Update on BO EMCAL studies

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Introduction

BGU group:

Person-power

- Zvi Citron (PI), Supervision
- Michael Pitt (Post-doc), 0.5FTE
- Eden Mautner (Student), 0.5FTE

Other involvements in forward physics detectors

- Currently involved in LHC experiments: ZDC (ATLAS), Roman-Pots (CMS)

B0 EMCAL studies

- We presented our plans during the roundtable discussion on Oct 18
- Today: First acceptance studies of B0 EMCAL detector

Simulation setup

Particle Gun using DDSIM

- Default simulation setup (275GeV mag. field)
- ddsim with particle gun: “gamma” (*SIM.gun.particle = 'gamma'*)
- Energy: from 0 to 60 GeV
- Angle: from 0 to 30 mrad (*SIM.gun.distribution = 'cos(theta)'*)
- Particles along the hadron-beam (*SIM.crossingAngleBoost = -25.0*mrad*)
- Coordinates (eta) defined with respect to the hadron beam axis

Goals

- Detection of photons in the B0EMCAL

Photon acceptance

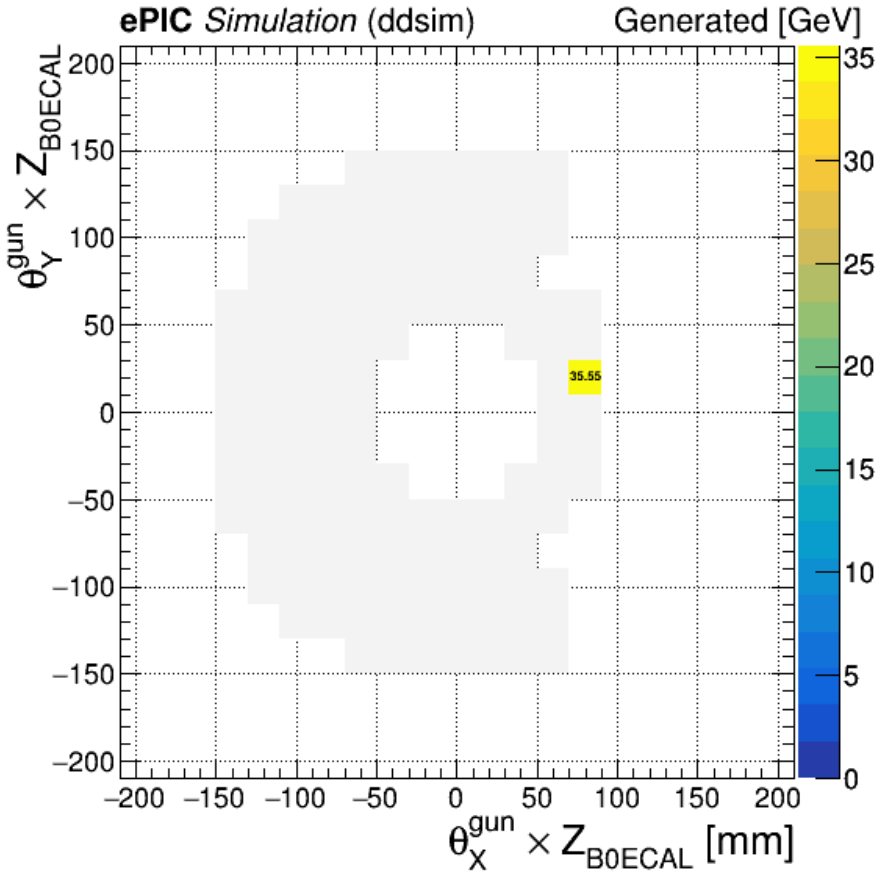
Definition

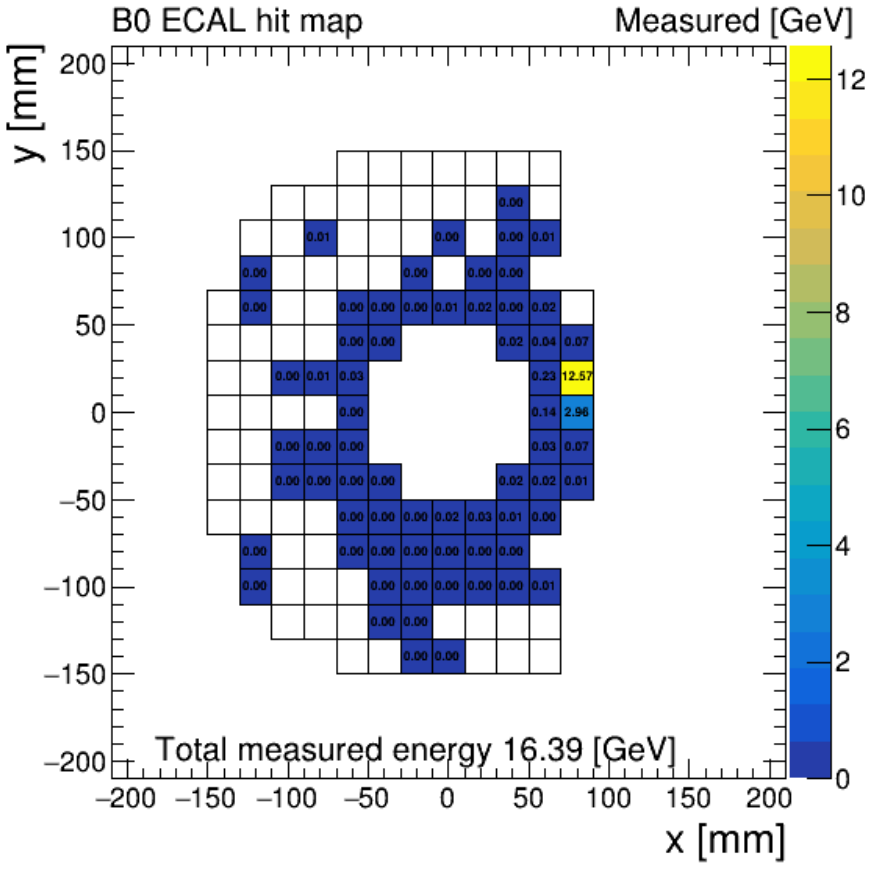
- Acceptance – events with energy deposit in the EMCAL (above given threshold) / total events

Example:

Photon detected

Photon pointing to B0 ECAL, deposit ~45% of its energy in a small cone





Photon acceptance

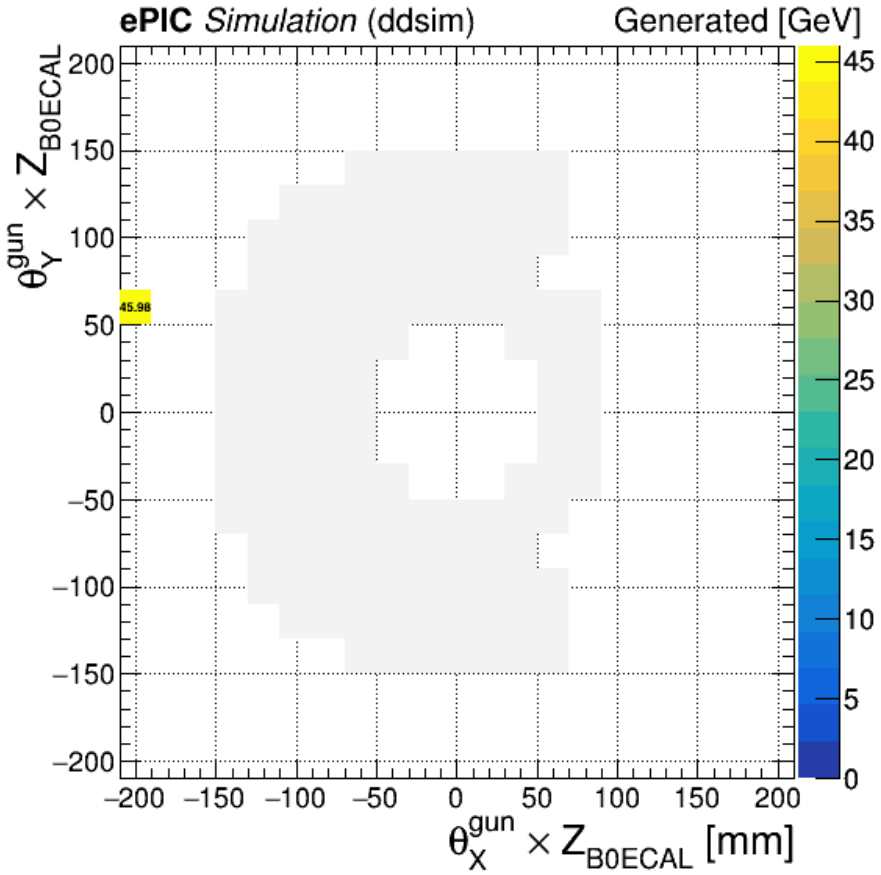
Definition

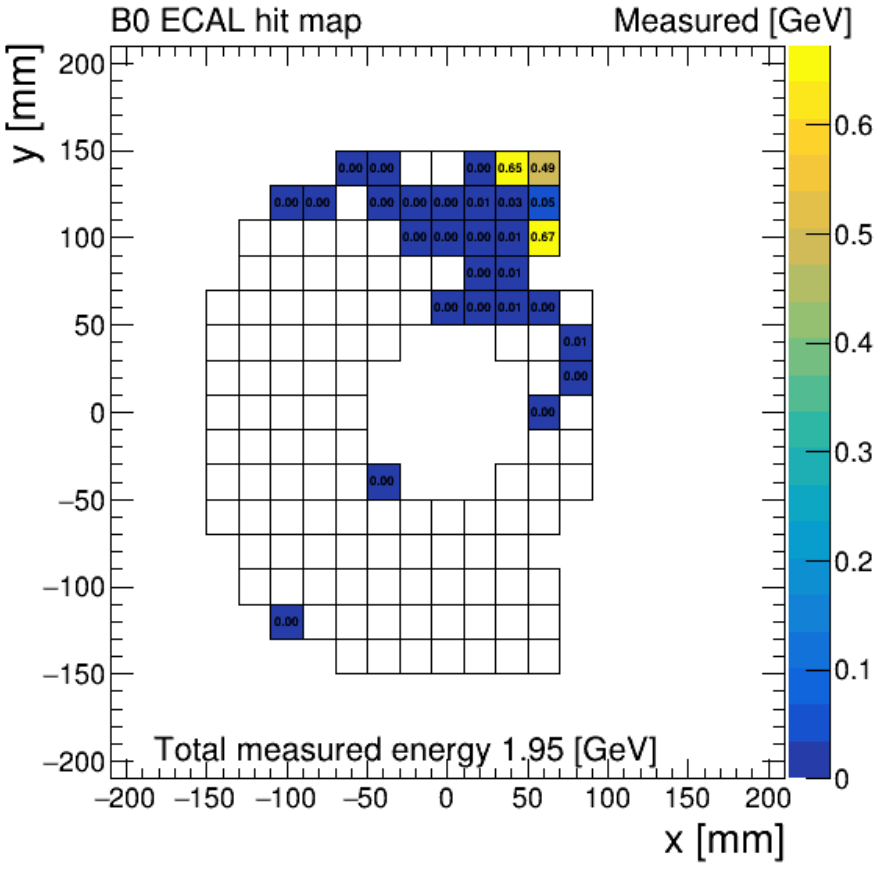
- Acceptance – events with energy deposit in the EMCAL (above given threshold) / total events

Example:

Photon detected

Photon outside B0 ECAL fiducial volume is measured by ECAL





Photon acceptance

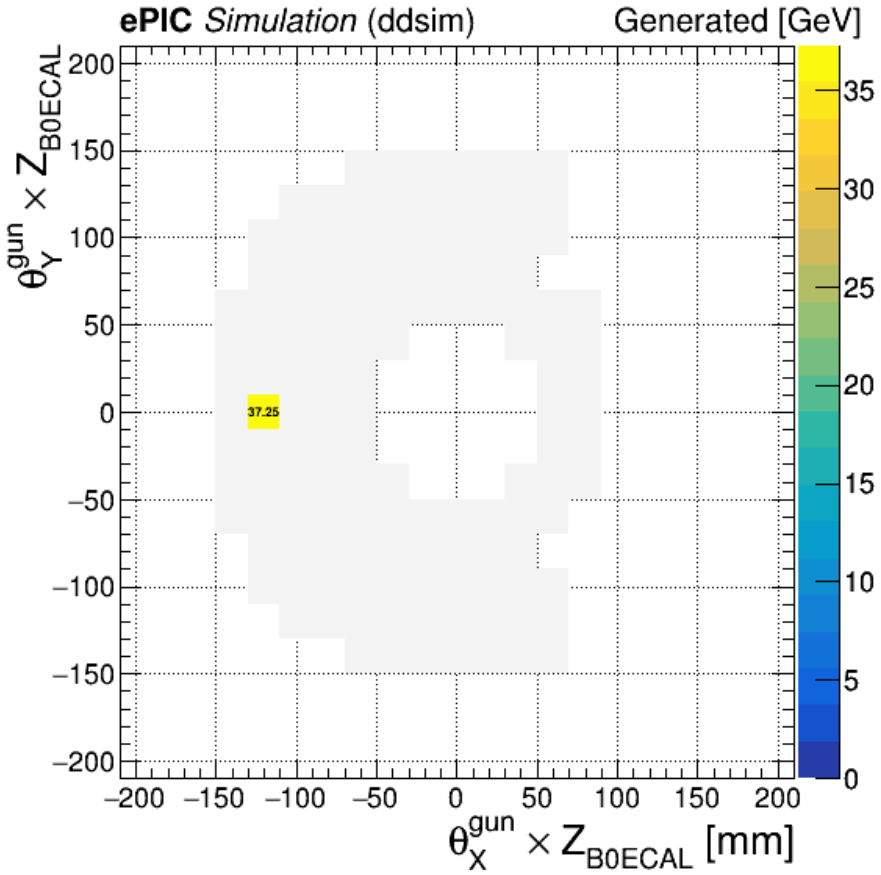
Definition

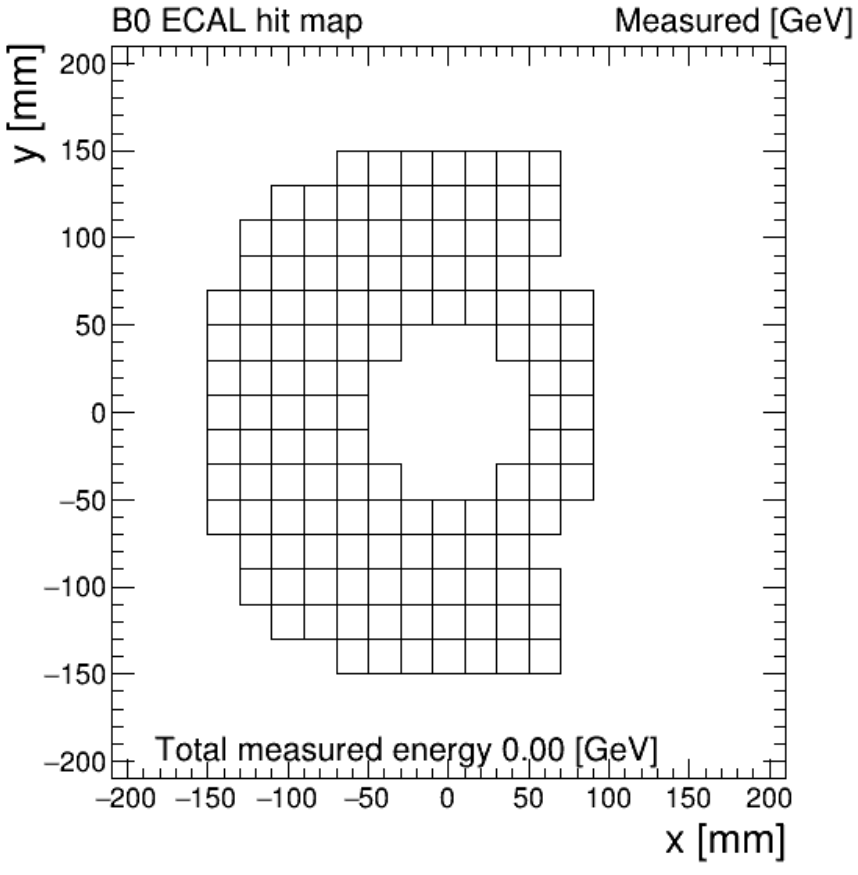
- Acceptance – events with energy deposit in the EMCAL (above given threshold) / total events

Example:

Photon undetected

Photon within B0 ECAL fiducial volume didn't reach the detector





Photon acceptance

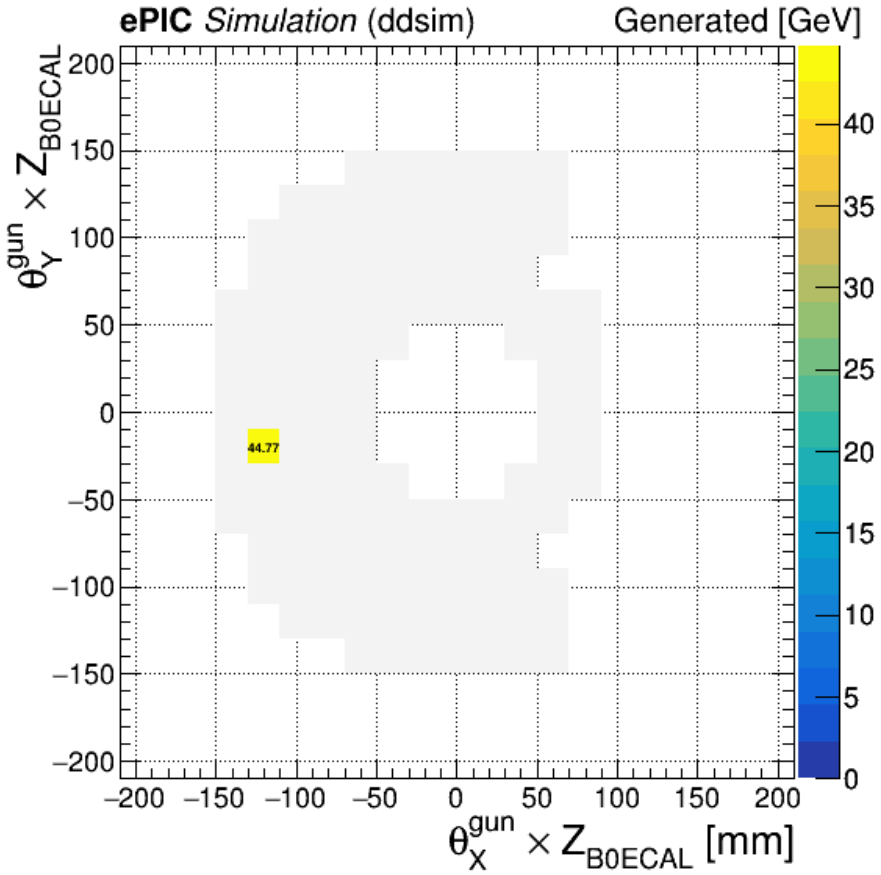
Definition

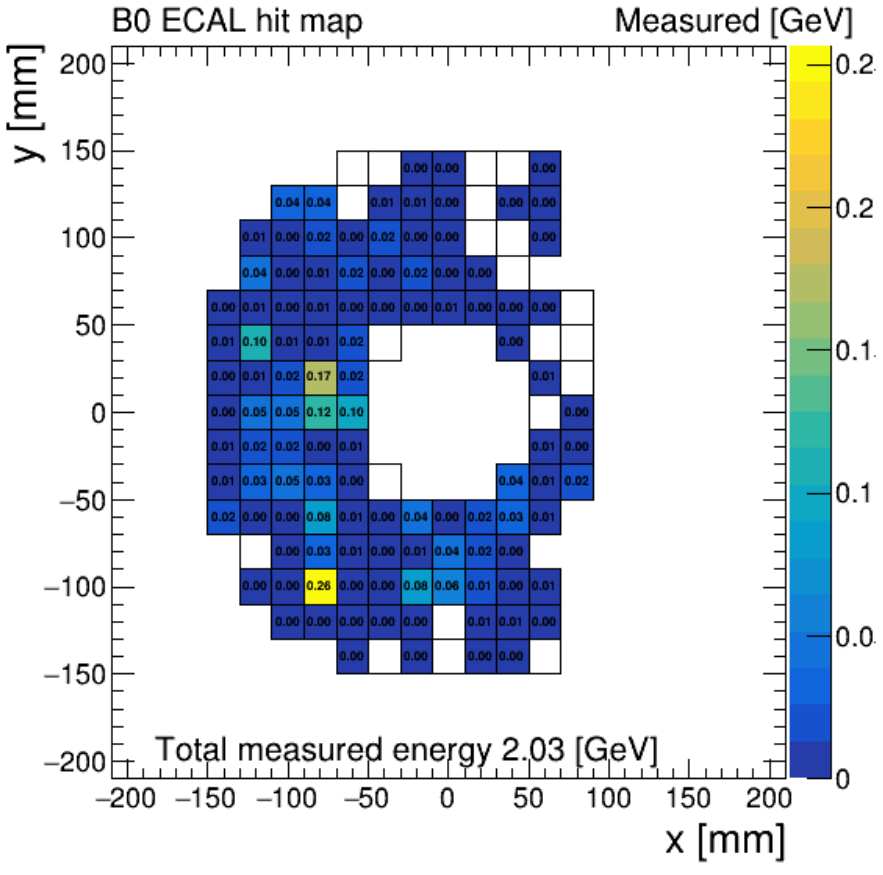
- Acceptance – events with energy deposit in the EMCAL (above given threshold) / total events

Example:

Photon detected

Photon pointing to B0 ECAL, deposit ~5% of its energy ~everywhere





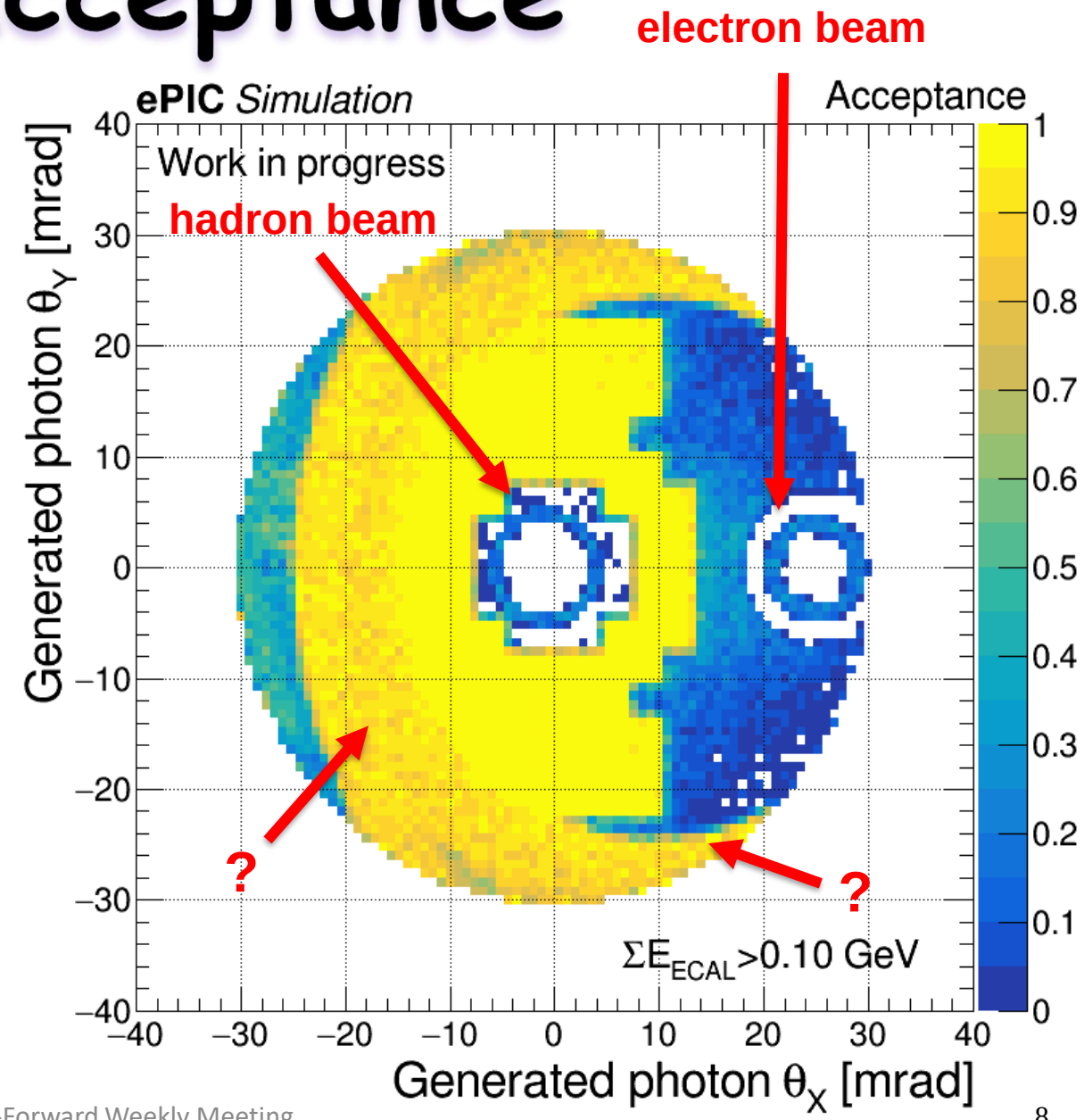
Photon acceptance

Acceptance in X-Y plane

- Spatial photon acceptance
- Energy threshold in EMCAL: 100 MeV

Observations

- Photons out-of-fiducial region (outside EMCAL) deposit energy in EMCAL.
- Caused by photon conversion in earlier detector's material



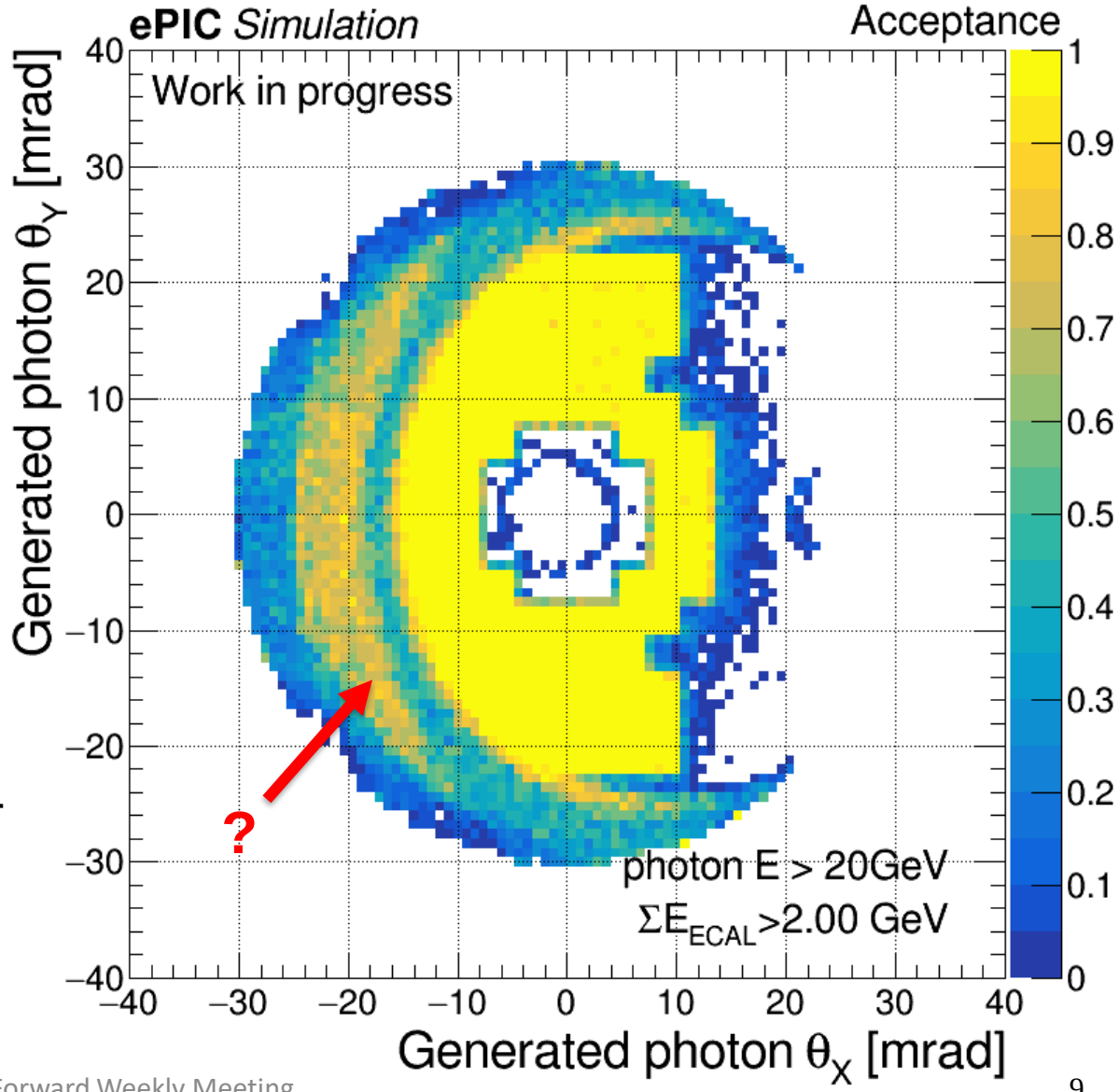
Photon acceptance

Acceptance in X-Y plane

- Spatial photon acceptance
- Photons with E > 20 GeV
- Energy threshold in EMCAL: 2 GeV

Observations

- Acceptance drops with increased energy threshold.
- Photons interact with material before B0 detector

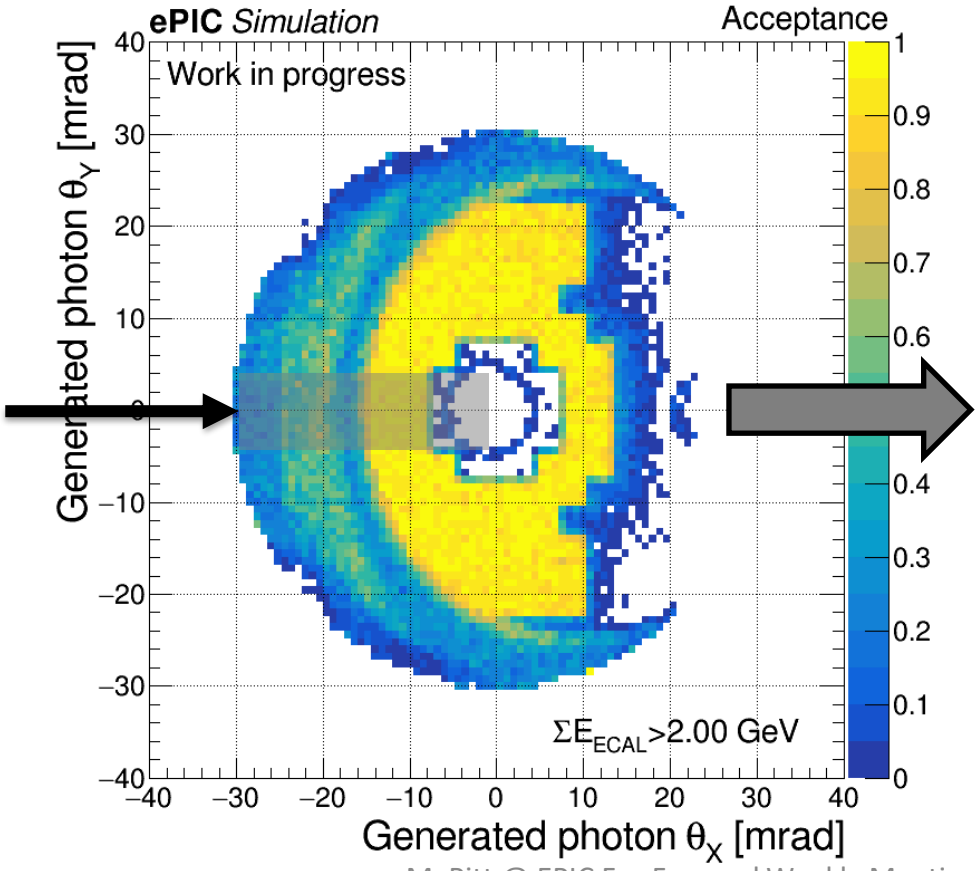


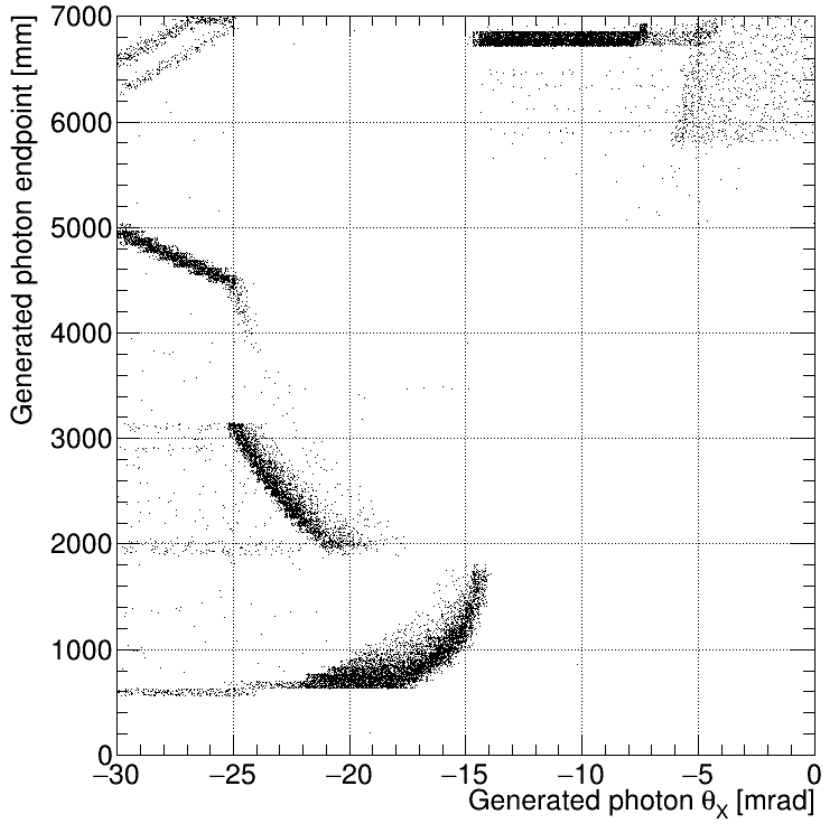
Photon acceptance

Acceptance in X-Y plane

- G4 simulation provides information of the photon endpoint (where $\gamma \rightarrow ee$ starts)

Plot photon endpoint along the X axis (θ_Y~0)





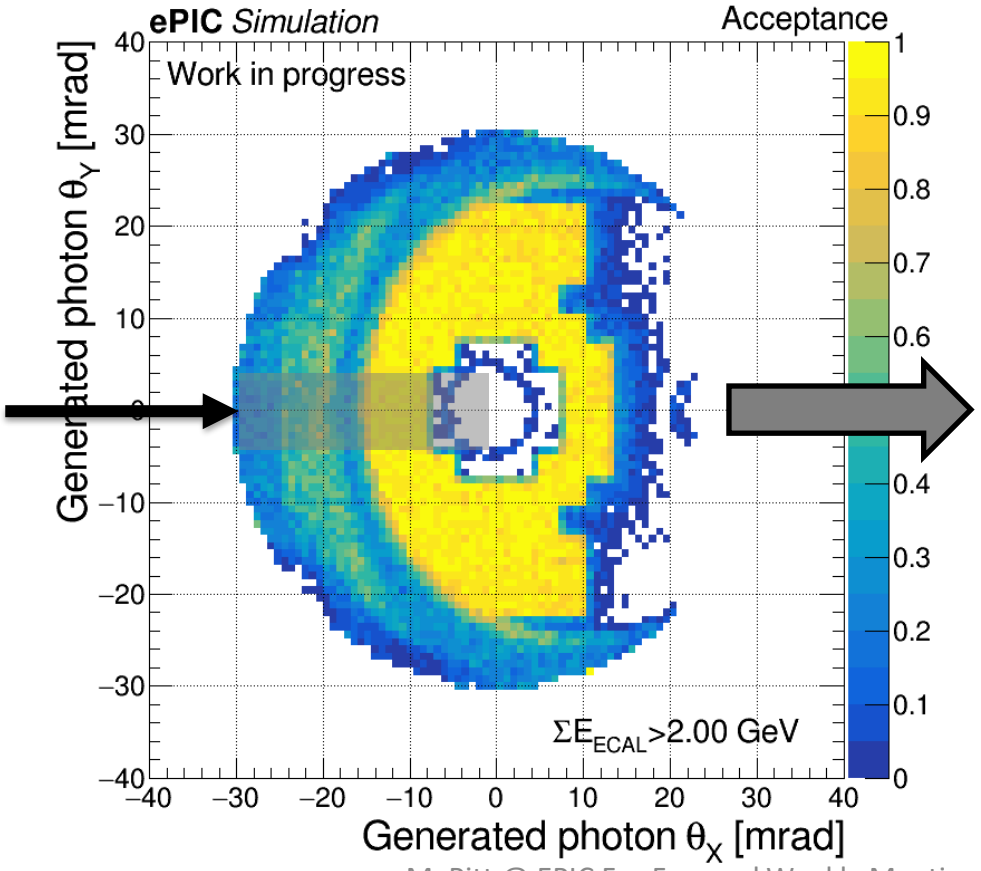
Photon acceptance

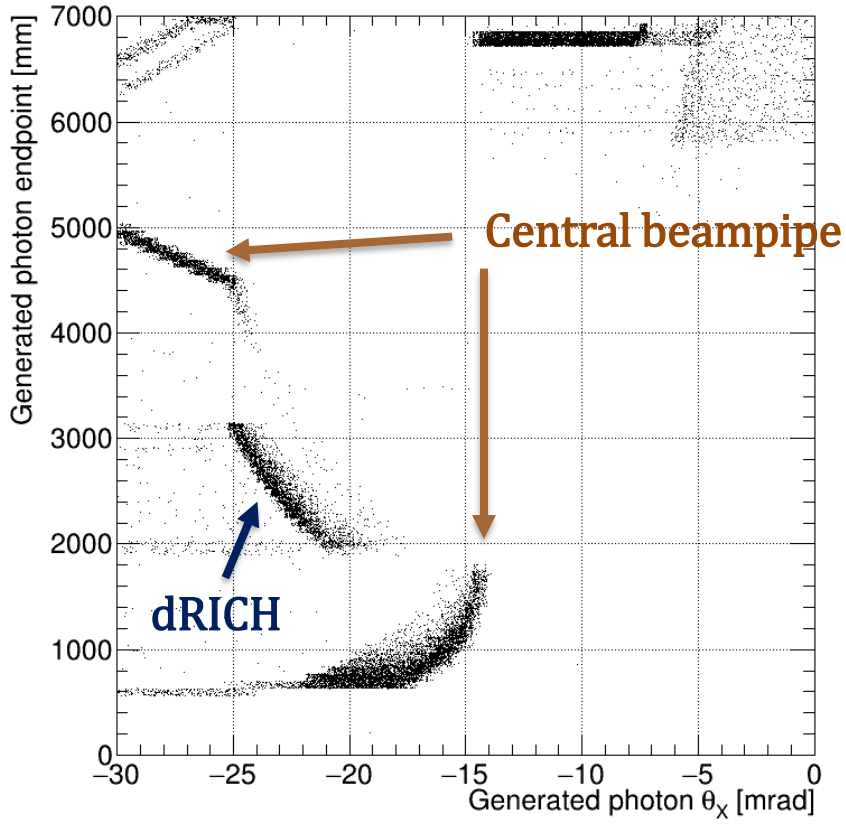
Acceptance in X-Y plane

- G4 simulation provides information of the photon endpoint (where $\gamma \rightarrow ee$ starts)

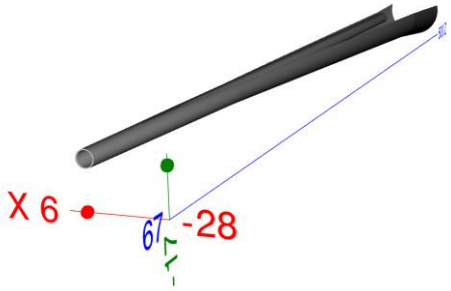
In the following two slides, we will remove the detector component and inspect how the acceptance changes.

Plot photon endpoint along the X axis (θ_Y~0)





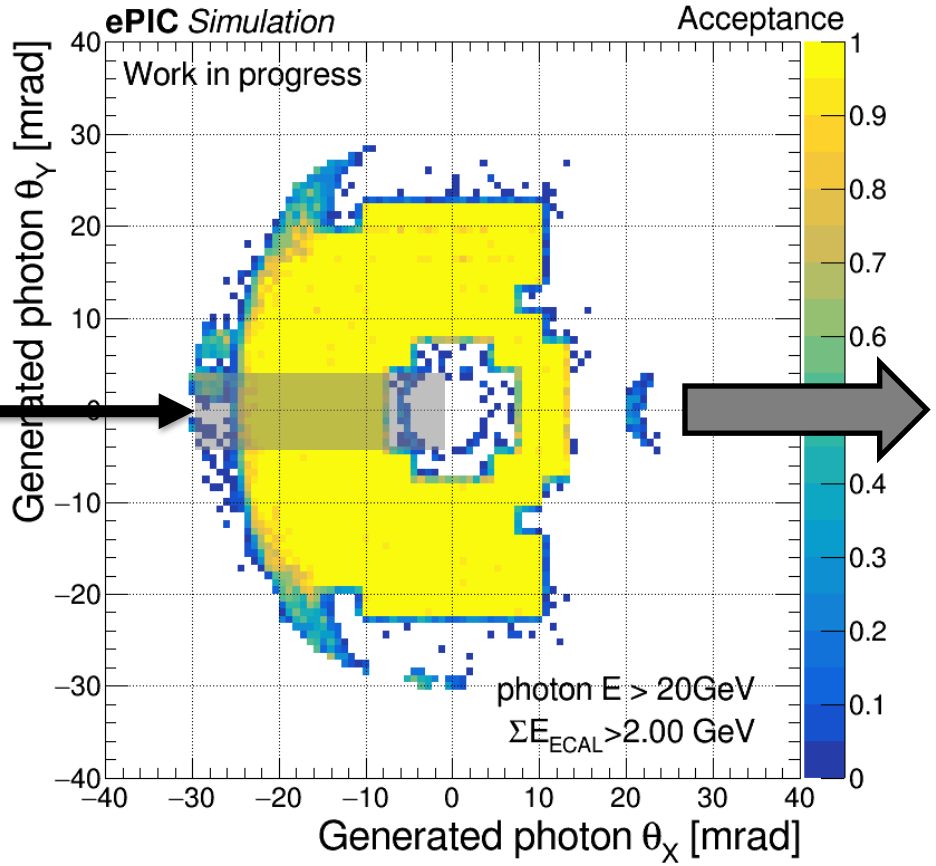
Photon acceptance

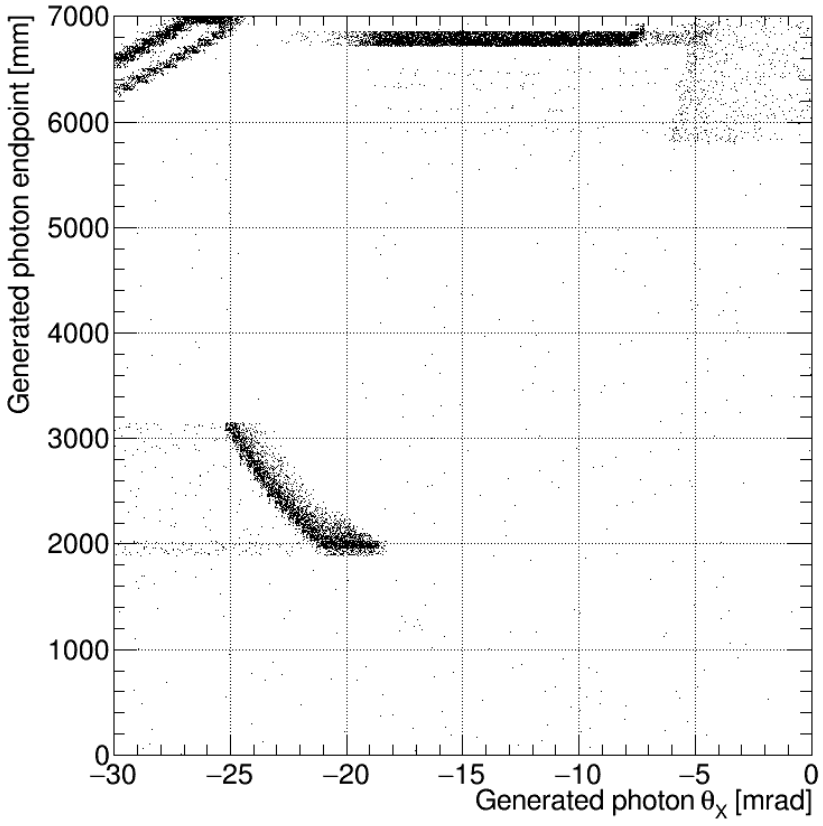


Acceptance in X-Y plane

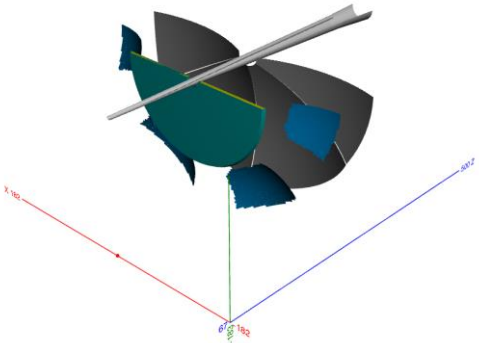
- G4 simulation provides information of the photon endpoint (where $\gamma \rightarrow ee$ starts)
- Remove central beampipe (${DETECTOR_PATH}/compact/central_beampipe.xml)

Plot photon endpoint along the X axis (θ_Y~0)





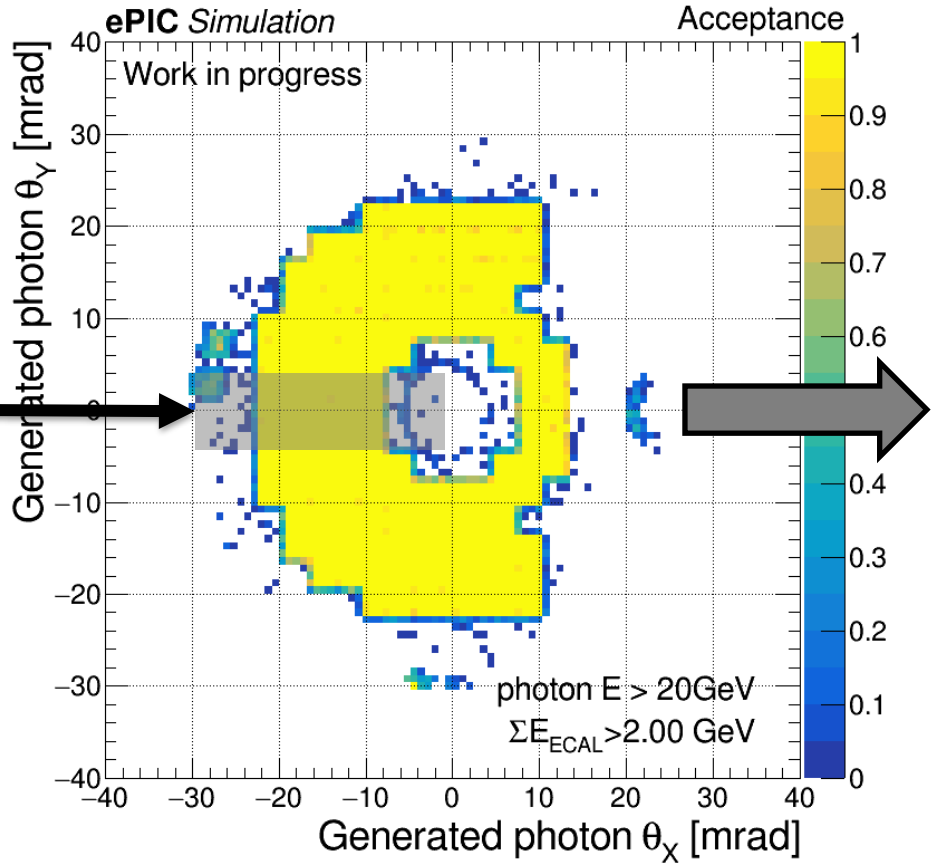
Photon acceptance

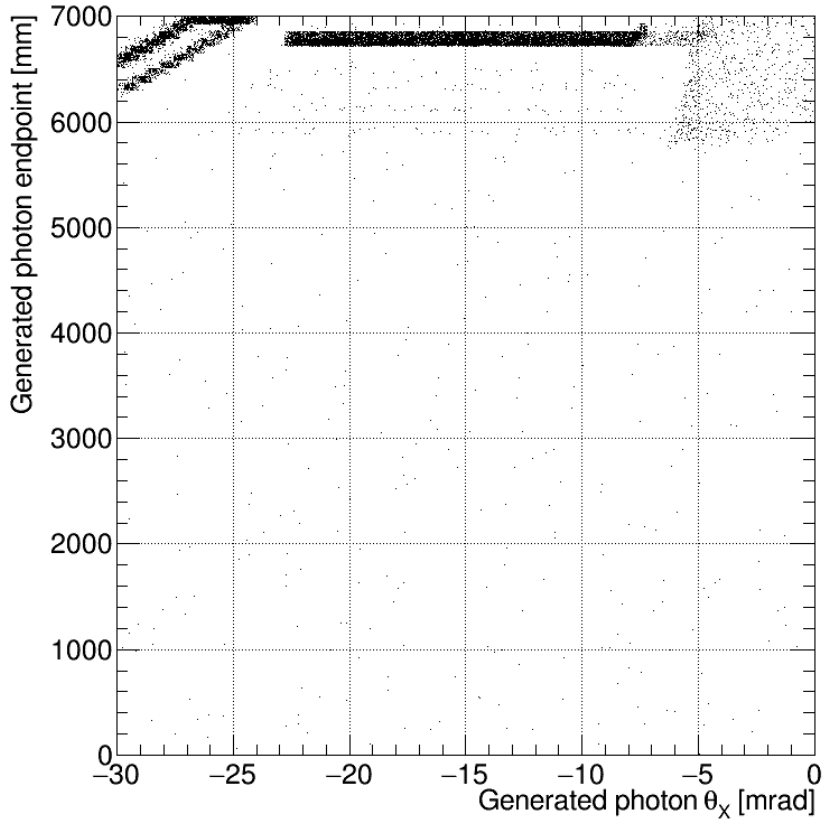


Acceptance in X-Y plane

- G4 simulation provides information of the photon endpoint (where $\gamma \rightarrow ee$ starts)
- Remove central beampipe (${DETECTOR_PATH}/compact/central_beampipe.xml)
- Remove dRICH (${DETECTOR_PATH}/compact/pid/drich.xml)

Plot photon endpoint along X axis (θ_Y~0)

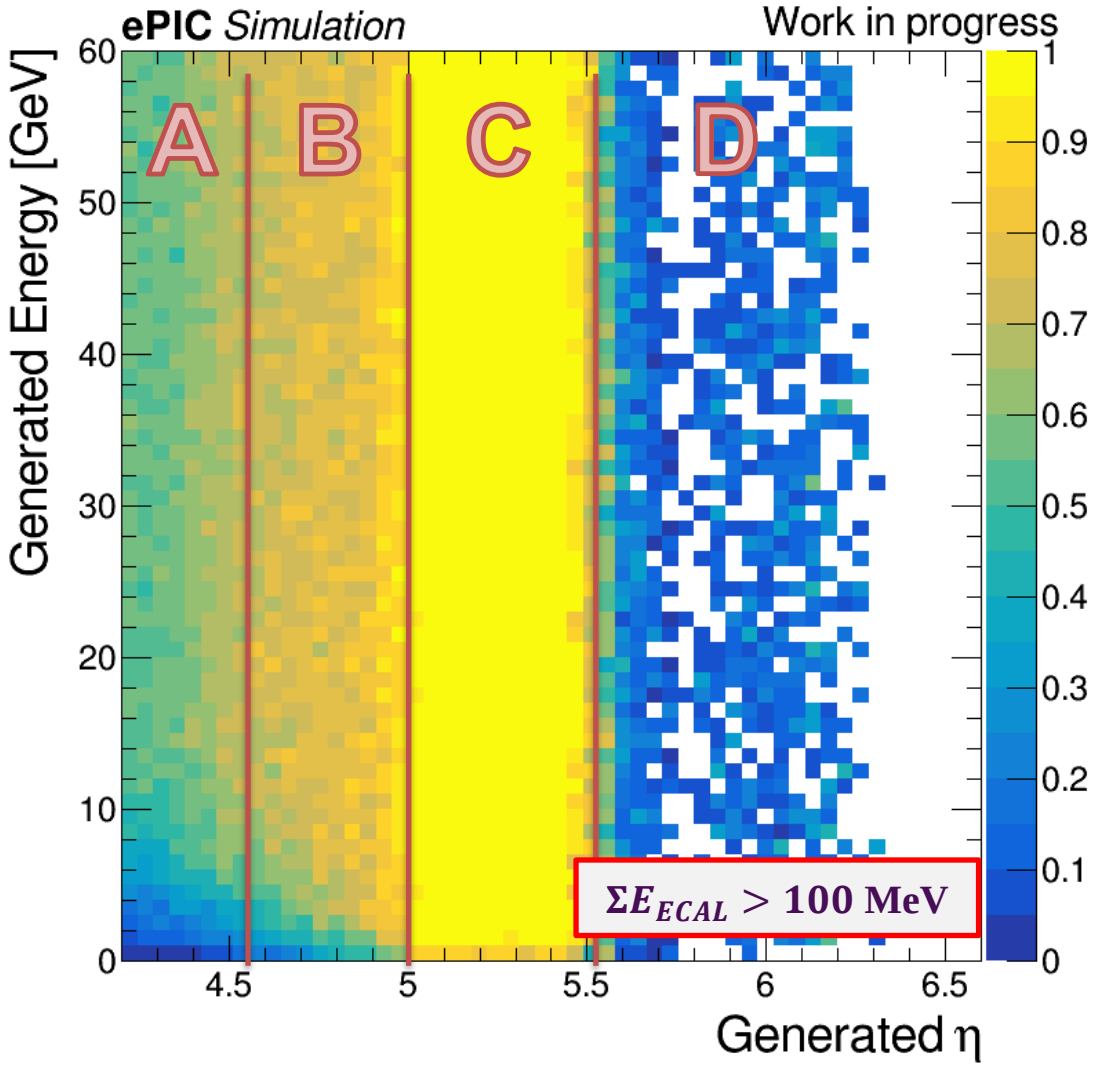




Photon acceptance

Acceptance

- Photon acceptance can be divided into 4 regions:
  - A. Outside EMCAL acceptance (low eta), covered by dRICH
  - B. Within EMCAL acceptance, and crossing the central beampipe
  - C. Within EMCAL acceptance, and within the central beampipe
  - D. Outside EMCAL acceptance (high eta), covered by ZDC

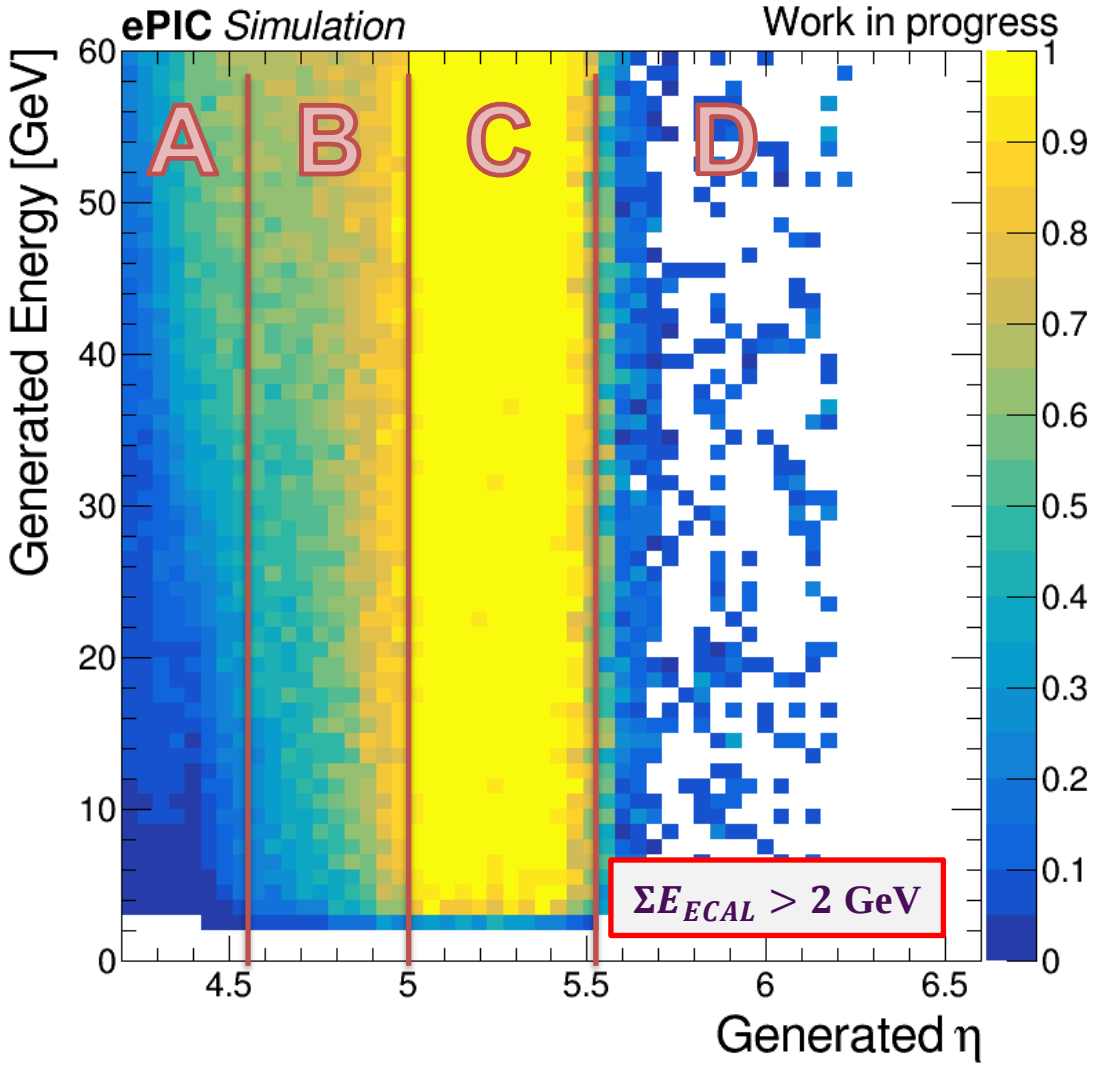


Photon acceptance

Acceptance

- Photon acceptance can be divided into 4 regions:
  - A. Outside EMCAL acceptance (low eta), covered by dRICH
  - B. Within EMCAL acceptance, and crossing the central beampipe
  - C. Within EMCAL acceptance, and within the central beampipe
  - D. Outside EMCAL acceptance (high eta), covered by ZDC

Resolution: Will vary a lot between region B and C



Summary and discussion

Acceptance:

- Photons outside EMCAL fiducial acceptance could deposit energy in ECAL due to conversion in earlier detector's parts (the main ones are central beampipe and dRICH)
- Photons inside EMCAL fiducial acceptance that cross the central beampipe can be converted to lepton pair, resulting in loss of the acceptance

Next steps / questions:

- Resolution – should we consider two regions to estimate the resolution
- Photon reconstruction – what is currently implemented, and should we consider different reconstruction algorithms due to early photon conversions? Interplay between dRICH/B0/ZDC…
- In the long term, consider different physics scenarios: DVCS, Photoproduction of neutral mesons

Backup