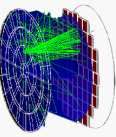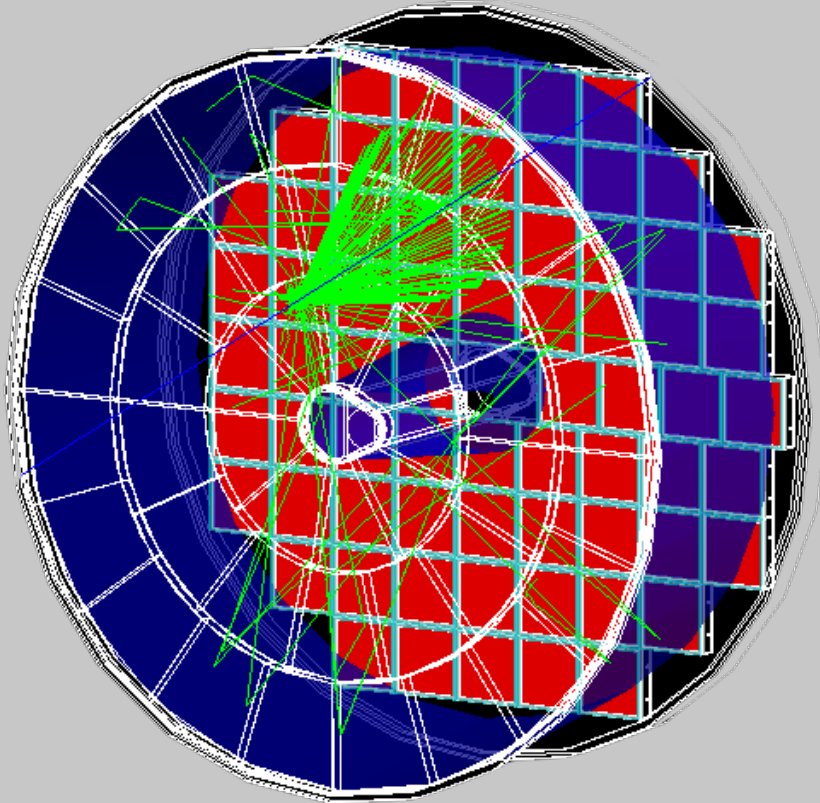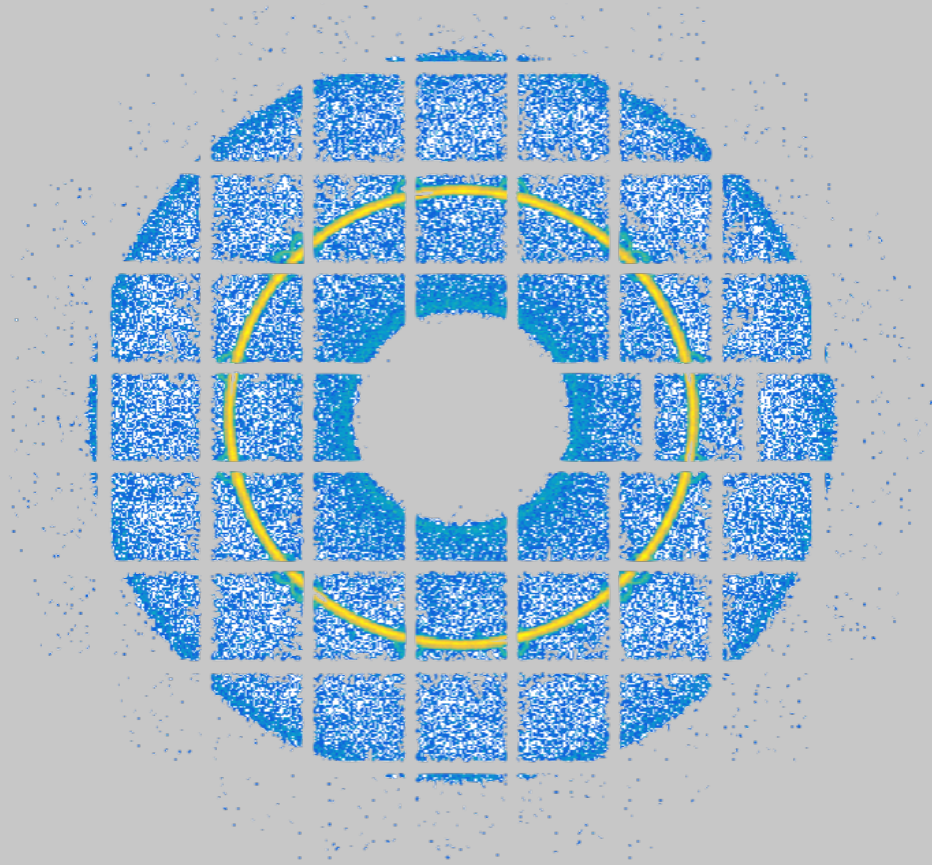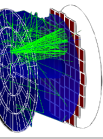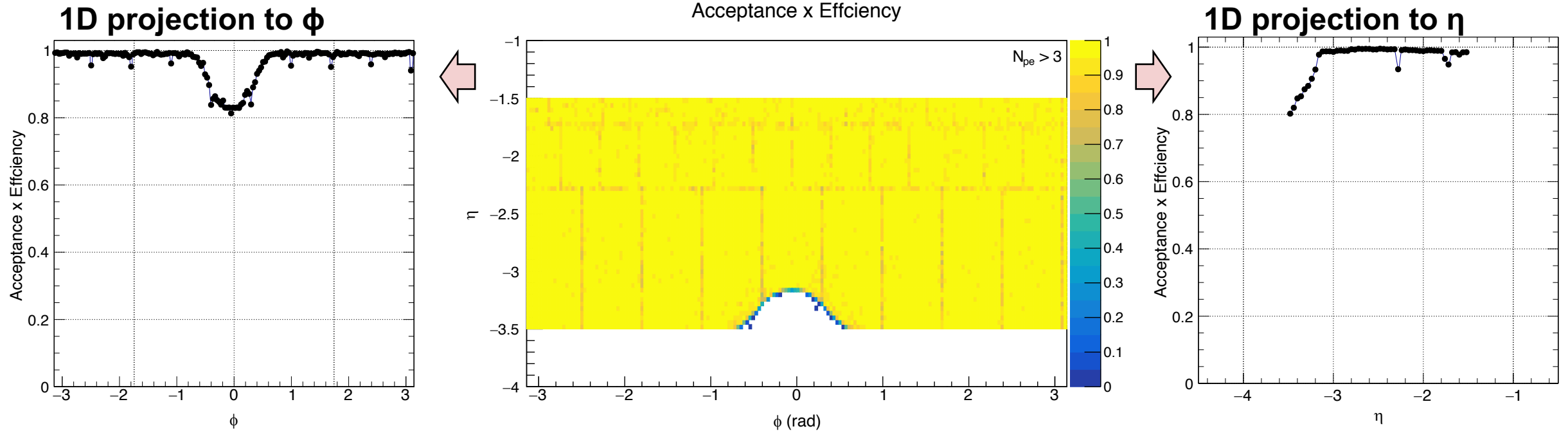# pfRICH Performance Study in ePIC

Chandradoy Chatterjee (INFN TS)

Alexander Kiselev (BNL)

Kong Tu (BNL)

Homework #1

Acceptance x Efficiency ($N_{pe} > 3$)
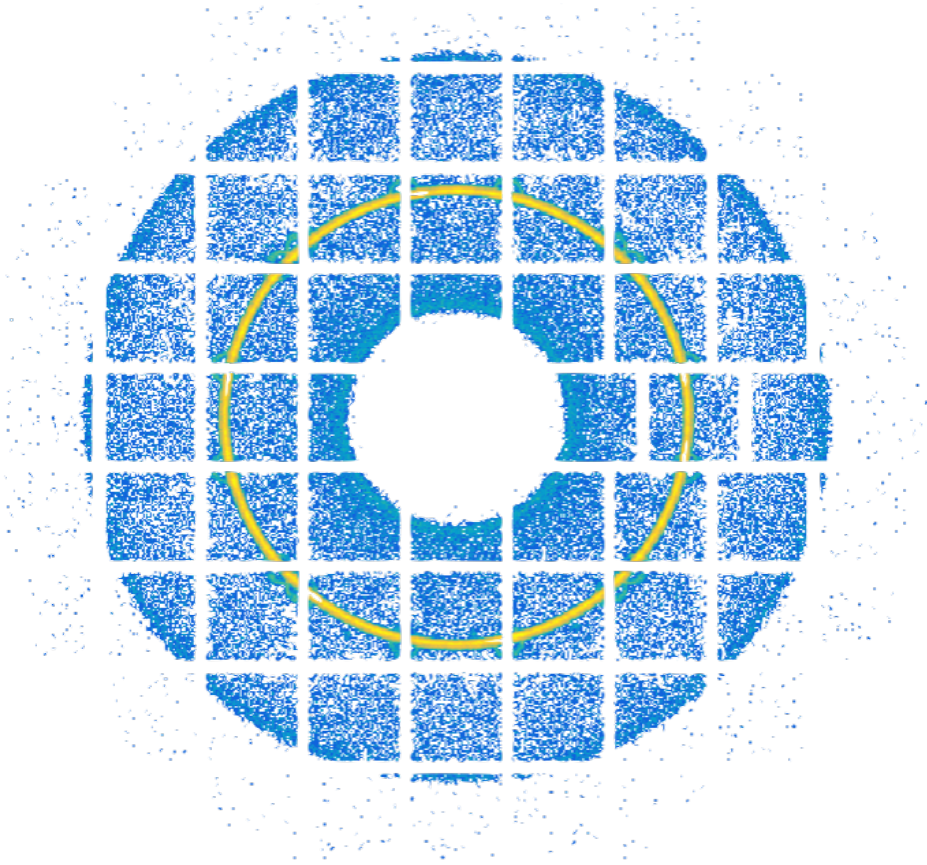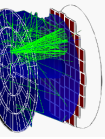
1D projection to φ

Acceptance x Effciency
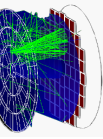
$N_{pe} > 3$

1D projection to η

YR requirement is to have 3σ separation of **π**/k up to 7 GeV/c which translates to an angular resolution better than 2.43 mrad.

- At 7 GeV/c, if N_{pe} = 4, angular resolution is ~4.5 mrad / sqrt(4) = 2.25 mrad
- **Meets the YR requirement**
- Cutting further on will balance between the efficiency and resolution.

Homework #2

Rayleigh scattering

➢ Scattering length parameterization as a function of wavelength: BelleII.xml   Materials.cc
➢ GEANT takes care about ~(1 + cos^2(theta)) dependency

➢ One turns Rayleigh scattering (and absorption) off -> no stray photons, $<N_{pe}>$ ~ 25

Forward scattering
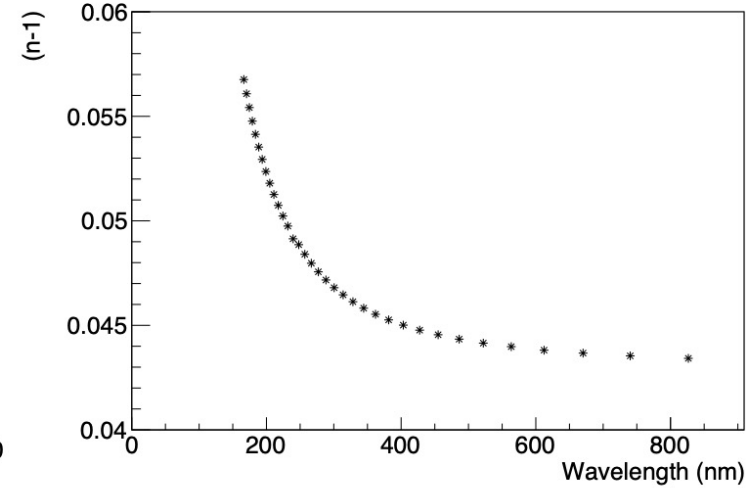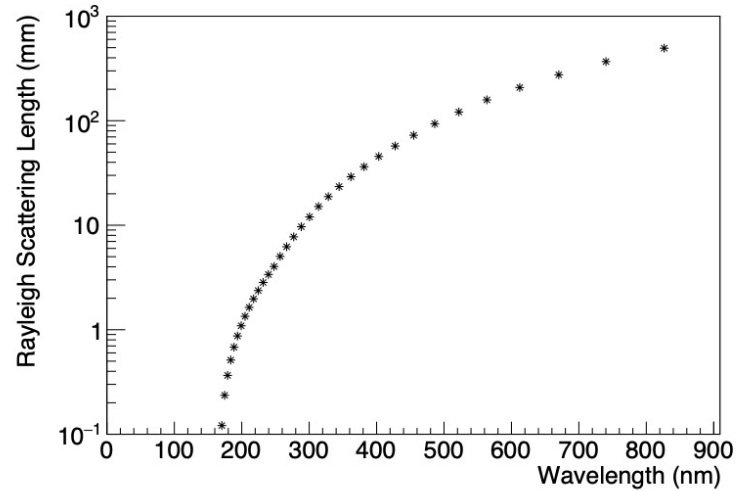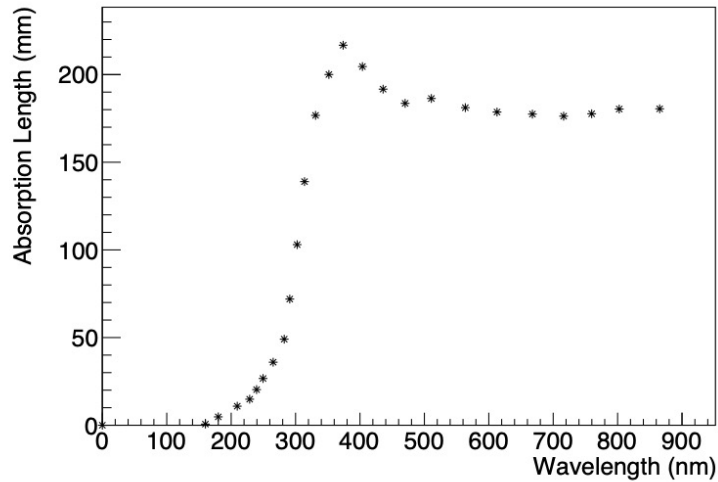
NIM A876 (2017) 168 [CLAS12 R&D]: 3cm thickness, n ~ 1.05
NIM A556 (2006) 140 [LHCb R&D   ]: 5cm thickness, n ~ 1.03

➢ In both cases effect is measured on the level of <1 mrad (compare to pfRICH σ_{SPE} ~ 4.5mrad)

➢ We have no means readily available to model this in GEANT
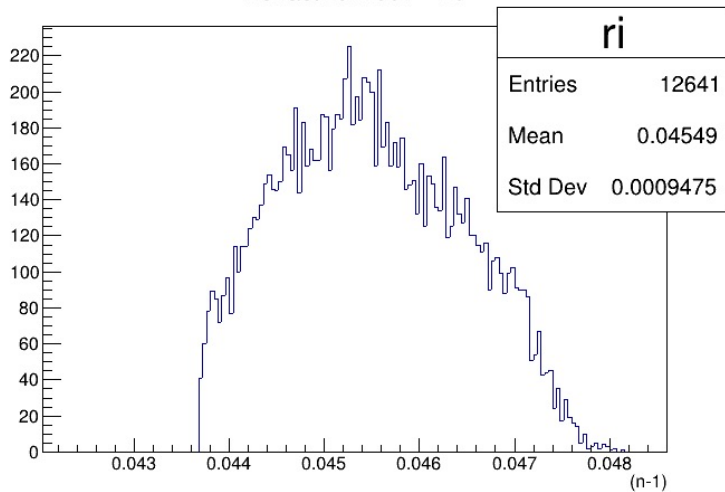➢ Can be added at the reconstruction stage, same way we apply ePIC tracker angular resolutions
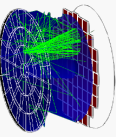
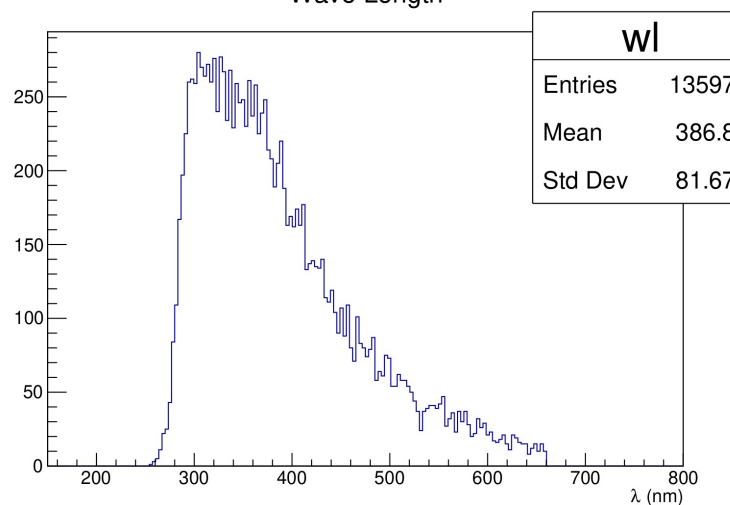# Parametrizations of Belle II aerogel #1

Simulation Outcome
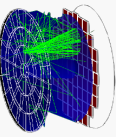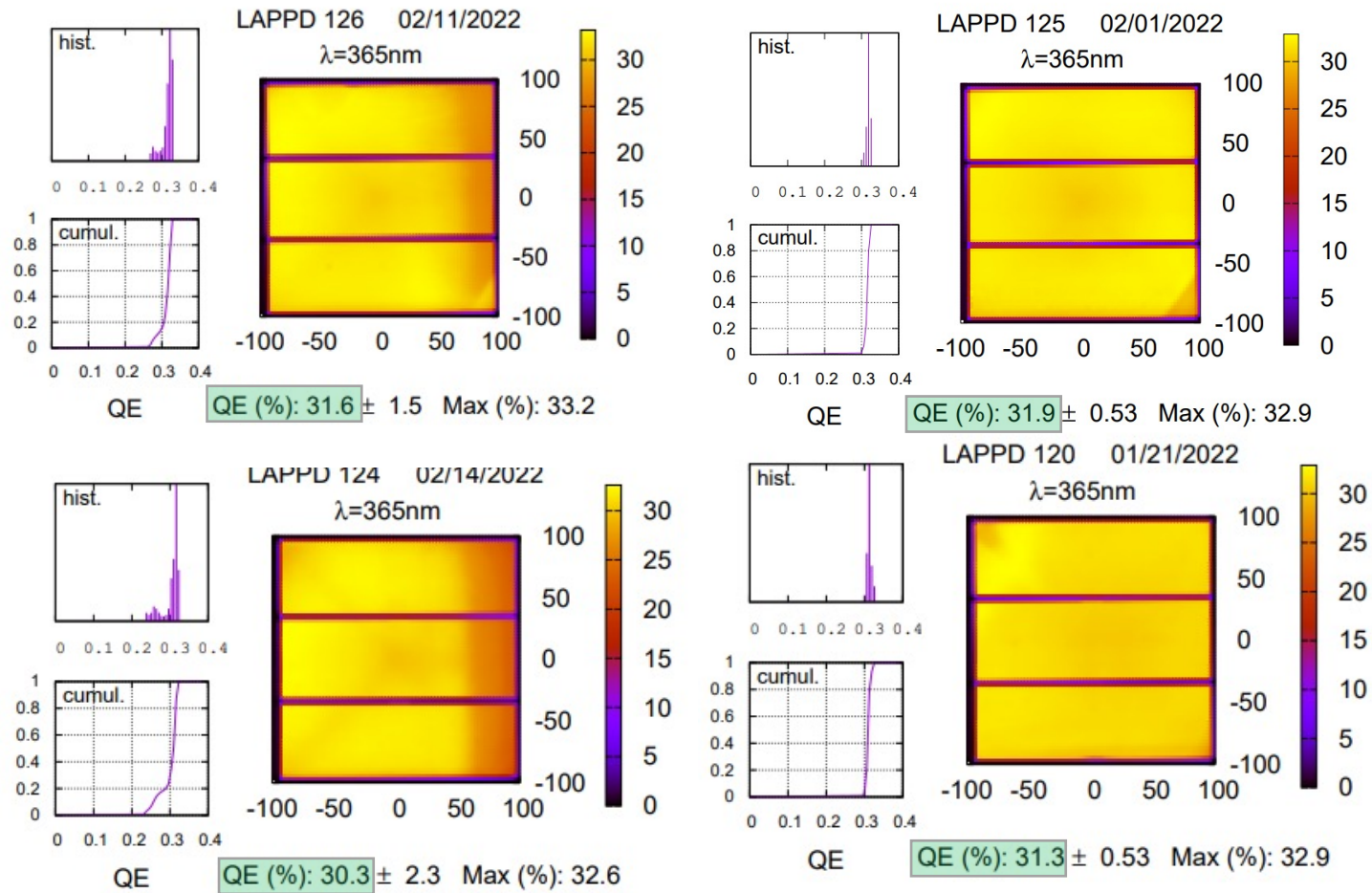

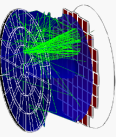Wavelength distribution is dictated by the cut from the acrylic filter.

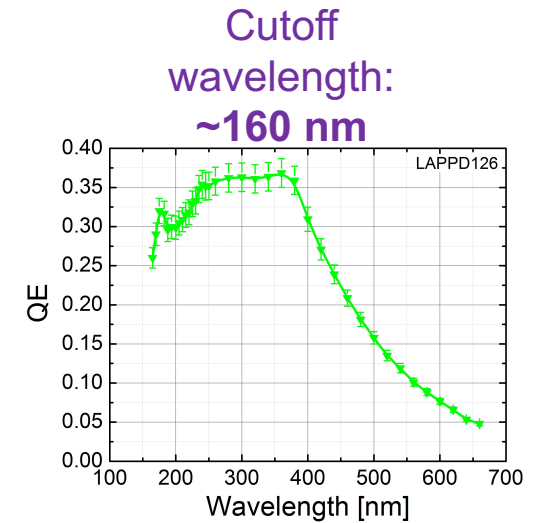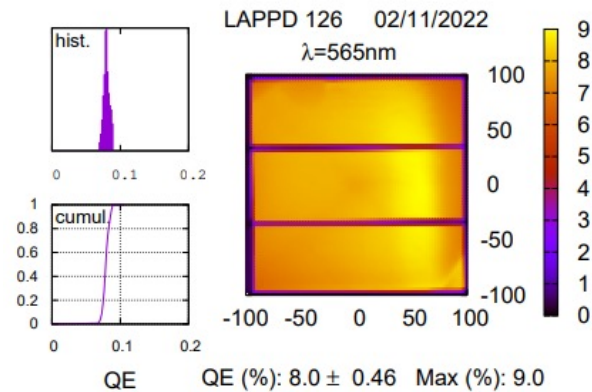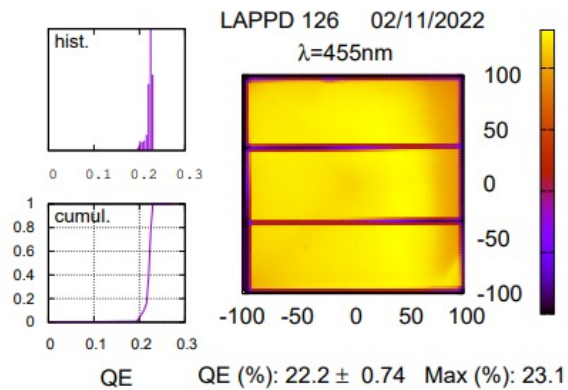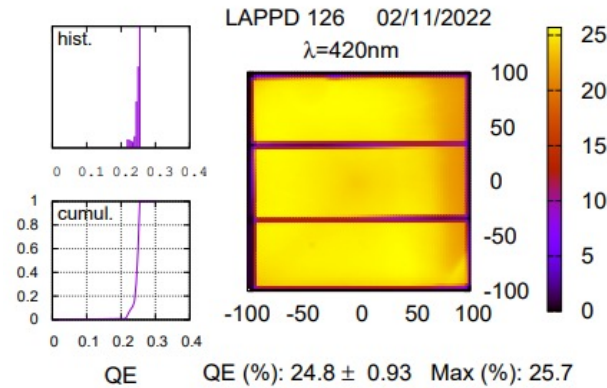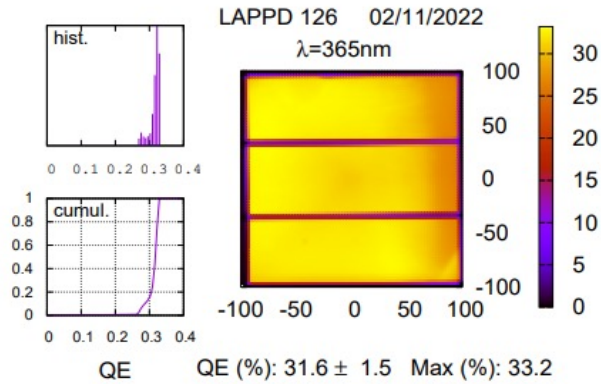→ Average wavelength of the distribution is compatible with average (n-1)

6

LAPPD Na$_2$KSb photocathode peak QE measurements

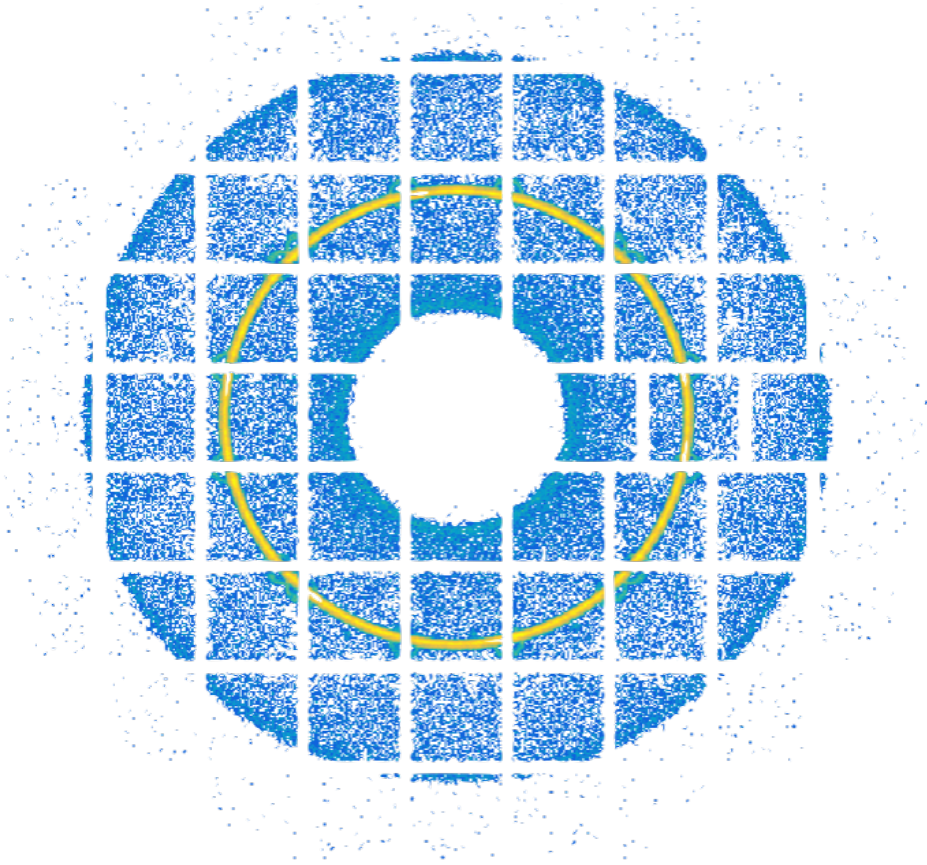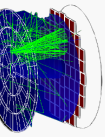A. Lyashenko (Incom), LAPPD Workshop #1, March 2022
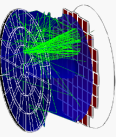
LAPPD Na₂KSb photocathode QE(λ) measurements

> ➤ pfRICH simulations:
> > ➤ QE(λ) curve as shown
> > ➤ Peak QE rescaled to 30%
> > ➤ Apply extra safety cff 0.7
>
> **-> Conservatively assume a peak PDE of 21%**
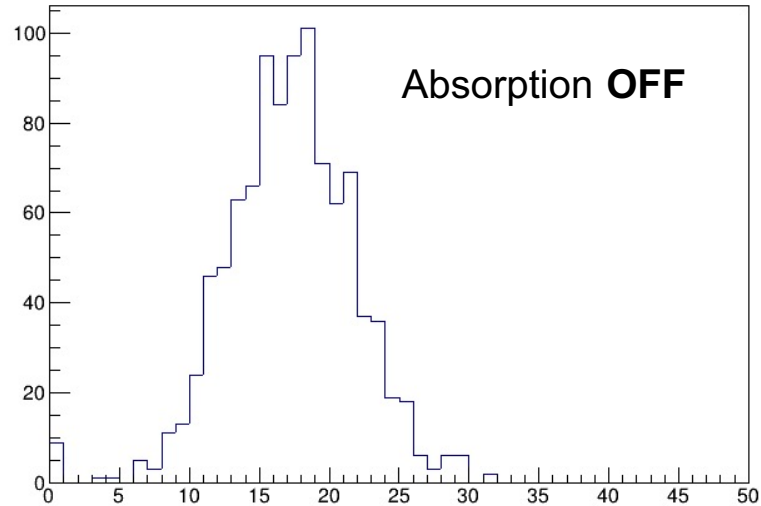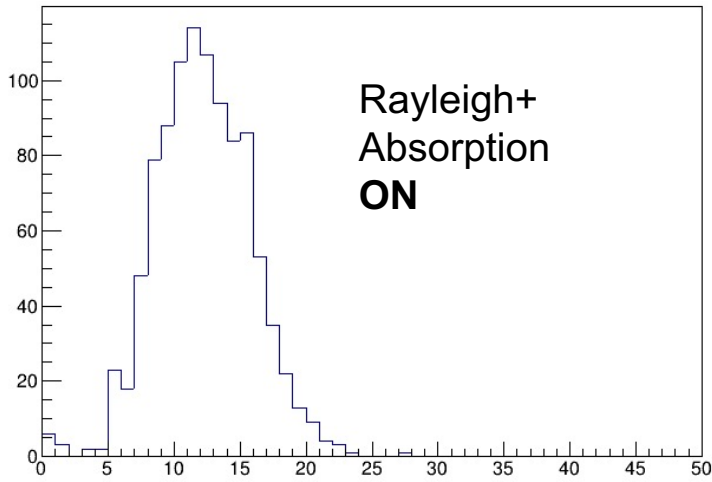
S. Shin (Incom), LAPPD Workshop #2, October 2022
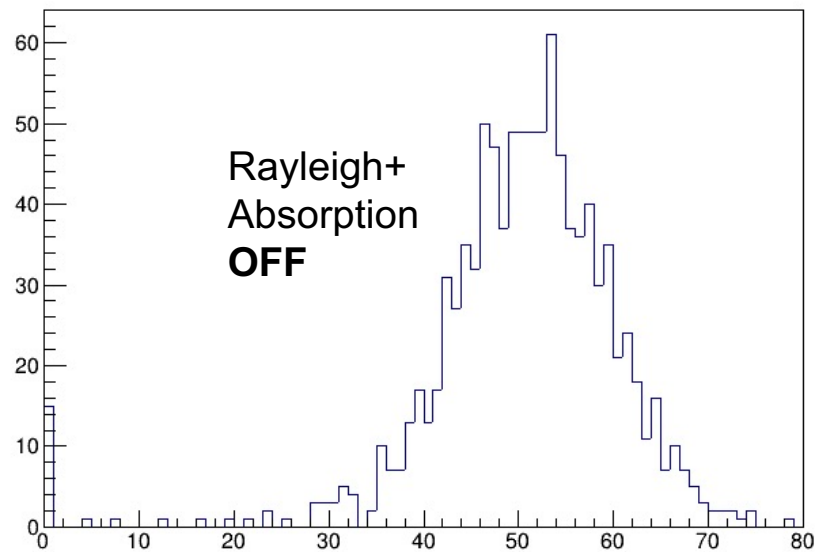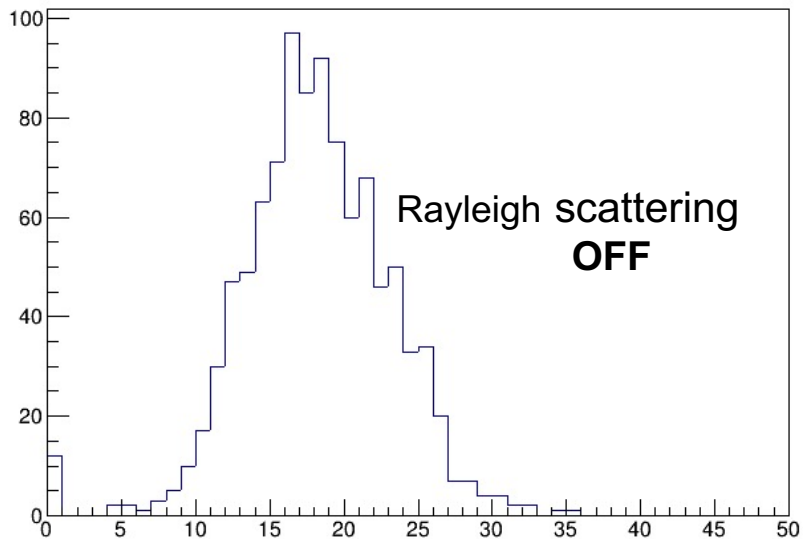
Backup

Effect of scattering and absorption: effect in Npe

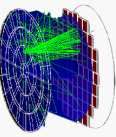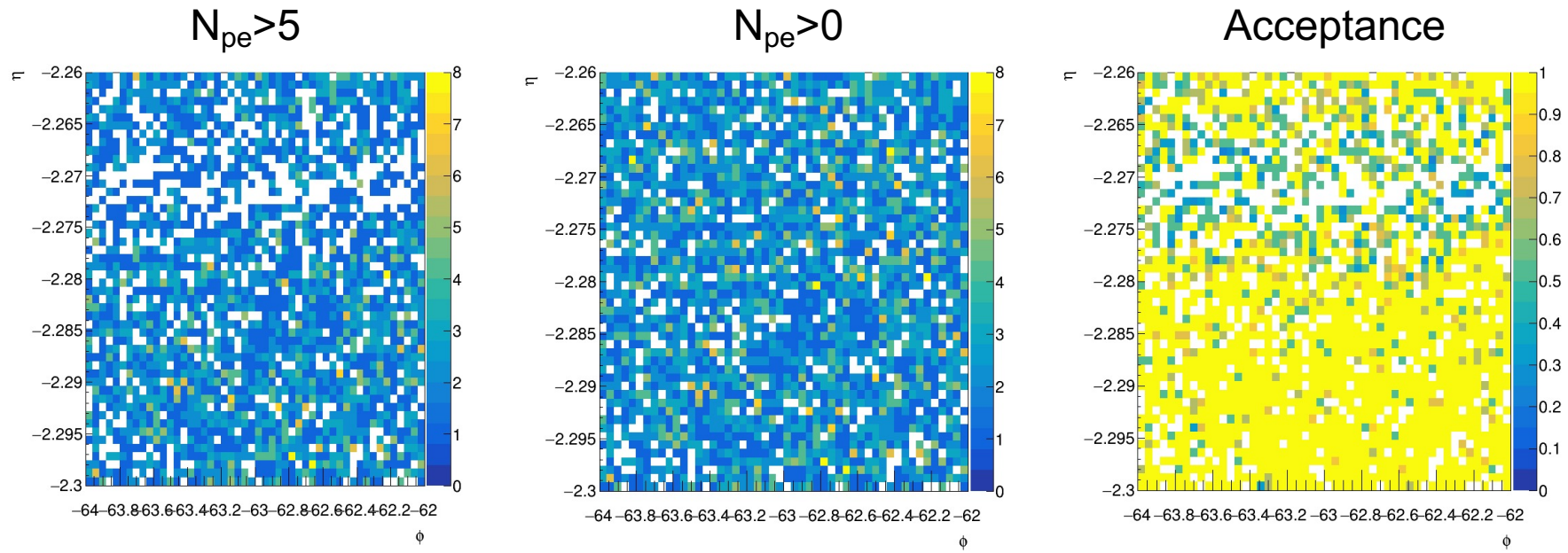Photon count per track — Rayleigh+ Absorption **ON**

Photon count per track — Absorption **OFF**

Photon count per track — Rayleigh scattering **OFF**

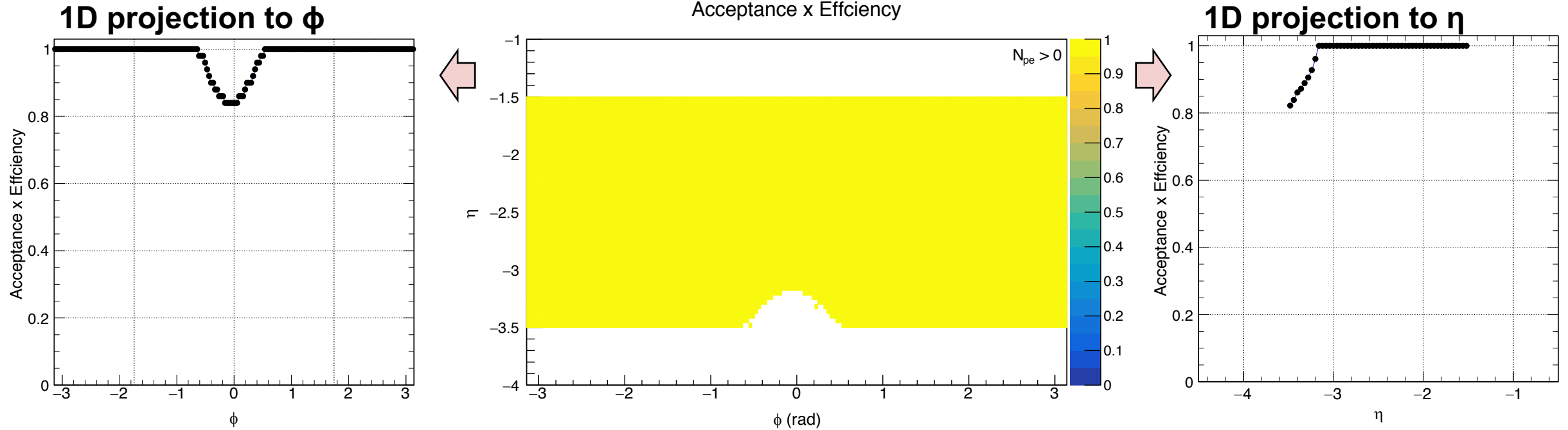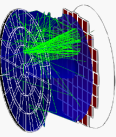Photon count per track — Rayleigh+ Absorption **OFF**

Scanning around a small region allows us to visualize the fact that the aerogel ribs are shadowing photon and contributing to the dead area. However, in the immediate vicinity, we are capable to recover the acceptance.
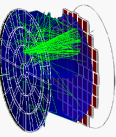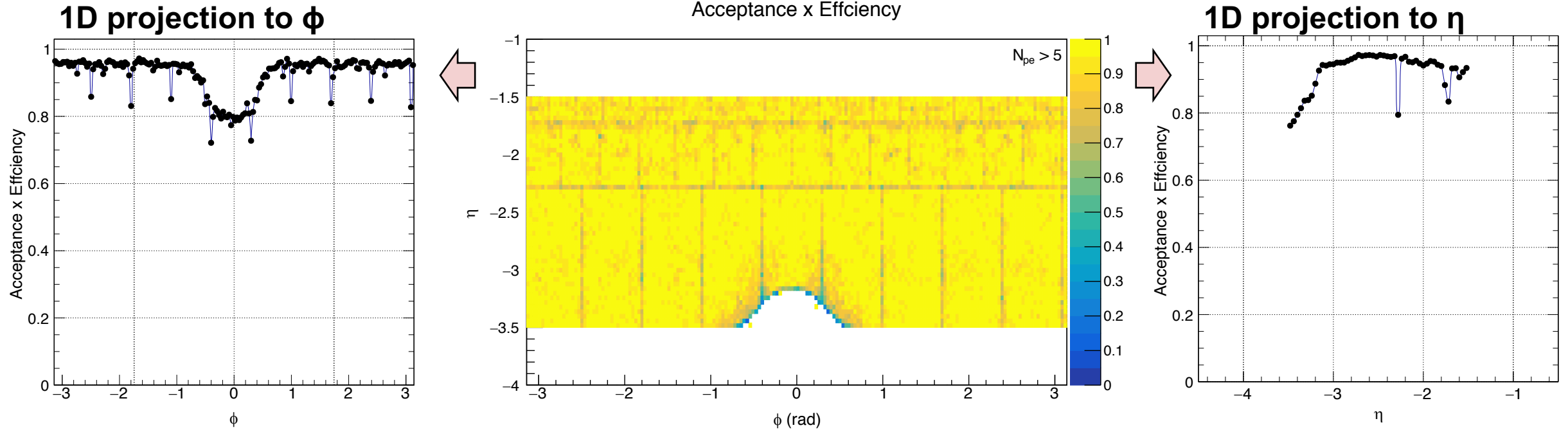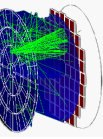
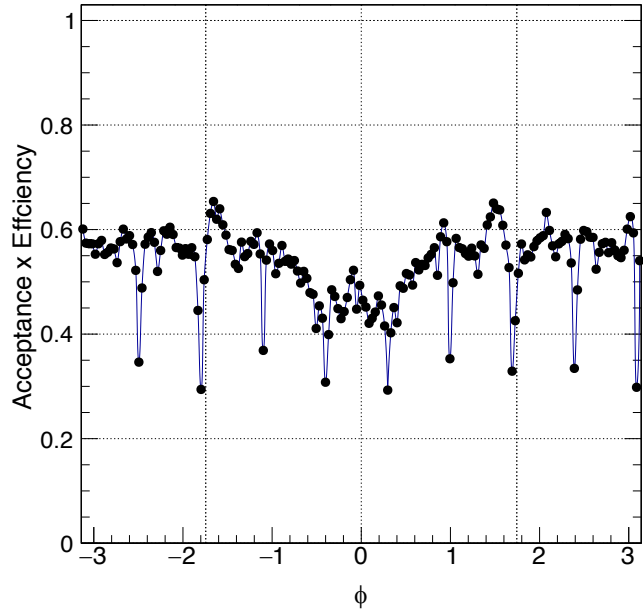# Acceptance x Efficiency ($N_{pe} > 0$)
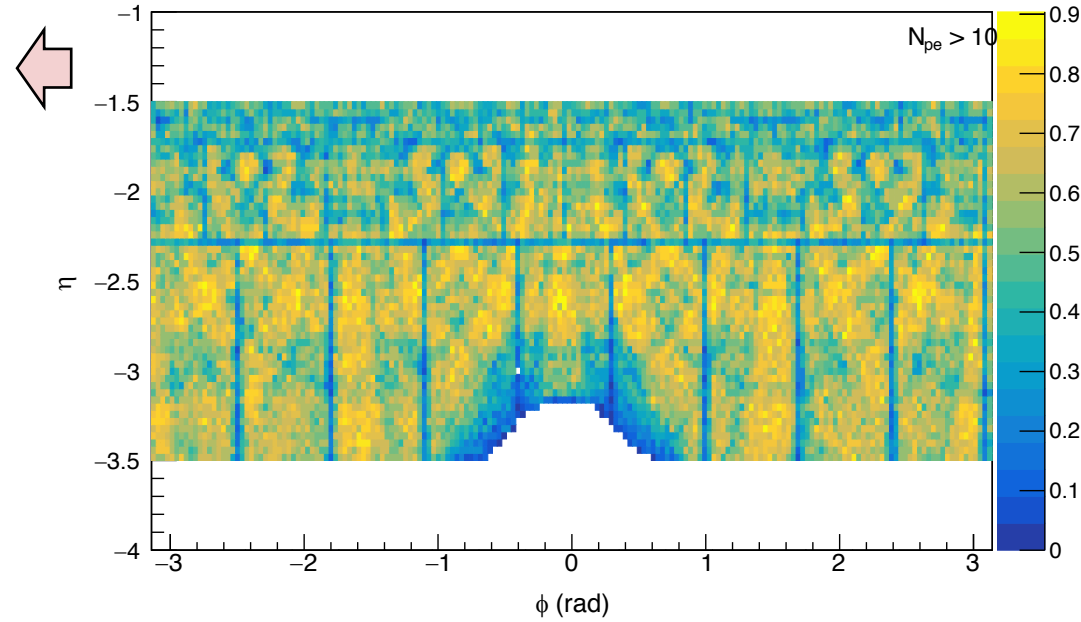
Acceptance x Efficiency ($N_{pe} > 5$)

1D projection to φ

1D projection to η

Acceptance x Efficiency ($N_{pe} > 10$)

1D projection to φ

1D projection to η

Acceptance x Effciency

$N_{pe} > 10$