Modular Ring Imaging CHerenkov Detector (mRICH)

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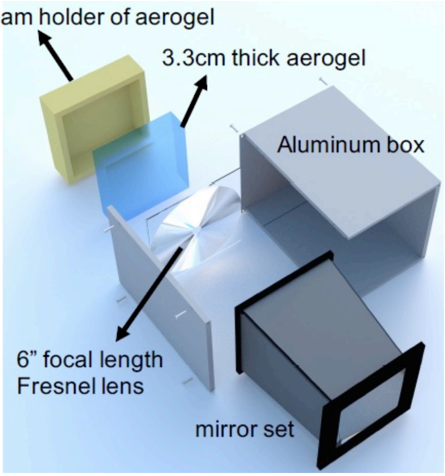
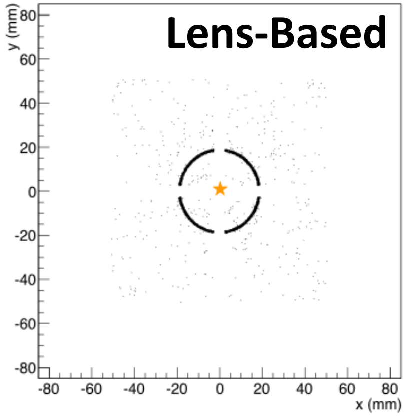
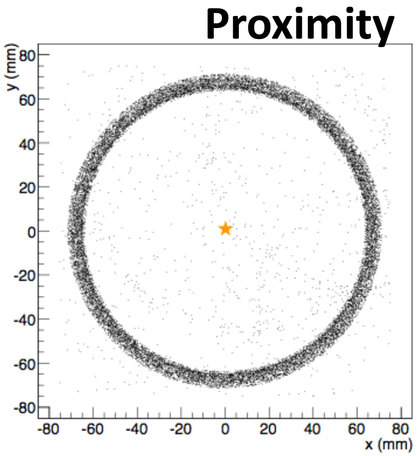
Overview:

- Modular and compact RICH detector (~15x15x25 cm)
- Radiator: Aerogel, L~3 cm and n=1.03
- Focusing: 6” Fresnel lens

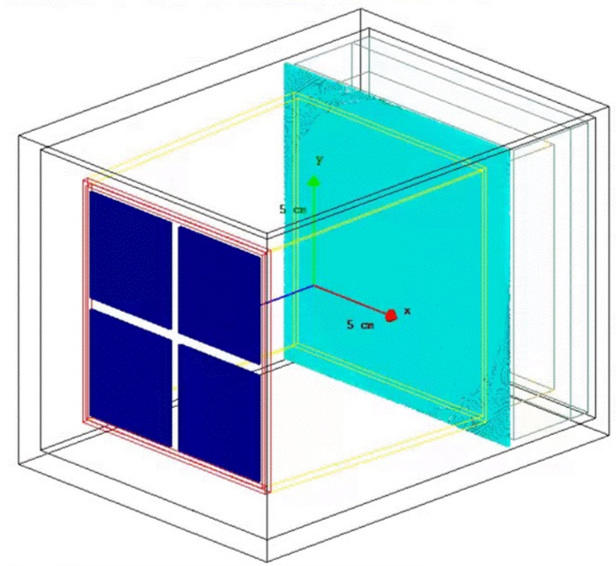




at 23 cm



- π/K separation up to 10 GeV/c and e/π separation up to 2 GeV/c.
- Have full GEANT4 (fun4all) and standalone simulation



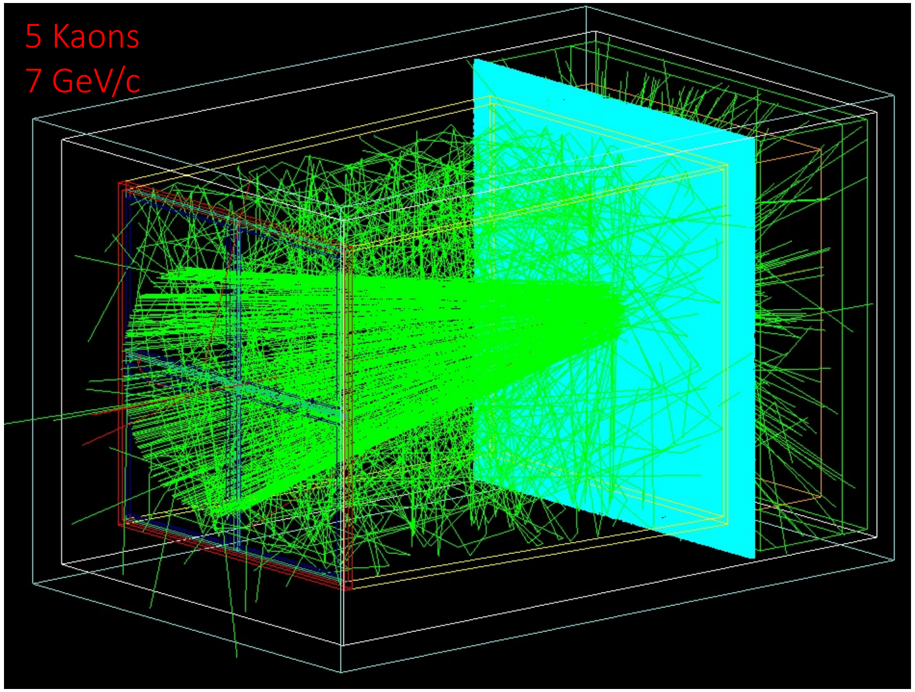
Systematic effects

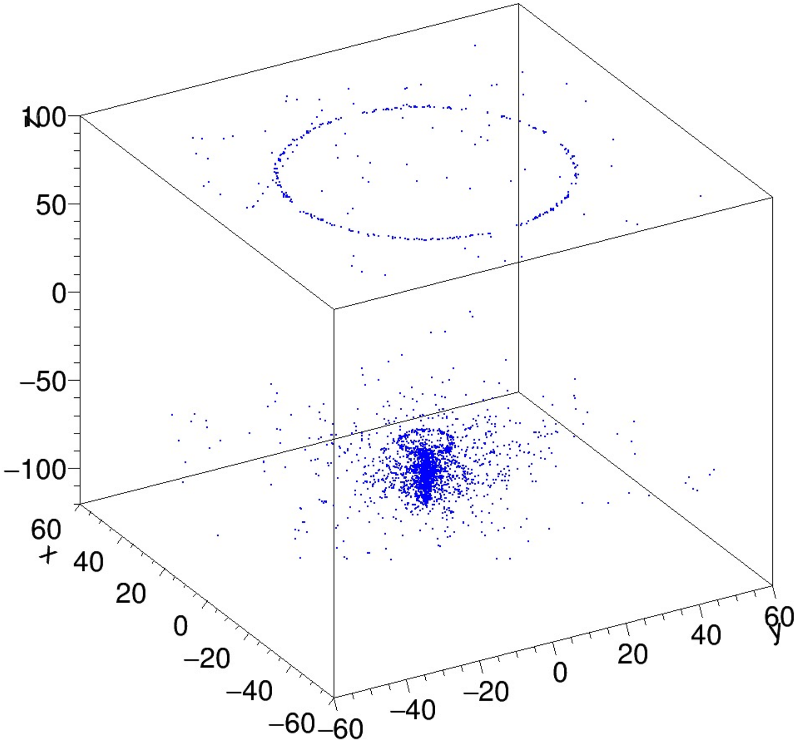
- Emission point error: minimized at the lens focal plane
- Chromatic dispersion error: reduced by UV filtering (acrylic).
- Pixel size error: the uncertainty raised by pixel size, a, error

mRICH in GEANT4

Standalone MC (GEMC/Geant4 + ROOT) (Xiaochun He)

–Model largely based on Perl scripts





mRICH in ECCE

Full implementation in ECCE Fun4All simulation framework:

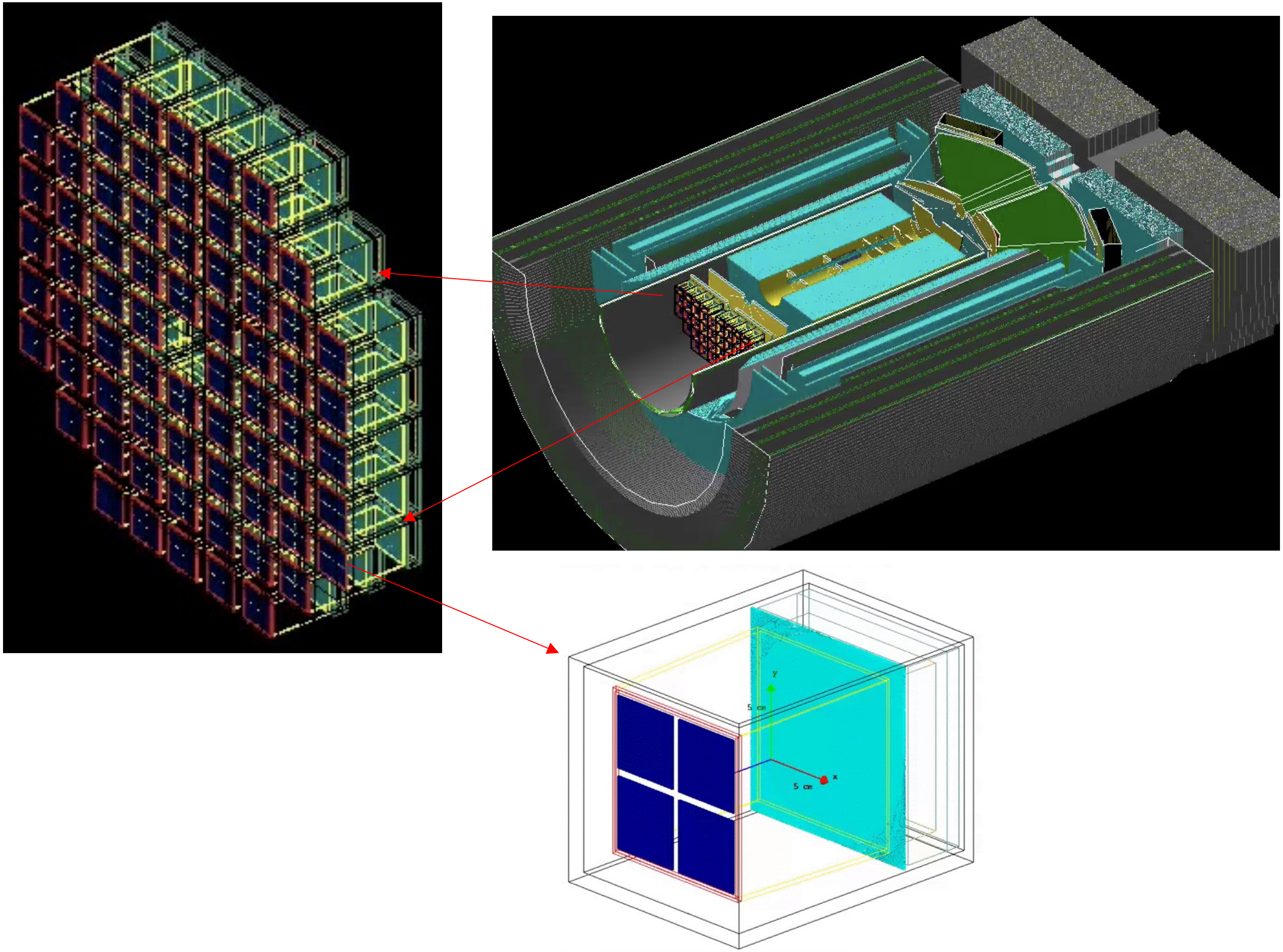
✷ 3 classes mandatory

- Subsystem: PHG4mRICHSubsystem.cc & PHG4mRICHSubsystem.h
- Detector: PHG4mRICHDetector.cc & PHG4mRICHDetector.h
  ➟ contains the detector description
- SteppingAction: PHG4mRICHSteppingAction.cc & PHG4mRICHSteppingAction.h

These are included in
coresoftware/simulation/g4simulation/g4detectors/
and must be compiled together to produce "libg4detectors.so”

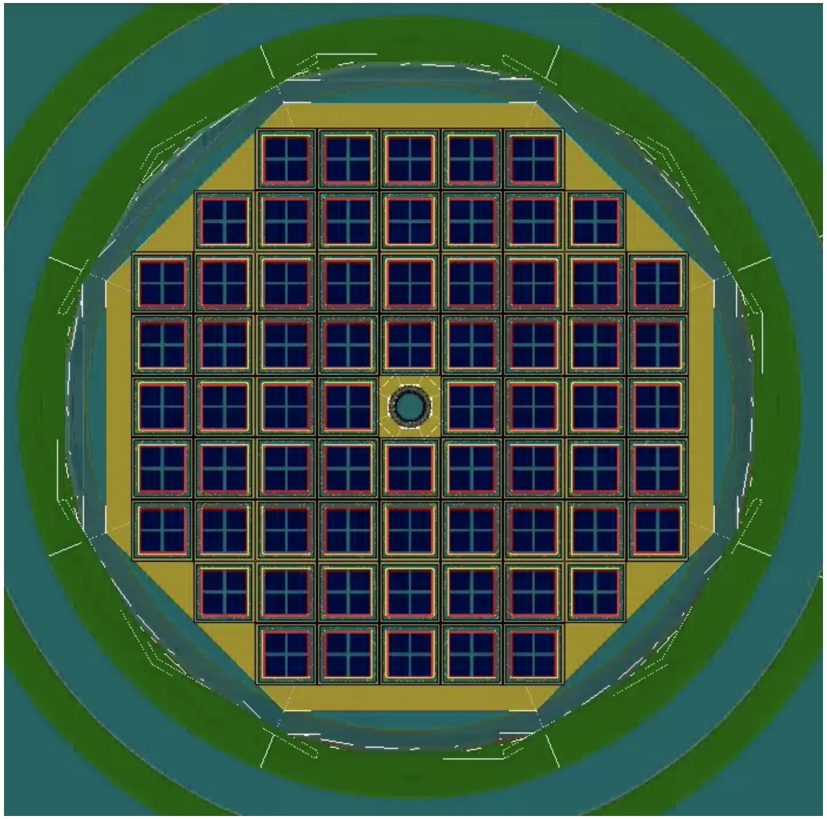
- mRICH has a macro "G4_mRICH.C" that sets up mRICH.
- mRICH is called by the overall setup macro "G4Setup_EICDetector.C”
- The setup macro gets called by the main macro "Fun4All_G4_EICDetector.C" The main macro has flags that allows enabling and disabling any detector

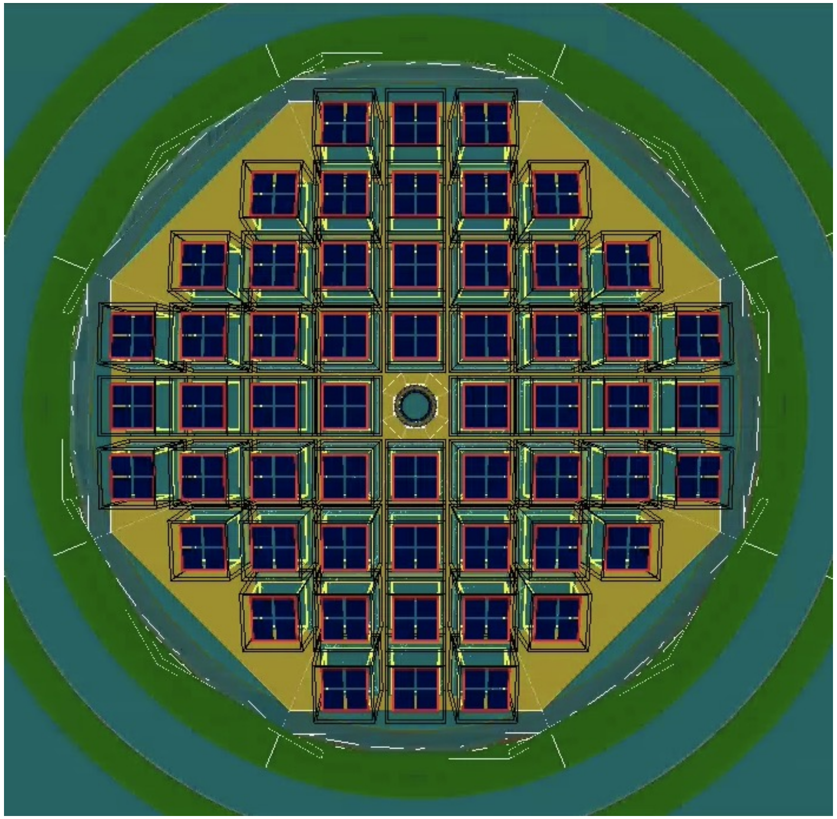
mRICH in ECCE

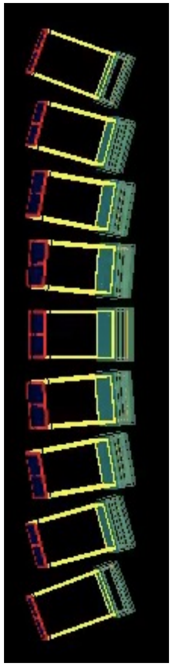


mRICH in ECCE

Flat vs. projective



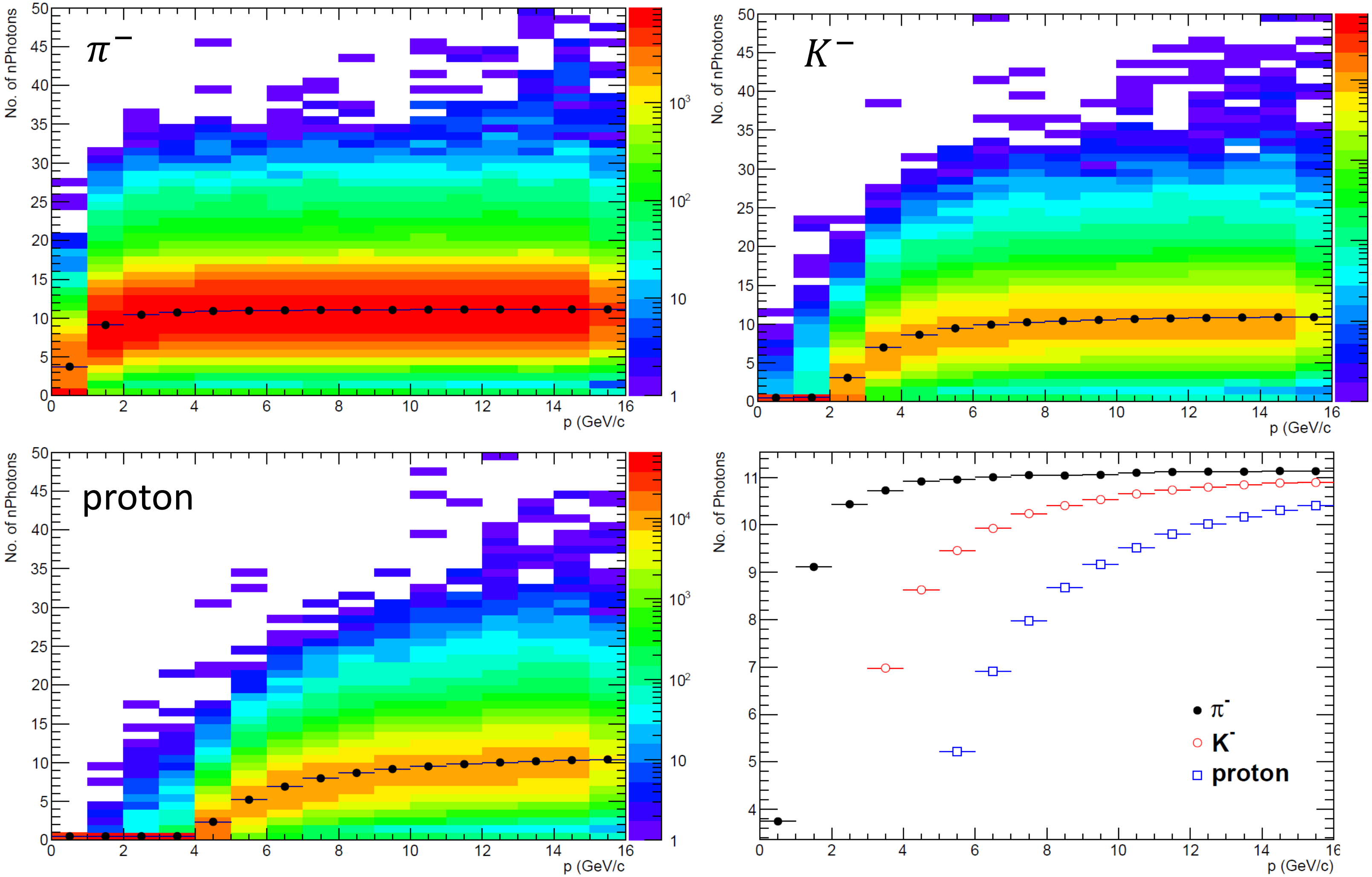




Analysis Code/ PID

Focusing on a single module for performance studies!

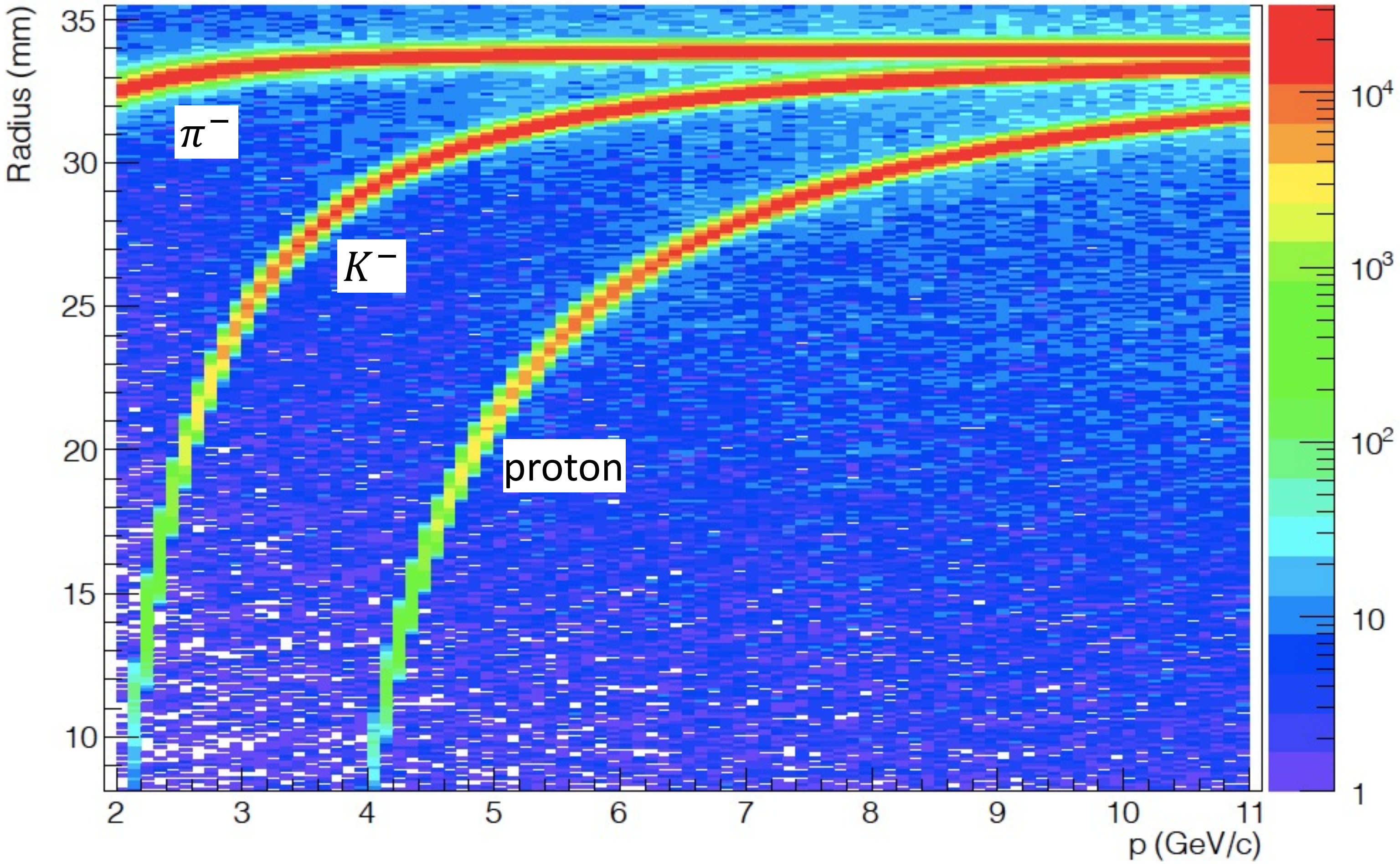
❖ No. of photons on the ring



Analysis Code/ PID

Focusing on a single module for performance studies!

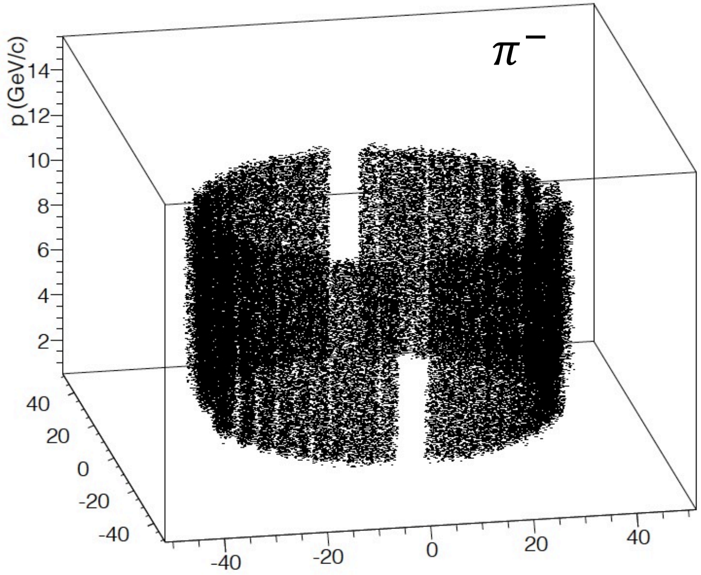
❖ Ring radius without considering the sensor pixelization!

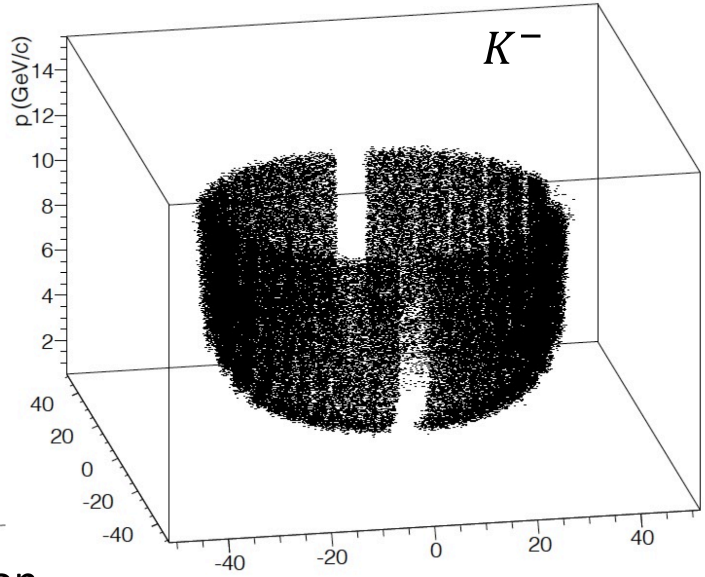


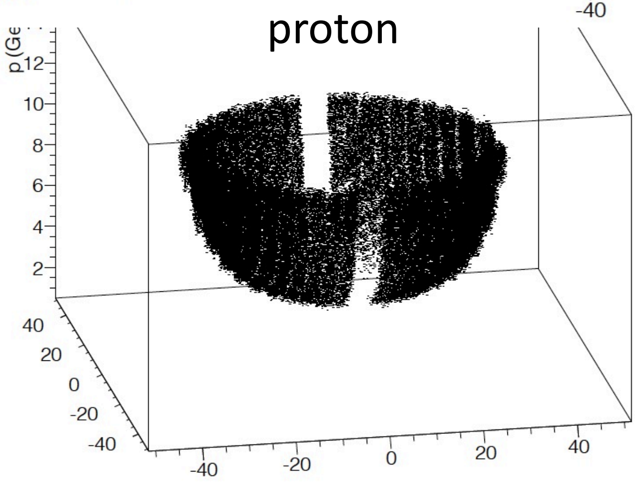
Analysis Code/ PID

Focusing on a single module for performance studies!

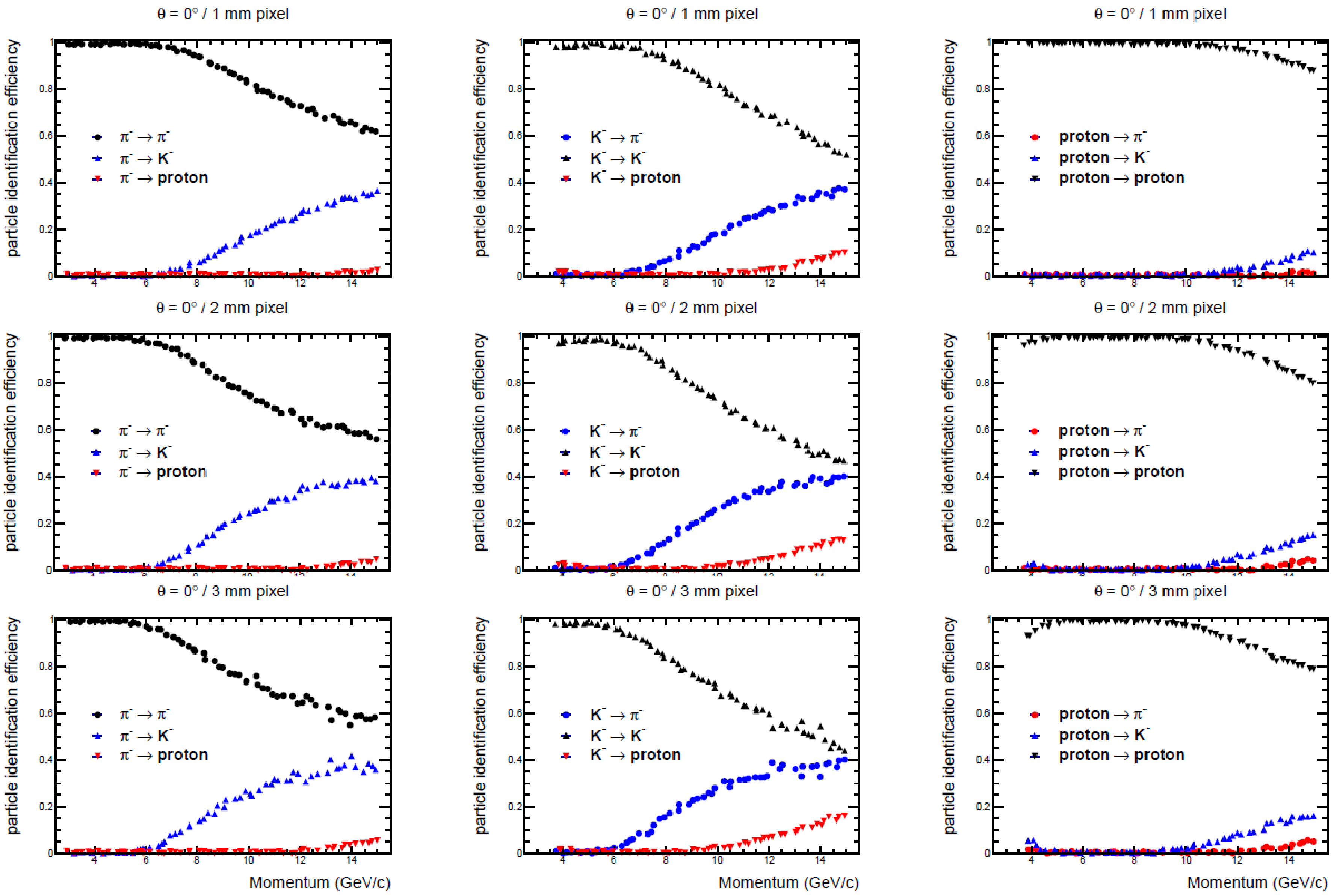
- ❖ Adding sensor pixelization complicates things!   Likelihood method
    - ❖ Establish a DB and match patterns based on Likelihood!



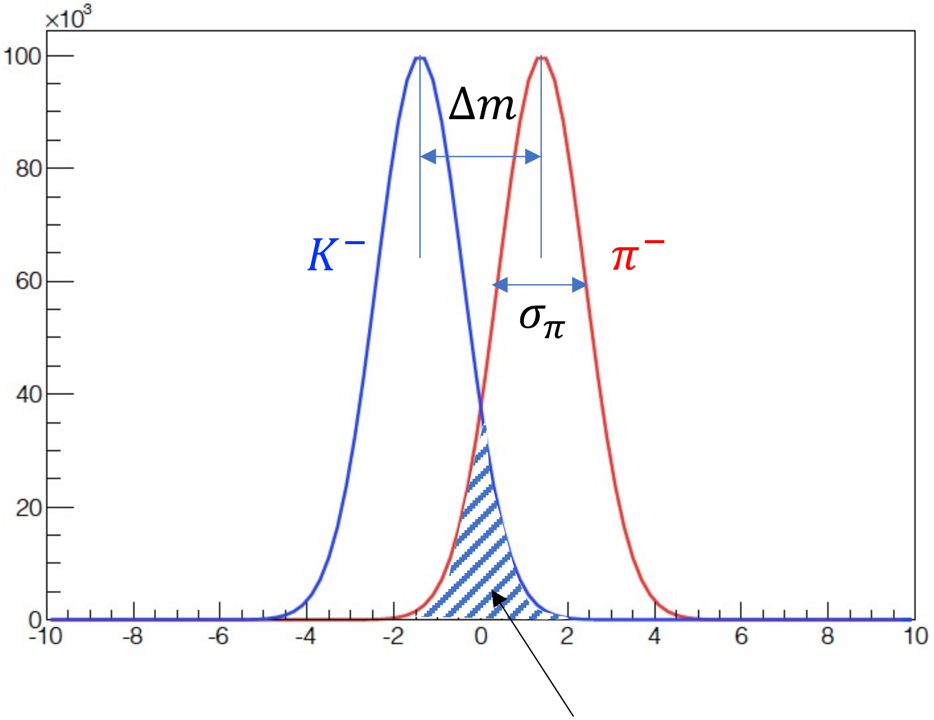


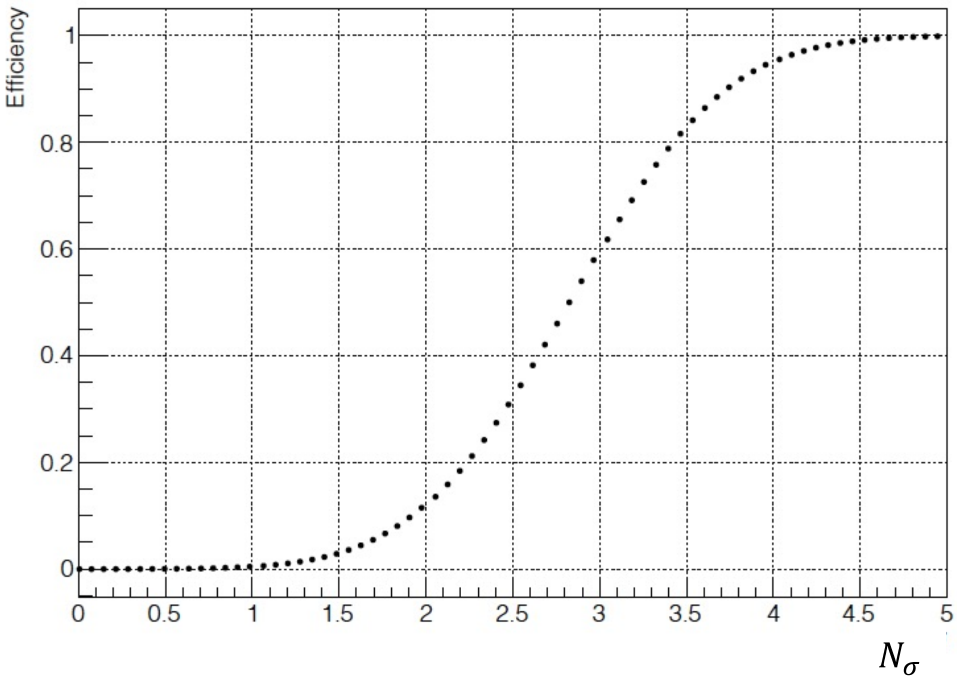


Performance at 0º at diff. pixel size



Understanding the Efficiency Plots!





$$N_\sigma = \frac{\Delta m}{\sqrt{\sigma_\pi^2 + \sigma_K^2}}$$

$$Eff = \frac{N_\pi - N_{\pi K}}{N_\pi}$$

To-do …

- Add mRCH to ECCE’s official code
- Performance studies (different positions, different angle of incidence, …)
- Develope analysis code that be used as PID for the general simulation
- …