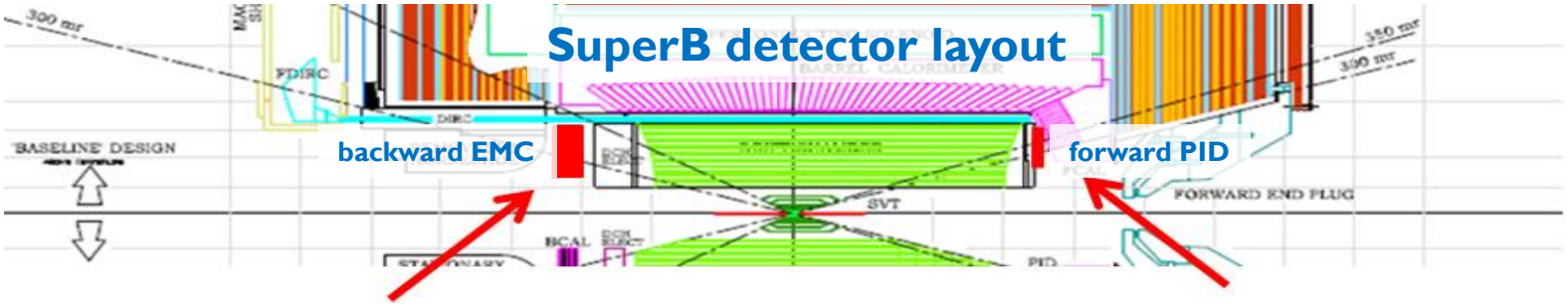
Updated study about the impact of the forward PID material on the EMC

M. Rama/A. Stocchi on behalf of the DGWG

Joint meeting of detector geometry task forces, 6 Apr 2011

Studies discussed at CalTech (Dec 2010)



potential pros and cons studied so far

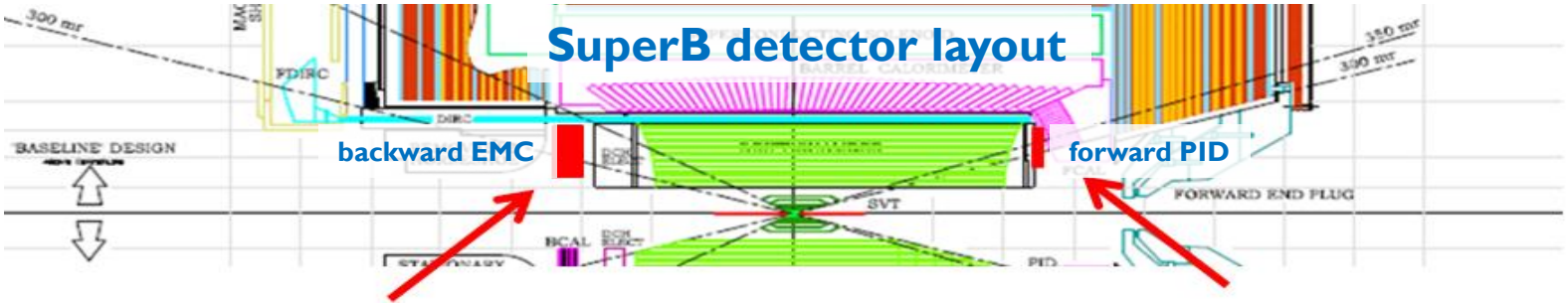
Backward EMC:

- ↑ **increased EMC angular coverage**
  tested with:
  -) $B \to K^{(*)}\nu\nu$ and $B \to \tau\nu$ physics reach
- ↓ **reduction of the drift chamber length**
  tested with:
  -) track & B reco. vs DCH length

Forward PID:

- ↑ **increase of PID efficiency**
  tested with:
  -) $B \to K^{(*)}\nu\nu$ and $B \to \tau\nu$ physics reach
- ↓ **material in front of the forward EMC**
  tested with:
  -) Geant4 study and FastSim study
- ↓ **reduction of the drift chamber length**
  tested with:
  -) track & B reco. vs DCH length

Updated studies discussed today



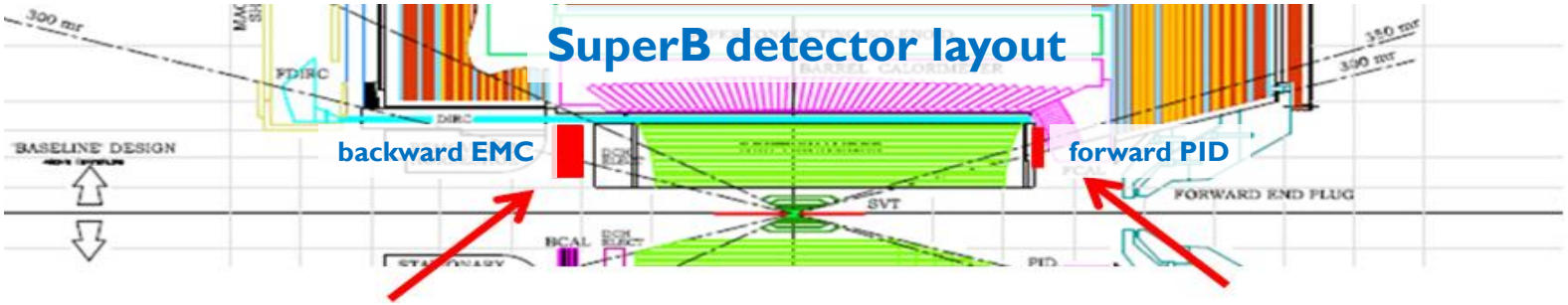
potential pros and cons studied so far

Backward EMC:

- **increased EMC angular coverage**
  tested with:
  -) $B \rightarrow K^{(*)}\nu\nu$ and $B \rightarrow \tau\nu$ physics reach
- **reduction of the drift chamber length**
  tested with:
  -) track & B reco. vs DCH length

Forward PID:

- **increase of PID efficiency**
  tested with:
  -) $B \rightarrow K^{(*)}\nu\nu$ and $B \rightarrow \tau\nu$ physics reach
- **material in front of the forward EMC** (update)
  tested with:
  -) Geant4 study and FastSim study
- **reduction of the drift chamber length**
  tested with:
  -) track & B reco. vs DCH length

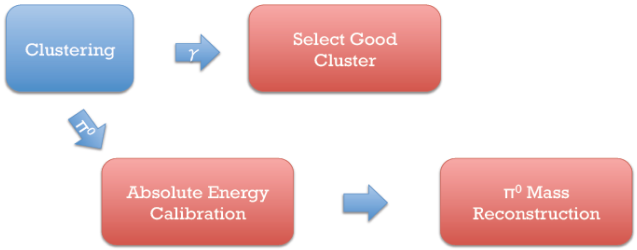


Material in front of the forward EMC

study done by Stefano Germani

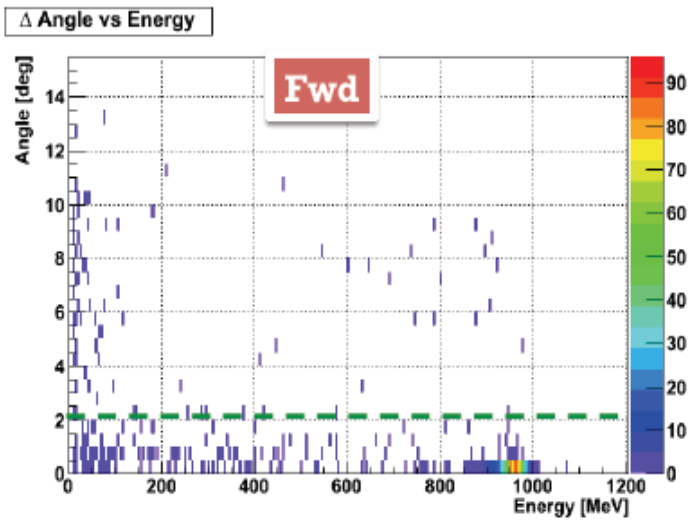
Strategy

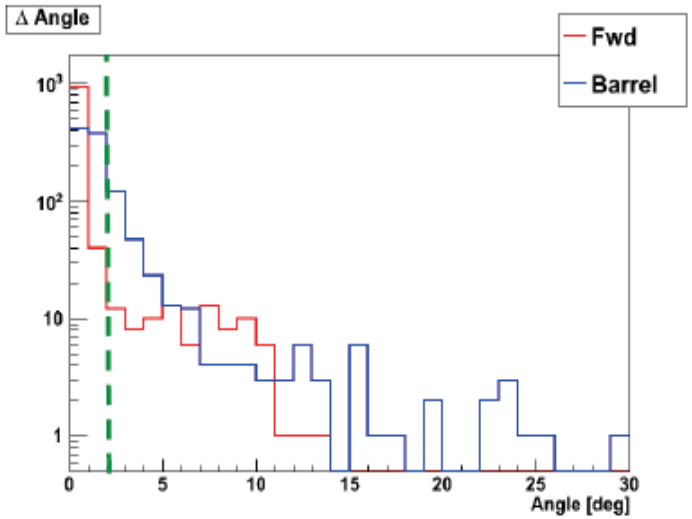
Single photons or single pi0s are simulated in Geant4
and shot in the forward region
Machine background is superimposed



The candidate photon is associated to the cluster with the smallest angle with respect to the MC truth

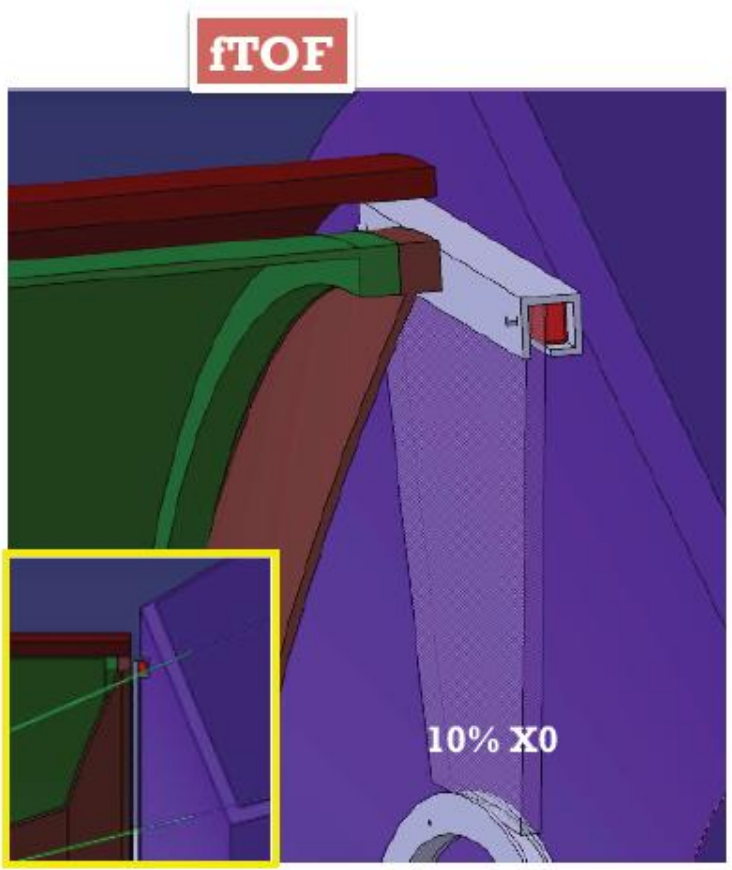
For the Fwd energy resolution only clusters with an angle < 2 deg are considered

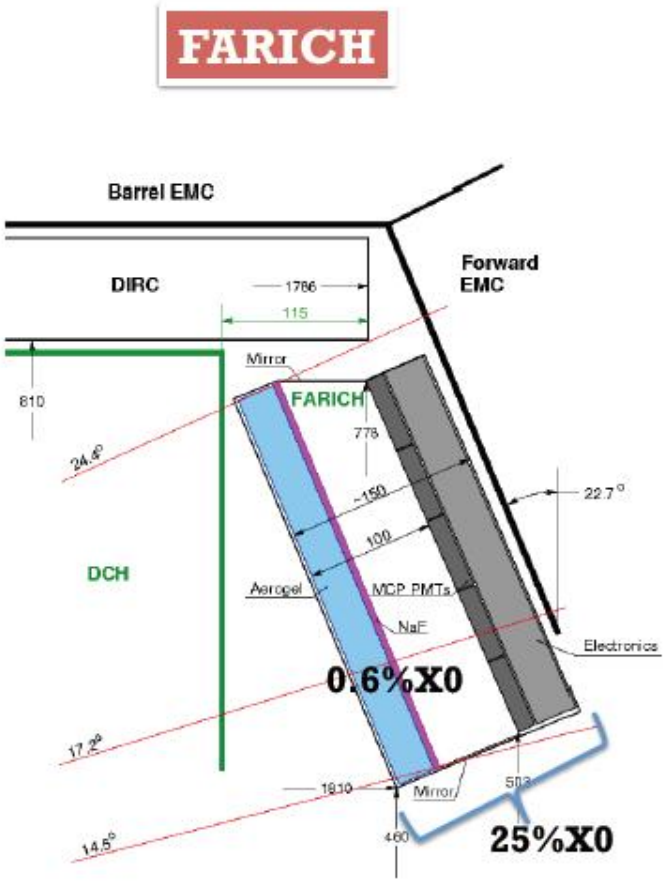




FTOF and FARICH geometries in Geant4

Fwd PID geometry options

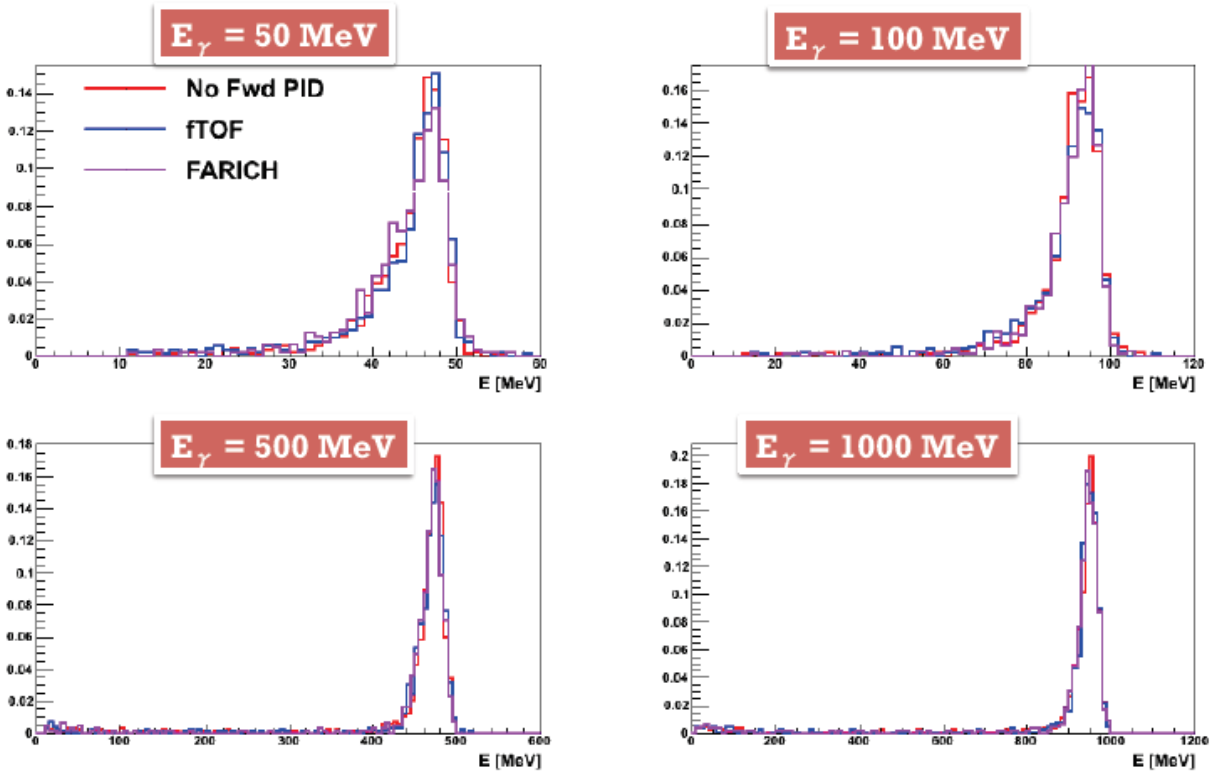




Photon reconstructed energy in fwd region

S. Germani

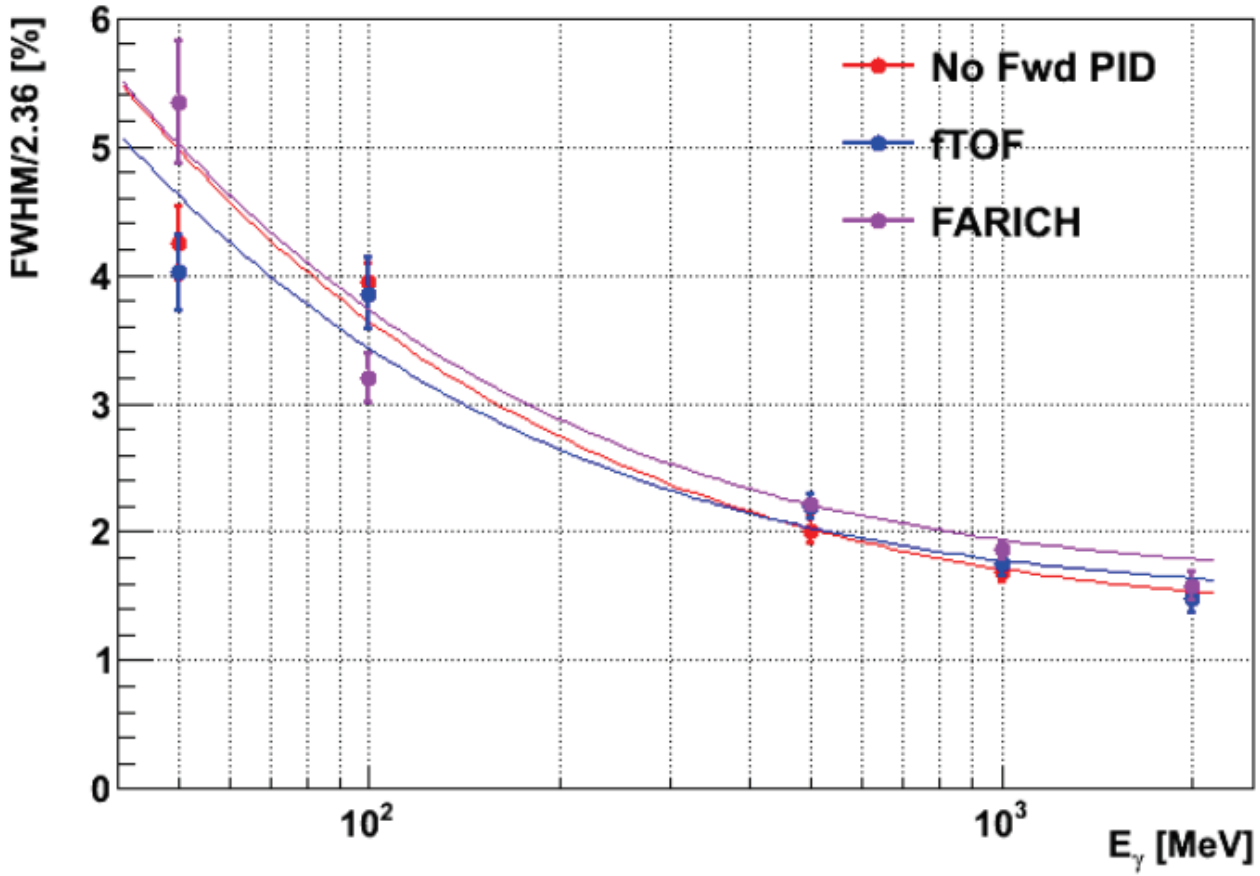
Fwd Emc Measured Energy Distribution



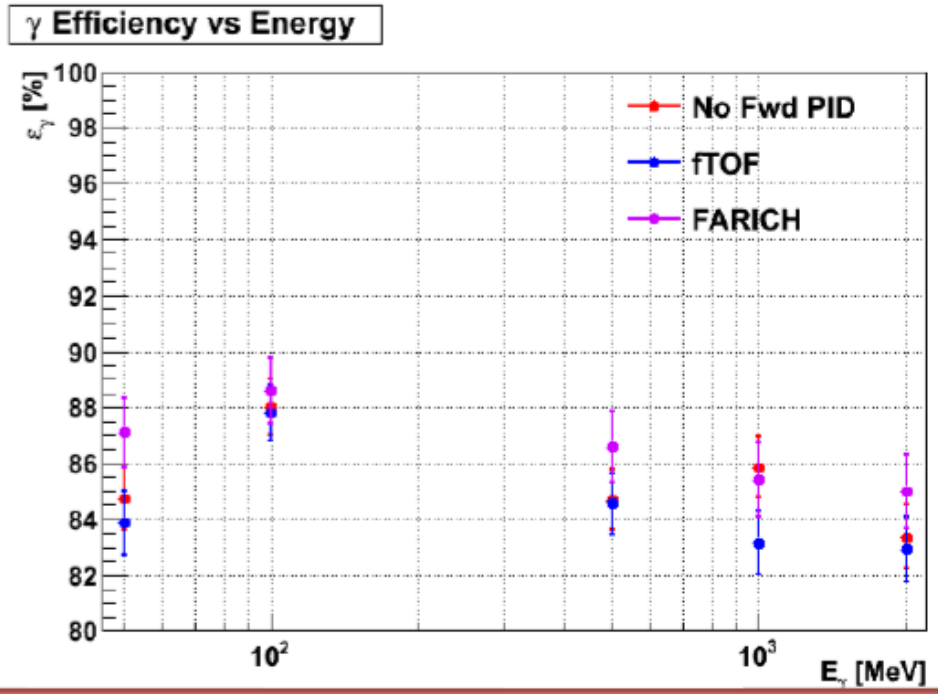
Photon energy resolution in fwd region

Fwd EMC Energy Resolution

S. Germani



Fwd EMC γ Efficinecy



eff(FARICH)>eff(fTOF)
(but single points are stat. compatible)

can it be due to different placement of fTOF compared to FARICH?

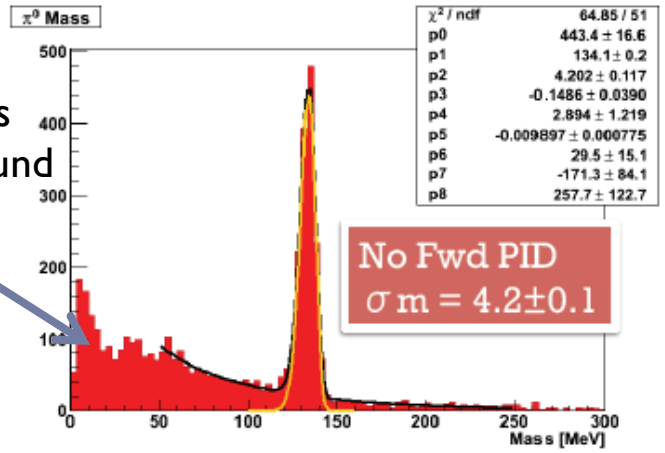
Due to the lack of tracking reconstruction with the angle selection some of the upstream converting photons are lost.
Clusters with angle-energy correlation for upstream converting γ @ 1 GeV are
~ 12% for No Fwd PID and FARICH
~ 15% for fTOF

π^0s reconstructed in fwd EMC

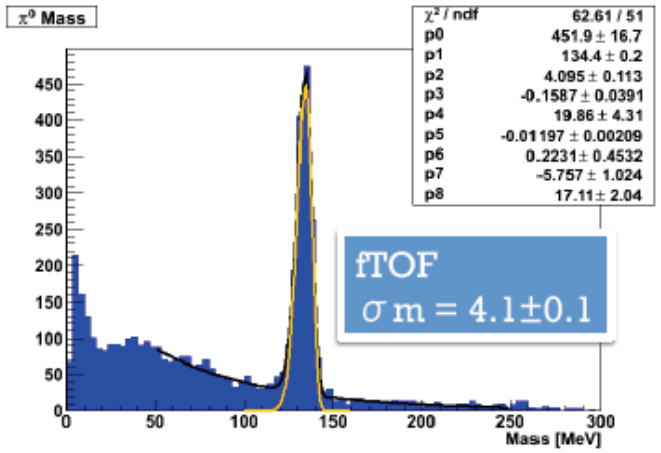
π^0 Mass

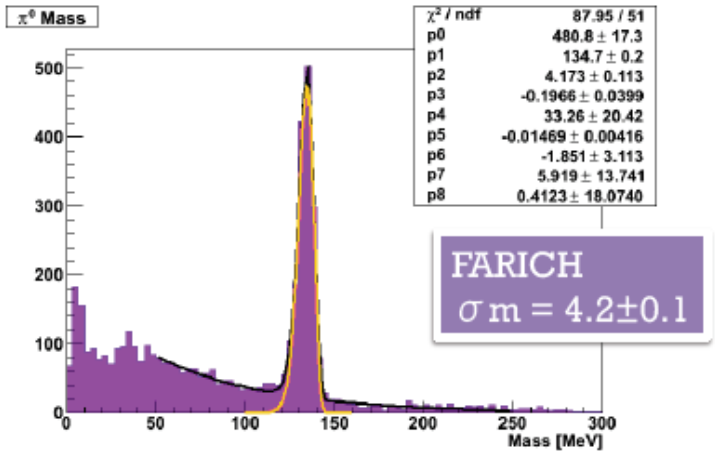
E kin(π0)=1 GeV

combinatorics with background photons



π^0 with Ek = 1 GeV
Both clusters in Fwd Endcap
Fit: Background + Novosibirsk

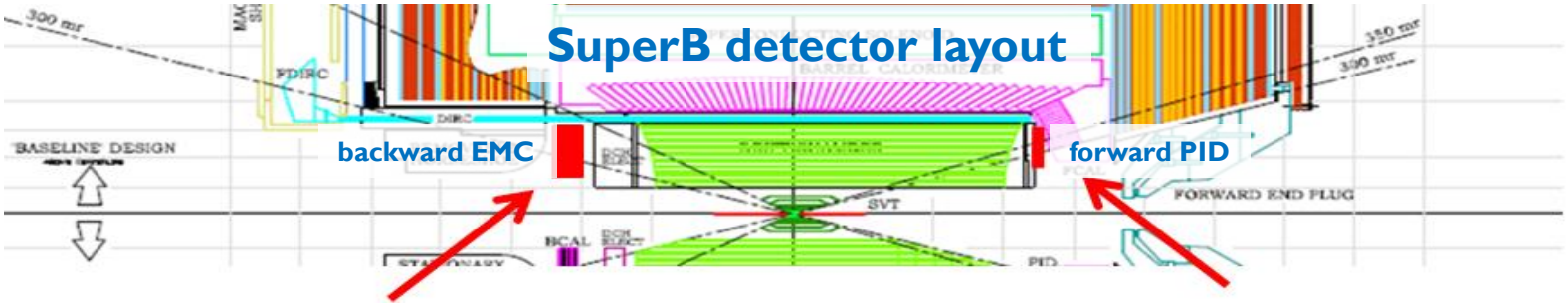




Stefano's conclusions

S. Germani

- Fwd PID Effects on EMC
  - γ
    - fTOF and FARICH effects on photons energy resolution are negligible
    - FARICH effects on photon detection efficiency is negligible
    - fTOF effect on photon detection efficiency is very small
  - $\prod^0$
    - fTOF and FARICH effects on pions mass resolution are negligible
    - fTOF and FARICH effects on pions detection efficiency is small


SuperB detector layout
backward EMC
forward PID
BASELINE DESIGN
FDIRC
SVT
FORWARD END PLUG
BCAL
PID

Summary

Summary I

Forward PID:

increase of PID efficiency

-) 2.0-2.5% efficiency gain per identified $K^{\pm}$. Therefore:

- The efficiency of signal + Breco tag increases by ~4.5% (~2.5%) when there is (not) a $K^{\pm}$ in the signal final state
- The Breco tag background increases as well (~2.5%). No significant background increase in the signal-side (errors still large)
- S/sqrt(S+B) increases by ~1-4 % depending on the mode

material in front of the forward EMC

-) Effect of fTOF or FARICH material on photon and p0 reconstruction seems to be negligible or small according to the current studies

updated

reduction of the drift chamber length

-) ~1% relative efficiency loss in $B \rightarrow \pi^+\pi^-$ or $B^+ \rightarrow D^{*-}K^+$ with a 20cm shorter DCH (FARICH)

-) Moderate worsening of dE/dx K/π separation in forward region with FARICH. E.g: -0.2σ at 2.5 GeV at θ=23deg. The variation is largely compensated by the fwd PID performance.

Summary II

Backward EMC:

increased EMC angular coverage

-) S/sqrt(S+B) increase:

-)3-6% with $B \rightarrow K(*)\nu\nu$ SL tag, $B \rightarrow \tau\nu$ HAD/SL tag

-)5-10% with $B \rightarrow K^{(*)}\nu\nu$ HAD tag (larger uncertainty)

reduction of the drift chamber length

-) ~0.5% relative efficiency gain if the DCH is 20cm longer (no backward EMC)

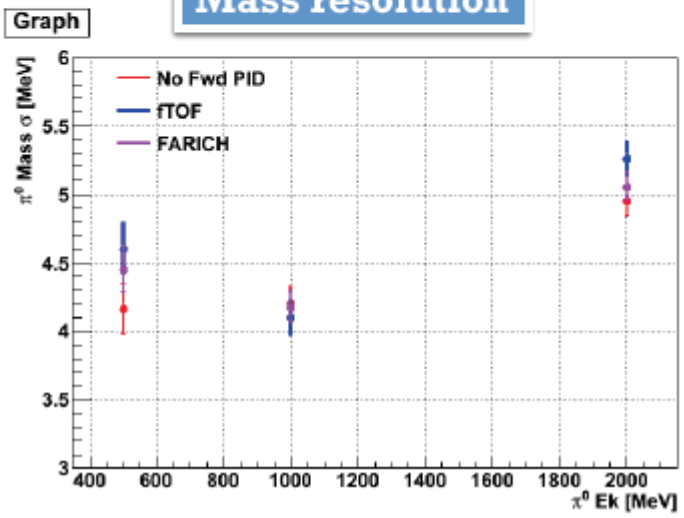
-) Moderate improvement of dE/dx K/π separation in backward region with no bwd EMC. E.g: $+0.4\sigma$ at 2.5 GeV at θ=150deg. But variations may be compensated by a possible PID capability of the bwd EMC.

backup

π^0 Mass and Efficiency vs Energy

2 Photons in the Fwd region

Mass resolution



Relative Efficiency

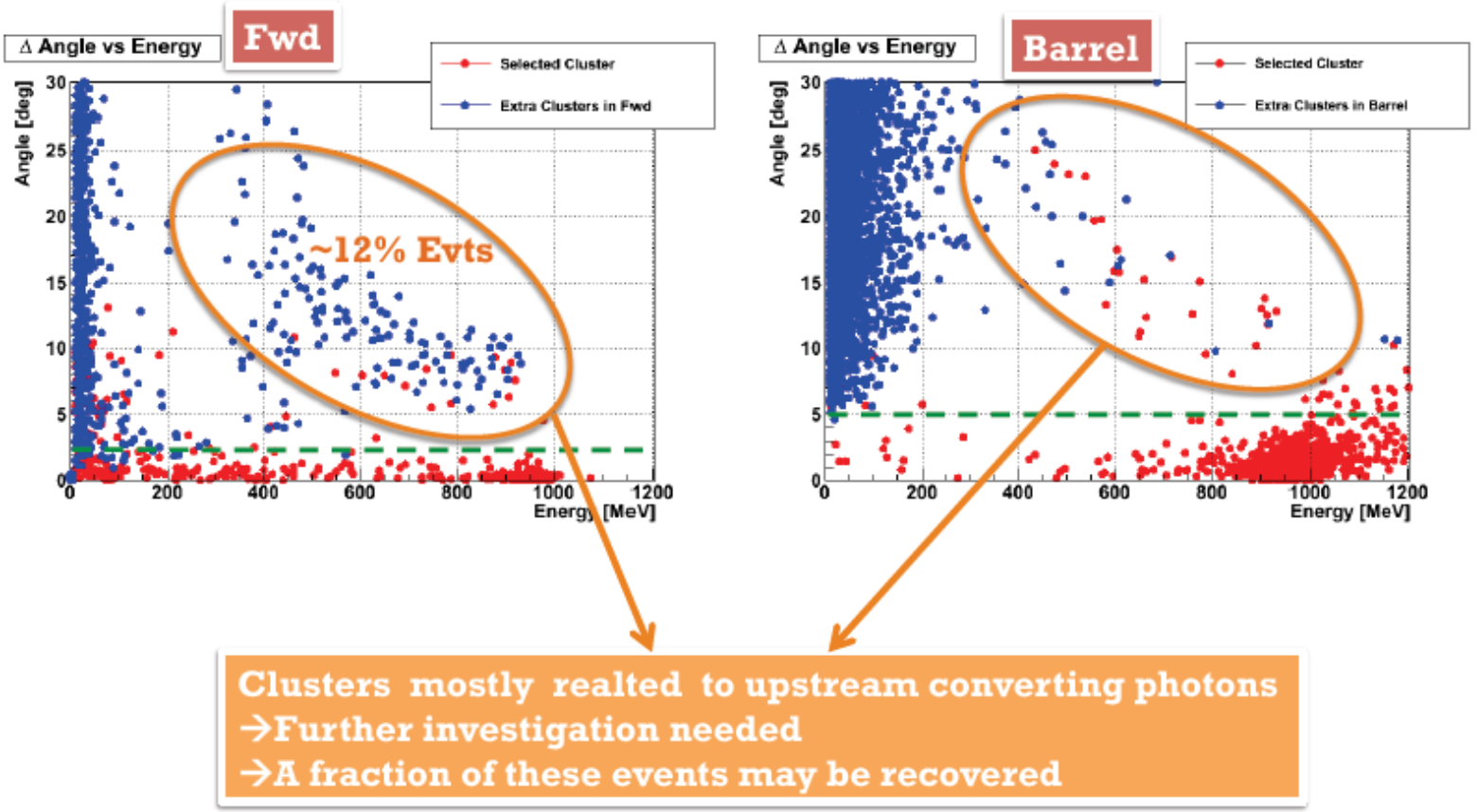
π^0 with Ek = 1 GeV
Both clusters in Fwd Endcap
Fit: Background + Novosibirsk

$\varepsilon_{\text{fTOF/NoPID}} = 98.0 \pm 1.2$
$\varepsilon_{\text{FARICH/NoPID}} = 96.5 \pm 1.5$

PRELIMINARY, TBC

Cluster Angle wrt Photon

S. Germani

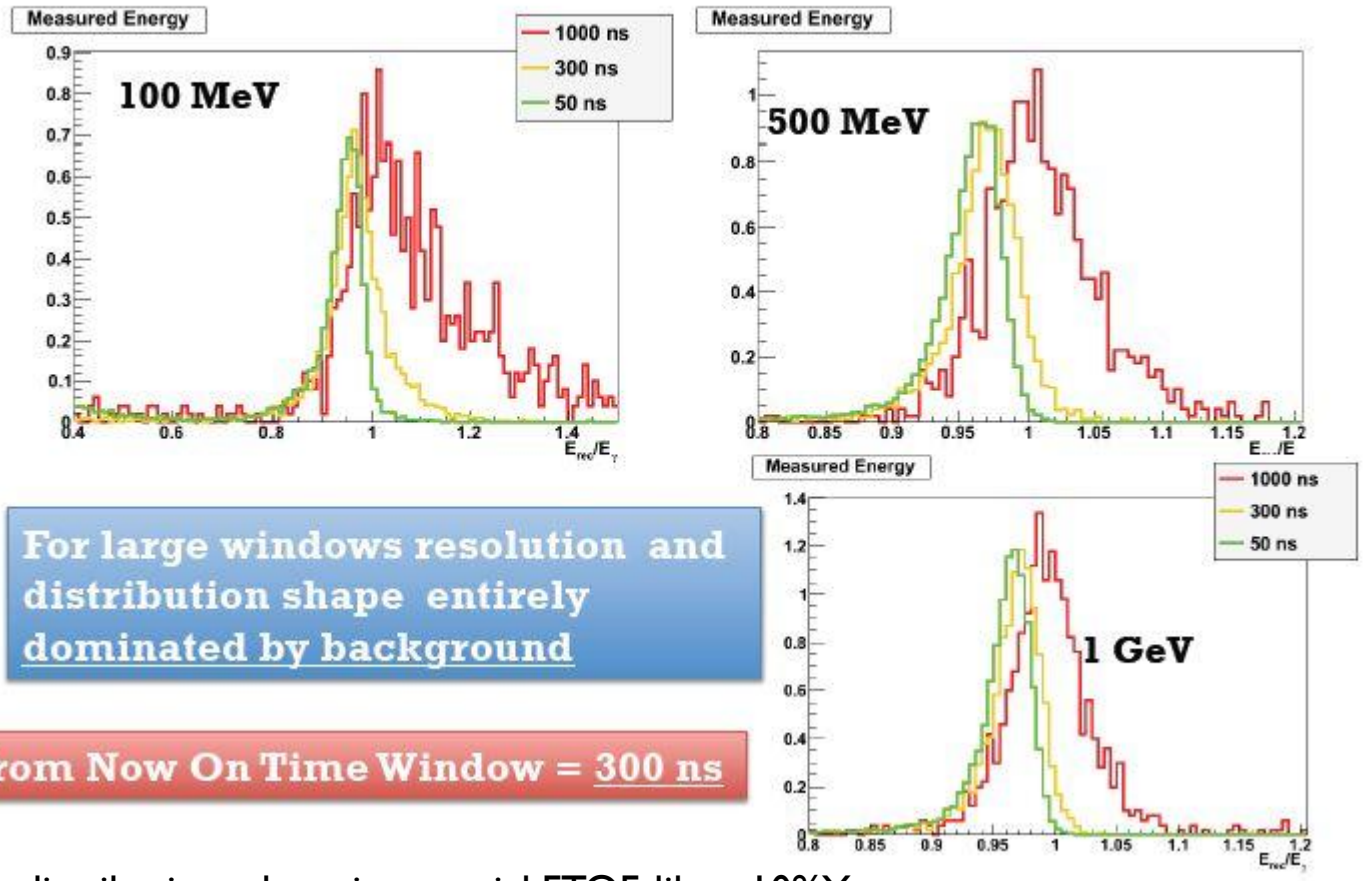


Clusters mostly realted to upstream converting photons
→Further investigation needed
→A fraction of these events may be recovered

E_{reco}/E_{γ} vs time window width

S. Germani

Geant4



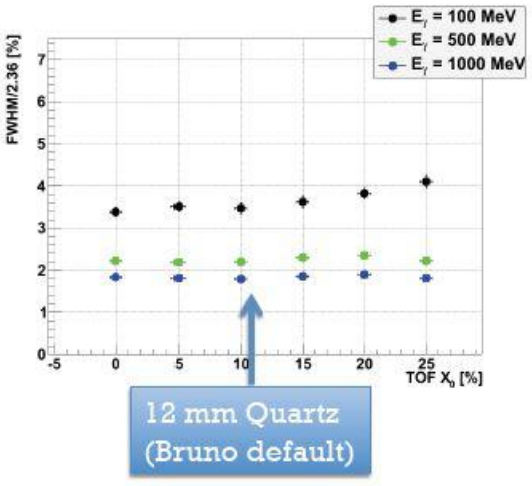
For this distributions there is material FTOF-like ~10%X_0

fwd EMC: E resolution vs PID material

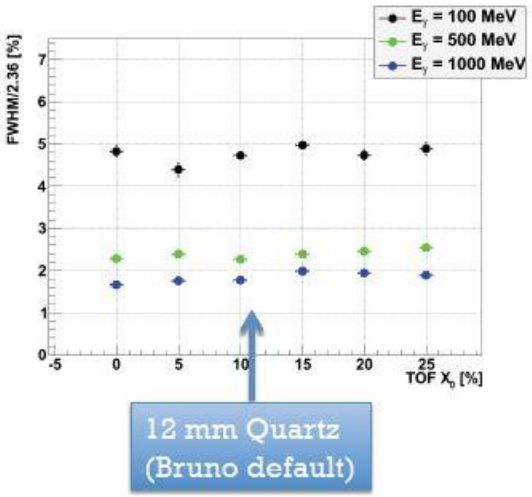
PID Thickness Effect on σ_E

S. Germani

100 ns Time Window



300 ns Time Window



shown at Elba'10

preliminary results

Preliminary results. Since the bkg makes the E distribution more Gaussian, it is assumed in these plots that the FWHM is a good estimator.