Fwd ECAL Simulation

SuperB Generla Meeting
(Calorimeter Group session)
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)

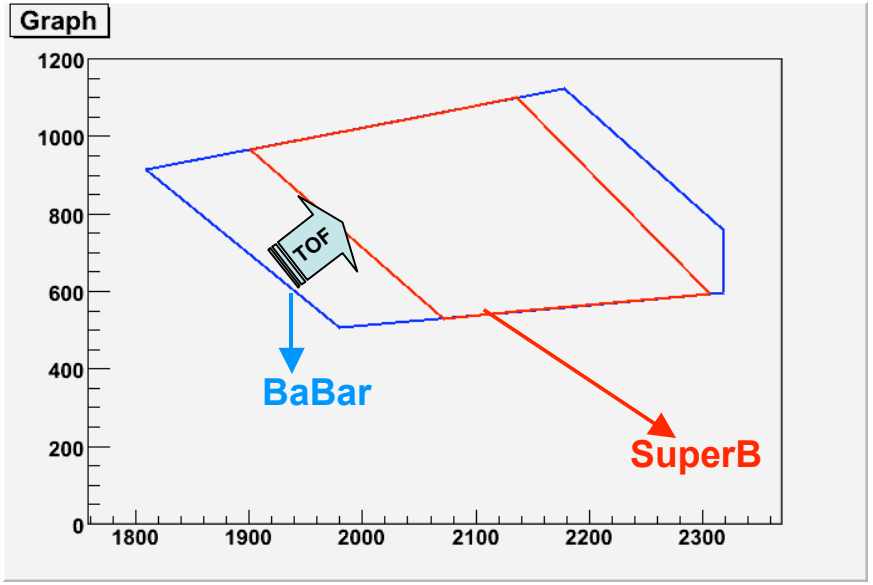
All the results are very preliminary and all the details need to be checked with more care

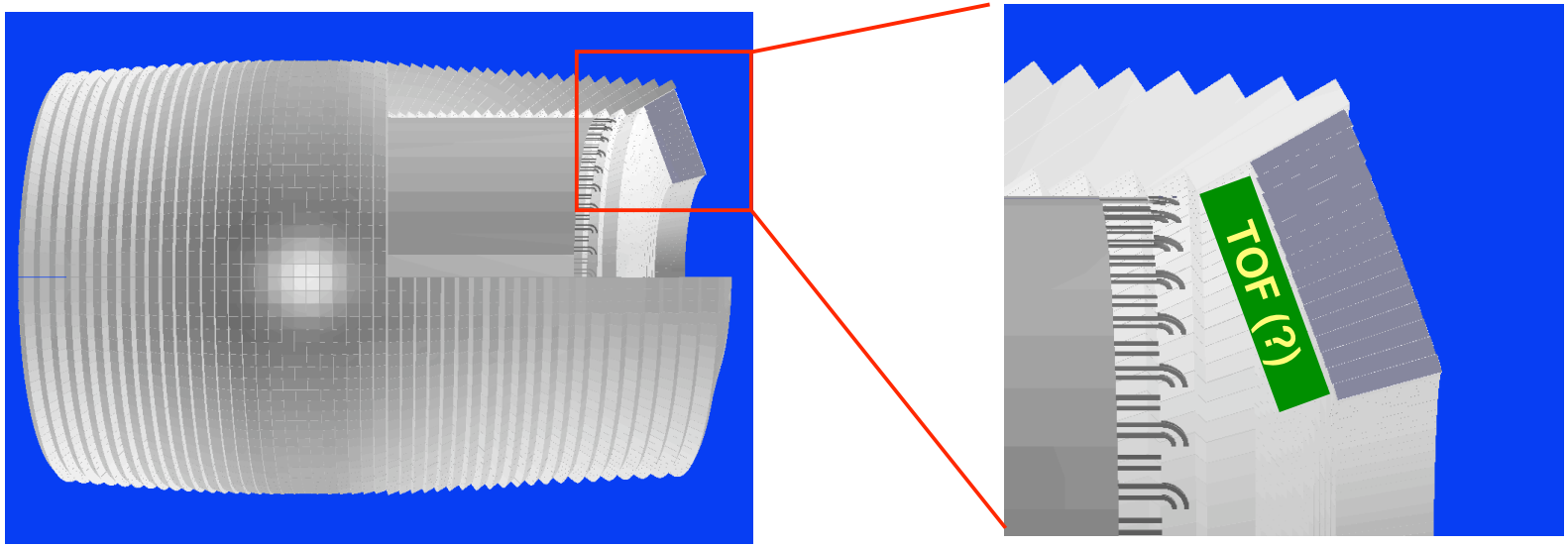
Performed studies:

- Investigate Barrel-Fwd transition region
- Effect of Fwd PID matrerial on energy resolution
- Quick look at a small sample of beam-strahlung background

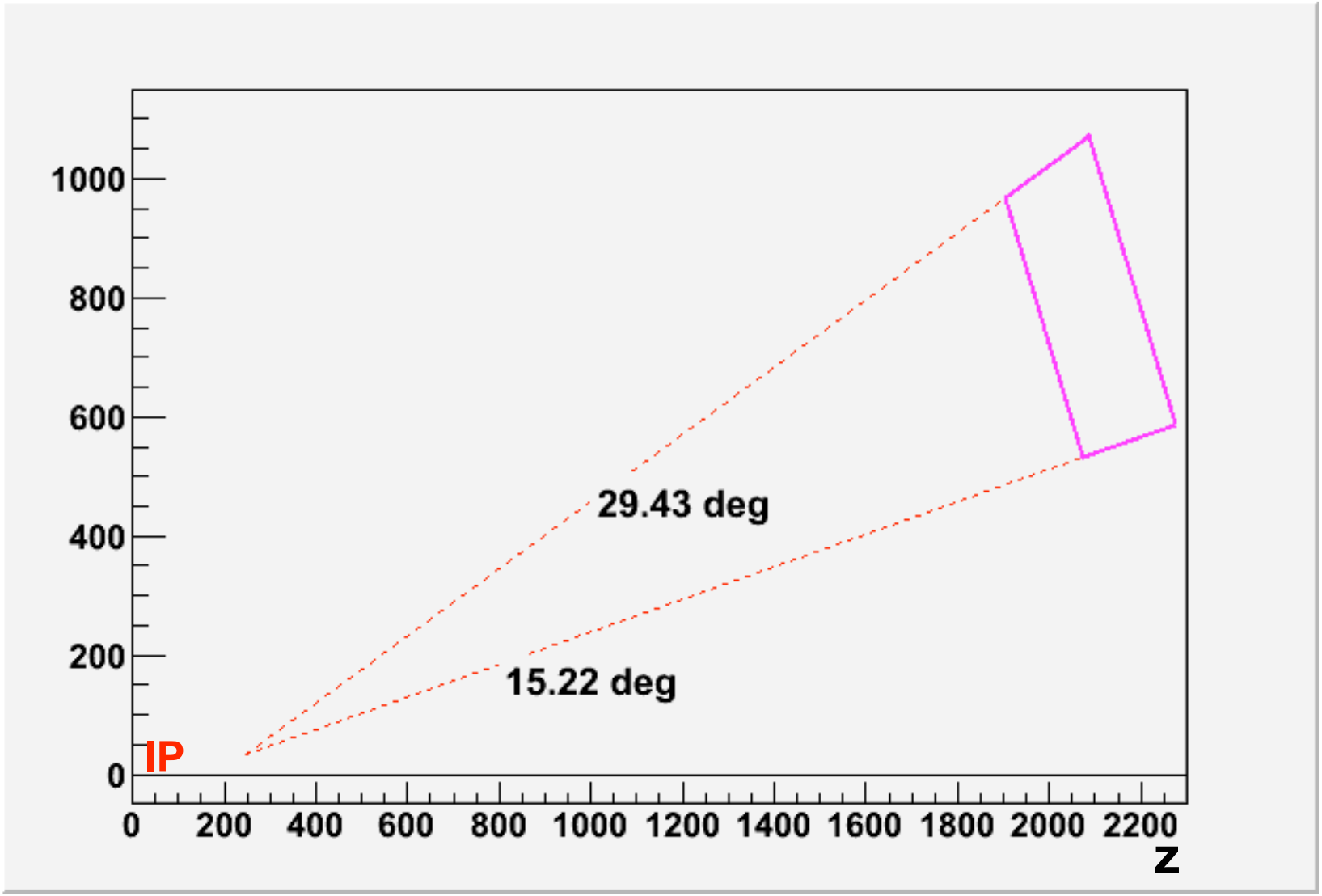
Fwd ECAL Geometry Envelop

- Fill the same BaBar angular region but
  - leave space for TOF: ΔZ = (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

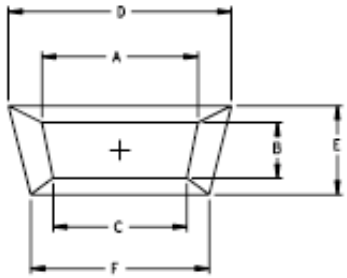
175 Xtals/Ring
35 Modules

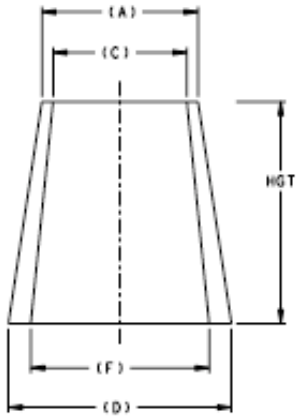
205 Xtals/Ring
41 Modules

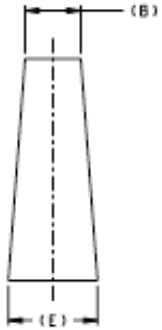
235 Xtals/Ring
45 Modules

260 Xtals/Ring
52 Modules

~4400 Crystals



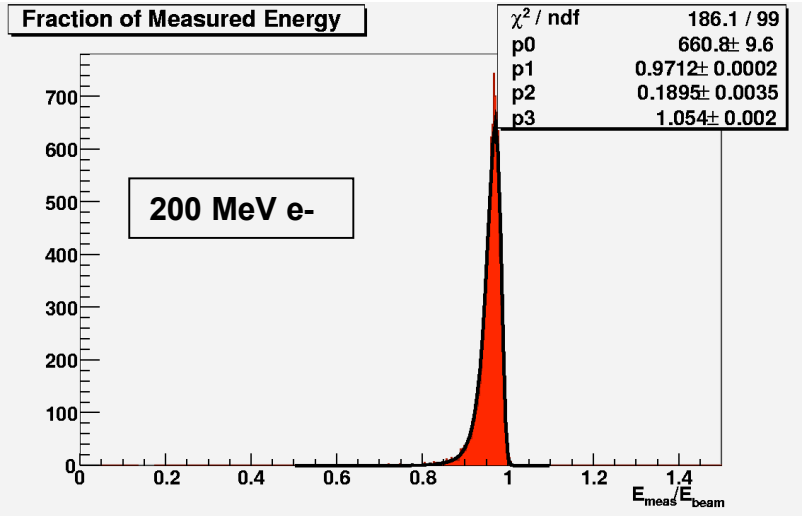




Energy Reconstruction

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



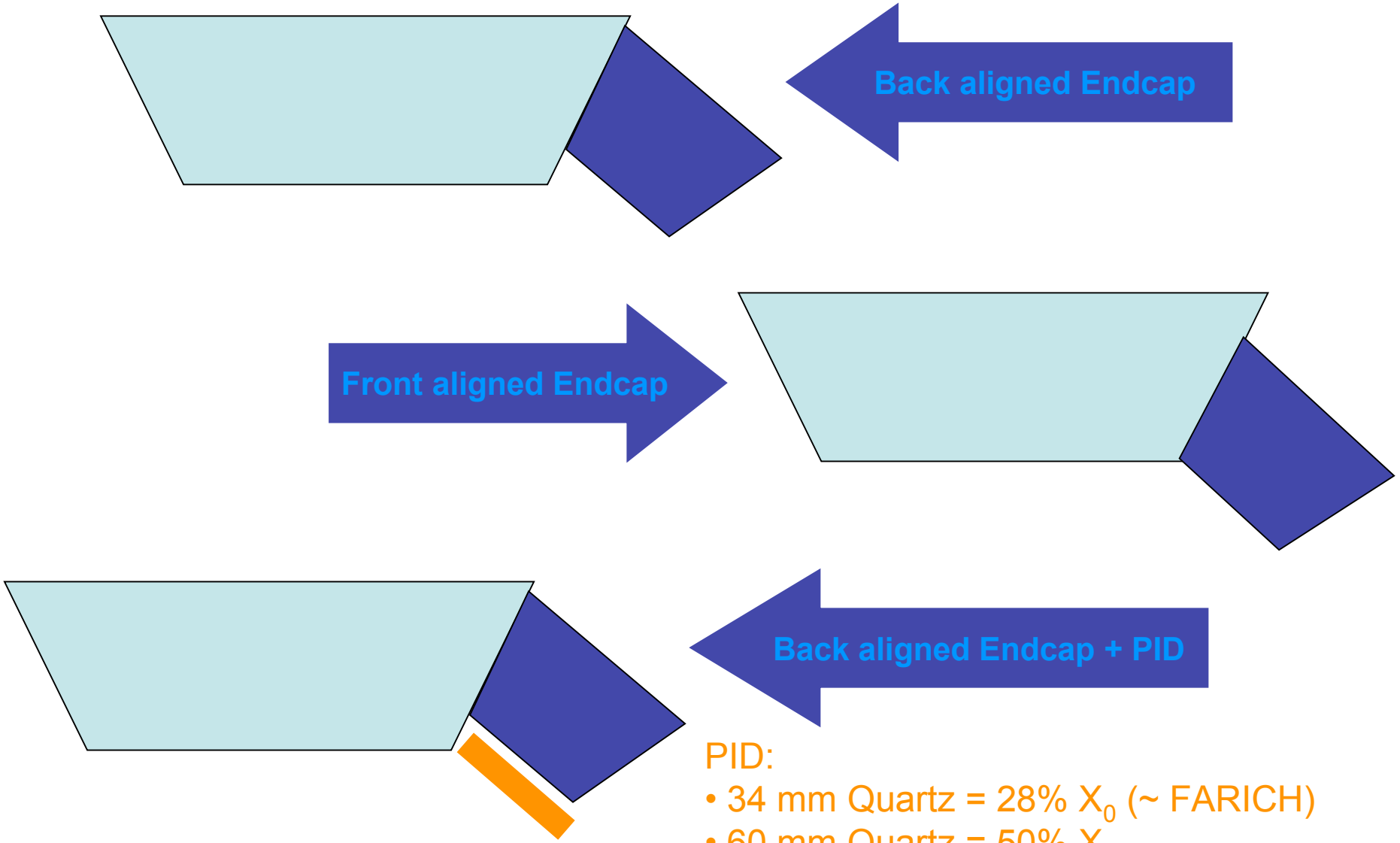
Comments:

- 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

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

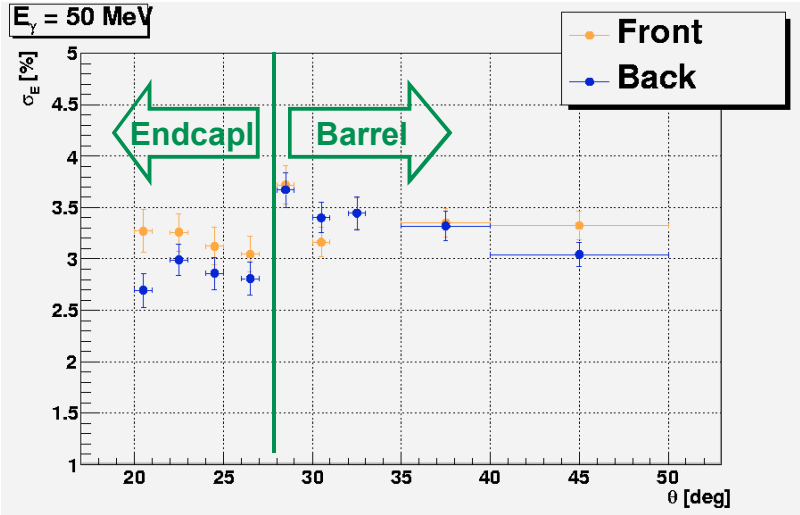
- P1 : most probable value (mpv)
- P2(P3-x) : running σ

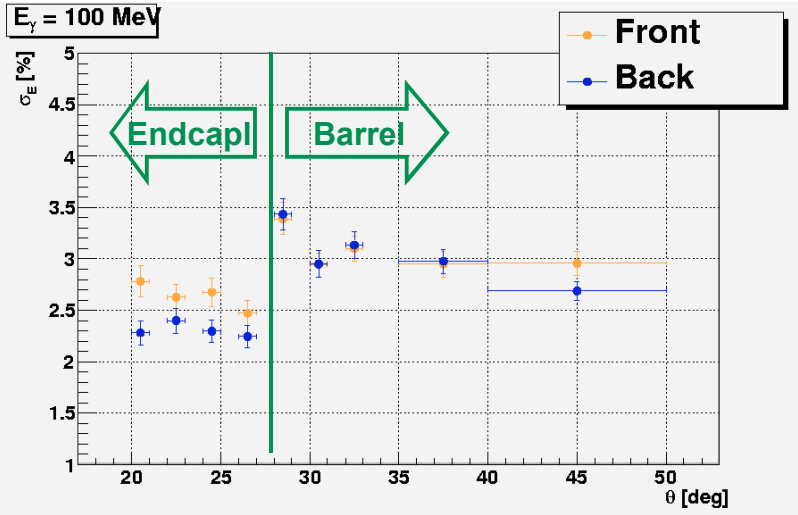
Geometry Options

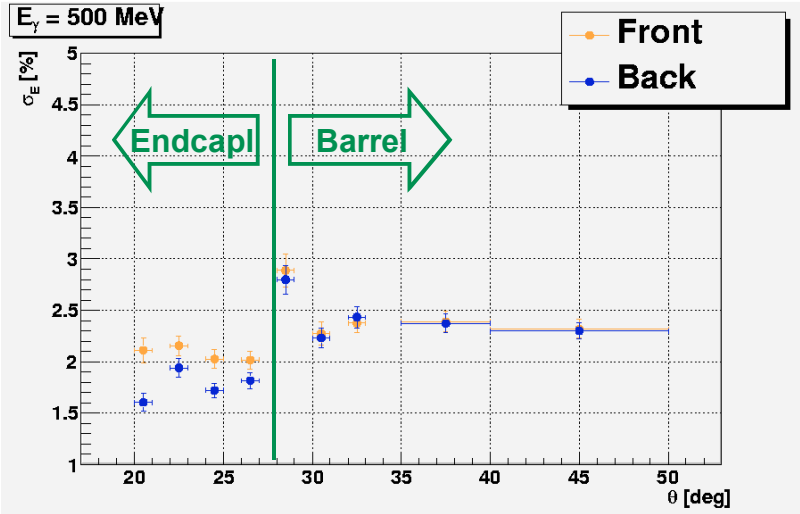


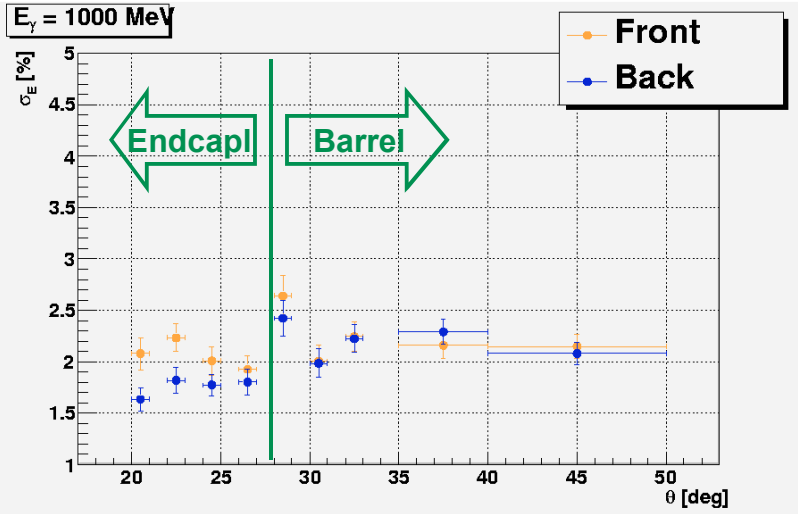
PID:
- 34 mm Quartz = 28% X_0 (~ FARICH)
- 60 mm Quartz = 50% X_0

Energy resolution vs Theta



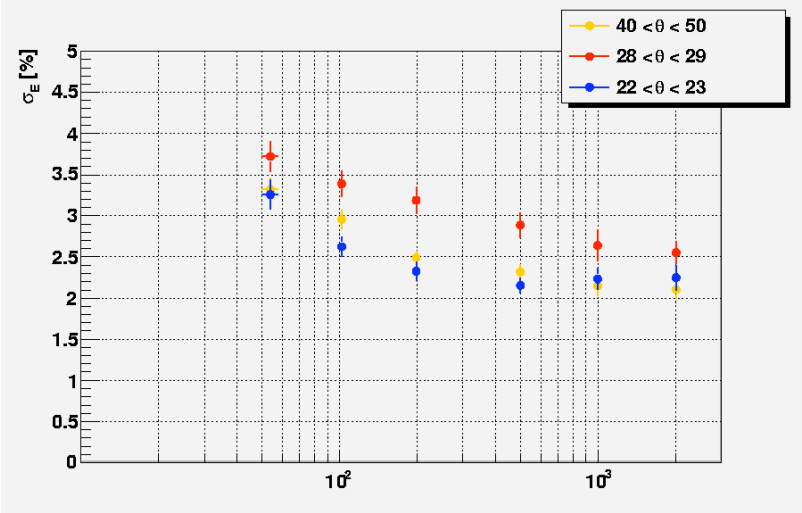




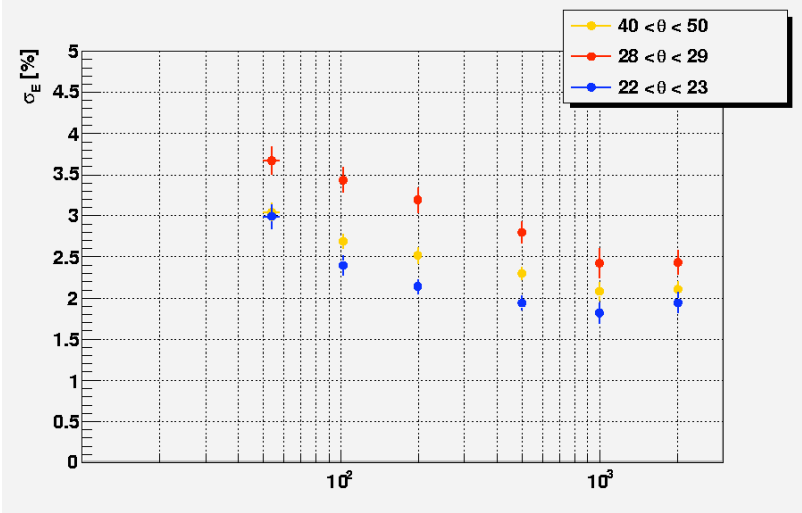


Energy resolution vs E

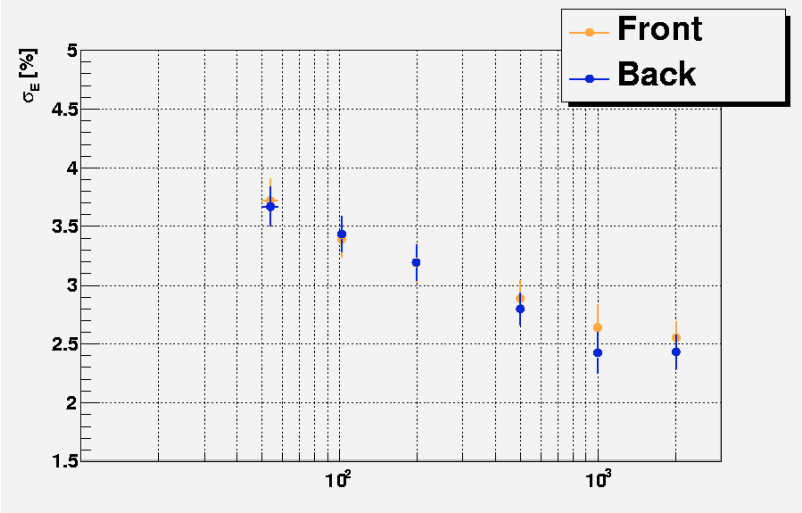
Front aligned Endcap



Back aligned Endcap



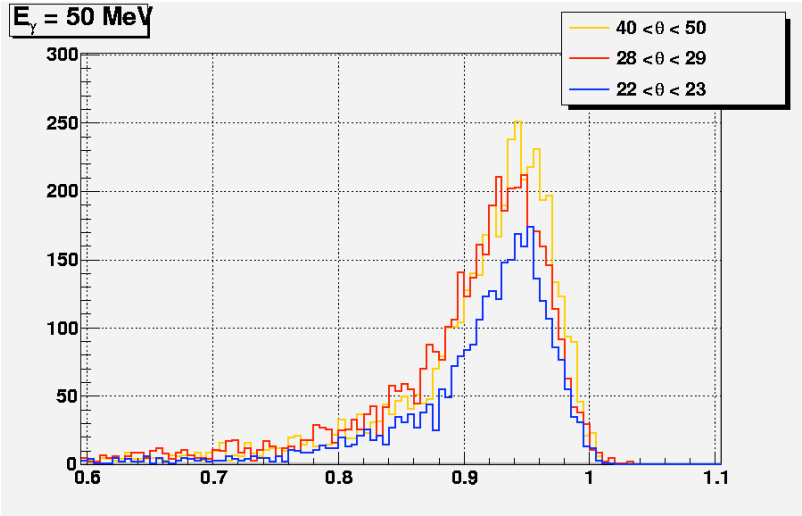
28 < Theta < 29



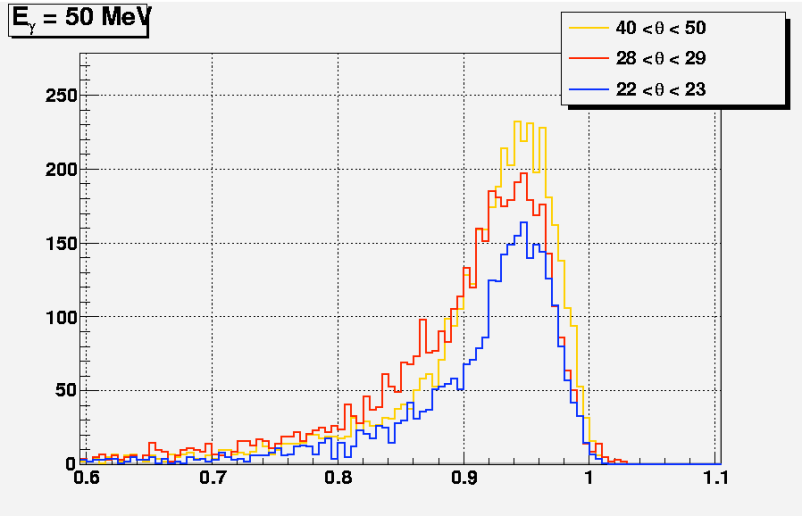
- The transition region has an impcat on the energy resolution
- The eefct seem not to depend on the endcap position

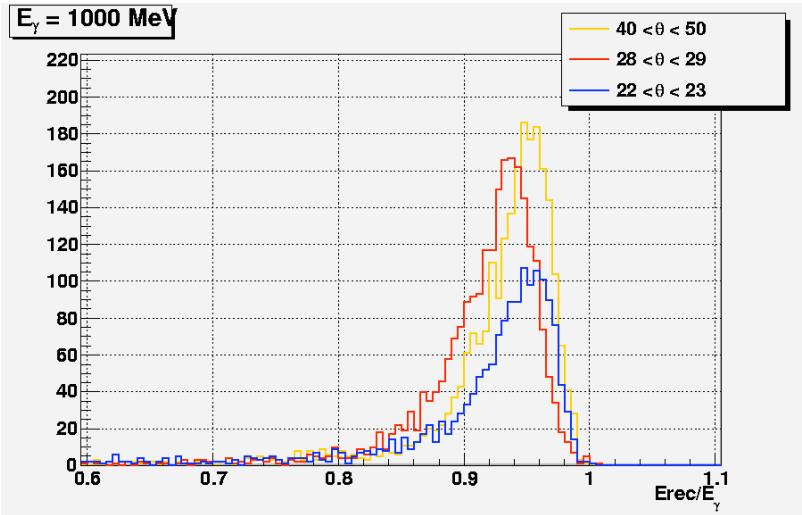
Reconstructed Energy

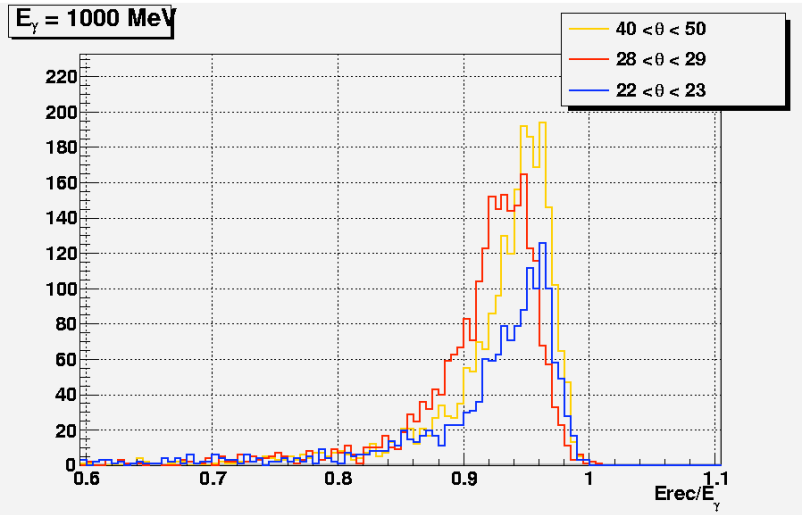
Front aligned Endcap



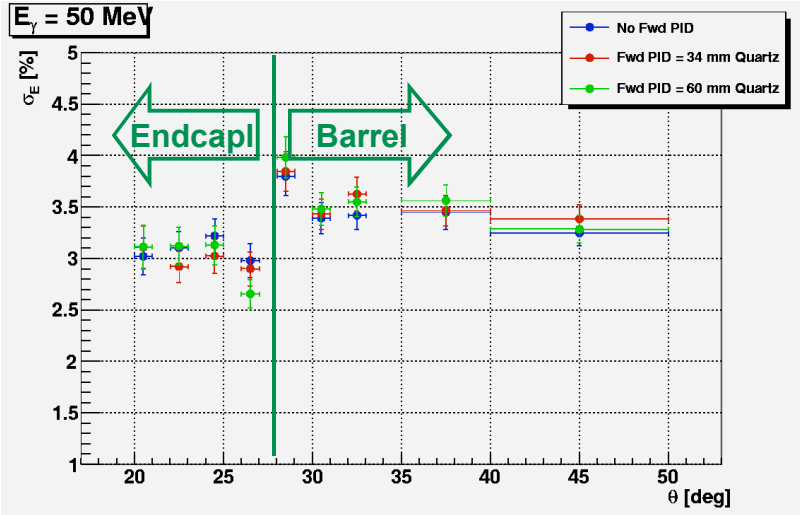
Back aligned Endcap

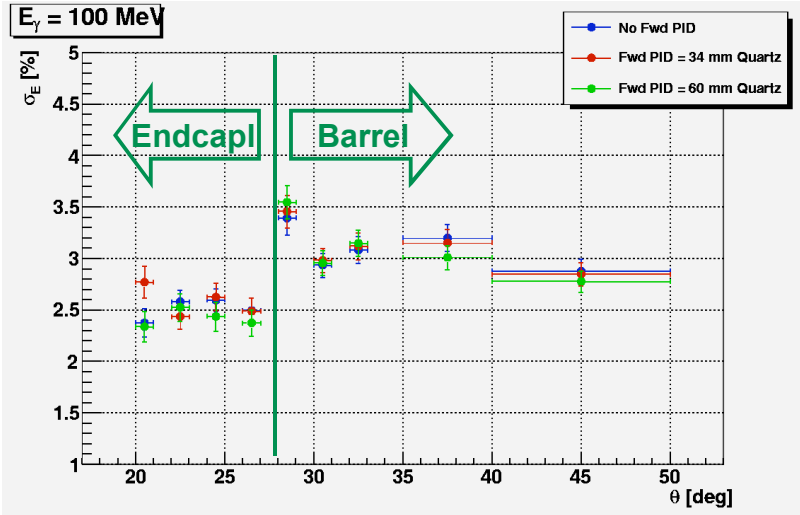


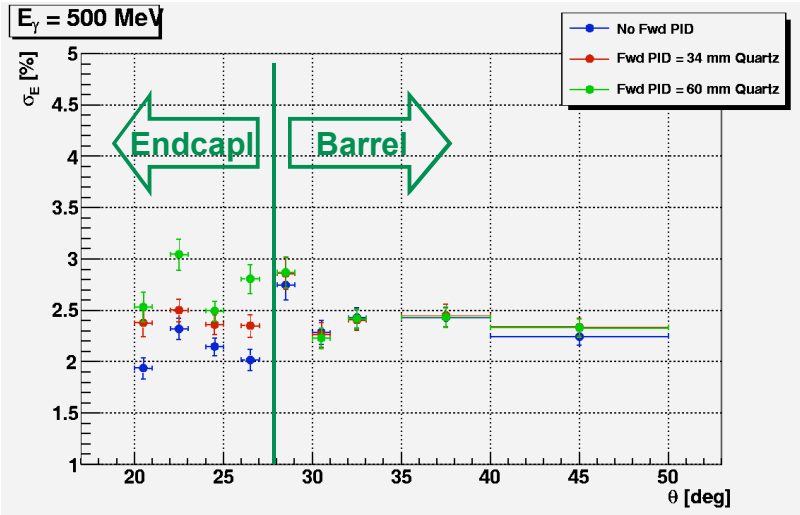


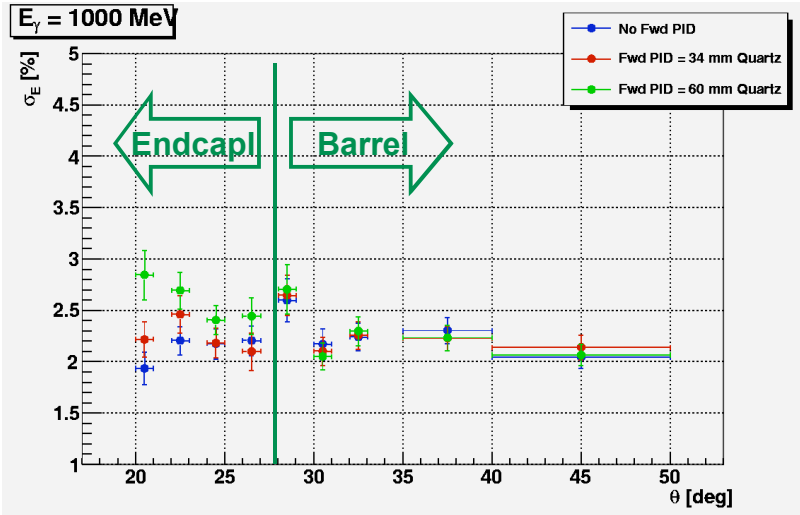


Fwd PID material effect







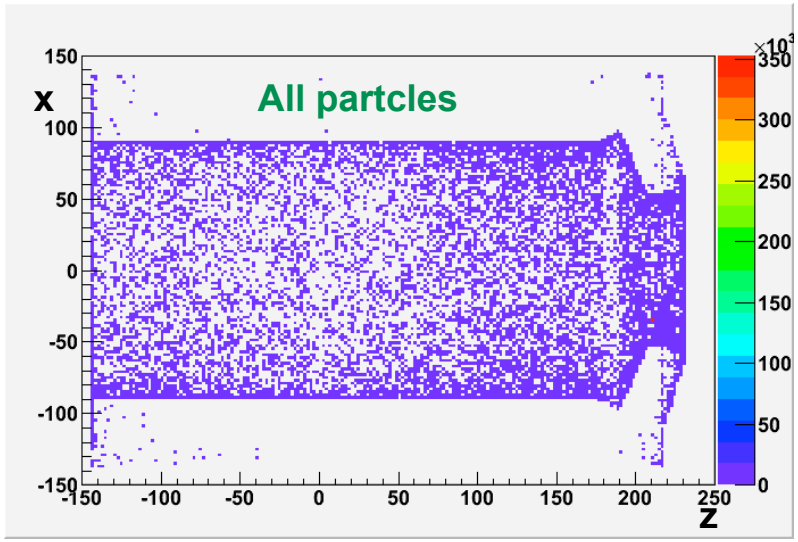


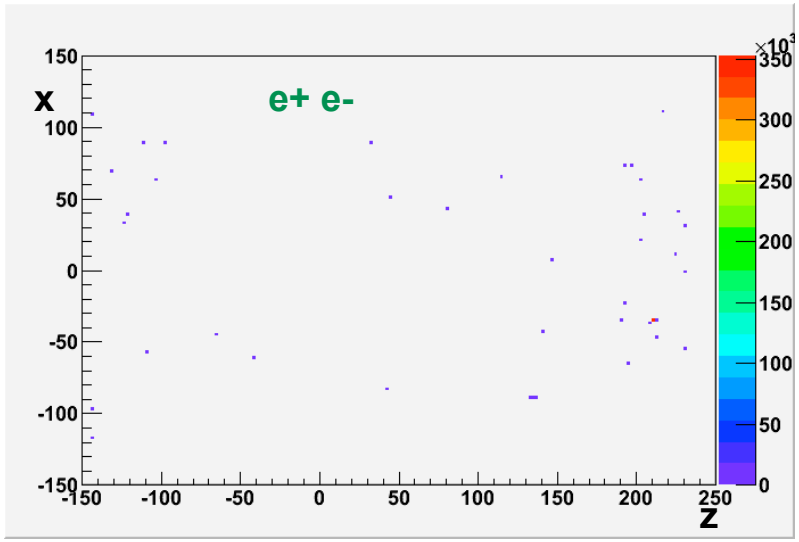
Background

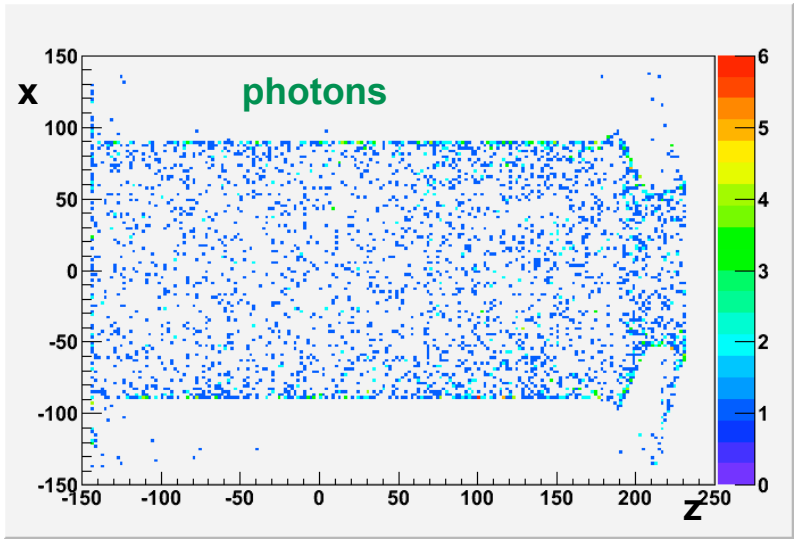
- Data sample
  - 1400 beam-strahlung events
  - Corresponding to 6.1 μs of SuperB run

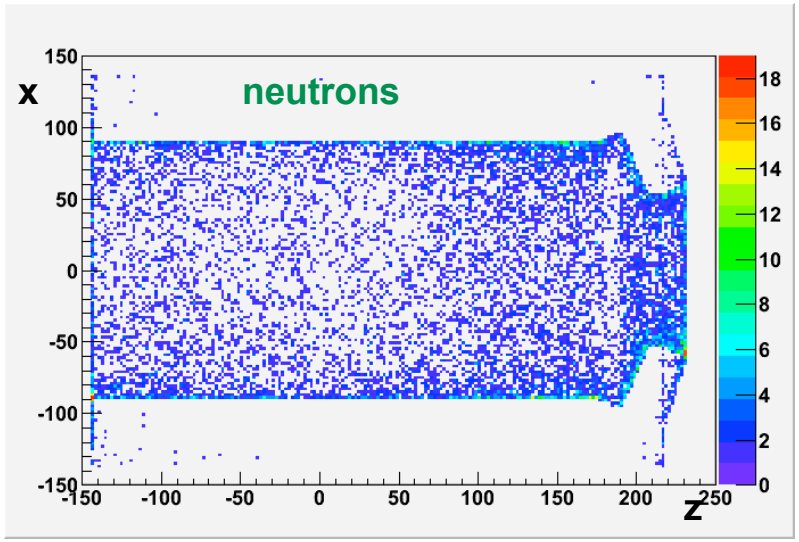
- Warnings
  - The sample has been generated with an ol vesion of the code
    - 15 rings in the encap
    - Bug to a bug in the ECAL recontruction code : no phi index available for calòorimeter crystals

Backgrond partcles entering the EMC volume

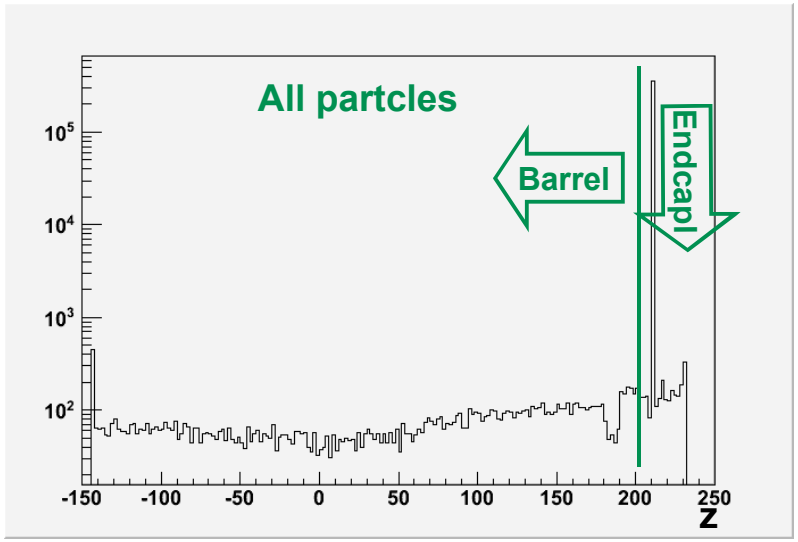


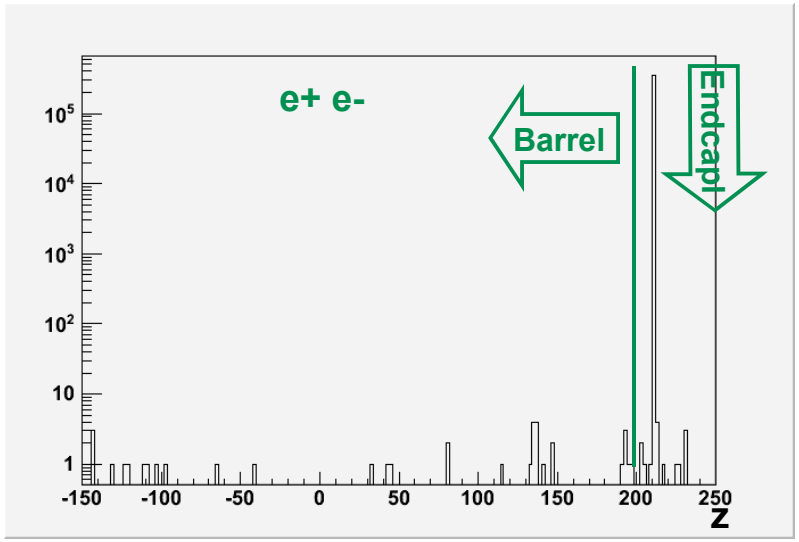


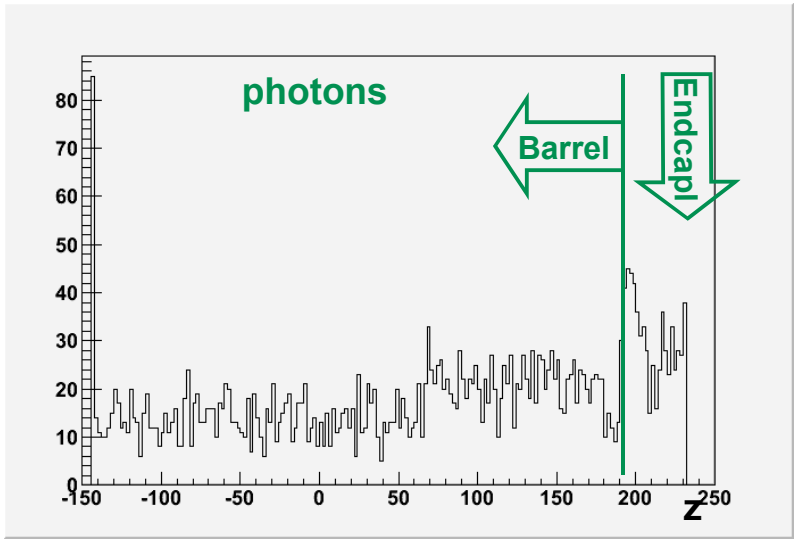


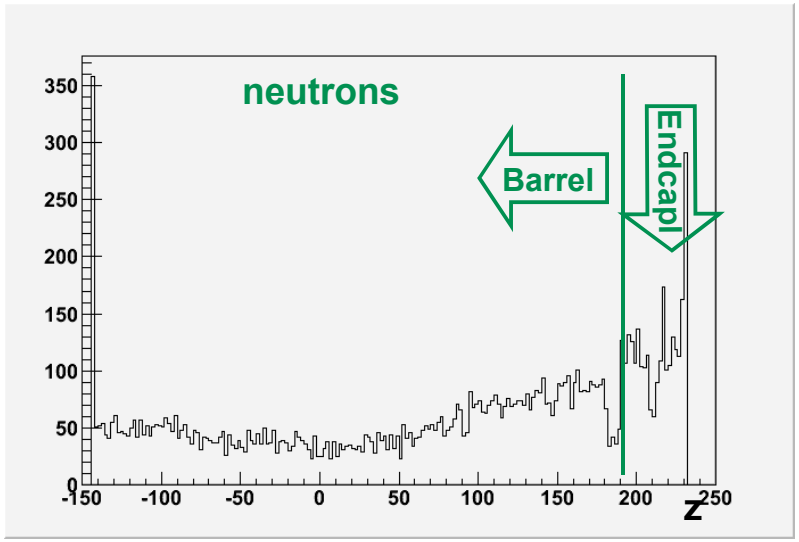


Backgrond partcles entering the EMC volume

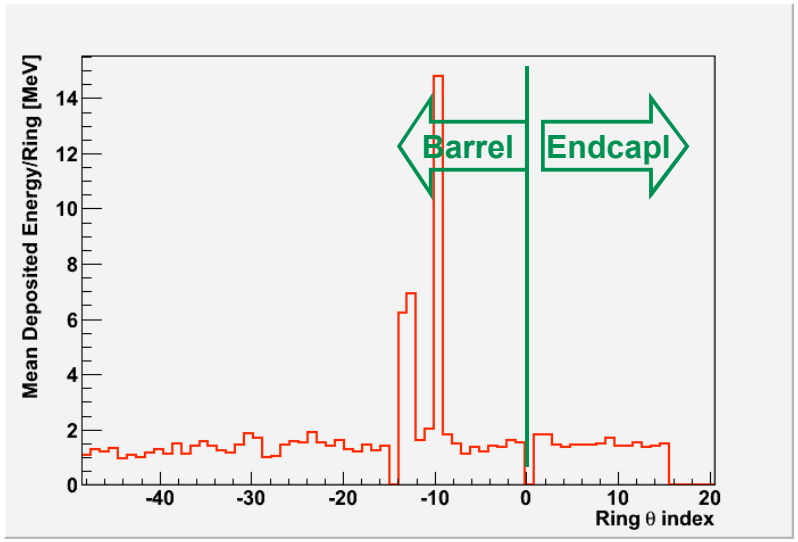






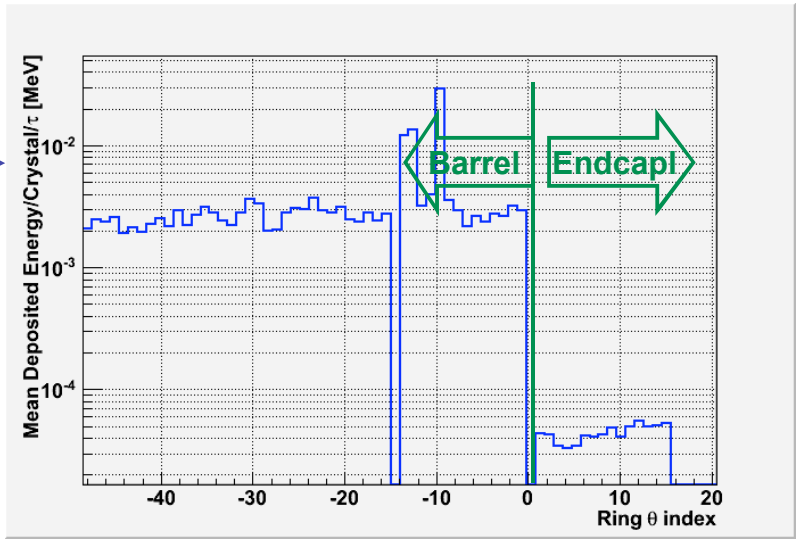


Deposited energy in background events



Mean Energy deposit per crystal in one decay constant

- CsI : 64% 680 ns + 36% 3.34 μs
- LSO 40 ns



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
- Background energy deposit seems not to be an issue
  - Need to compute particles rate