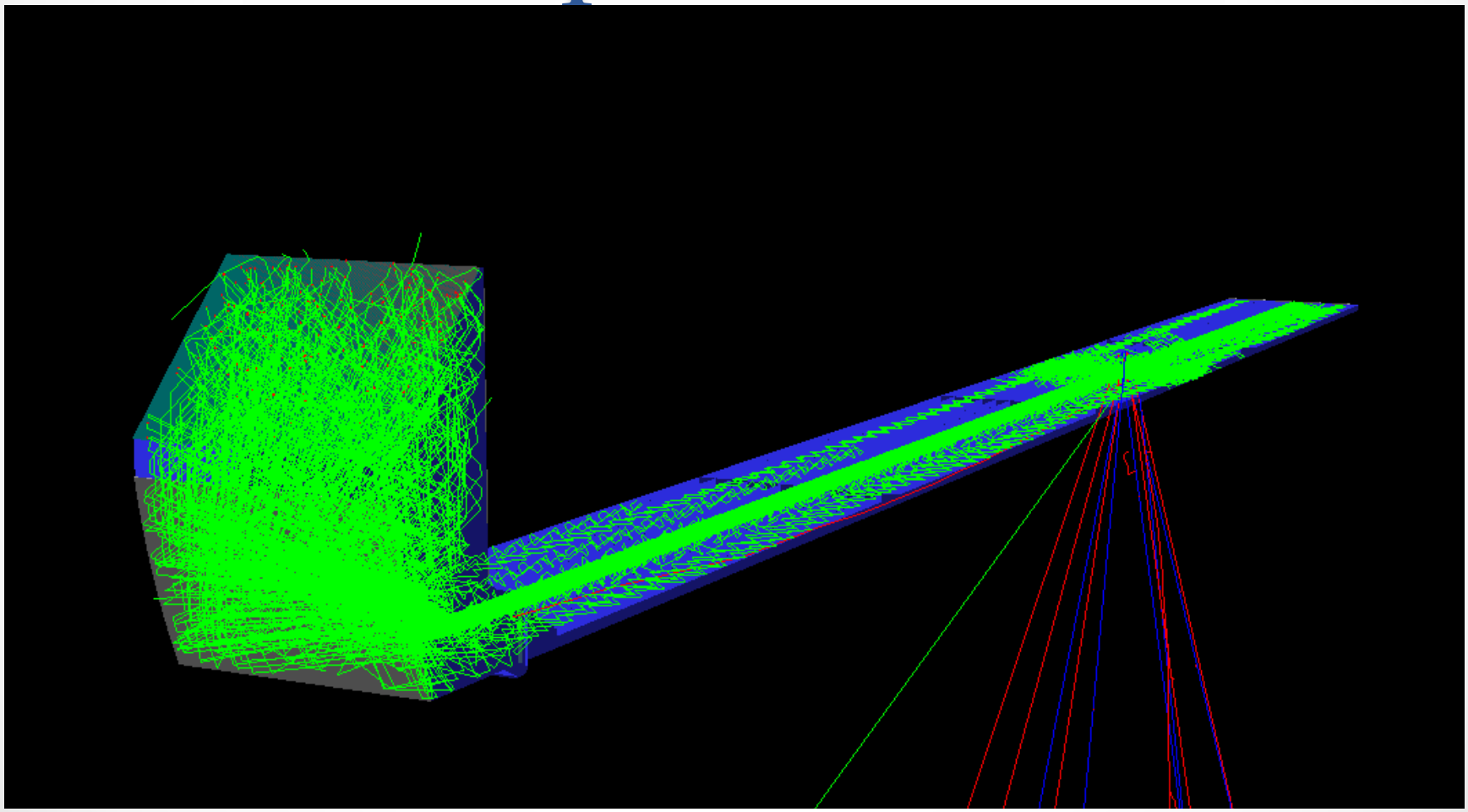
Software Preparation for FDIRC Prototype

- Started working on adapting FDIRC GEANT4 simulation for use as the CRT prototype analysis tool
- Created a parallel geometry configuration:
  - One for default, nominal values. Used in FullSim.
  - One that will contain actual measured dimensions of the prototype as they become available.
    - Already have numbers for the new wedge.
- Implemented a cosmic ray generator
  - $1/p^2$ momentum distribution with $p > 1.5$ GeV
  - $\mathrm{Cos}^2\theta$ angular distribution modified by geometric acceptance of the CRT as described in SLAC-PUB-13873
  - Starting point of cosmics described by shape of quartz start counter

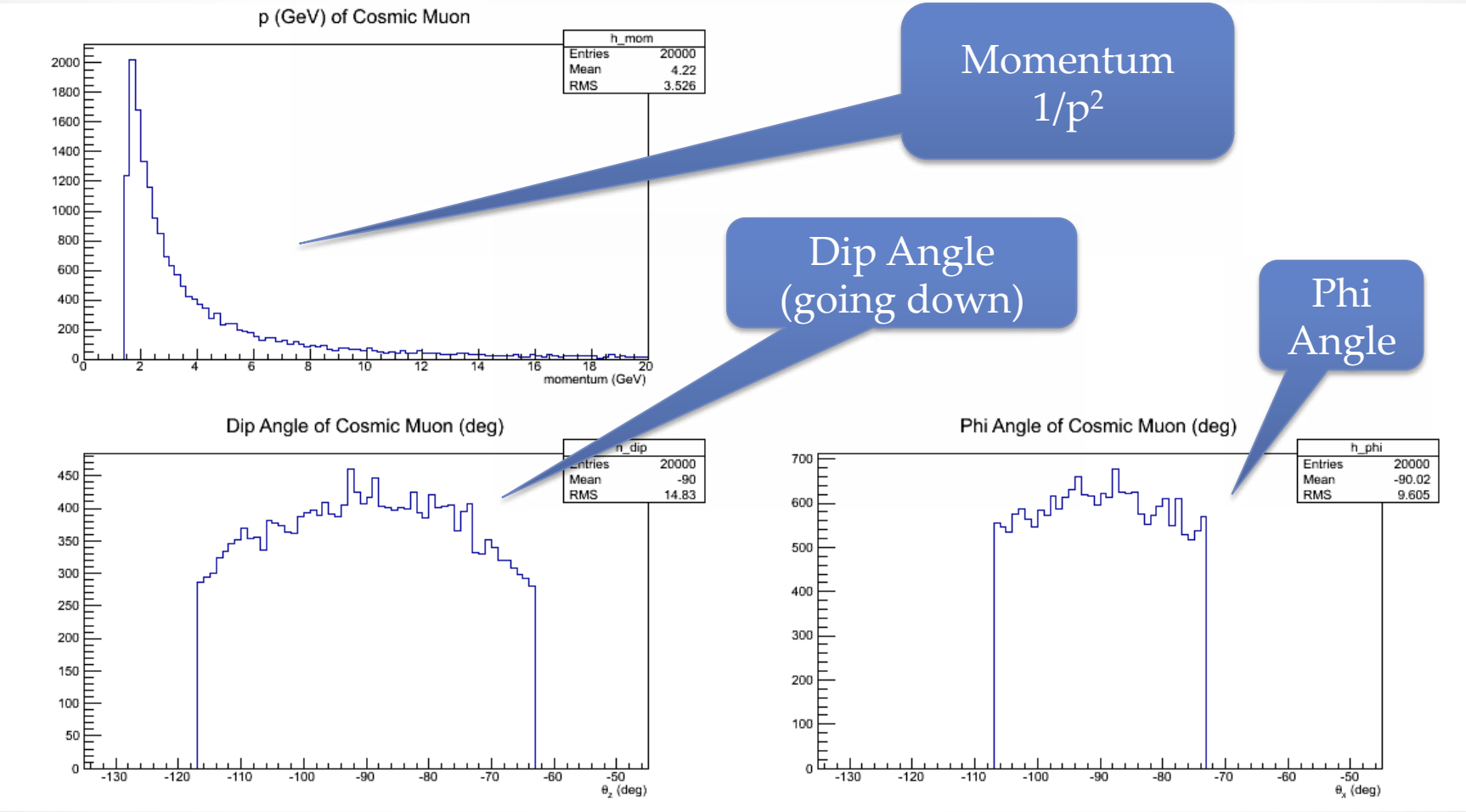
Single Cosmic Event



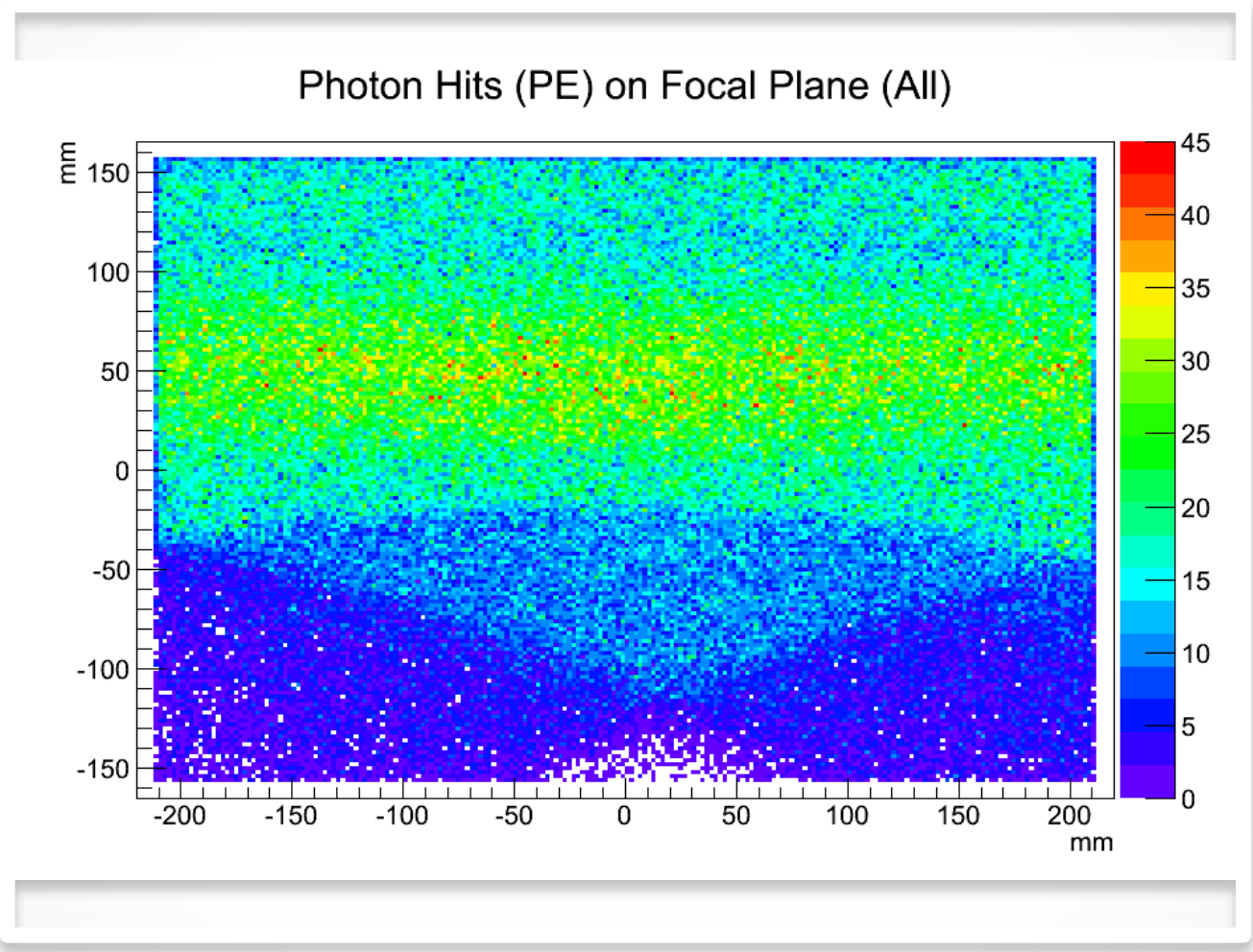
Multiple Cosmics



Parameters of Generated Cosmics

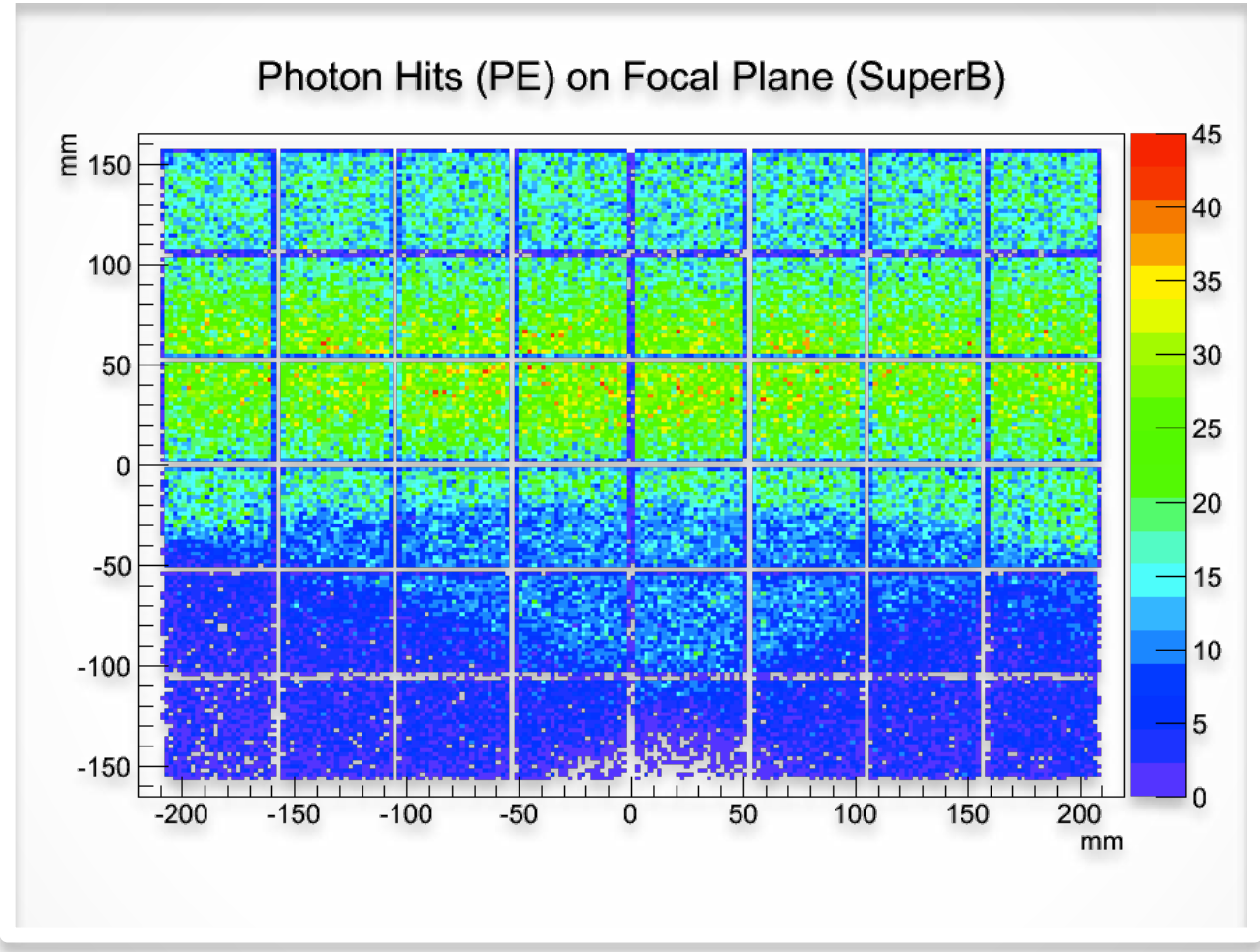


Cosmics, All Photons at Focal Plane



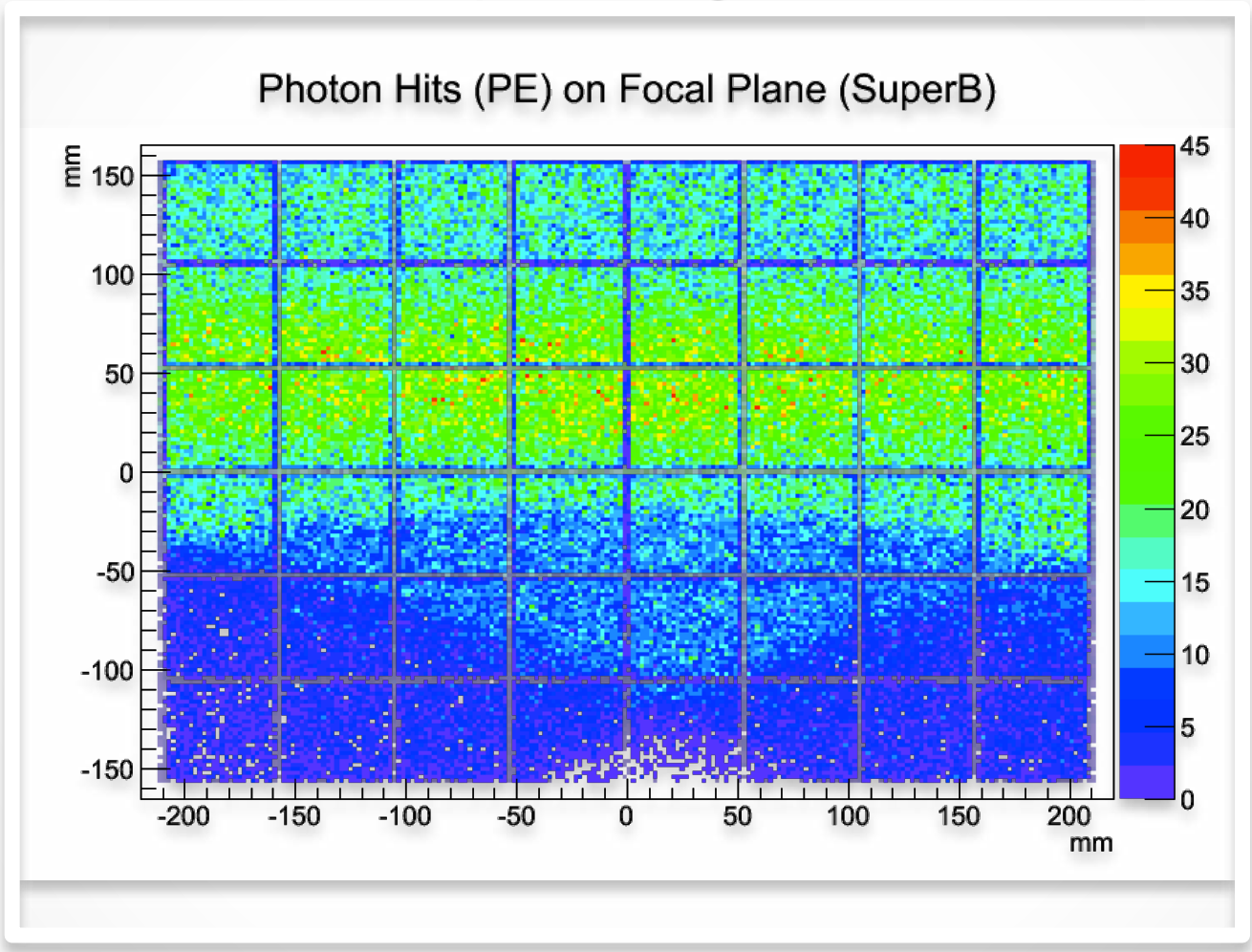
Track pointed at Bar 6 in box (central)

Hits from Cosmics, All 48 PMTs



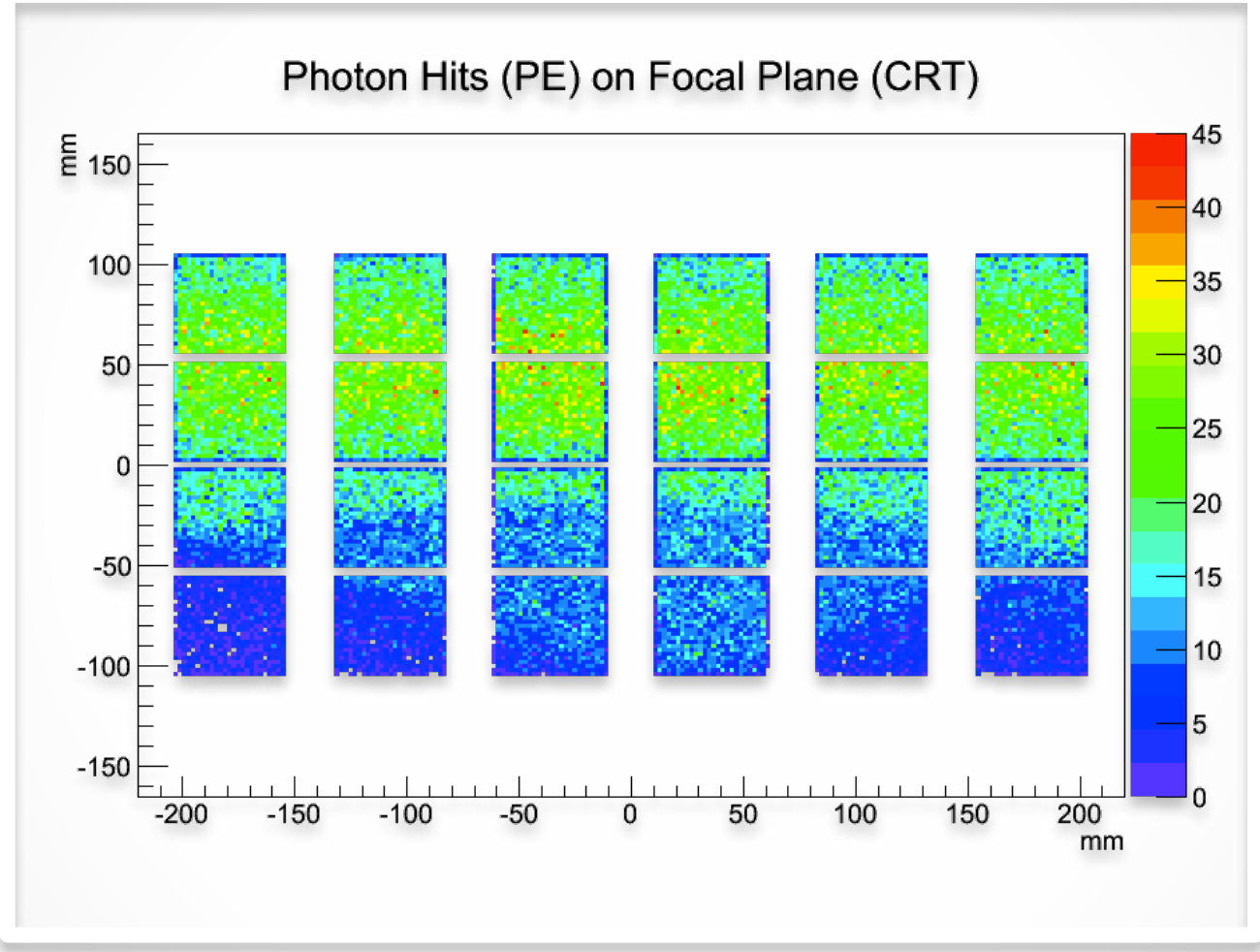
NOT for CRT. Assumes 0.5mm gap between tubes and some dead space around edge of tube.

Hits from Cosmics, All 48 PMTs



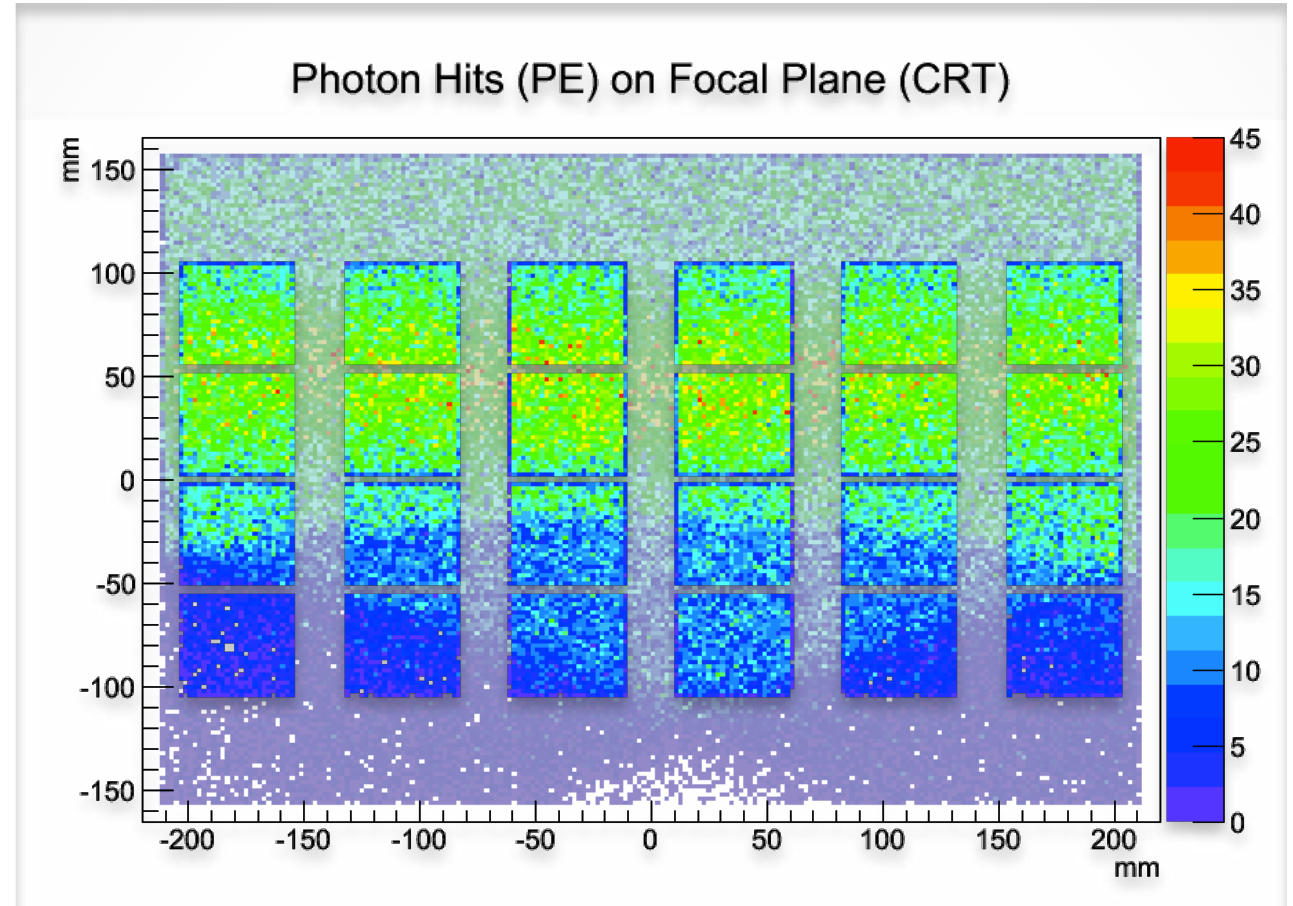
Overlaid on All Hits distribution.
Detect ~87% of photons.

Default CRT PMT Distribution



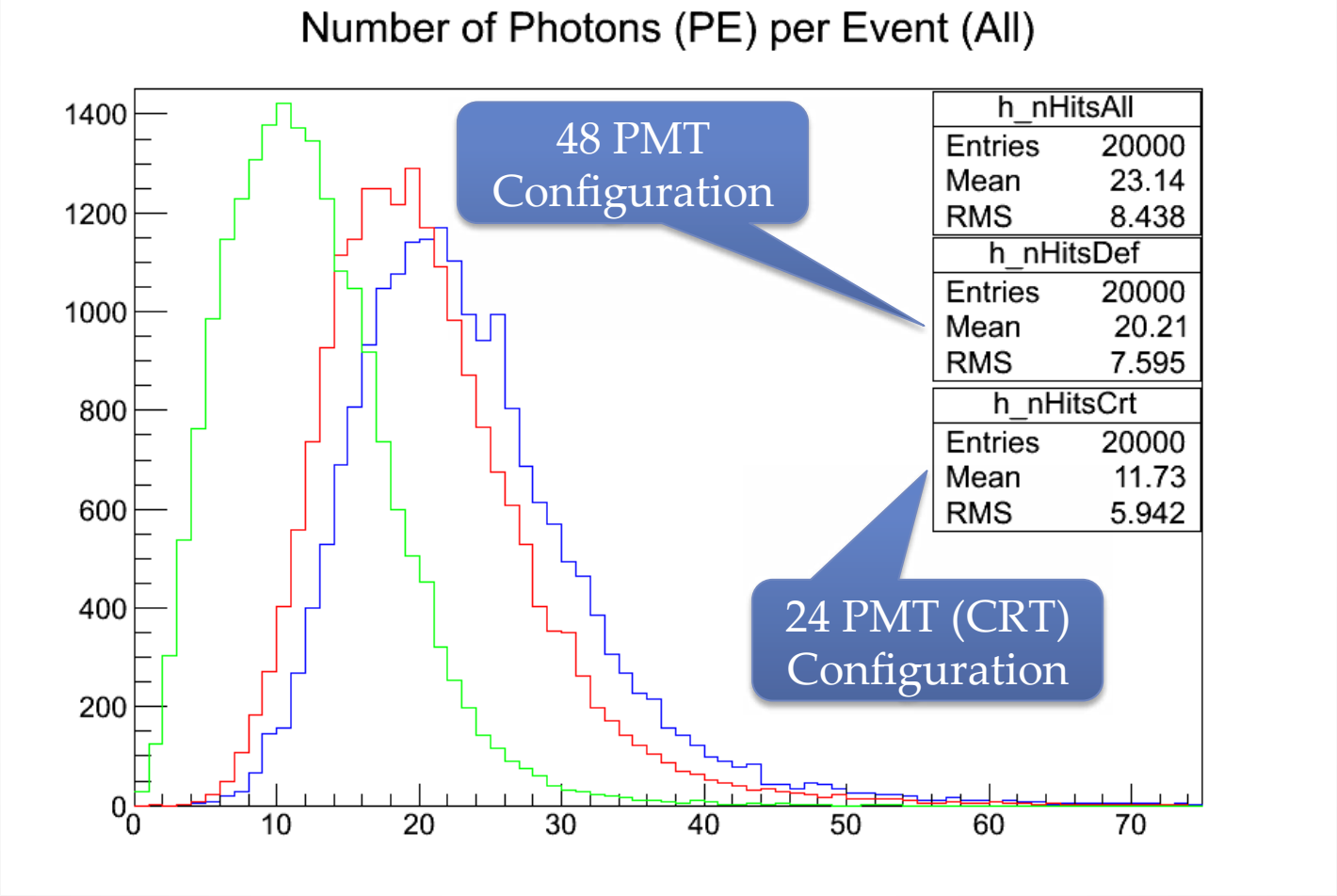
See ~58% of hits compared to 48 PMT configuration.

Default CRT PMT Distribution



Overlaid on all hits

Number of Hits Per Event



Analysis Steps

- Generate single-photon dictionary
  - Simulate millions of single, monochromatic, isotropic, photons in each bar
    - Will we look at every bar or should we focus on a few? It's just CPU time here.
    - Can start running this now using nominal geometry and PMT locations.
    - Will have to be re-run once we have surveyed numbers.
  - Process single photons
    - For each bar, and for each pixel in the detector, create a look-up table that maps pixel location to (θ_x, θ_y, Δt) solutions.
    - Each pixel will have multiple solutions to the possible exit angles and time of a photon leaving a quartz bar. This on top of the 8-fold (*x,y,z*) ambiguities.
- Using the dictionary, we can analyze simulated or real data to get Cerenkov angle for each photon, given measured track direction
  - Still some studies that could be done on how to best deal with ambiguities, backgrounds, multiple tracks/sector (probably not an issue for the CRT)

Documentation

- Started writing a Wiki to describe the simulation and analysis tools
  - Not sure where to put this? I started using Alfresco, but maybe that's not the correct tool.
  - In general, where are we keeping documents, like Jerry's "Critical Dimensions" document?
- All of the code, simulation and analysis, is in the SuperB svn repository. You just need GEANT4, ROOT.
  - I run on a Mac, but everything has also been run on Linux
- Will also need to develop some way of sharing things like the single photon dictionary. We should be able to use the same files.