Status of the Barrel DIRC software

Roman Dzhygadlo,
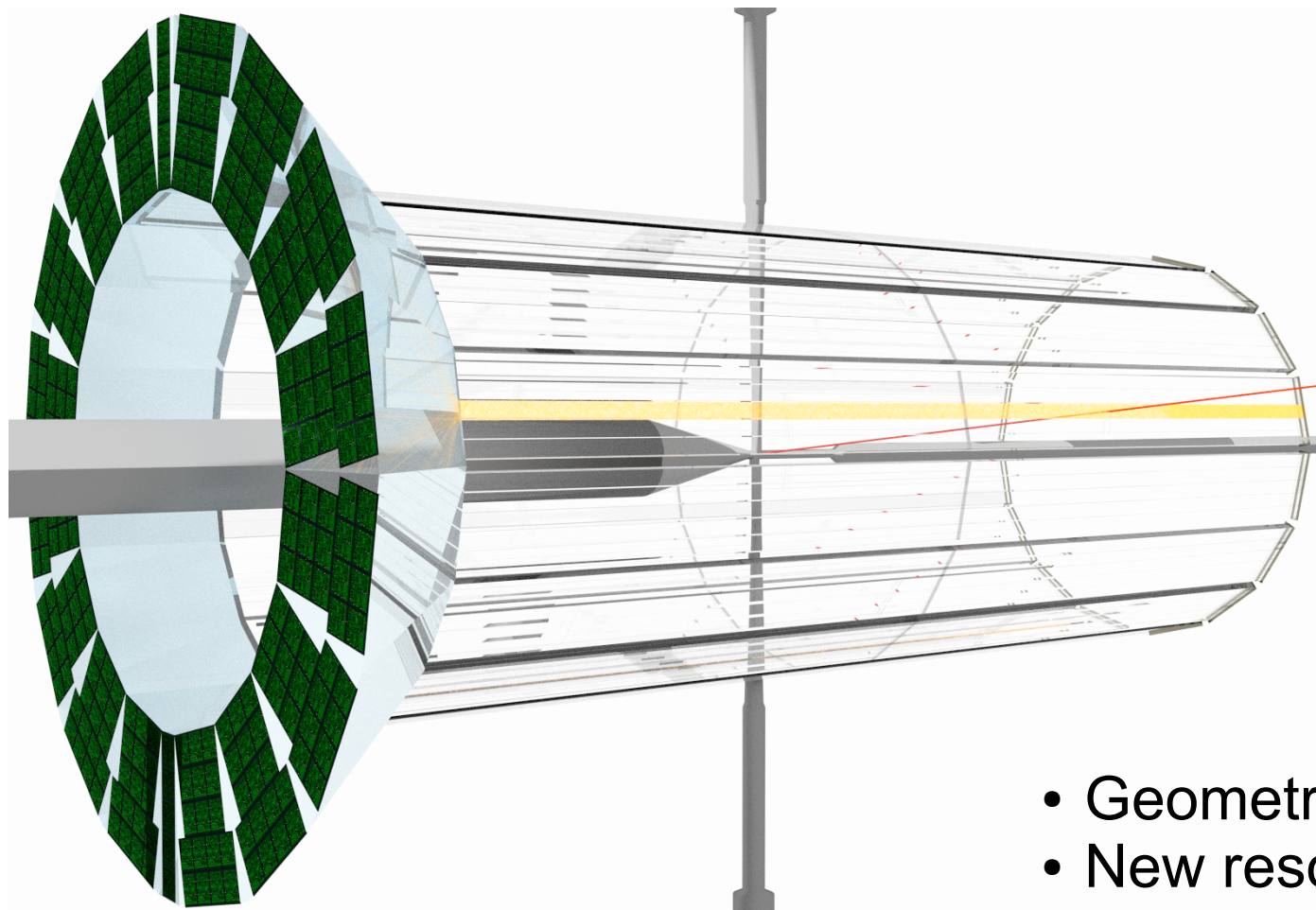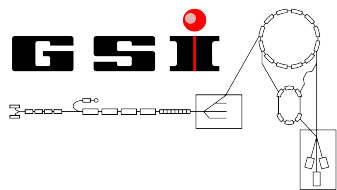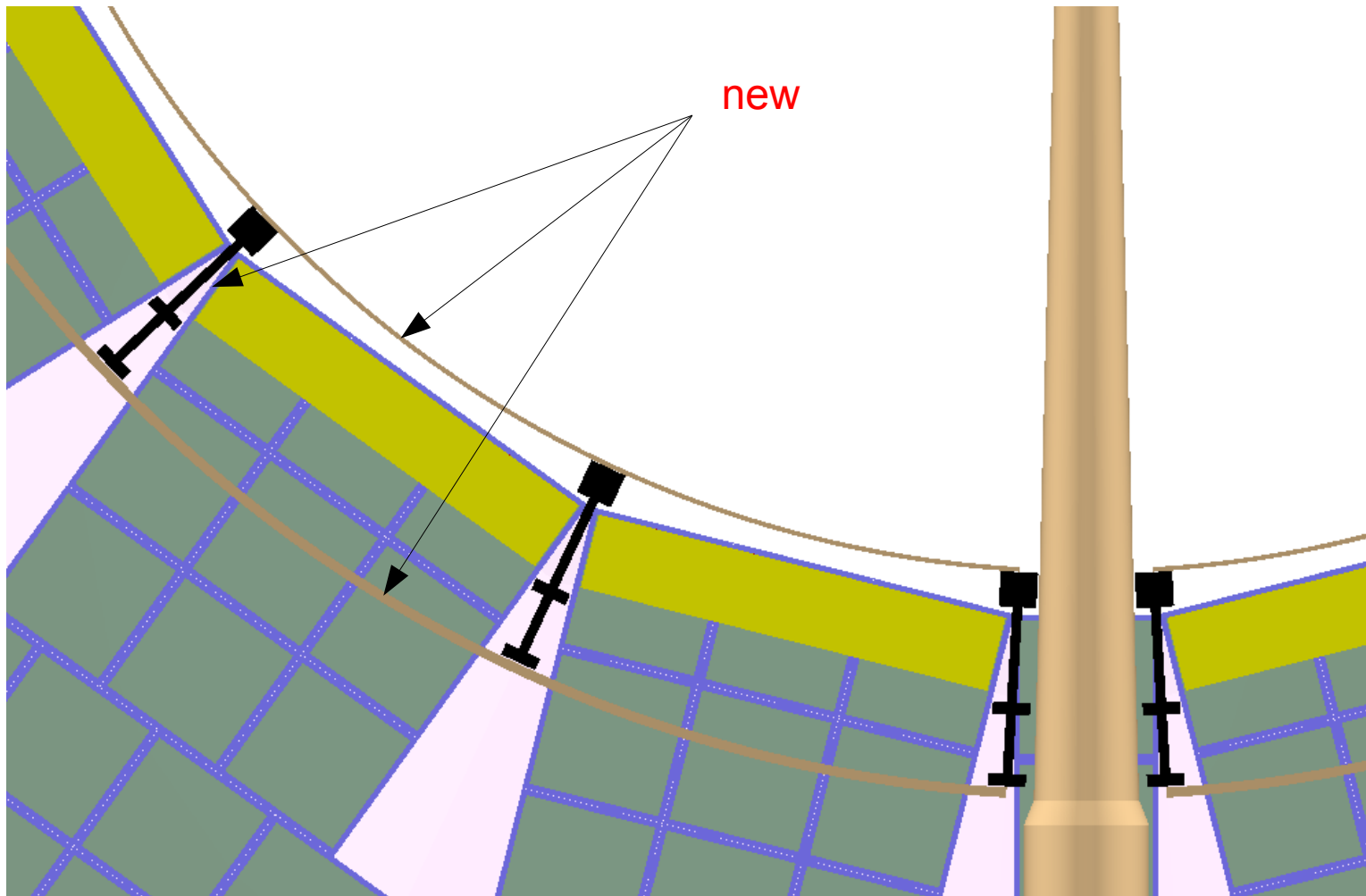PANDA Cherenkov Group

- Geometry update
- New resolution curve
- Time based simulations
- Prototype simulations
- Summary and Outlook

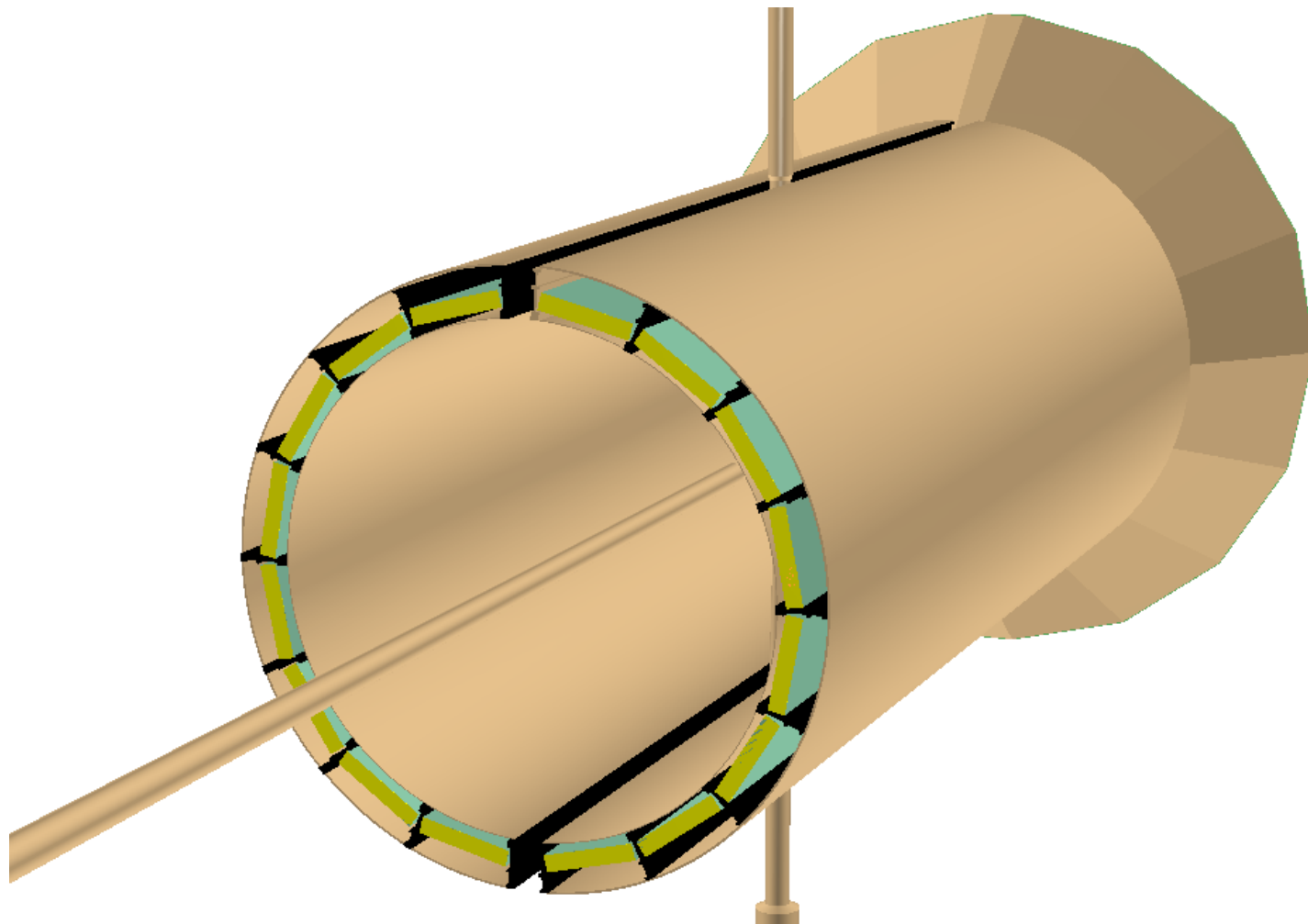# DIRC Geometry update in PandaRoot

- Added cover sheet and support.
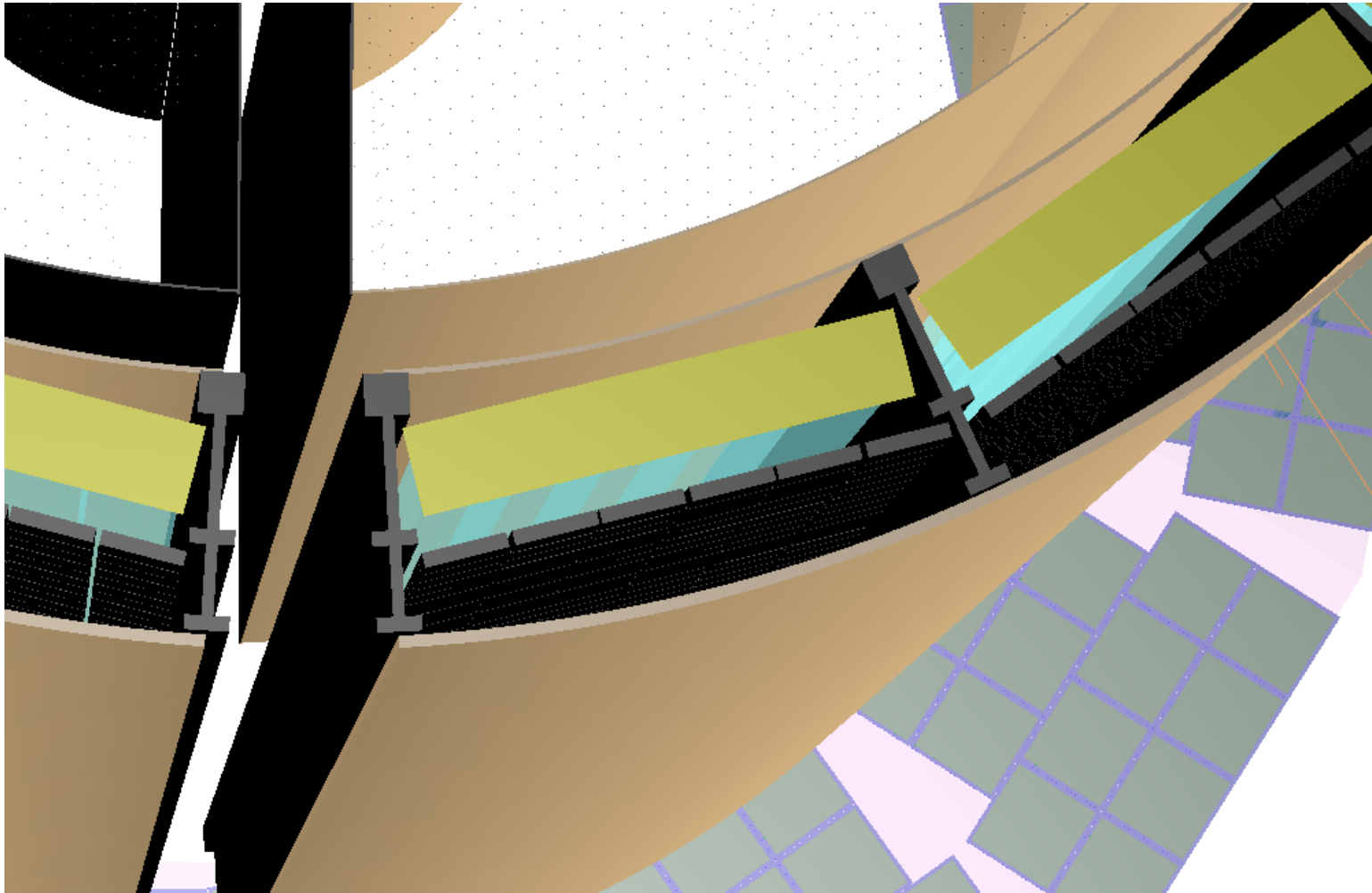- Material - carbon fiber.

new

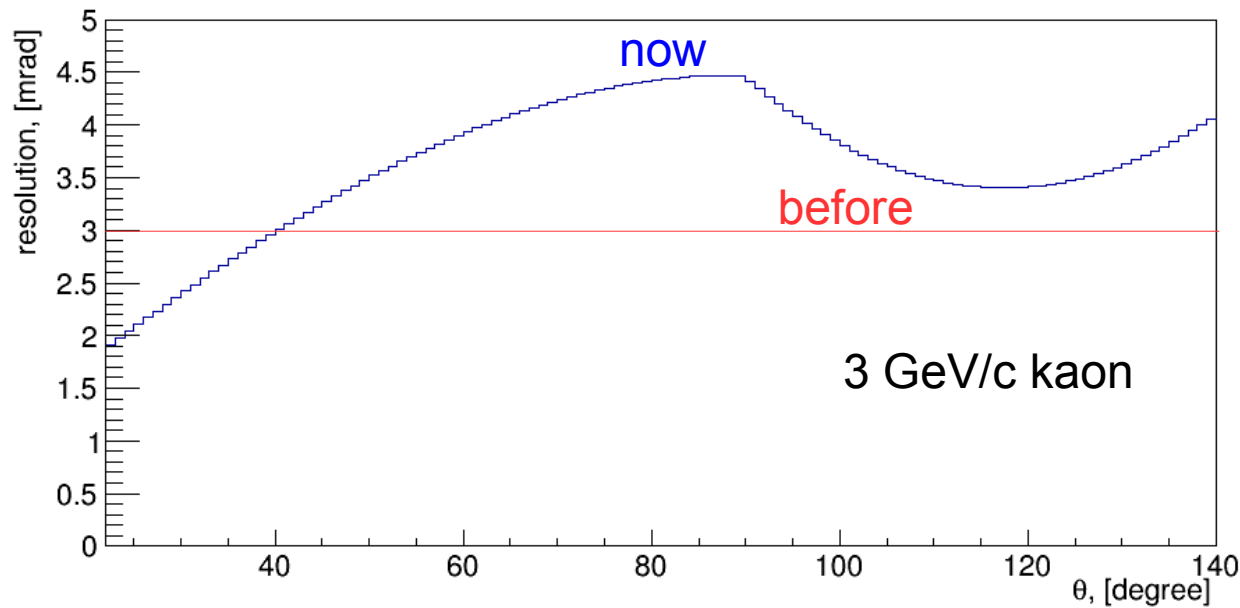# DIRC Geometry update in PandaRoot

DIRC Geometry update in PandaRoot
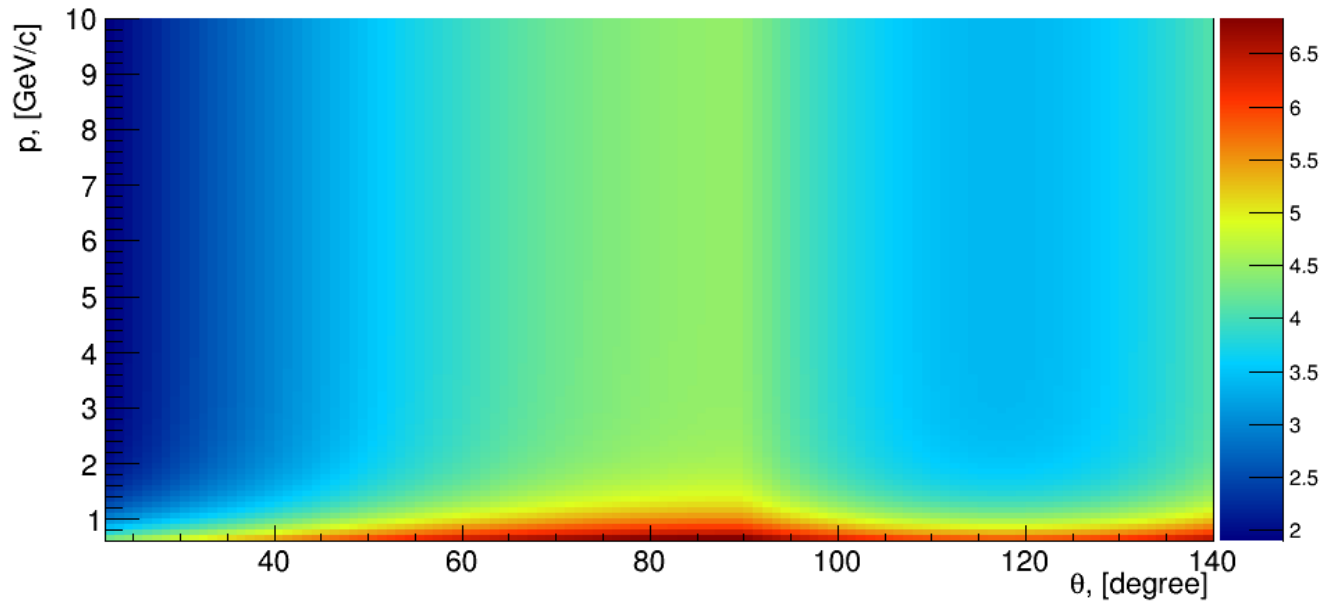
View with STT and SciTil:

New resolution curve for the fast sim
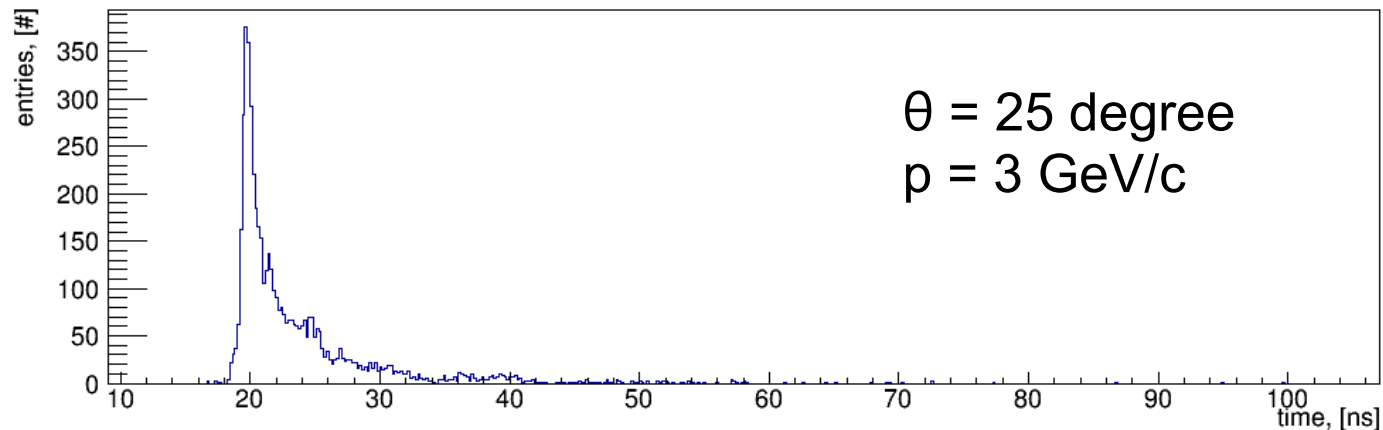

Used in:
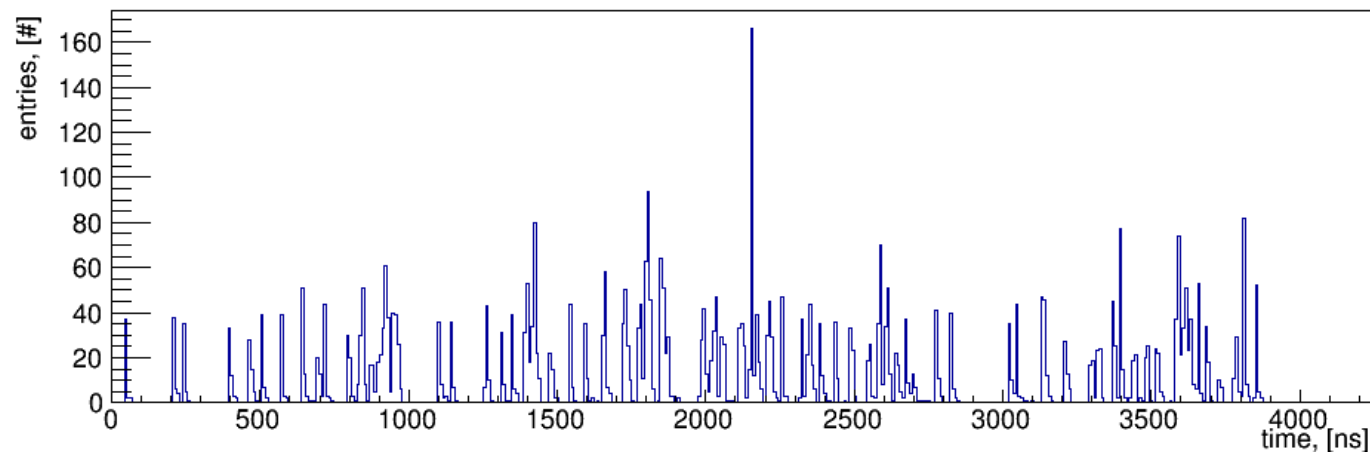- PndDrcHitProducerReal
- PndPidDrcAssociatorTask

Convolution of the momentum resolution obtained from tracking and DIRC resolution.

Time based simulations

- Simulation is event like
- Digitization after adding the time stamp to each event based on the event rate
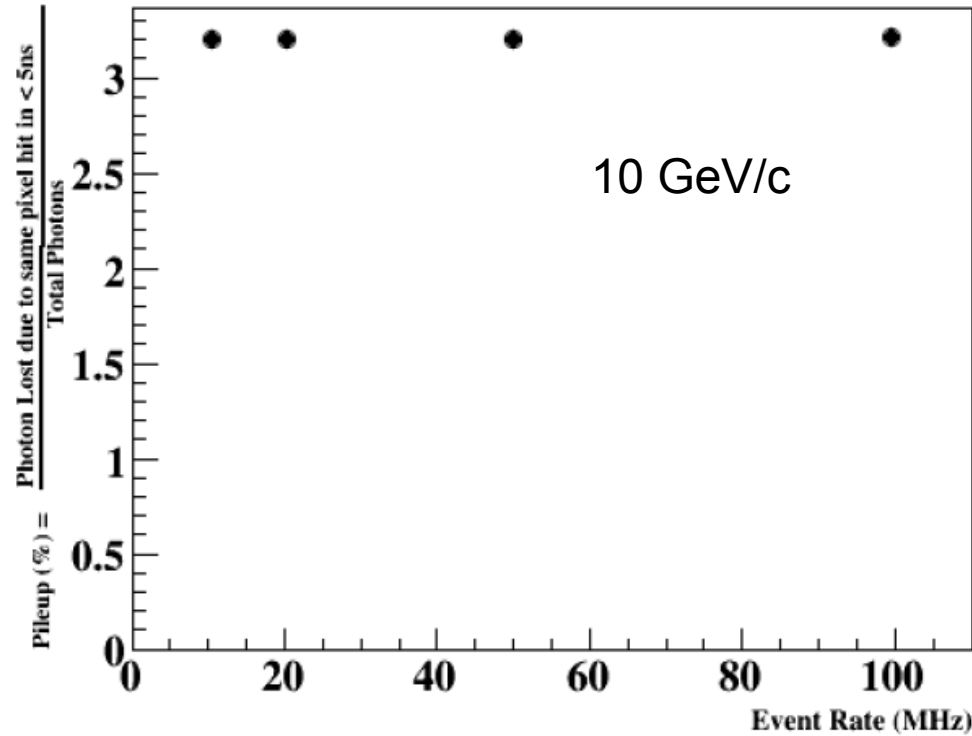

θ = 25 degree
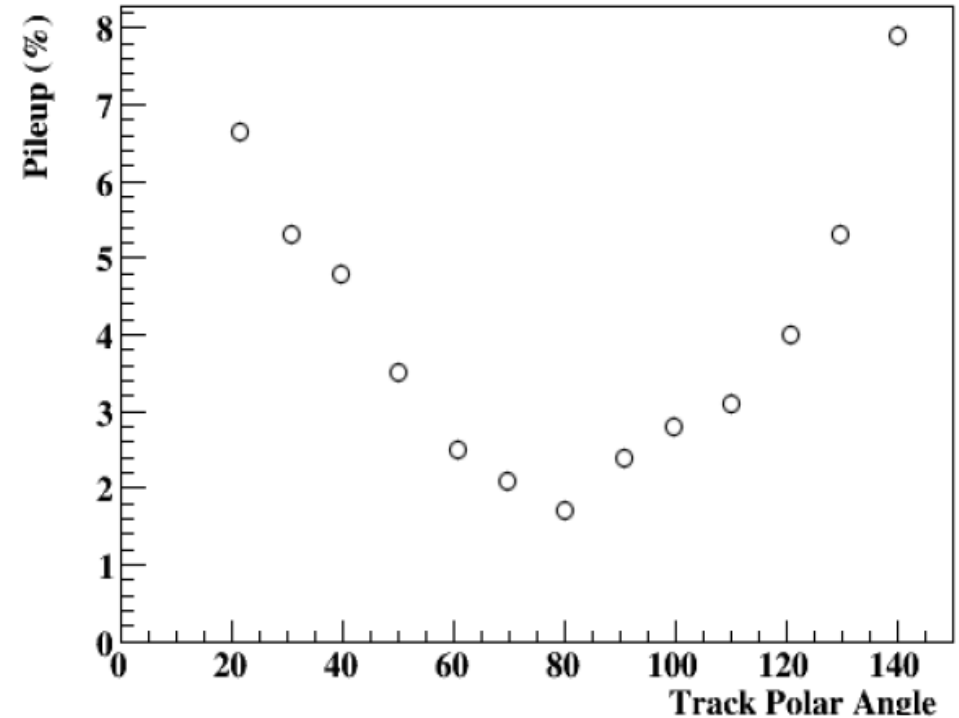p = 3 GeV/c

- Electronic resolution (0.3ns)

- Dead time (5ns)

- Data are sorted in time

Time based simulations: Pileup behavior
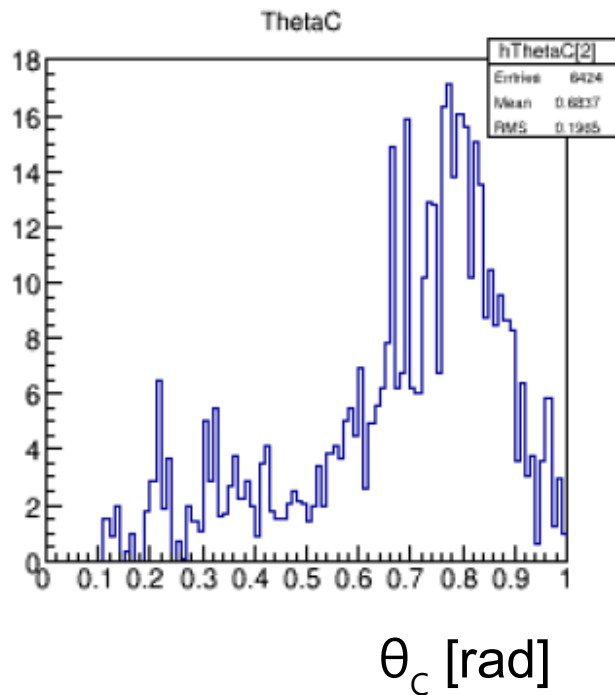

DPM generator

10 GeV/c

3.5GeV/c Muon uniform distribution

- ~3 % of photons are lost due to pileup.
- Pileup is almost constant up to 100 MHz.

Time based simulations: Two tracks in same barbox

Reconstructed Cherenkov angle

Likelihood without delta timing
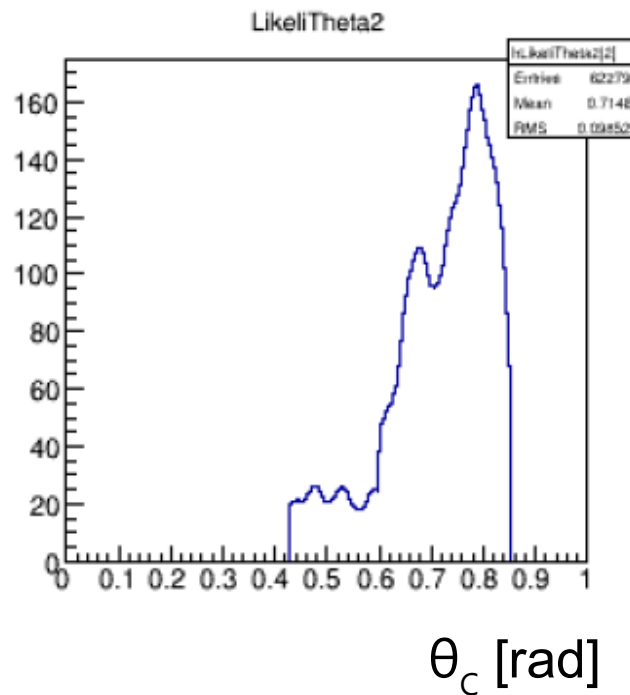
Separation of the events

θ_C [rad]

θ_C [rad]

$t_{mesured} - t_{calculated}$ [ns]
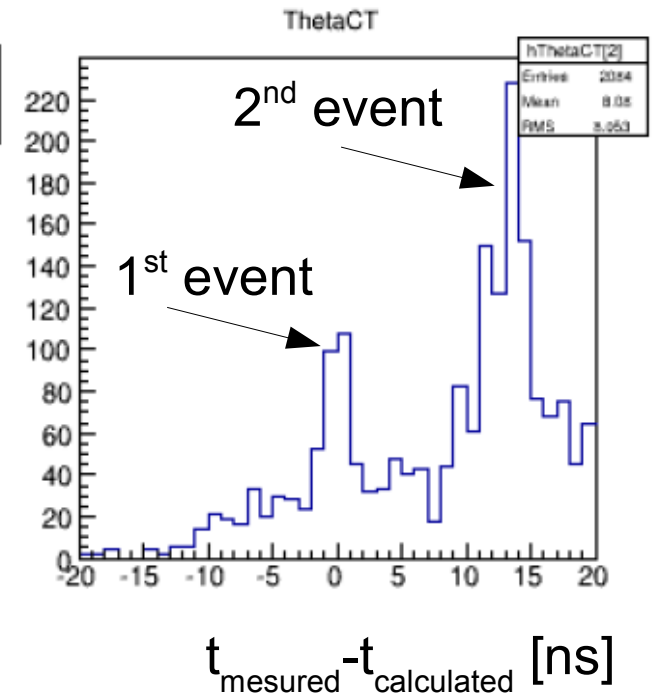
Probability of hitting the same barbox within 50ns (time spread of photons from the event) is ~4% for DPM and ~1.5% for uniform distribution. 90% of these events still could be separated using delta timing.

Prototype simulations: geant-based framework

- Better control of the physics list.

- Control of the Virtual Monte Carlo in PandaRoot

- Used to study:
  - Photon yield.
  - Single photon resolution.
  - Influence of the multiple scattering.
  - Influence of the delta-electrons.
  - Optimization of the prototype geometry (e.g. MCP layout, pixel size and orientation).
  - Optimization of the focusing system.

    ...

Synopsis

```
prt [OPTION] [ARGUMENT] ... [OPTION] [ARGUMENT]
```

```
example:
./prt -a 40 -l 0 -x "pi+" -p 1 -w 0 -g 0 -e 1
```

Options

```
-o      output file name
-i      input file name
-u      look-up file name

-s      run type
                0       simulation
                1       look-up table generation
                2       reconstruction
                5       calibration

-g      geometry configuration
                1       in vacuum
                2       in air
                3       in air + 1cm plastic at front
                5       for calibration

-l      focusing system
                    ...
```
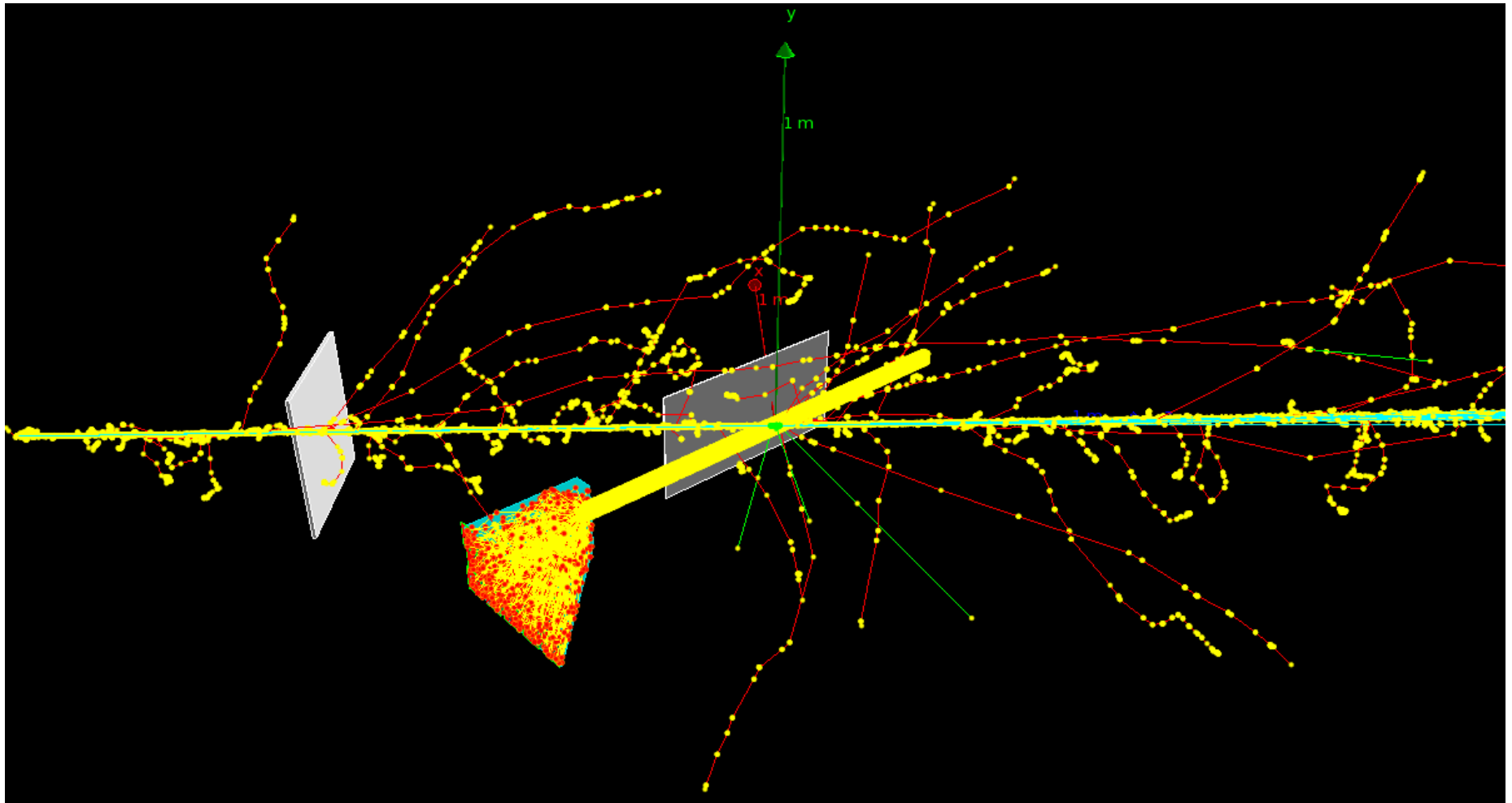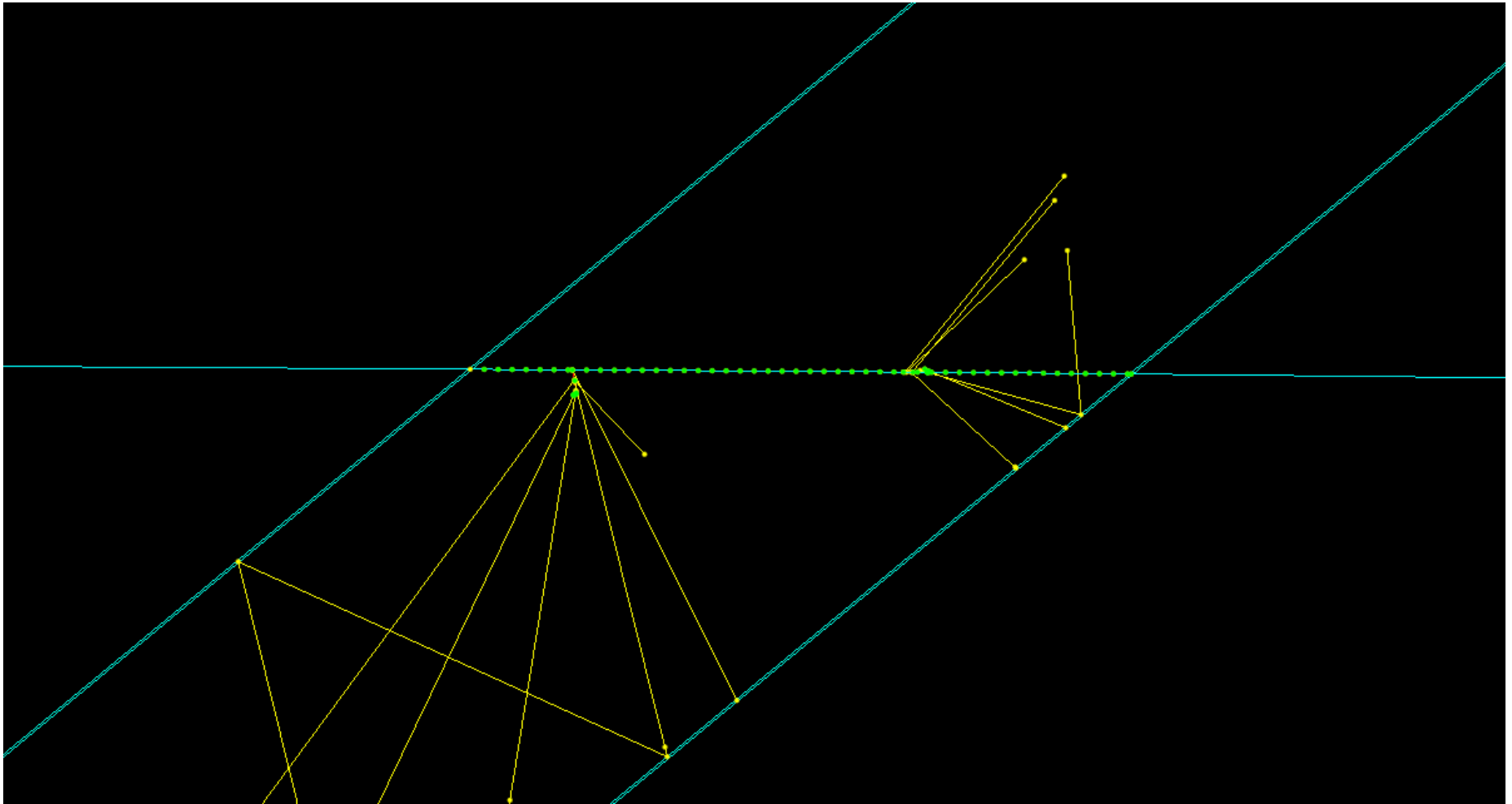
Example 1: Delta electrons

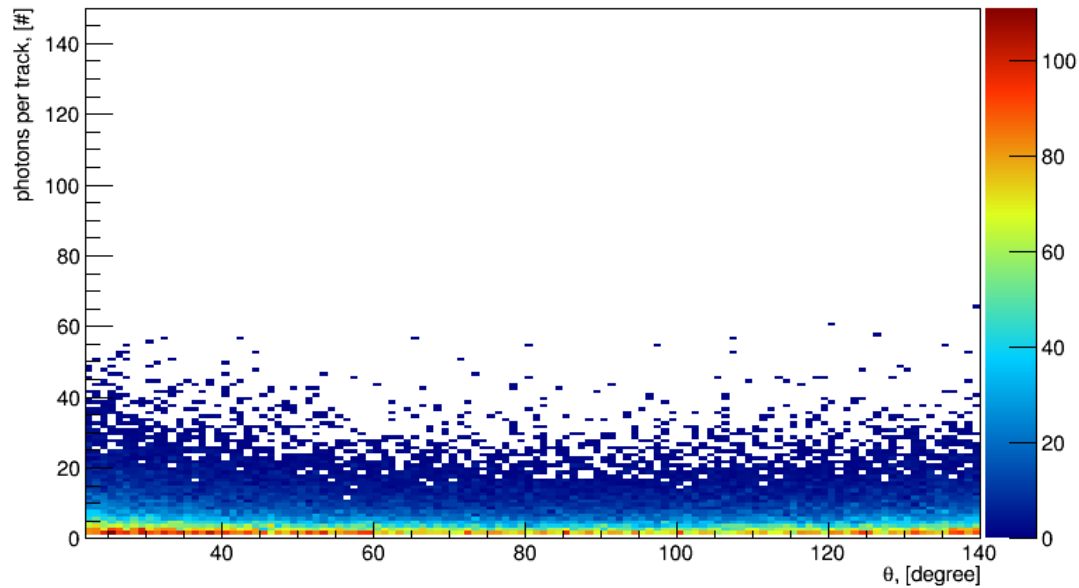Event display for 100 protons with 3 GeV/c momentum
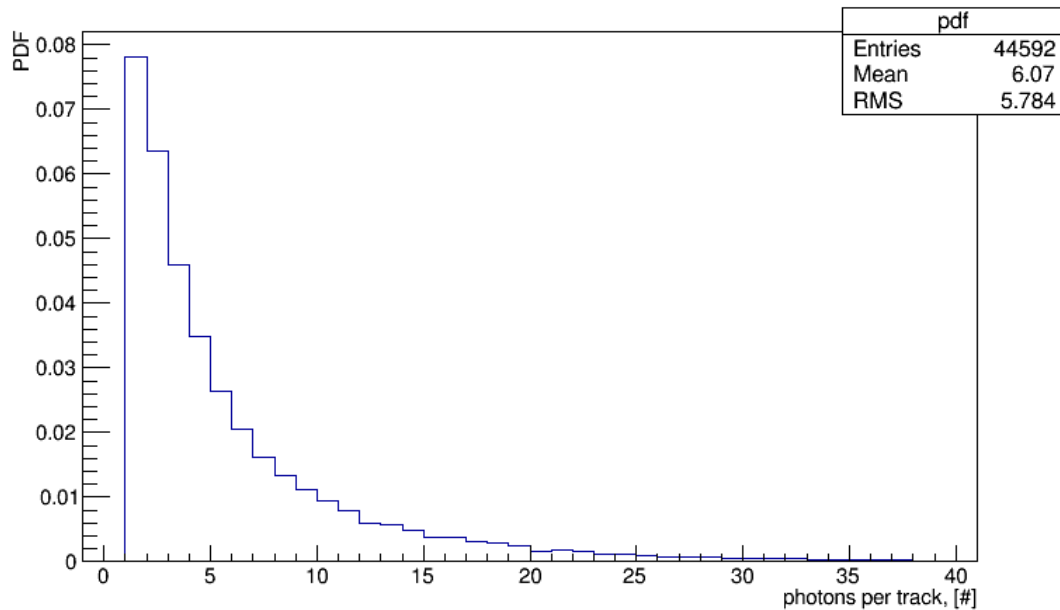
Example 1: Delta electrons

Majority of detected photons are induced by delta-electrons produced inside radiator.
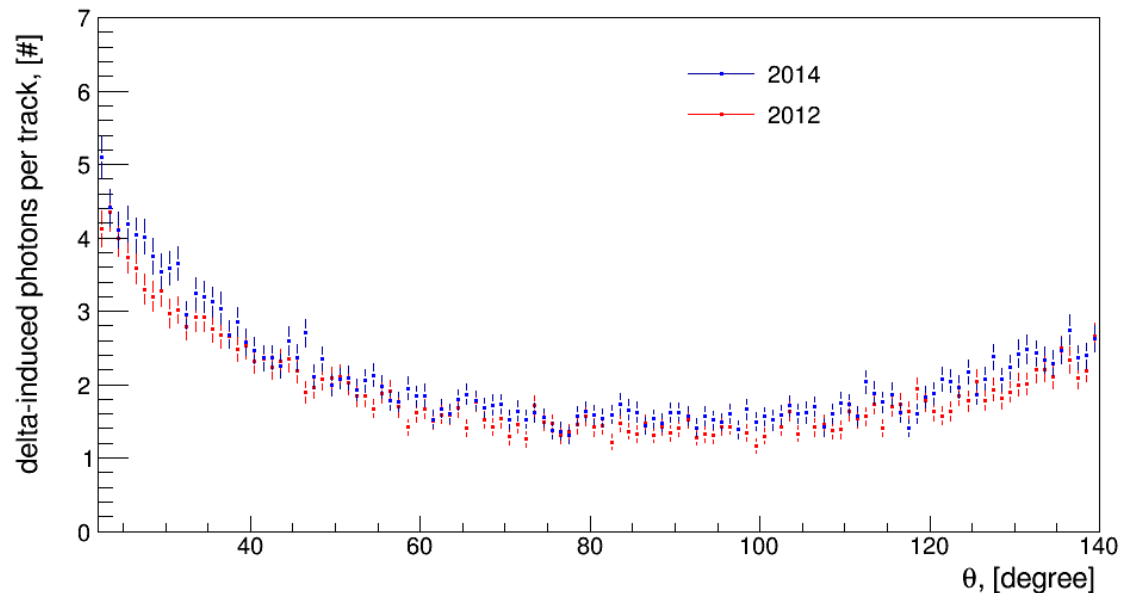
Example 1: Delta electrons

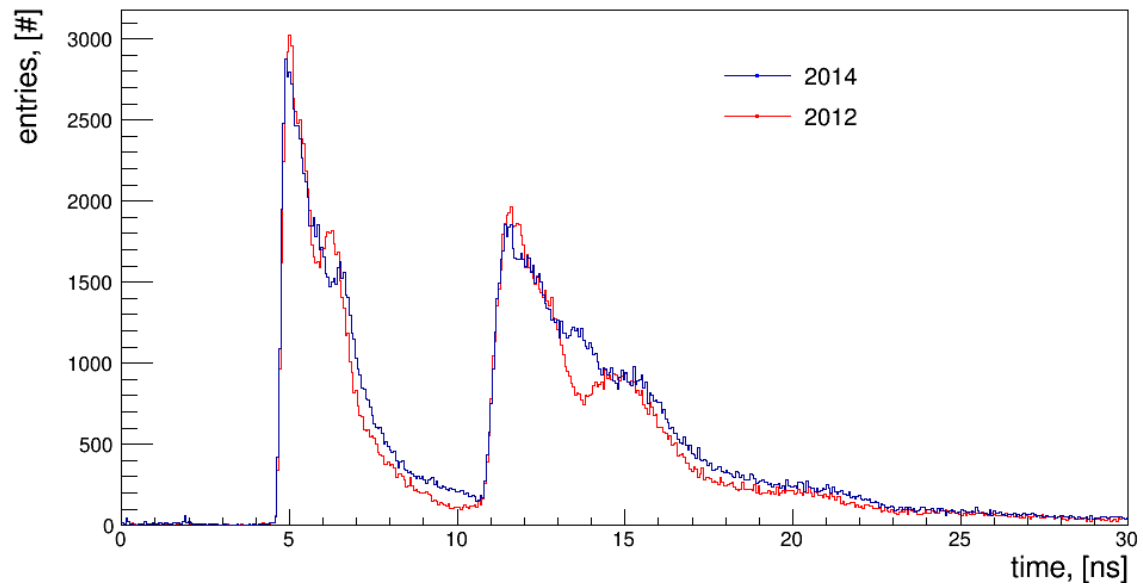
Map of the photon yield for 3 GeV/c proton

Probability function to detect photons from delta electrons
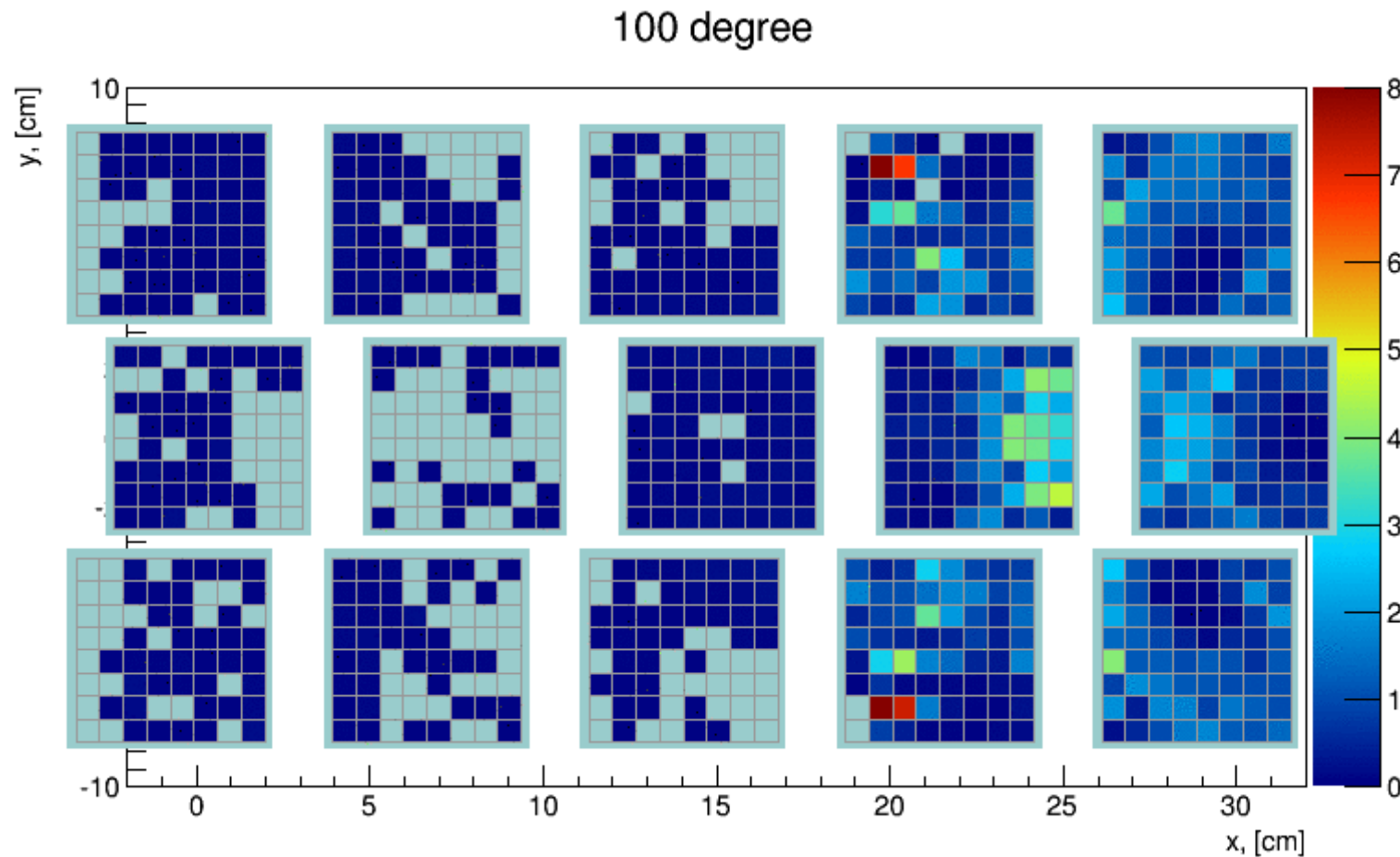
10.06.14

Example 1: Delta electrons

2012 vs. 2014 design

3 GeV/c protons

Example 2: MCP layout optimization

Animation

100 degree

Summary

- Updated geometry.
- Updated fast simulation.
- Implemented time-based simulation.
- Developed geant-based framework for the prototype, conducted multiple studies for the upcoming prototype test.

Outlook

- Reconstruction of the time-based simulated data. Both for prism and tank type expansion volume (in progress).
- Reconstruction algorithms for the plate radiator (in progress).
- Focus on the upcoming prototype beam data. Both simulation and reconstruction.
- Preparing TDR.