# Fwd ECAL Simulation

**SuperB Generla Meeting**
(DGWG)
*SLAC*
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# SuperB ECAL full simulation (Bruno)

All the studies have been performed using the Bruno package (SuperB G4 Full simulation package)

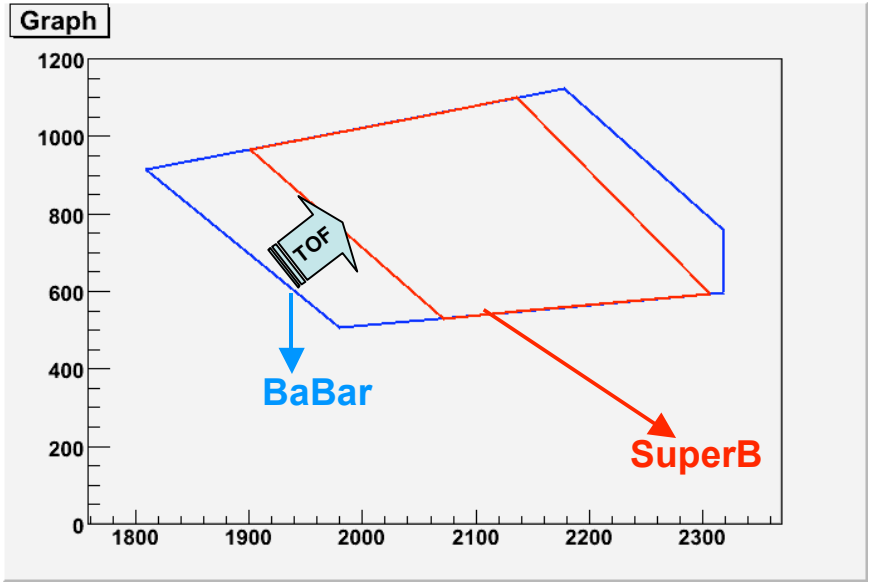
All the results are very preliminary and all the details need to be checked with more care

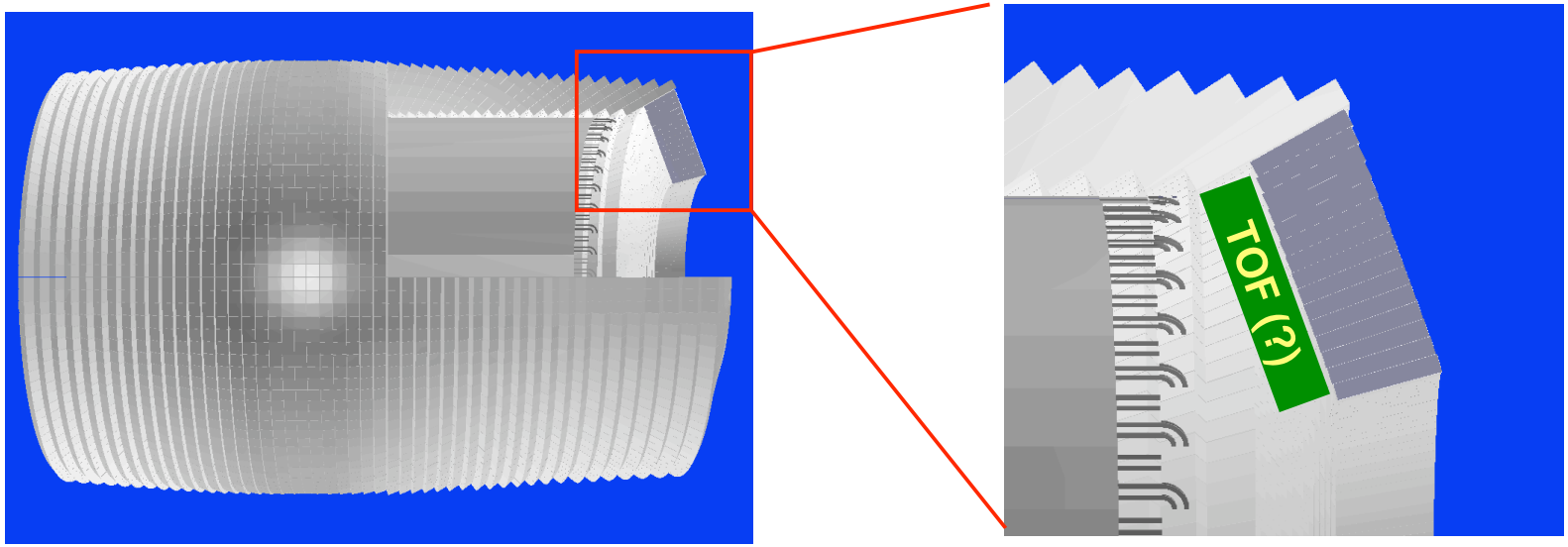
Performed studies:

- Investigate Barrel-Fwd transition region
- Effect of Fwd PID matrerial on energy resolution

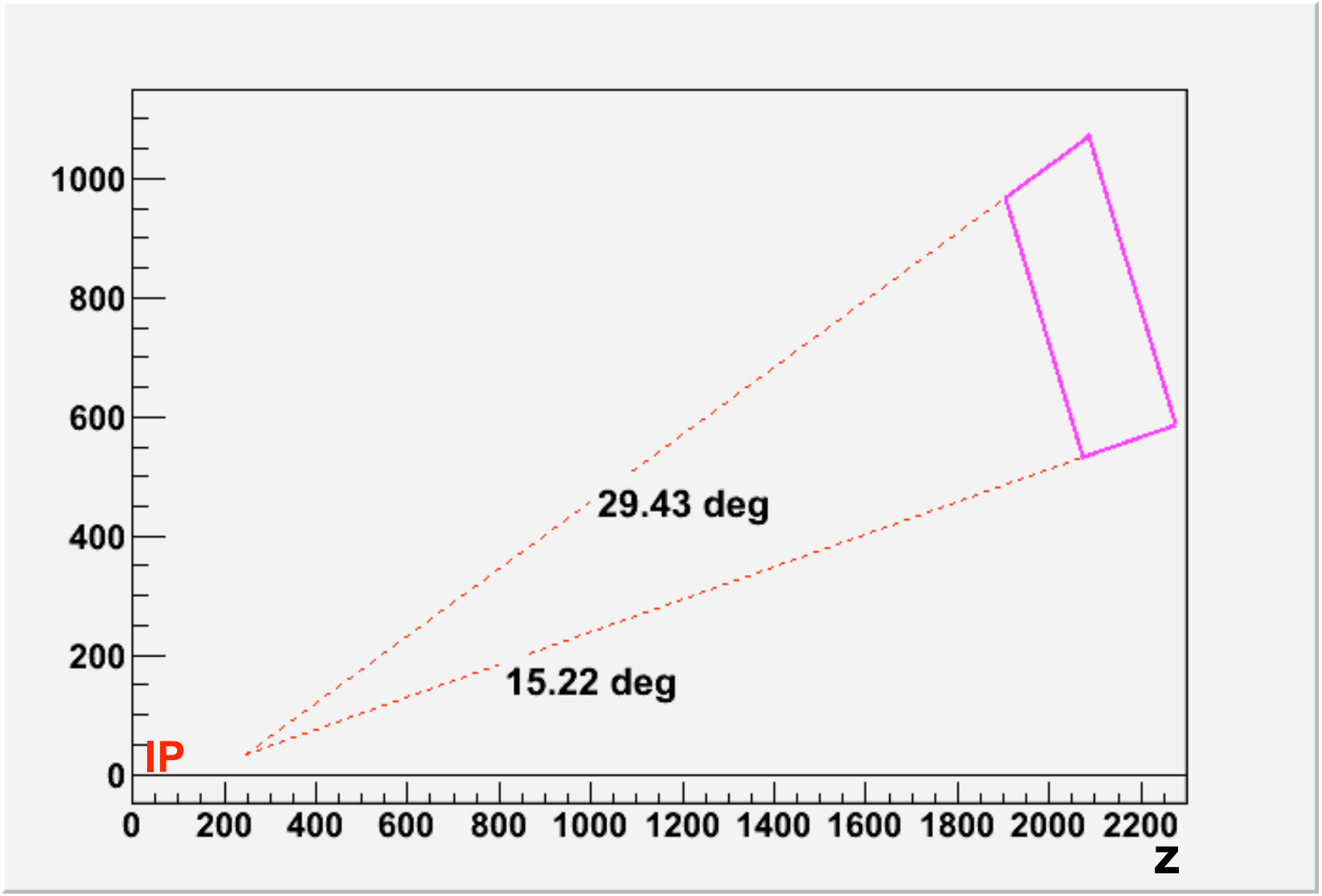
# Fwd ECAL Geometry Envelop

- Fill the same BaBar angular region but
  - leave space for TOF: $\Delta Z$ = (100 mm)*cos(22.7)
  - Xtals material : LSO (LYSO)
    - Xtal depth = 200 mm (~17.5 $X_0$)
- Barrlel-Endcap Transition region modeled according to M,Lebeau suggestion
  - 5 mm no-go zone (air)
  - 10 mm CF



# Fwd Endcap Pointing



# Crystals Dimensions

LSO crystas

- depth: 20 cm ~17.5 $X_0$
- Crystas arranged in 20 rings within 5x5 modules

| Ring | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 19.52 | 23.05 | 18.66 | 21.53 | 25.53 | 20.58 |
| 2 | 20.30 | 23.01 | 19.44 | 22.40 | 25.49 | 21.45 |
| 3 | 21.08 | 22.98 | 20.22 | 23.27 | 25.46 | 22.31 |
| 4 | 21.86 | 22.95 | 20.99 | 24.13 | 25.43 | 23.18 |
| 5 | 22.63 | 22.82 | 21.77 | 24.99 | 25.29 | 24.04 |
| 6 | 19.92 | 22.90 | 19.18 | 22.02 | 25.38 | 21.19 |
| 7 | 20.58 | 22.89 | 19.84 | 22.75 | 25.37 | 21.93 |
| 8 | 21.24 | 22.87 | 20.49 | 23.49 | 25.35 | 22.66 |
| 9 | 21.90 | 22.86 | 21.15 | 24.22 | 25.34 | 23.39 |
| 10 | 22.55 | 22.76 | 21.80 | 24.95 | 25.23 | 24.11 |
| 11 | 20.16 | 22.85 | 19.50 | 22.31 | 25.33 | 21.57 |
| 12 | 20.73 | 22.85 | 20.07 | 22.95 | 25.33 | 22.21 |
| 13 | 21.31 | 22.86 | 20.64 | 23.59 | 25.34 | 22.85 |
| 14 | 21.89 | 22.87 | 21.22 | 24.23 | 25.35 | 23.48 |
| 15 | 22.46 | 22.80 | 21.79 | 24.87 | 25.27 | 24.12 |
| 16 | 20.83 | 22.90 | 20.21 | 23.07 | 25.38 | 22.38 |
| 17 | 21.36 | 22.92 | 20.73 | 23.65 | 25.40 | 22.96 |
| 18 | 21.88 | 22.95 | 21.26 | 24.23 | 25.43 | 23.54 |
| 19 | 22.41 | 22.98 | 21.78 | 24.82 | 25.46 | 24.12 |
| 20 | 22.93 | 22.93 | 22.30 | 25.40 | 25.40 | 24.70 |

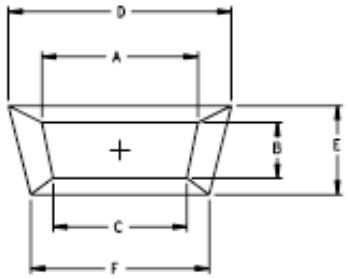
175 Xtals/Ring
35 Modules

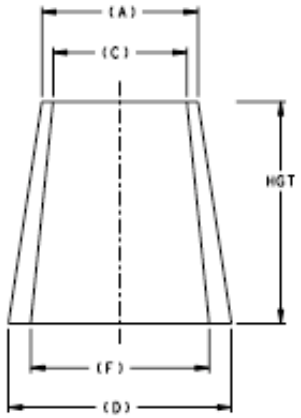
205 Xtals/Ring
41 Modules

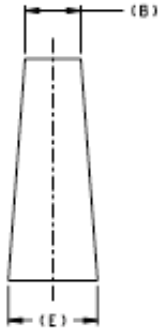
235 Xtals/Ring
45 Modules

260 Xtals/Ring
52 Modules

**~4400 Crystals**



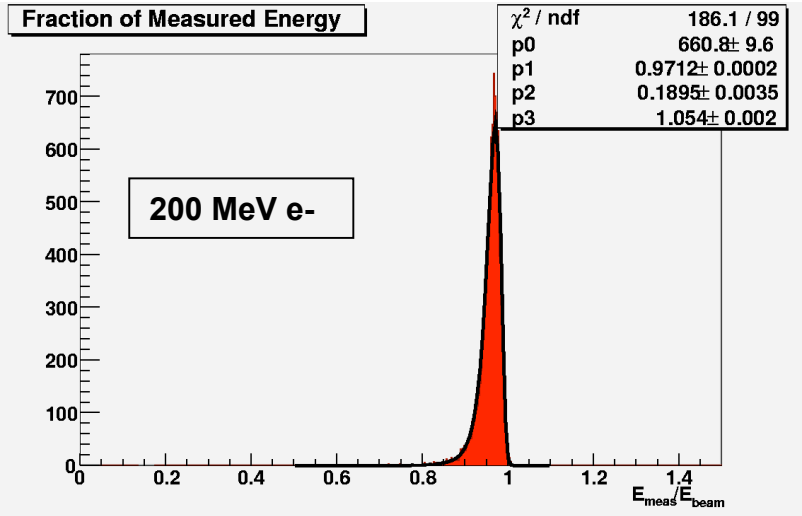



# Energy Reconstruction

**Algorithm:**

1. Get Xtal deposited energy
2. Perform Poisson smearing with 8k pe/MeV
3. Assign 1% calibration error to crystals
   - Reconstruct with 1.5k±1% pe/MeV
4. Apply minimum energy cut for each xtal
   - 1 MeV to be tuned
5. Sum Xtal energy



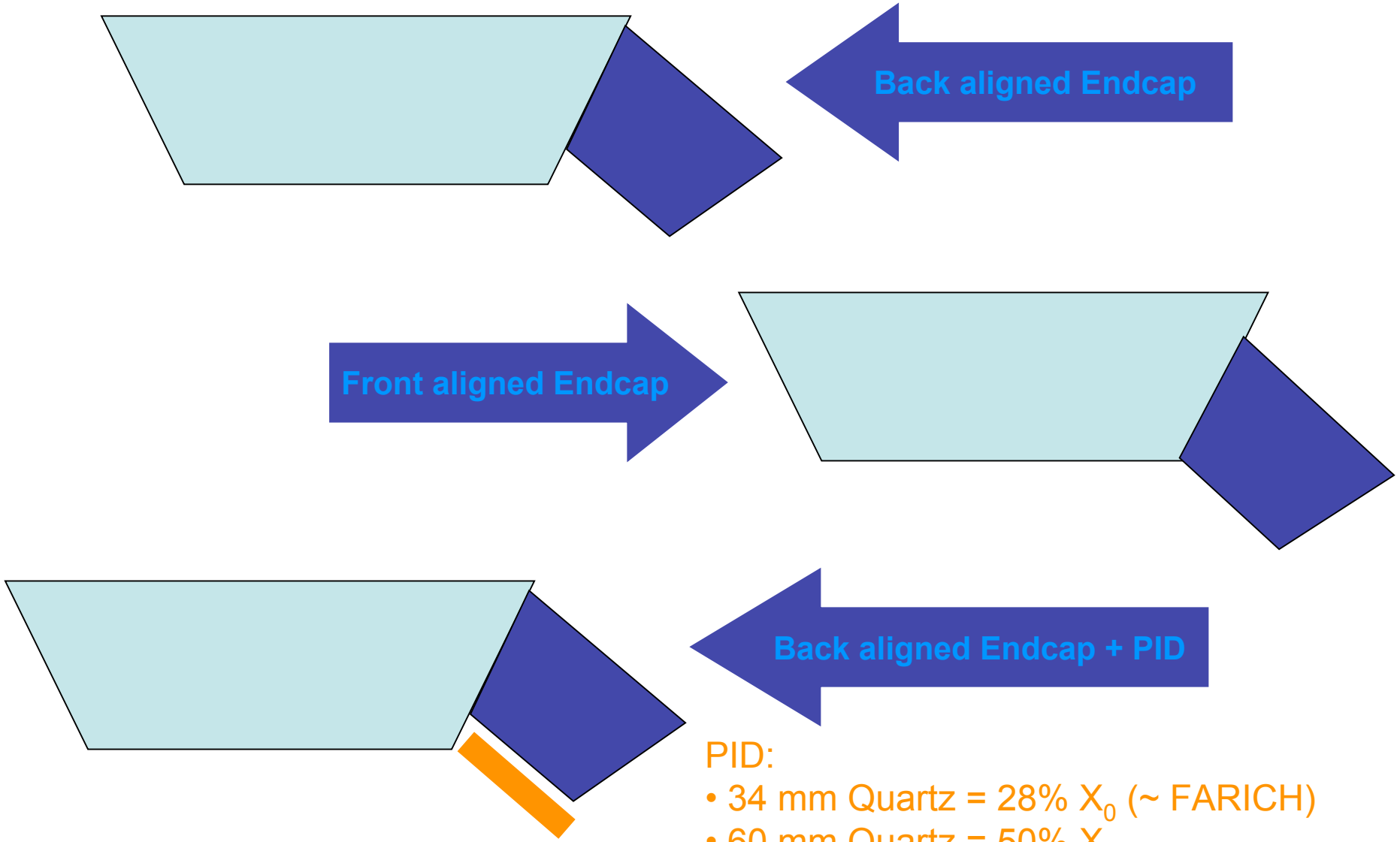

**Comments:**

- All distributions have asymmetric low energy tails
  - Backsplash for low E particles
  - Forward leakege for high E particles
- Energy distributions fit with asymmetric Gauss function: $\sigma = \sigma(E)$
- Proposed parameterisation uses fit of p1,p2,p3 vs Energy

$$F(x) = P_0 e^{-\frac{(x-P_1)^2}{2[P_2(P_3-x)]^2}}$$

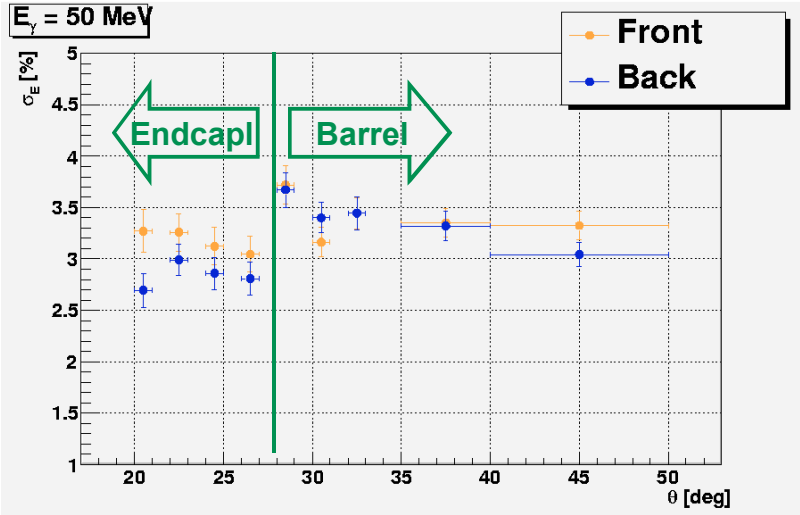
- P1 : most probable value (mpv)
- P2(P3-x) : running $\sigma$

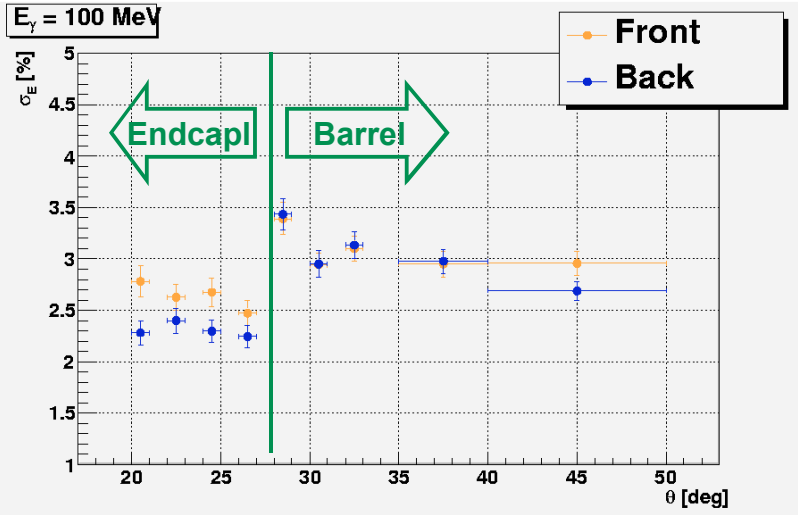
# Geometry Options

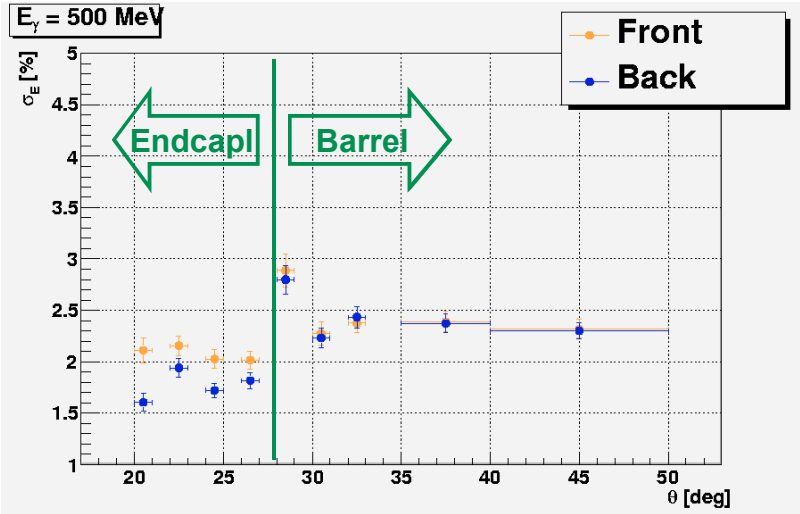


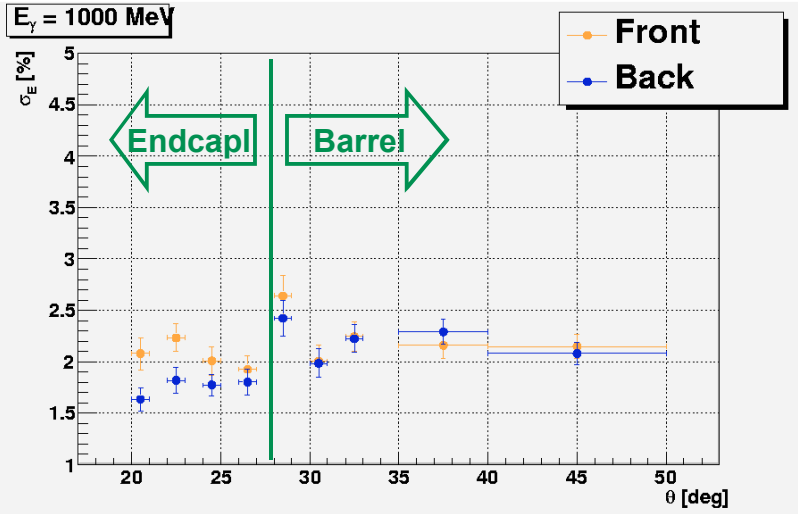

PID:
- 34 mm Quartz = 28% $X_0$ (~ FARICH)
- 60 mm Quartz = 50% $X_0$

# Energy resolution vs Theta



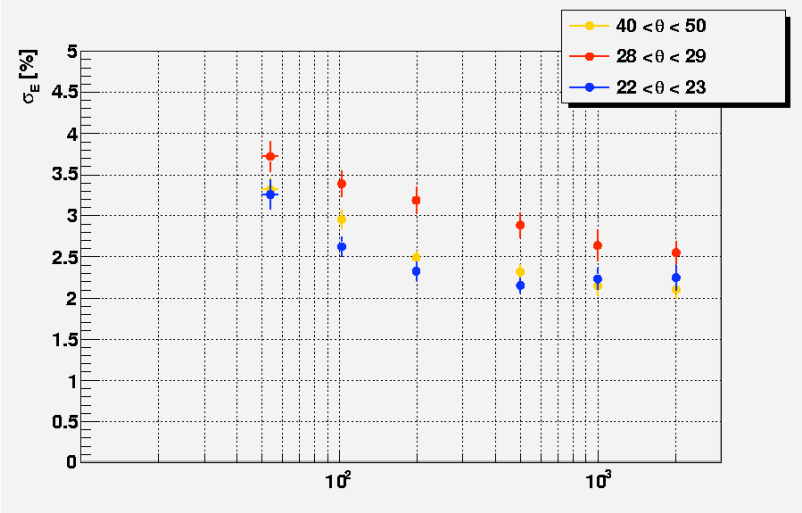



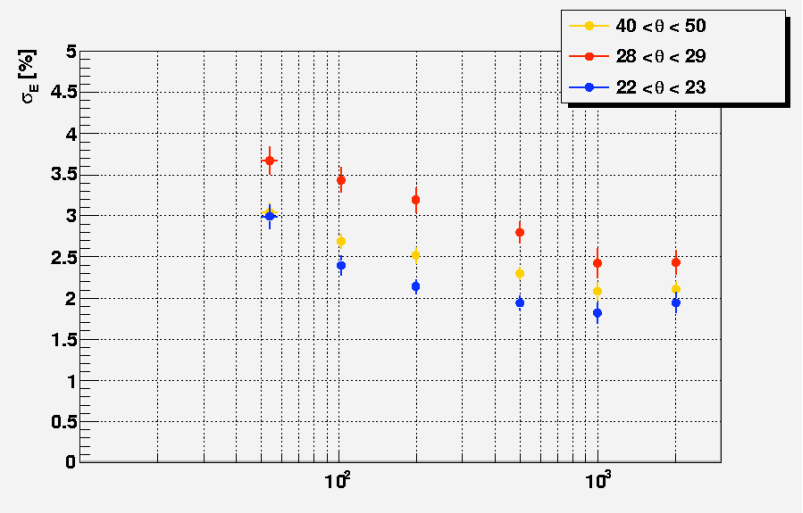



# Energy resolution vs E

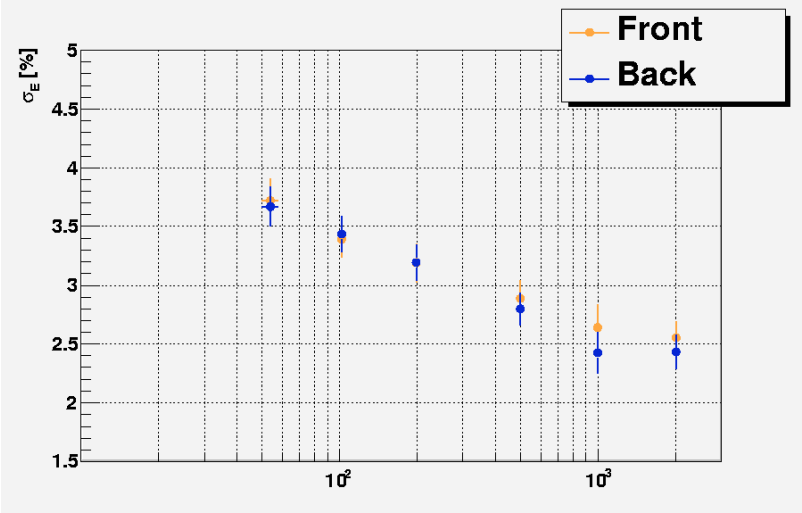
## Front aligned Endcap




## Back aligned Endcap



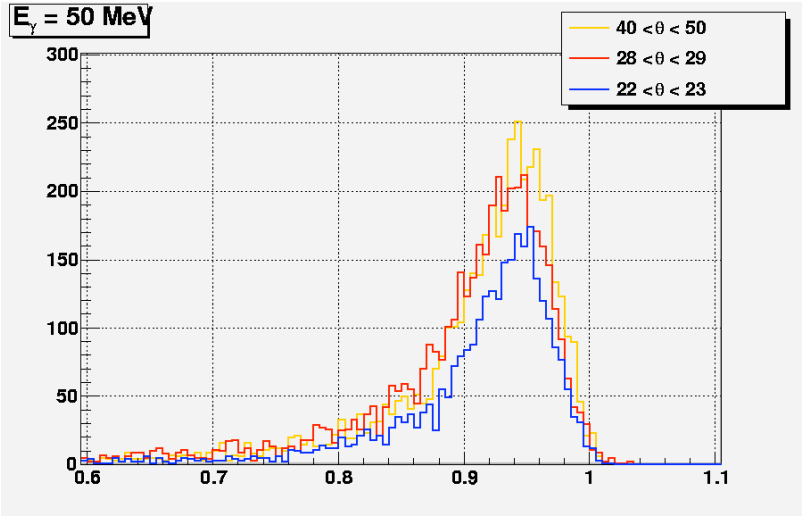

## 28 < Theta < 29



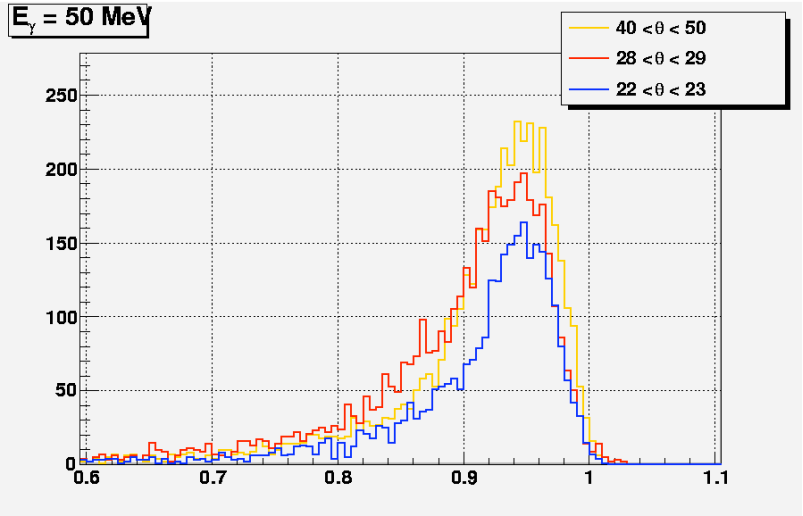

- The transition region has an impcat on the energy resolution
- The eefct seem not to depend on the endcap position

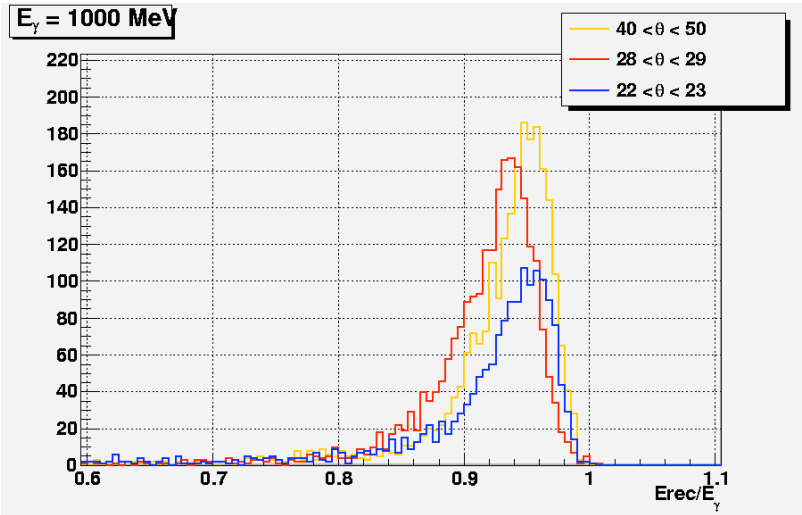
# Reconstructed Energy

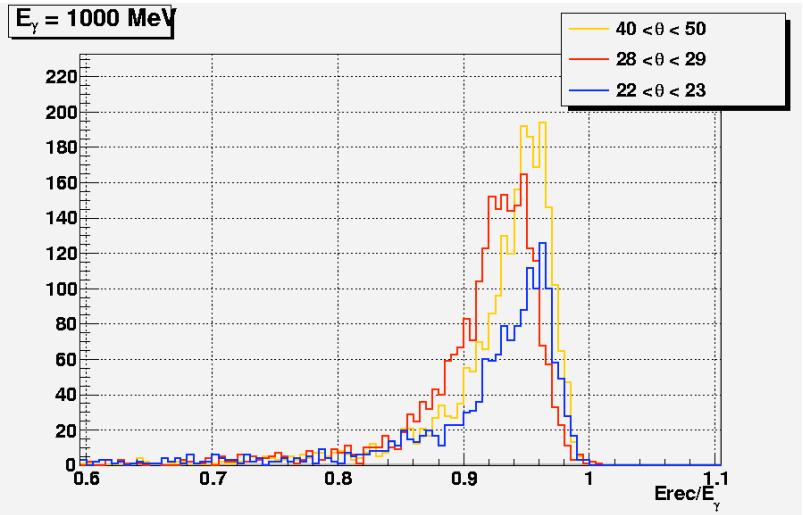
## Front aligned Endcap



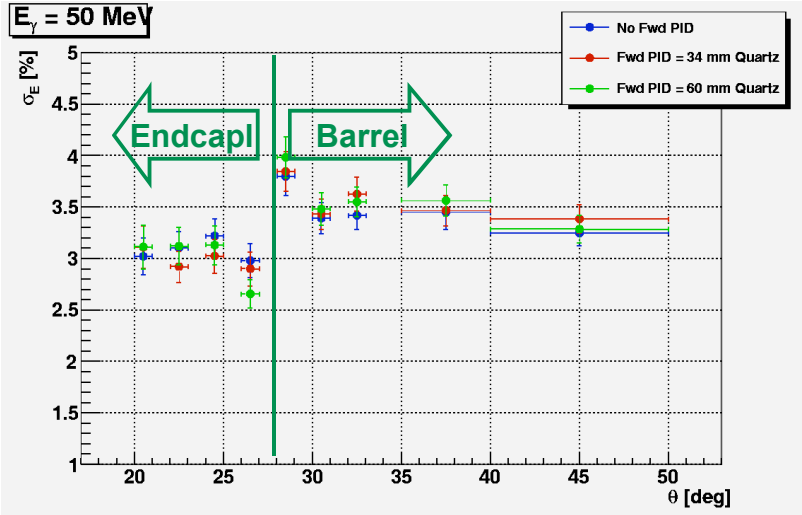

## Back aligned Endcap

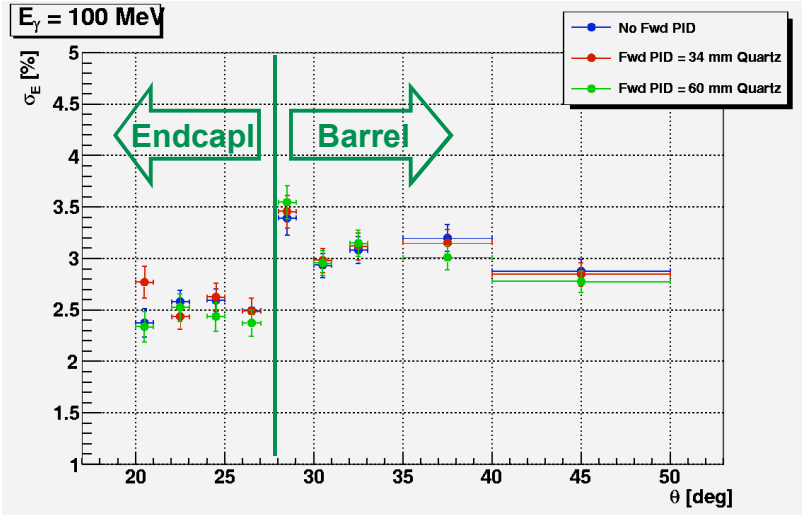


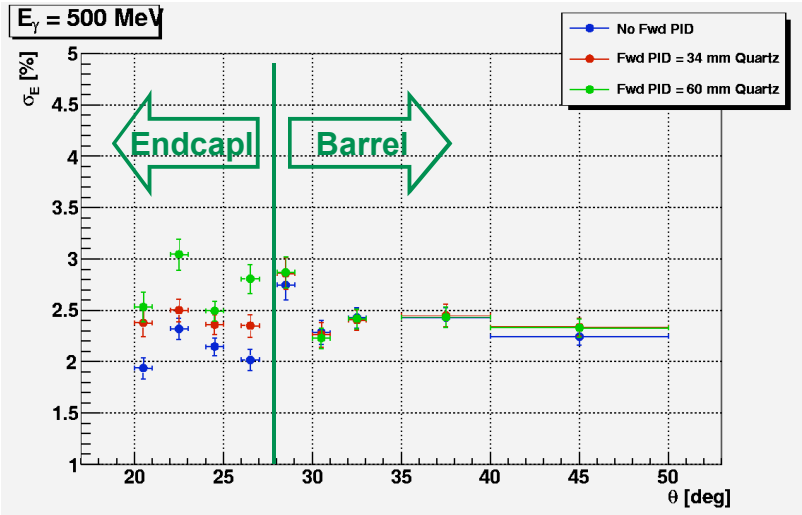



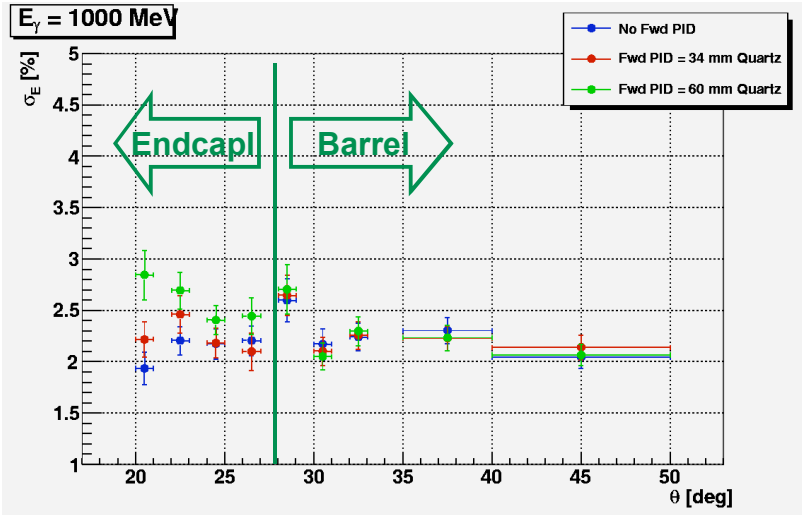



# Fwd PID material effect



# Conclusions

- The position of the endcap wrt the barrel alone does not seem to have an impact on the energu resolution

- The PID material seems to have a non negligible effect on the energy resolution
  - More detailed analysis needed