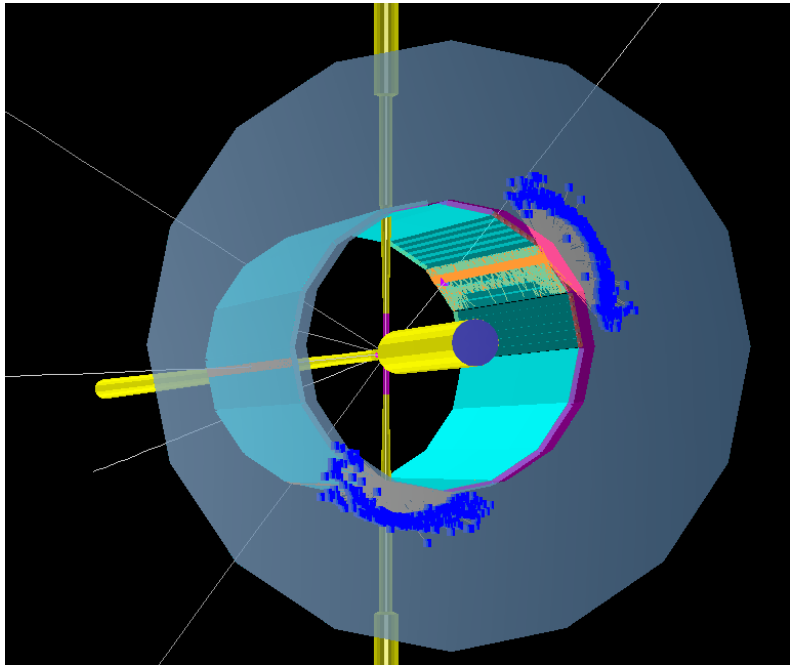


Barrel DIRC: Progress Report

Simulation & Reconstruction

Maria Patsyuk

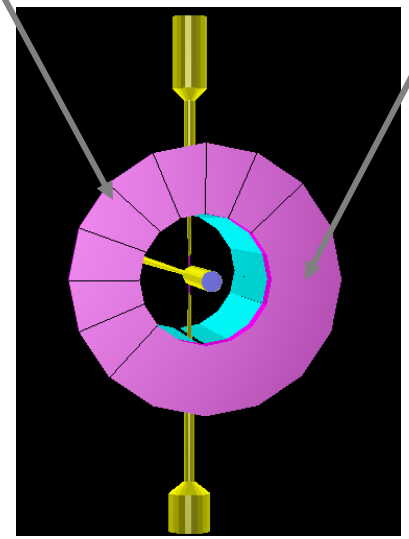
Motivation

Current PANDA Barrel DIRC version is based on BABAR DIRC with several improvements.
Many parameters are not yet optimized.

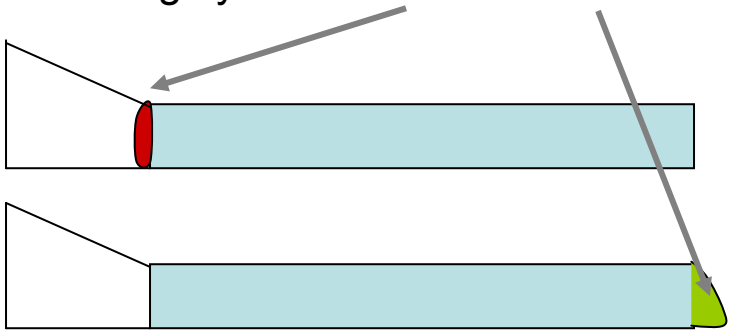
Goal: determine the performance of different DIRC designs → **single photon resolution** and **number of detected photons.**

Some options of PANDA DIRC design:

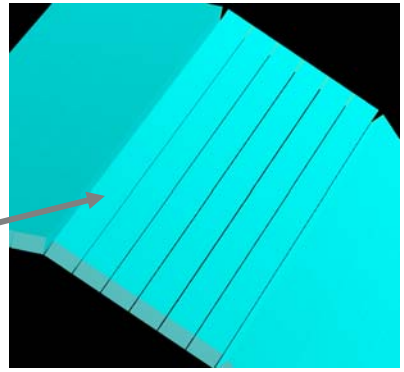
Expansion volume: single tank or 16 optically isolated ones?



Focusing system: lenses or mirror?

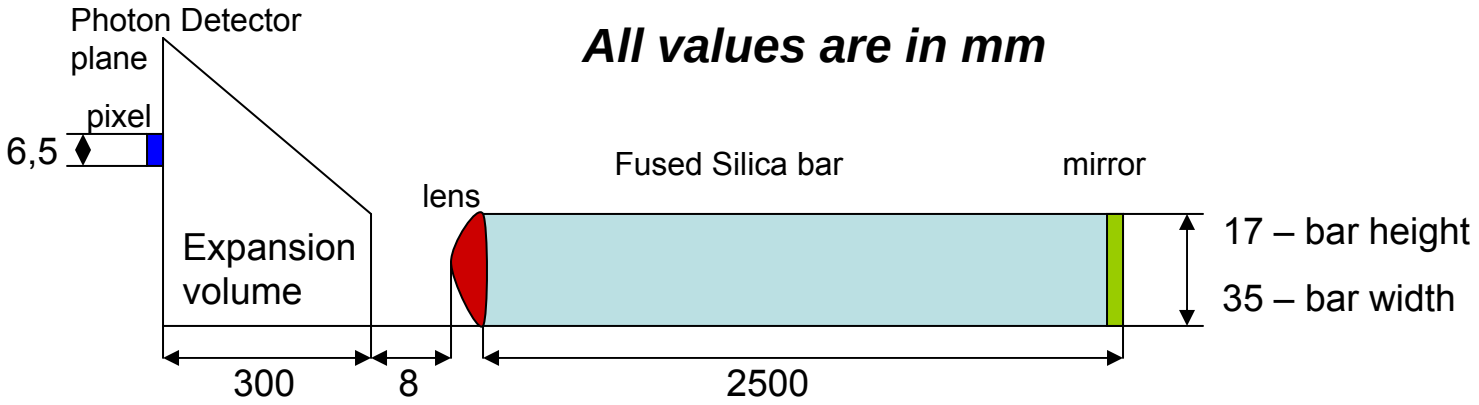


Number of bars in a bar box (6 or less), bar thickness.

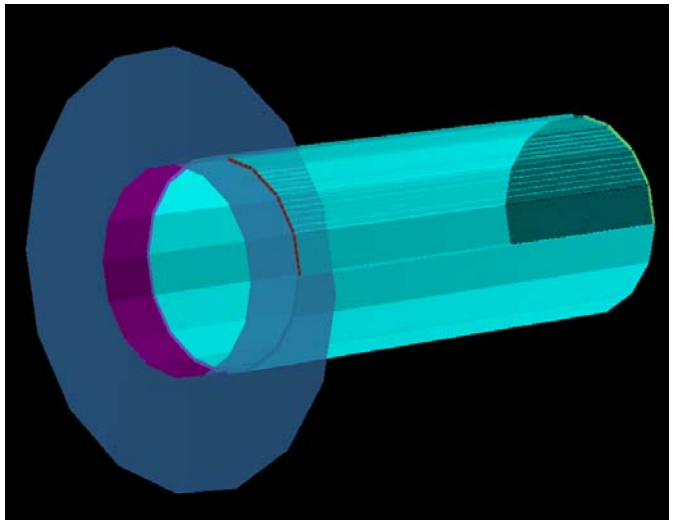


Current Barrel DIRC layout

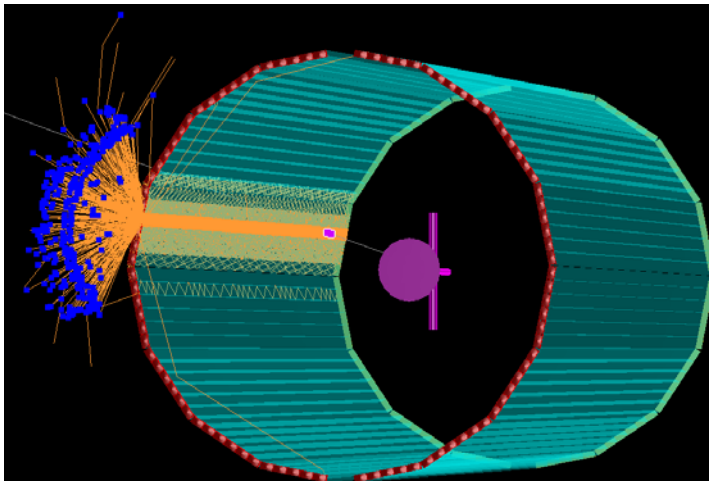
Baseline Design:



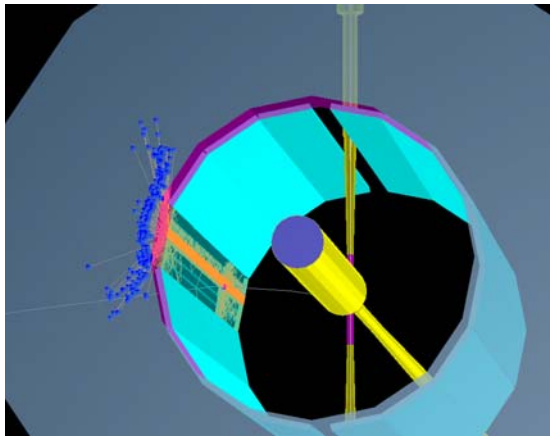
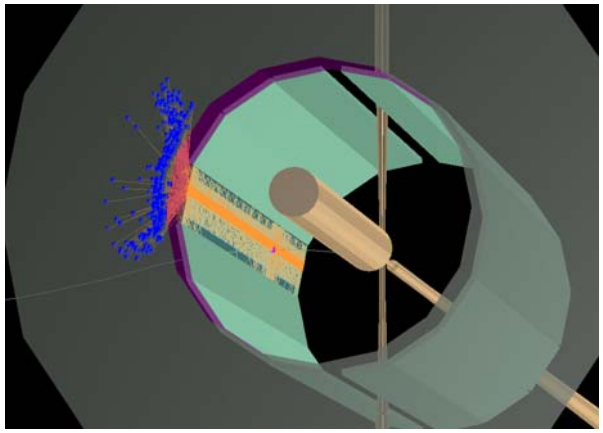
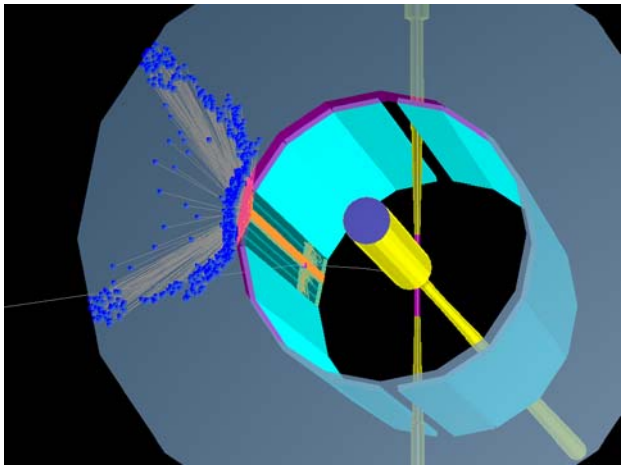
All values are in mm



16 bar boxes with 6 bars each



Ring images with eventDisplay

	GEANT3	GEANT4
focusing		
No focusing		

While the rings look good both in g3 and g4, time per single track event is different:

T(g3) = 3 s/event

T(g4) = 30 s/event !

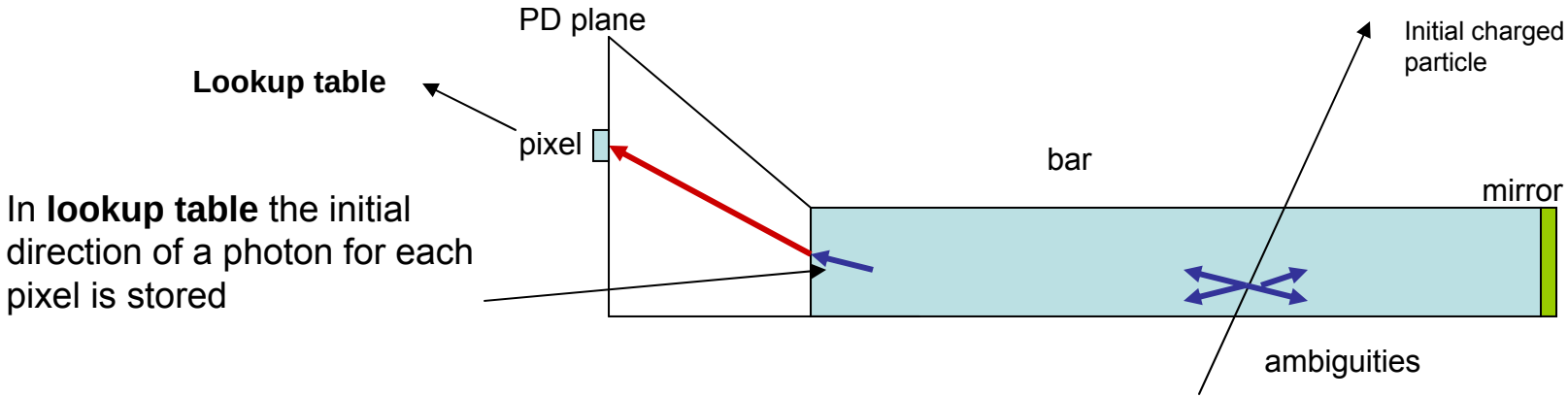
Barrel DIRC reconstruction

- Proven reconstruction method – BABAR-type reconstruction using lookup tables
  - Uses association “pixel - bar”
  - Fast access to θ_c using lookup tables
  - Continuation of work started by Dipanwita Dutta

- Implementing it in PANDA Root
  - Will become commonly available in reconstruction

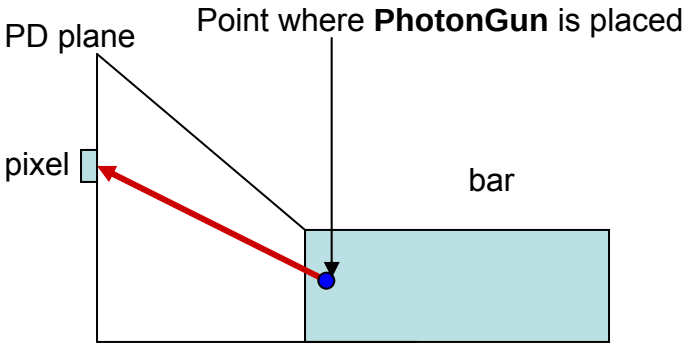
Reconstruction approach

Proof of principle: simplest case (no focusing), Fused Silica bar attaches directly to the Expansion Volume (EV), charged particles hit one given bar:



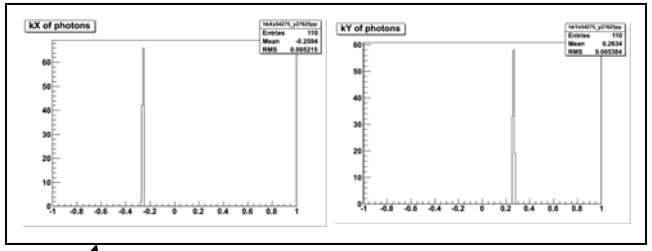
To create a look up table we used “PhotonGun” GEANT4 (*in GEANT3 “PhotonGun” crashes*):

- Cherenkov photons produced at a point close to the bar end covering the whole detector plane
- Store photon direction for each pixel



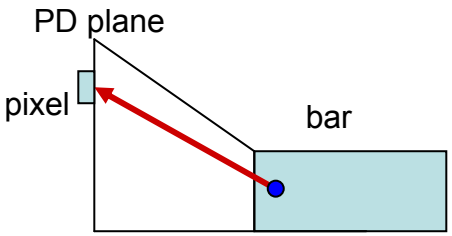
Lookup table (LUT)

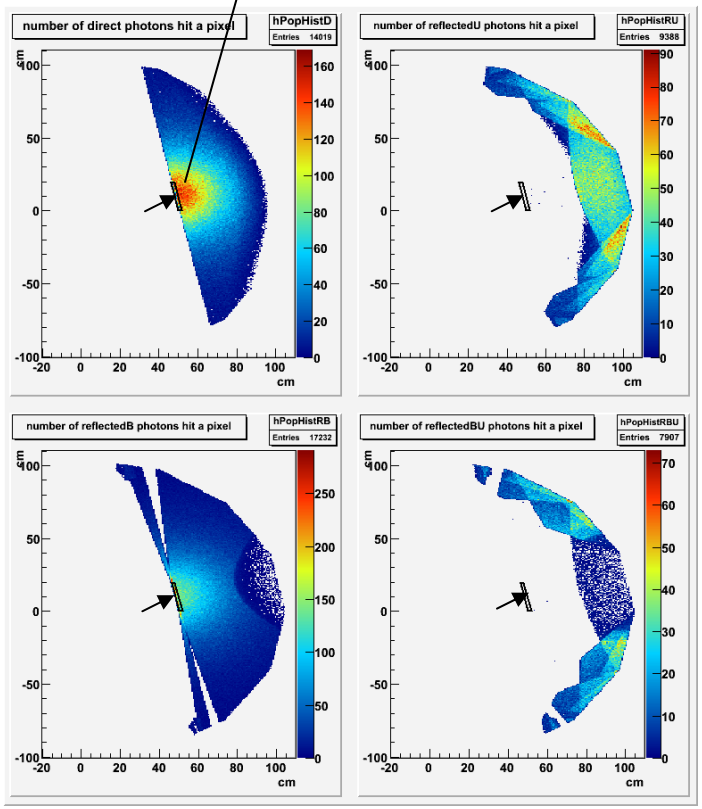
Hit pattern on the PD plane made with Photon Gun – different ambiguities are shown:



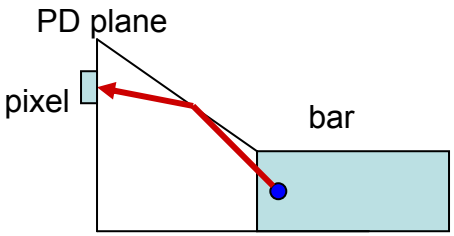
Photon direction vector k = (kX, kY, kZ) in bar coordinate system

Direct photons

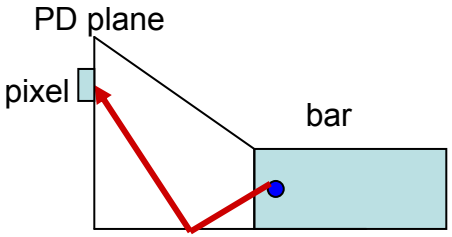




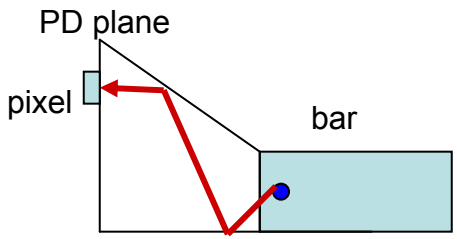
Photons reflected from the cone part of EV



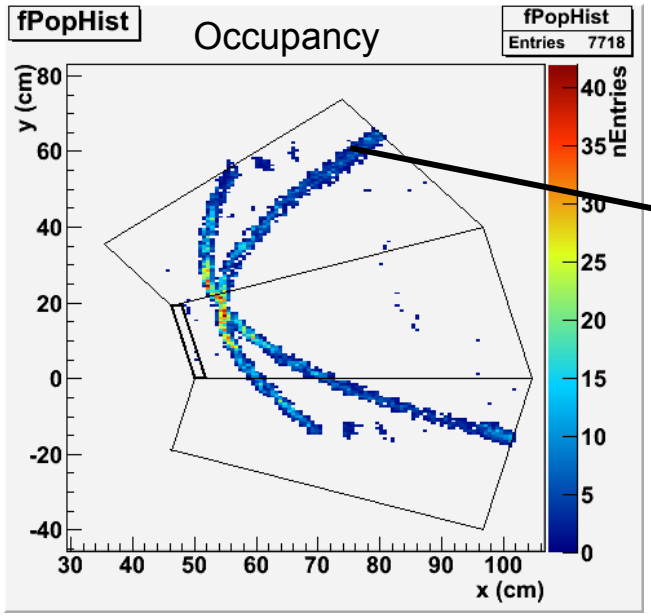
Photons reflected from the cylinder part of EV



Photons reflected from the cylinder and then from the cone part of EV



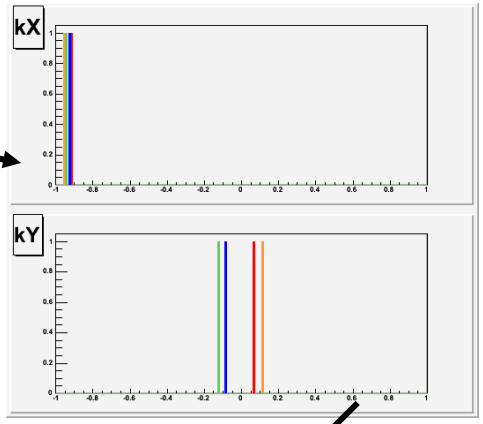
Reconstruction: step-by-step



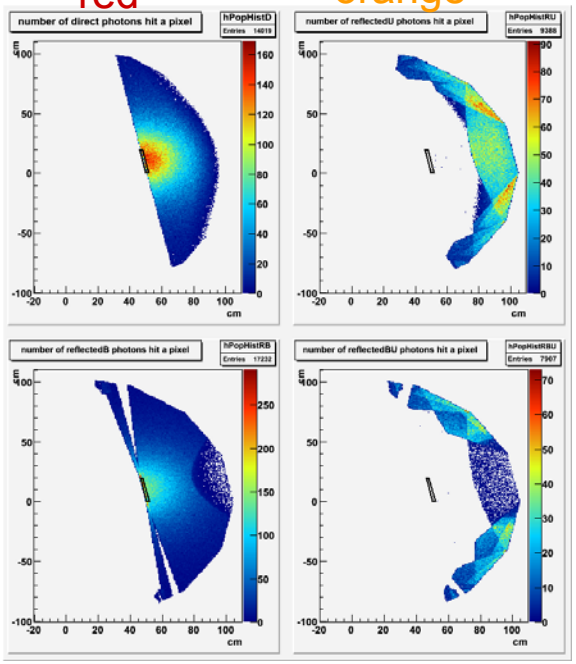
Single track events (3 GeV/c pions, θ=120°, φ=16°, 440 events)

Photon direction for each pixel,

colors show different ambiguities -

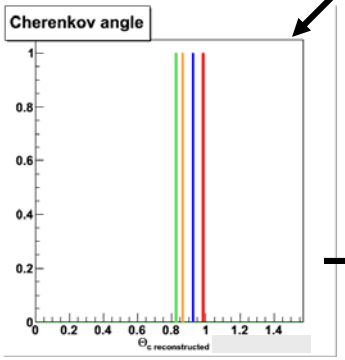


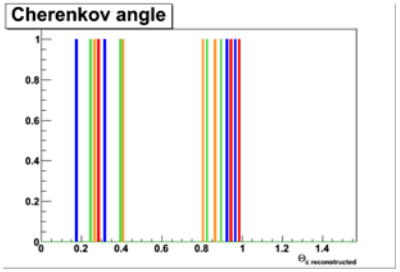
red orange



blue green

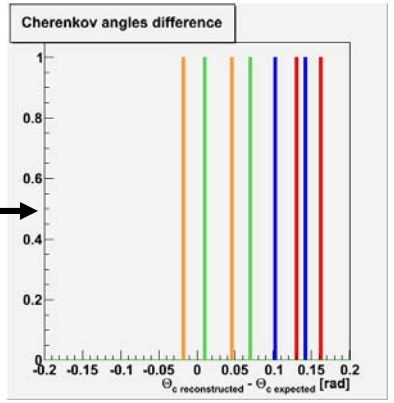
+ charged track information





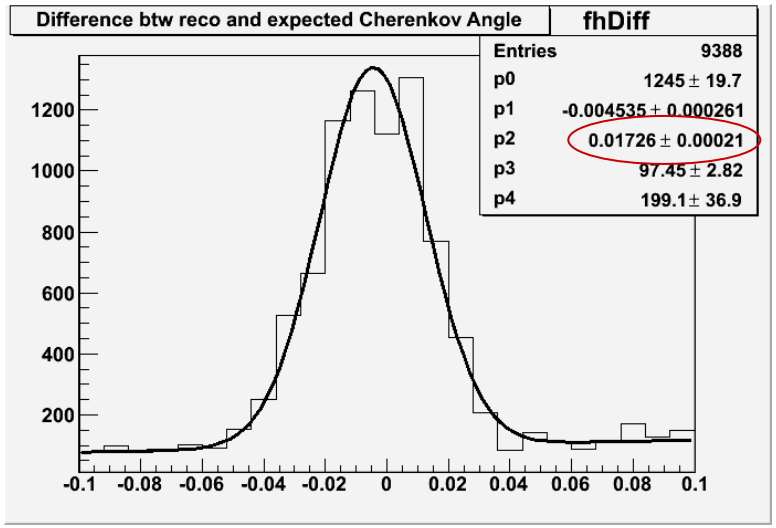
with bar ambiguities

Calculate expected θ_c value and plot the difference



Results

Apply described method to all hits:

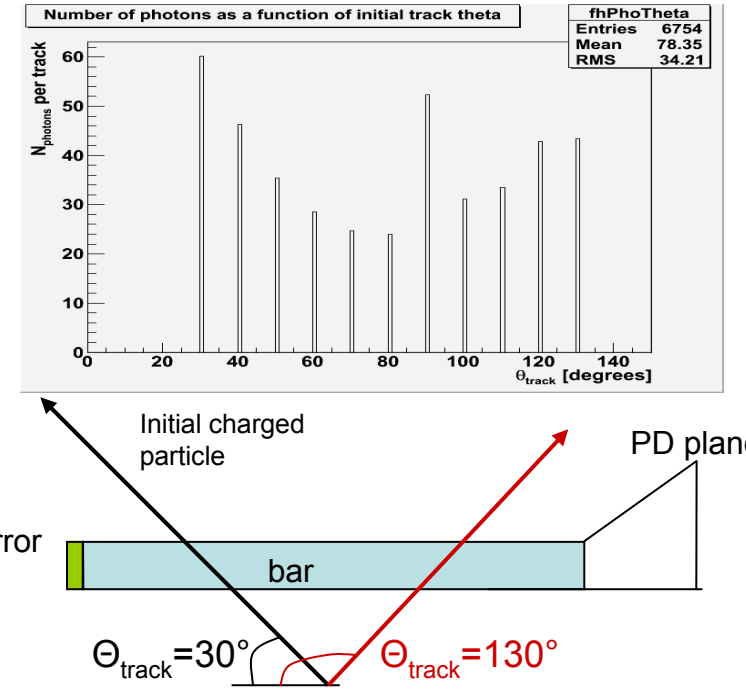


Single photon resolution is ***17 mrad***

Expected resolution is ***18 mrad*** *(pixel size, bar size, chromatic dispersion)*

Reconstruction result is consistent with expected value

Number of detected photons per track as a function of polar angle:



No focusing → at least 24 photons per track

Summary & Outlook

- Goal – study the performance of different DIRC designs (Number of photons, single photon resolution)
- First reconstruction attempt using simplified design (no focusing) and look-up table → obtained θ_c resolution consistent with expectations
- Next:
  - focusing options: thin lens, thick lens, forward mirror (already implemented in PANDARoot)
  - radiator bar shapes: thickness, width, plate vs bar

lenses

mirror