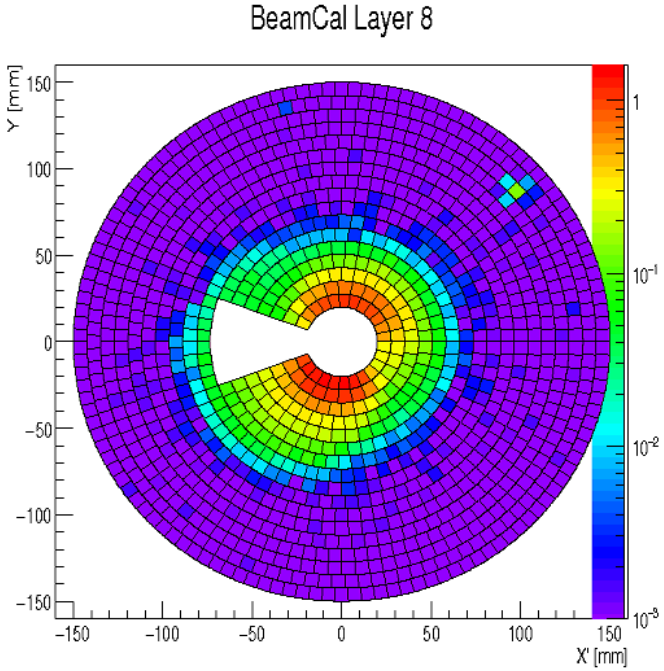
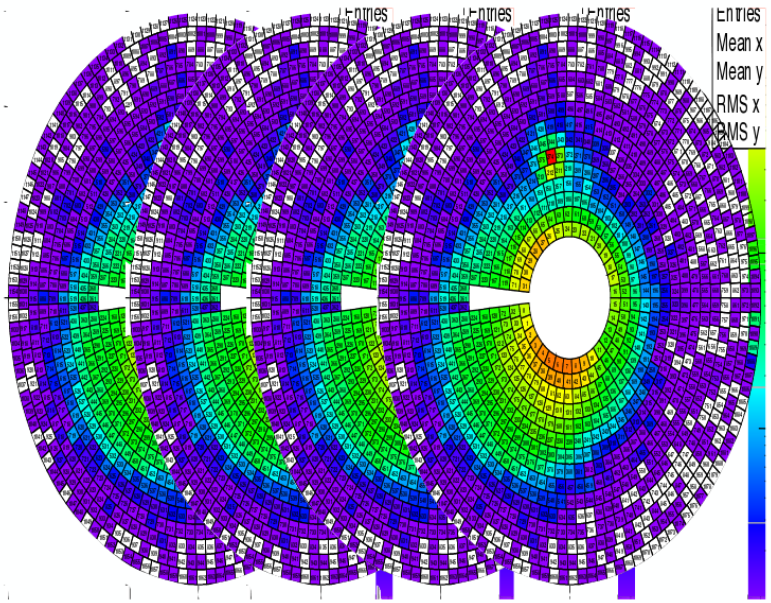




BeamCal Reco

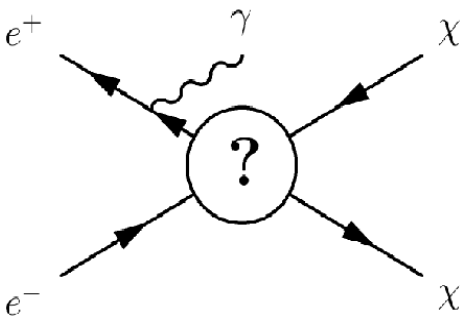
Moritz Habermehl

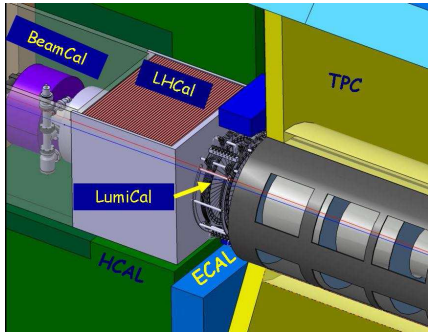
ILD Software and Optimisation Workshop

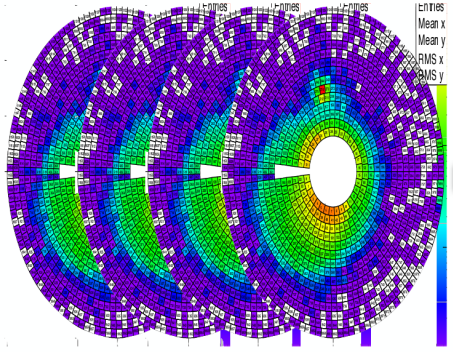
25 February 2016

DESY

Motivation







- Why am I interested in the BeamCal Reconstruction ?
  $\Rightarrow$ WIMP search in the mono-photon channel
- one of main backgrounds: Bhabhas
  - $e^+e^- \rightarrow e^+e^-\gamma$
  - if e^+e^- undetected $\rightarrow$ "mono-photon"
  - detection of Bhabha leptons in BeamCal reduce background by factor 60
- BeamCal reconstruction challenging
  - e^+e^- pairs coming from Beamstrahlung photons
  - *many, but low energy* $\rightarrow$ overlay

BeamCalClusterReco: Overview

- Marlin processor: BeamCalClusterReco
- by A.Sailer and A.Sapronov
- tuning of parameters
- included in /ILDConfig/v01-17-09/StandardConfig/current/bbudsc_3evt_stdreco.xml
  - Mode: **Gaussian**
  - pair background overlay file: BeamCal_bg_E500-TDR_ws.root
    - approx. half of the simulated eepairs = half a bunch train
    - other $\sqrt{s}$ underway

BeamCalClusterReco: Modes

ILCSoft v01-17-**08**

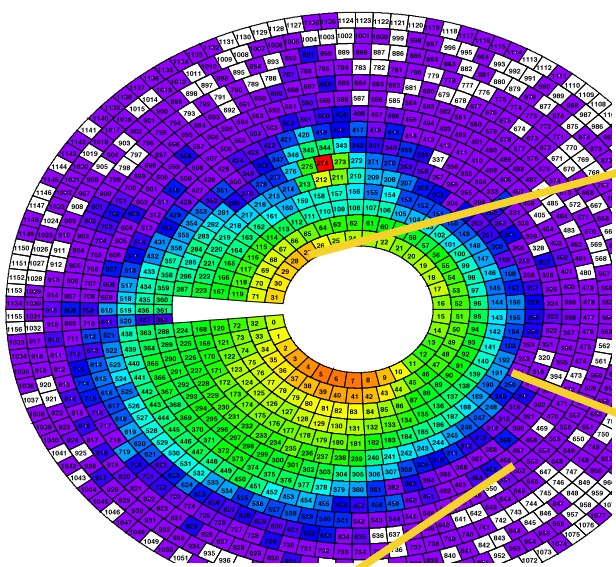
- three modes:
  - **pregenerated**:
    random background samples are directly overlaid
  - **averaged**:
    calculate average and stdev in each pad,
    generate background accordingly,
    usually used for ILD (`bg_aver...root`)
  - **parametrised**→ in v01-17-09: called **gaussian** !!!
    same as averaged, but with several bunch crossings

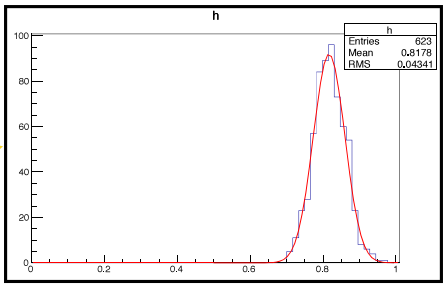
ILCSoft v01-17-**09**

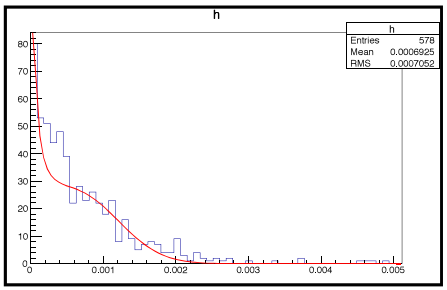
- four modes: Pregenerated, Averaged, Gaussian
  (=Parametrised in v01-17-08)
- **parametrised**: parametrisation for each pad

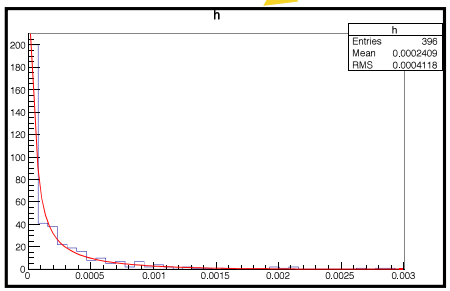
Slide from A.Sapronov, FCal workshop, 20 Oct 2015

Background parametrisation: fits





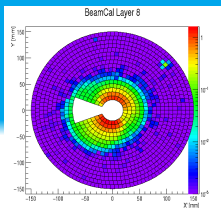




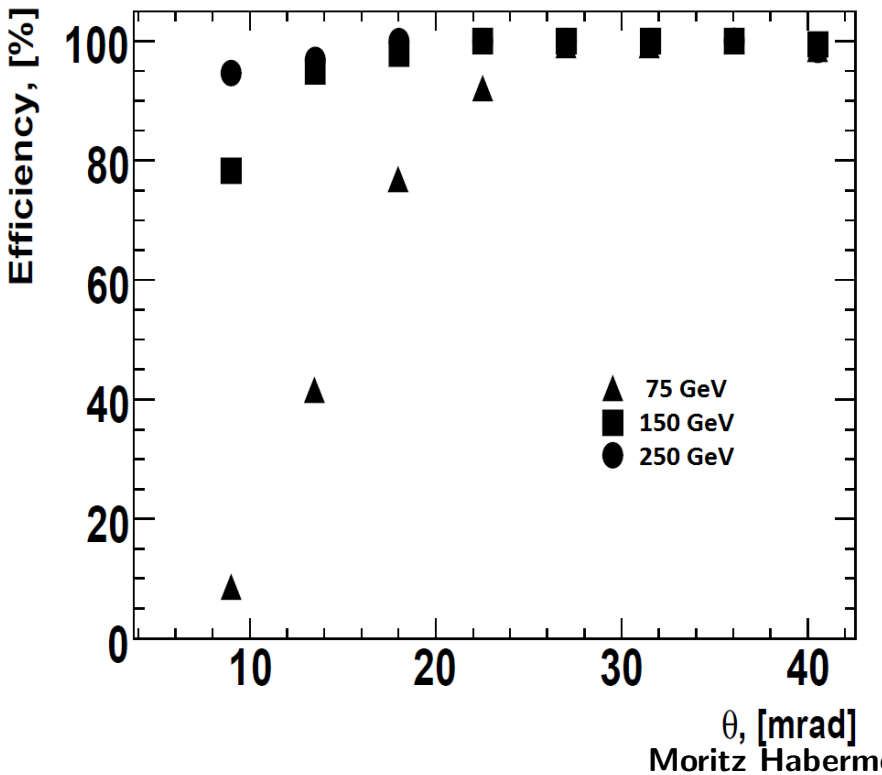
General formula:

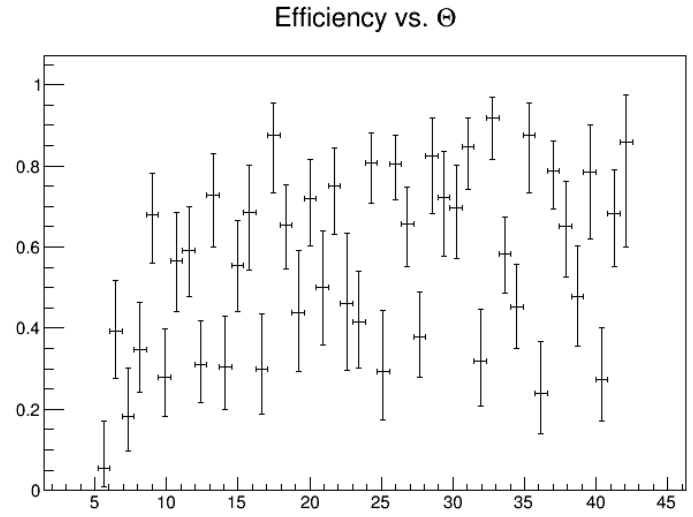
$$f(x) = \frac{[1]}{x} \exp\left[-\left(\frac{x-[2]}{[3]}\right)^2\right]$$

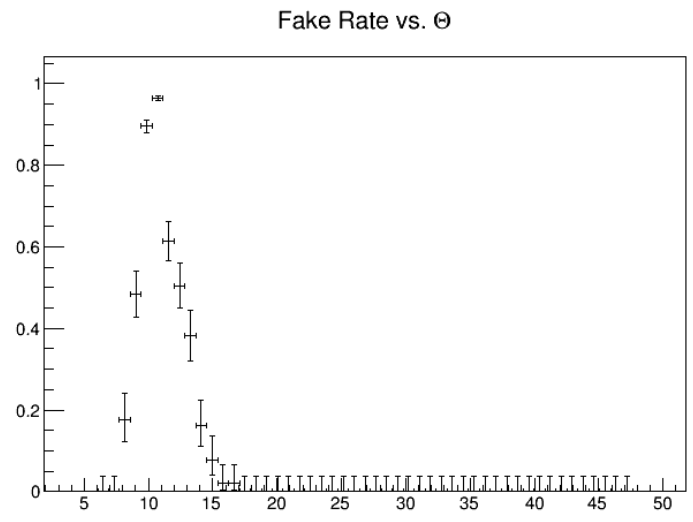
Particle Gun Samples



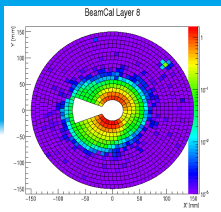
- Particle Gun sample:
  electrons, 50 GeV / 200 GeV
  - 200 GeV: could be better



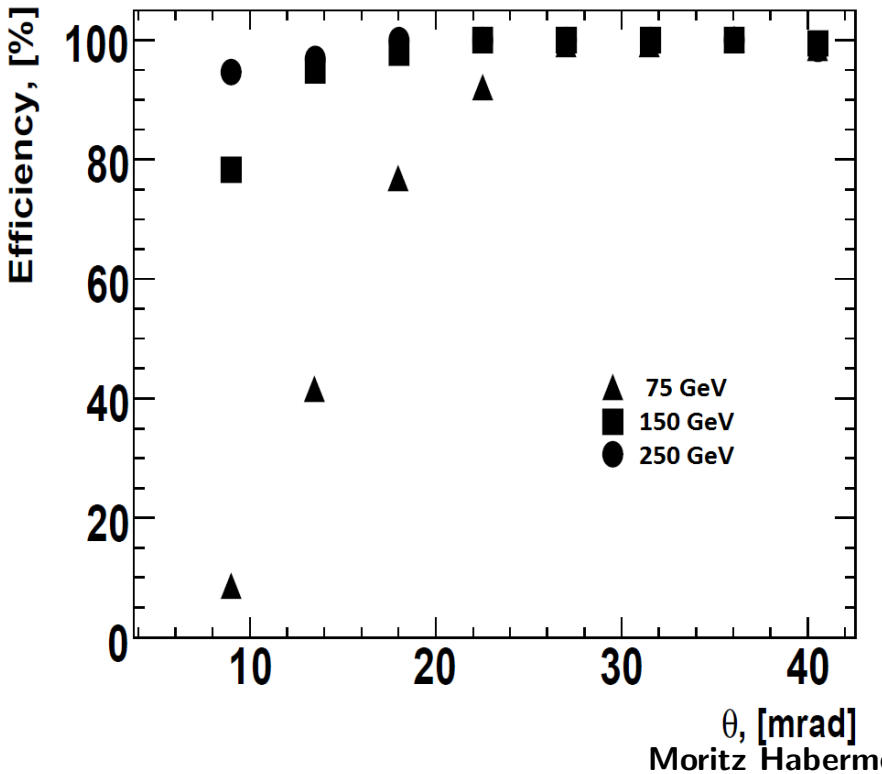


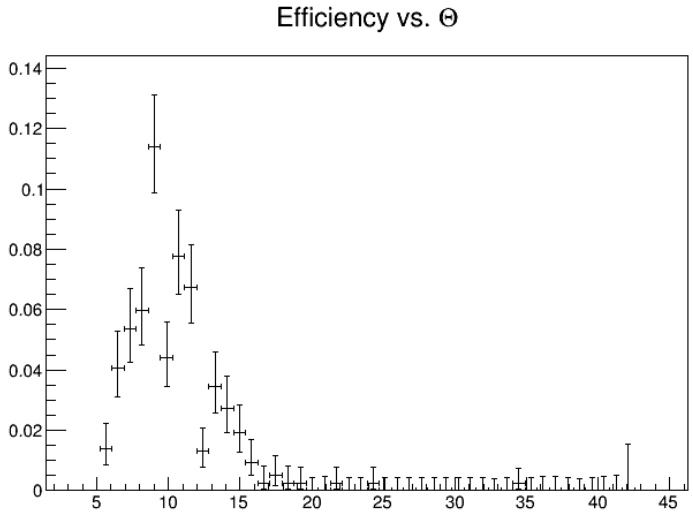


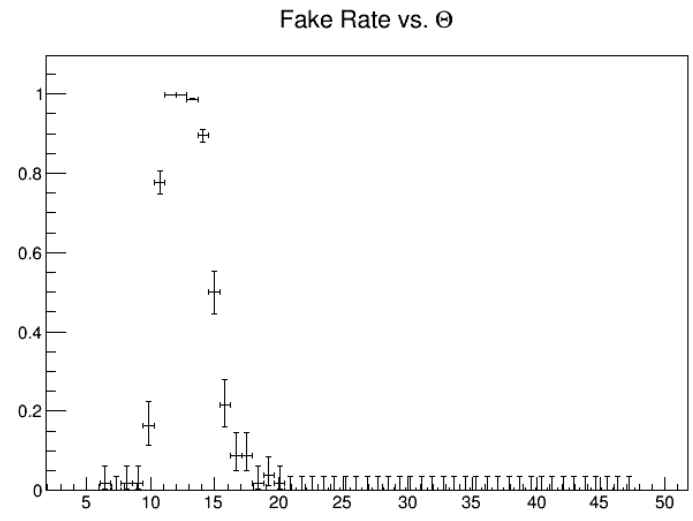
Particle Gun Samples



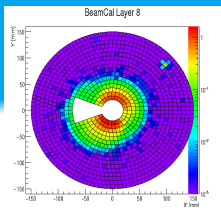
- Particle Gun sample:
  electrons, 50 GeV / 200 GeV
  - 200 GeV: could be better
  - 50 GeV: even worse



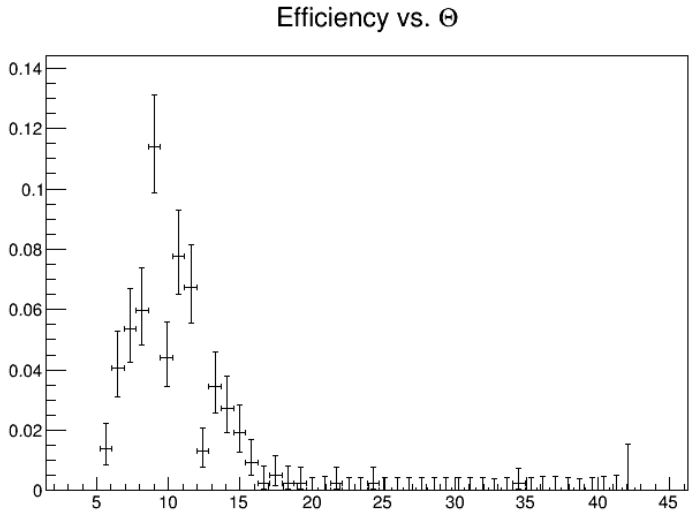


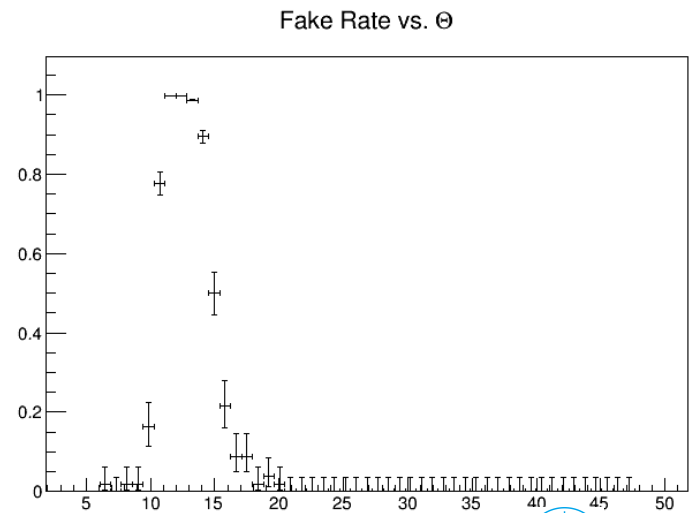


Parameters

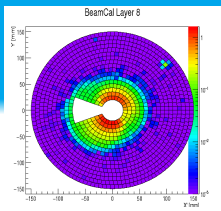


- parameters have to be tuned
- after subtraction of pair background in each pad (average + 1σ)...

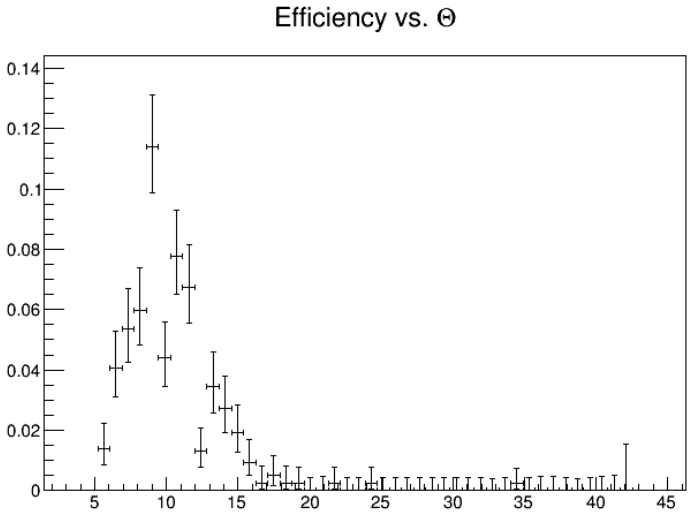


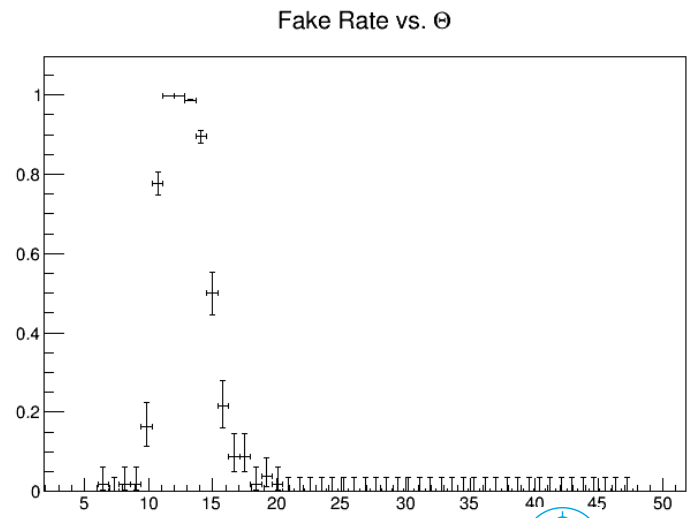


Parameters



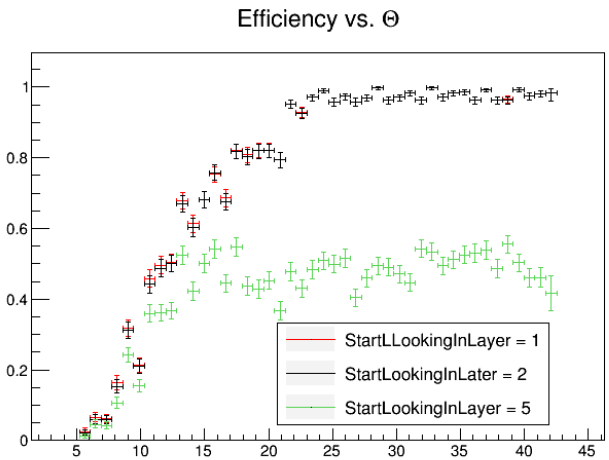
- parameters have to be tuned
- after subtraction of pair background in each pad (average + 1σ)...
- ... events have to fulfill the following to be considered as Bhabha event:
  - **SigmaCut**:
    energy in pad: x·σ above the average
  - **ETPadMin**:
    energy in pad has to be higher
  - **MinimumTowerSize**:
    pads in x consecutive layers
  - **StartLookingInLayer**:
    first layers contain most overlay
    $\rightarrow$ ignore them

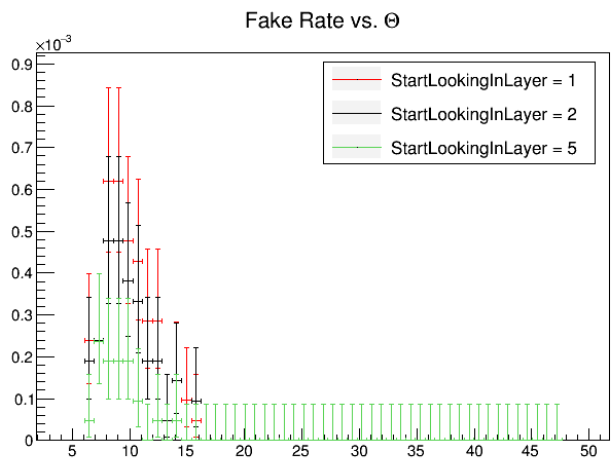




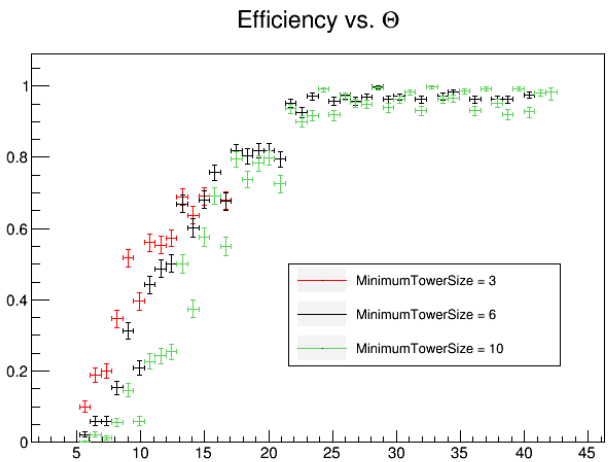
Tuning: Gaussian (=Parametrised in v01-17-08) I

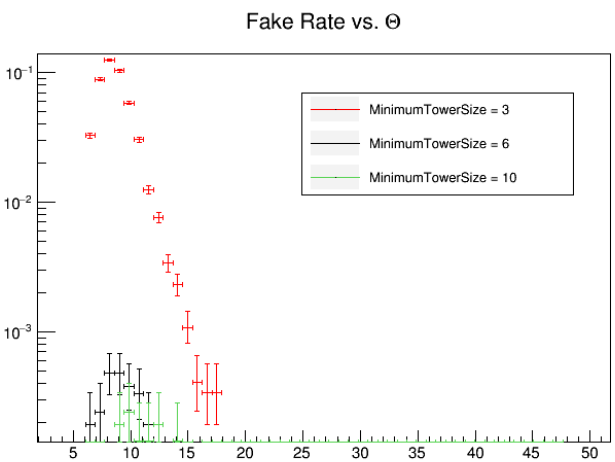
- StartLookingInLayer = 1 / **2** / 5





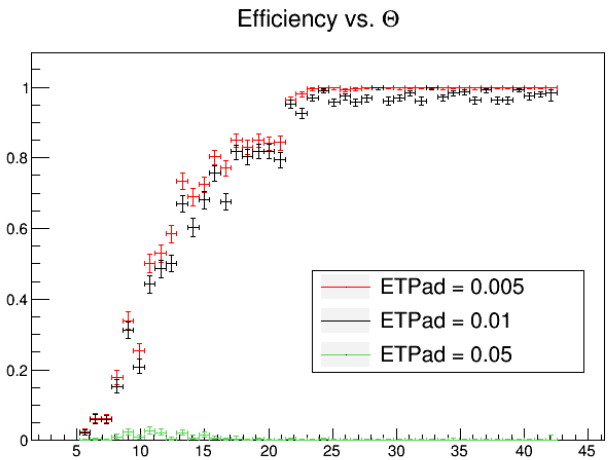
- MinimumTowerSize = 3 / **6** / 10

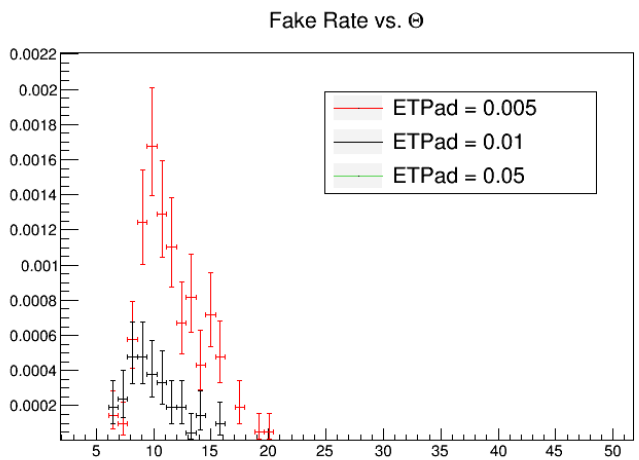




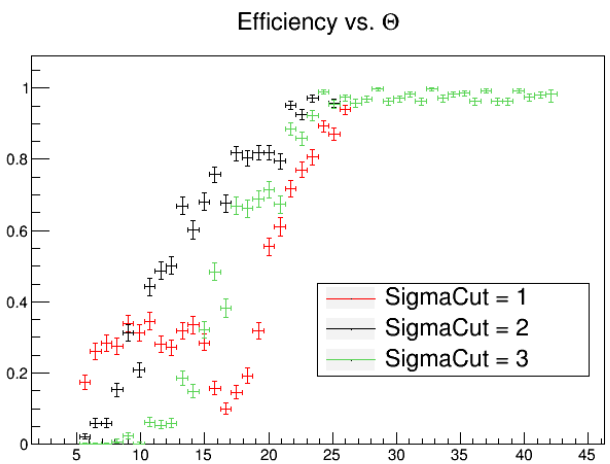
Tuning: Gaussian (=Parametrised in v01-17-08) II

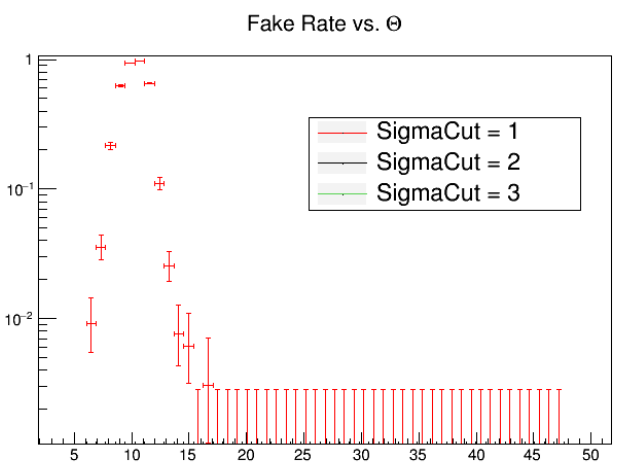
- ETPadMin = 0.005 / **0.01** / 0.05



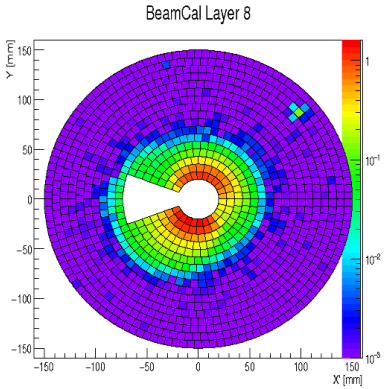


- SigmaCut = 1 / **2** / 3

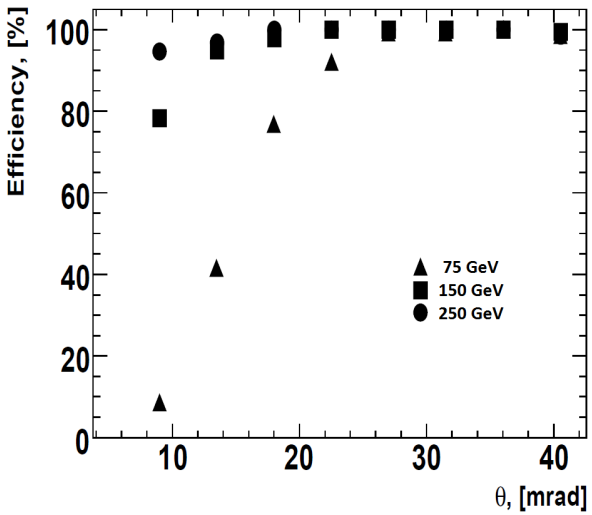


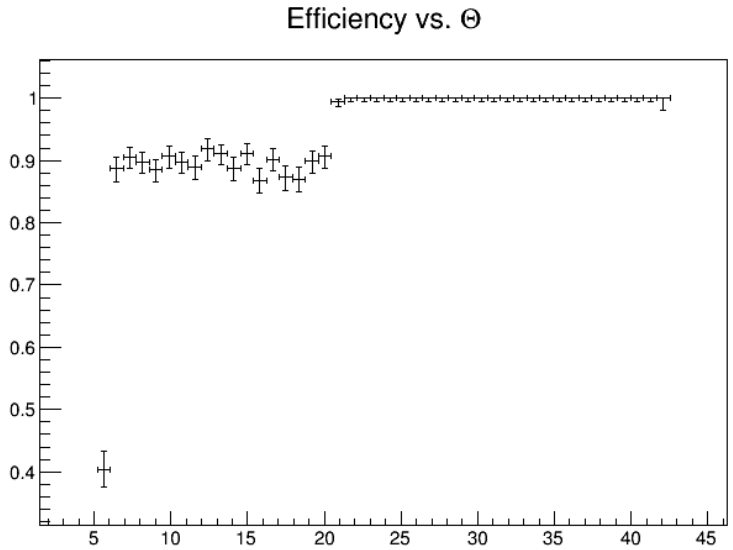


Results



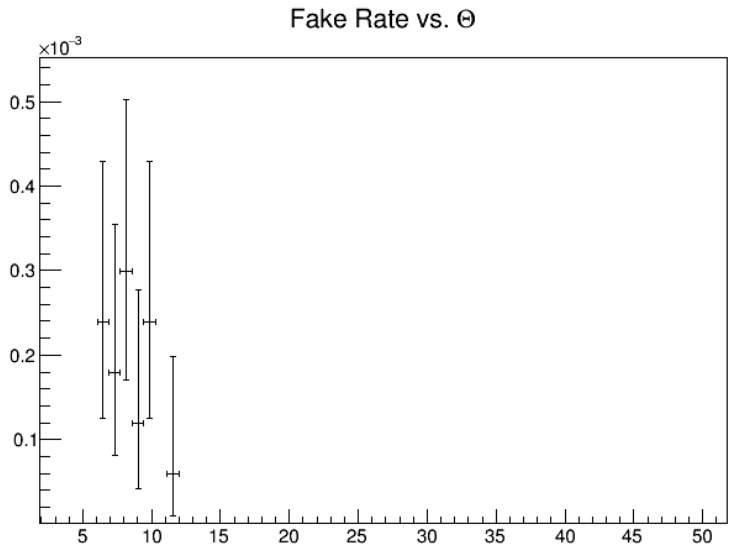
- preliminary values:
  - SigmaCut = **2**
  - ETPadMin = **0.01 GeV**
  - MinimumTowerSize = **6**
  - StartLookingInLayer = **2**





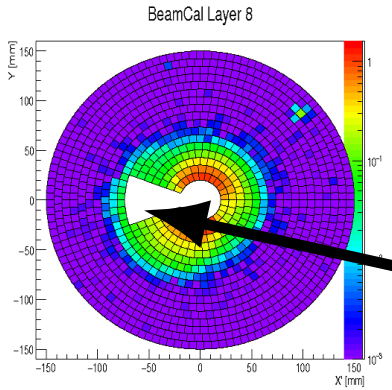
200 GeV
electrons

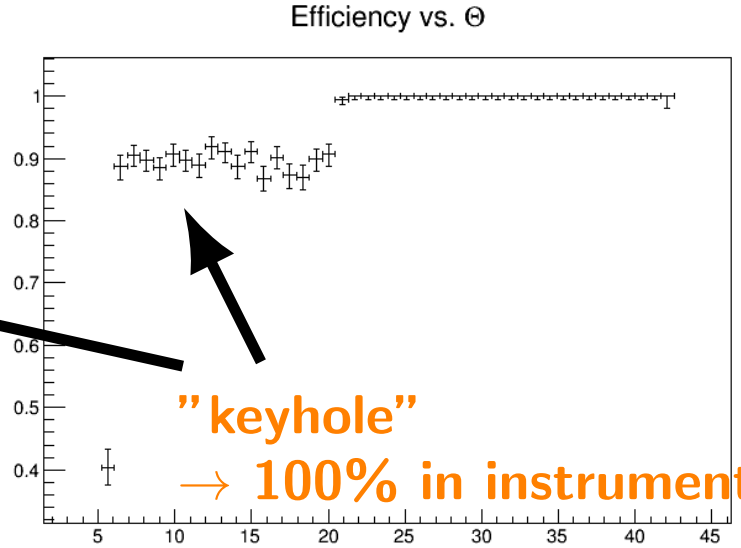
- efficiency



- fake rate

Results



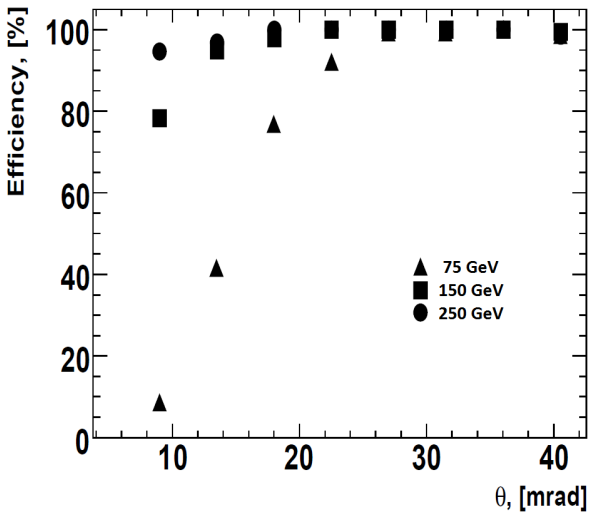


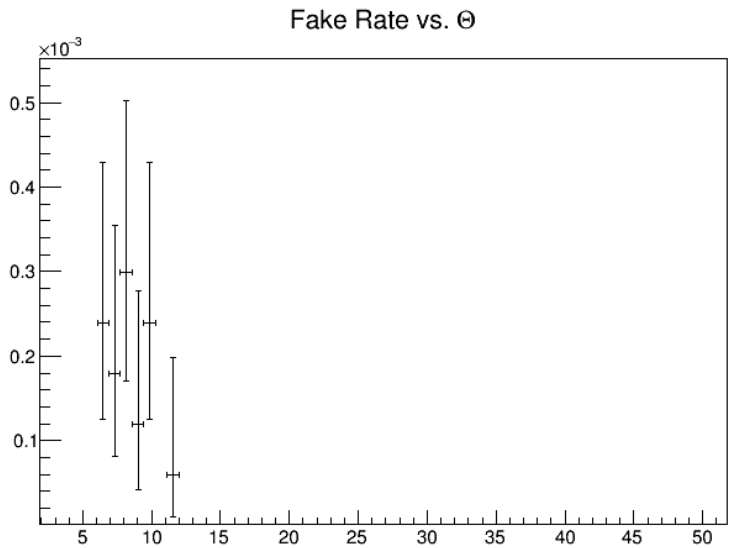
200 GeV electrons

- efficiency

"keyhole"
→ 100% in instrumented region

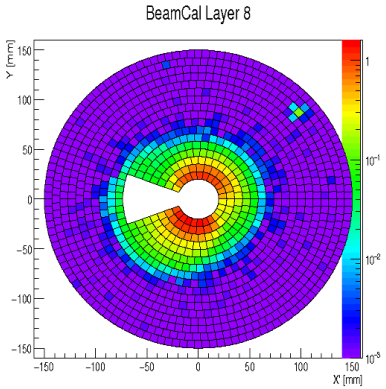
- preliminary values:
  - SigmaCut = **2**
  - ETPadMin = **0.01 GeV**
  - MinimumTowerSize = **6**
  - StartLookingInLayer = **2**



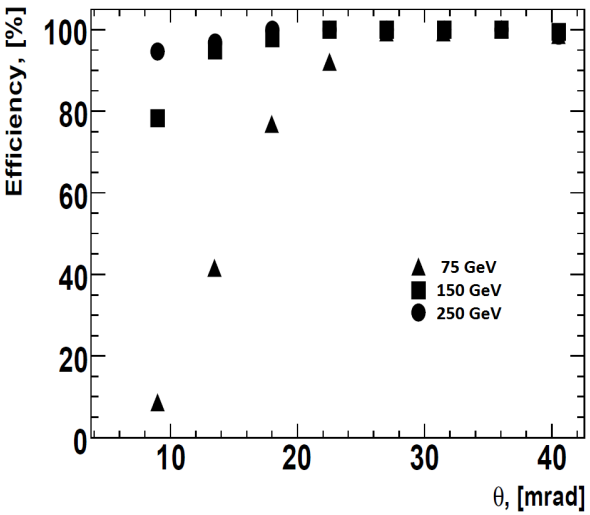


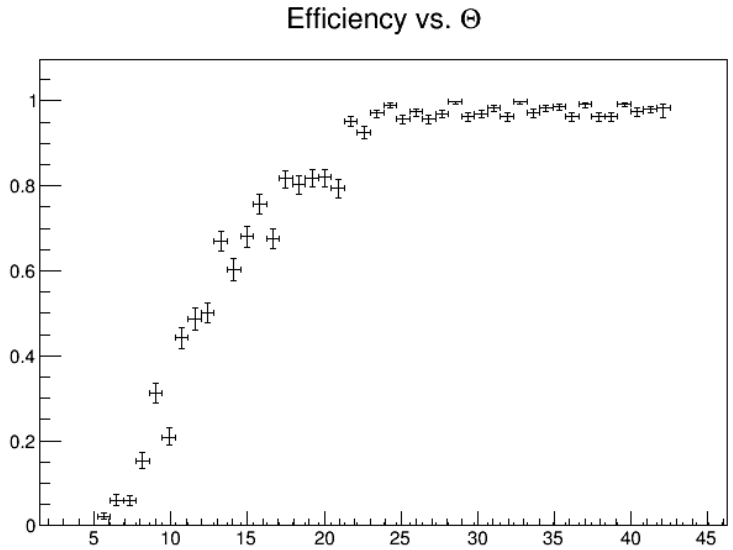
- fake rate

Results



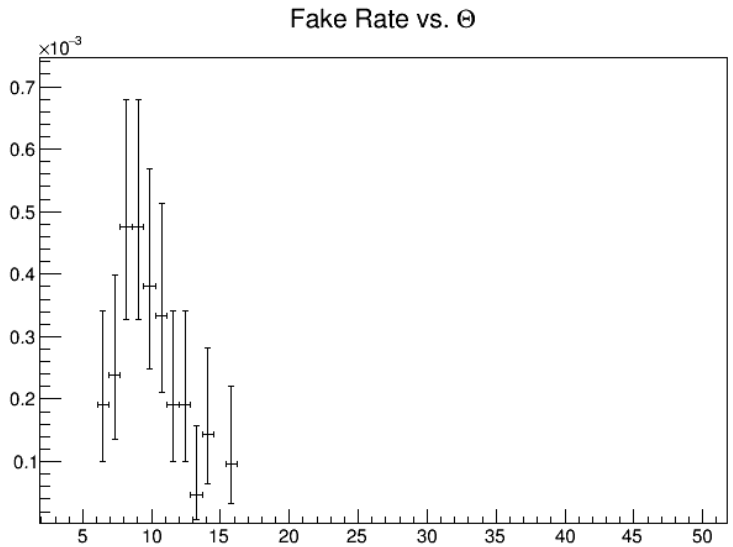
- preliminary values:
  - SigmaCut = **2**
  - ETPadMin = **0.01 GeV**
  - MinimumTowerSize = **6**
  - StartLookingInLayer = **2**





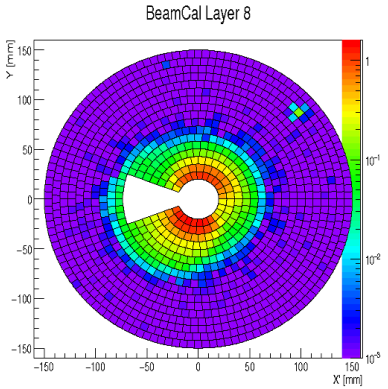
50 GeV electrons

- efficiency

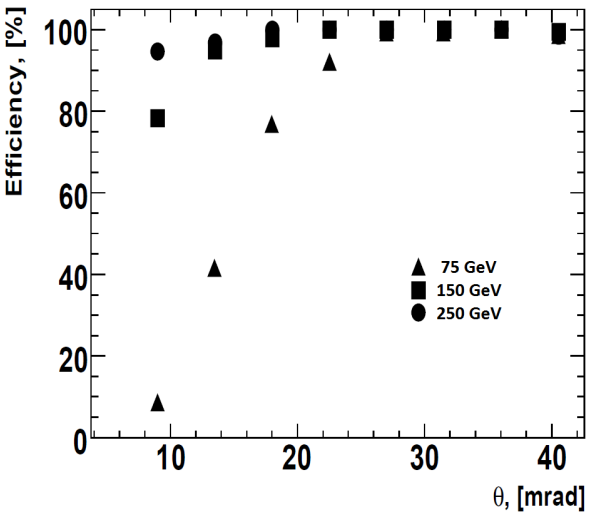


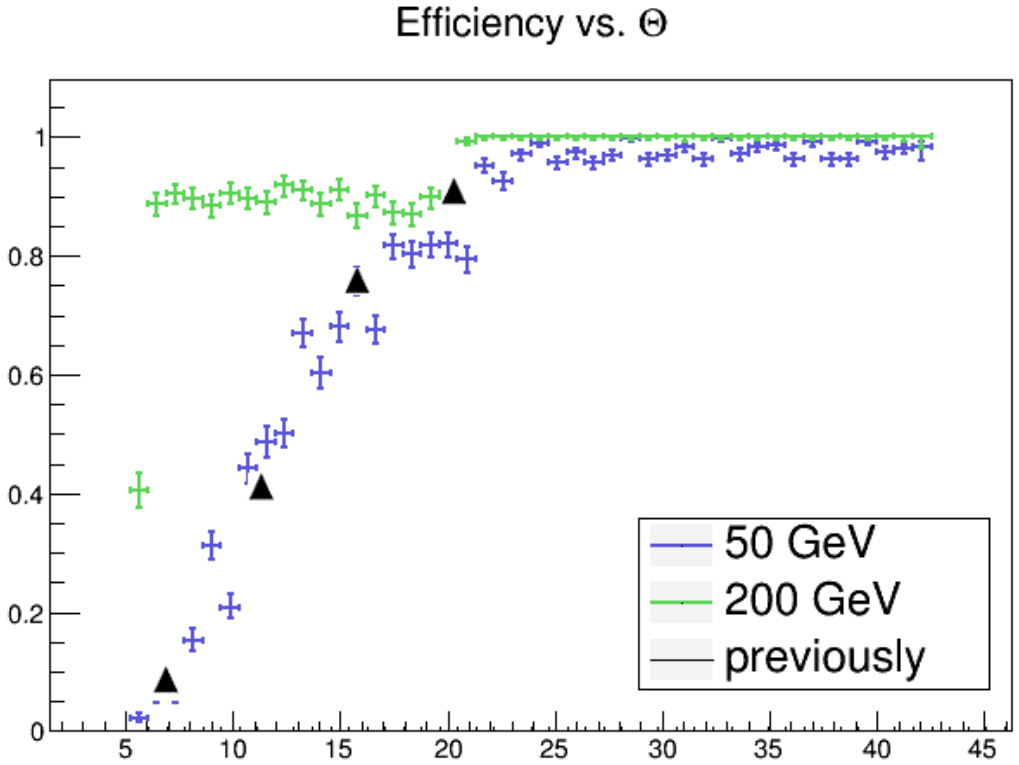
- fake rate

Results II



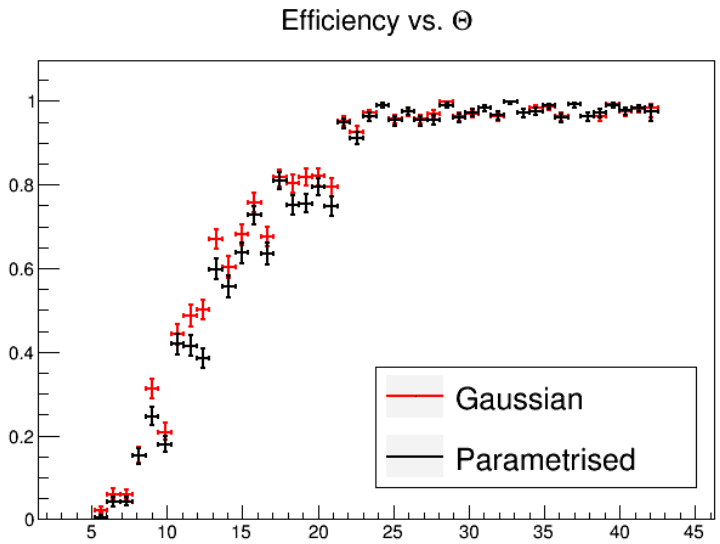
- preliminary values:
  - SigmaCut = **2**
  - ETPadMin = **0.01 GeV**
  - MinimumTowerSize = **6**
  - StartLookingInLayer = **2**

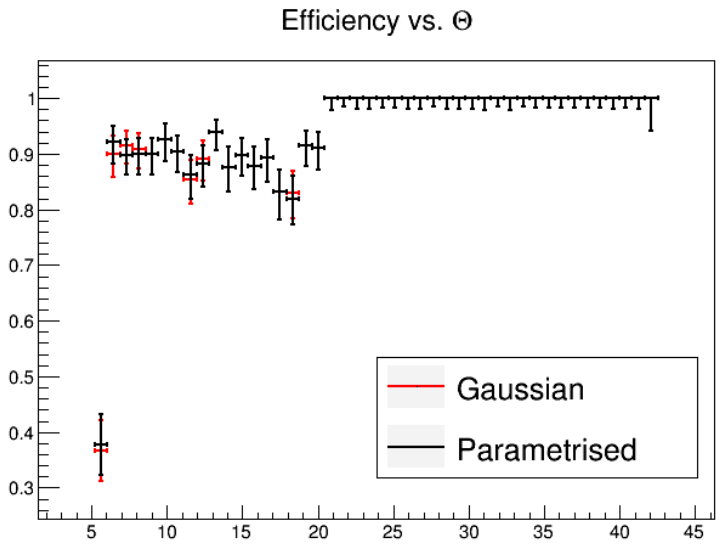




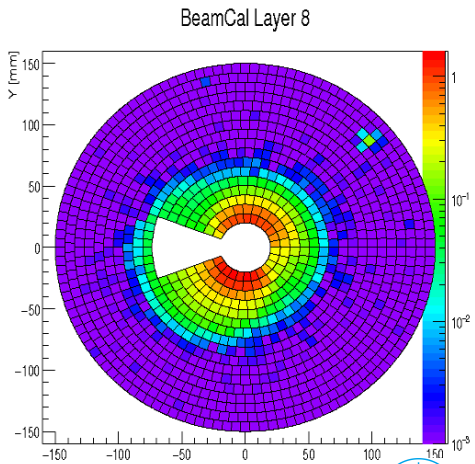
- performance better than in previous reconstruction
- further improvement: fine-tuning of parameters

Parametrised vs. Gaussian I

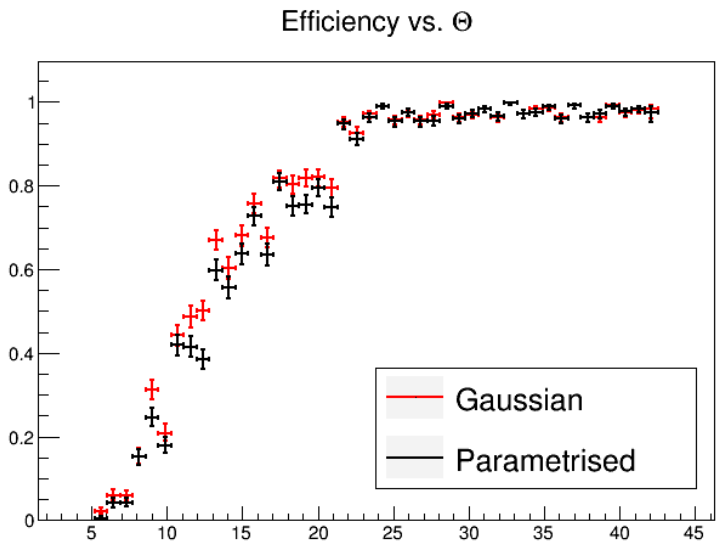


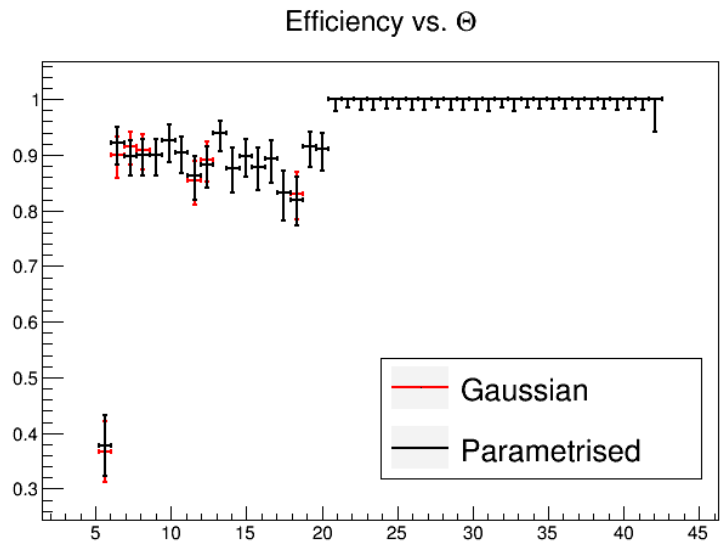


- "Parametrised" very similar to "Gaussian"
- small deviations in transition region
  $\Leftrightarrow$ energy distribution not well descibed by Gaussian



Parametrised: Issues

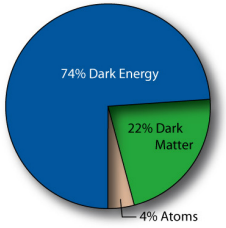


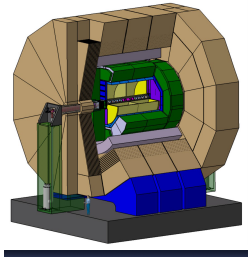
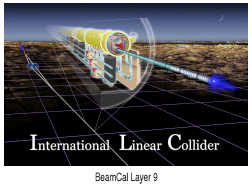


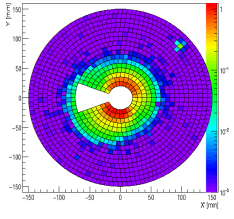
- in v01-17-09: "Pregenerated" needs huge memory and many warnings (8000)
  Andre fixed the memory issue (svn)
- warnings: if parametrisation in a pad fails
  → falls back to "Gaussian" in that pad
  → safe to suppress the warning
  fixed by Andre (svn)

Summary







- BeamCalClusterReco tested and tuned for ILD
- efficiency better than in for previous approach
- modes "Gaussian" and "Parametrised" similar efficiency