$\bar{\text{P}}$ANDA Backward Electromagnetic Calorimeter Studies with BaBar-like framework

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Outline

1. Comparison PandaROOT - BaBar framework with same production cuts.
2. Study separation signal/background. Better fit function.
3. Momentum reconstruction with BW EMC.

COMPARISON PANDAROOT-BABAR FRAMEWORK WITH THE SAME PRODUCTION CUTS

Production cuts in BaBar framework.

Cuts in range(mm)

Material	γ	e-	e+
Air	1	1	1
Carbon	1	1	1
Aluminum	1	1	1
Silicon	1	1	1
Stt_AlBe	1	1	1
Mylar	1	1	1
Stt_Ar_CO2_90_10	1	1	1
CarbonFiber	1	1	1
DCgas	1	1	1
Gem_G10	1	1	1
Gem_ArCO2	1	1	1
quartz	1	1	1
Argon	1	1	1
Iron	1	1	1
Vacuum	1	1	1
Stainless steel	1	1	1
Al+Be	1	1	1
Aluminium	1	1	1
Copper	1	1	1
E_PWO	1	1	1
E_CarbonFibre	0.01	0.01	0.01
Fsc_Lead	0.1	0.1	0.1
Fsc_Scintillator	0.1	0.1	0.1

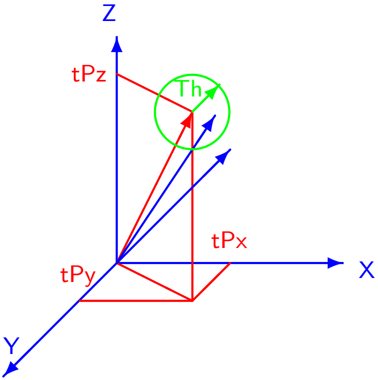
Cuts in energy(MeV)

Material	γ	e-	e+
Air	0.00099000	0.00099000	0.00099000
Carbon	0.00329462	0.56801100	0.55419600
Aluminum	0.00688731	0.59668000	0.56801100
Silicon	0.00688731	0.54071800	0.52111300
Stt_AlBe	0.00452342	0.46646000	0.44954700
Mylar	0.00297898	0.41753900	0.40240000
Stt_Ar_CO2_90_10	0.00099000	0.00120121	0.00118651
CarbonFiber	0.00236543	0.54741600	0.52756800
DCgas	0.00099000	0.00099000	0.00099000
Gem_G10	0.00413892	0.47808700	0.46646000
Gem_ArCO2	0.00099000	0.00099000	0.00099000
quartz	0.00551637	0.53410200	0.51473700
Argon	0.00099000	0.00099000	0.00099000
Iron	0.02083230	1.28002000	1.21851000
Vacuum	0.00099000	0.00099000	0.00099000
Stainless steel	0.02083230	1.31192000	1.23361000
Al+Be	0.00336548	0.50221900	0.48400900
Aluminium	0.00688731	0.59668000	0.56801100
Copper	0.02460720	1.39521000	1.31192000
E_PWO	0.08477680	1.13176000	1.06419000
E_CarbonFibre	0.00099000	0.03306340	0.03265890
Fsc_Lead	0.02934060	0.23994500	0.23124500
Fsc_Scintillator	0.00099528	0.08531340	0.08426960

Output from logfile in simulation.

STUDY SEPARATION SIGNAL/BACKGROUND - BETTER FIT FUNCTION

Separation signal/background



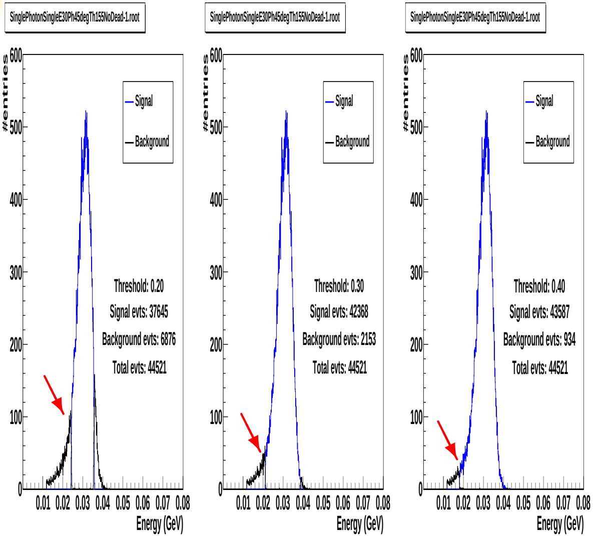
If $\sqrt{(Px - tPx)^2 + (Py - tPy)^2 + (Pz - tPz)^2} <$ Th

$\rightarrow$ SIGNAL

else

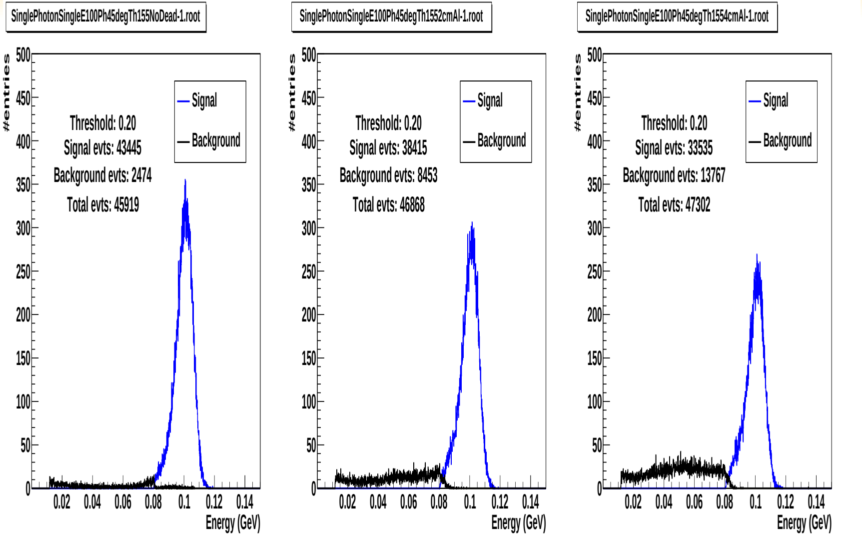
$\rightarrow$ BACKGROUND

Plots 30 MeV, ϕ =45°, θ =155°, No dead material, different thresholds.

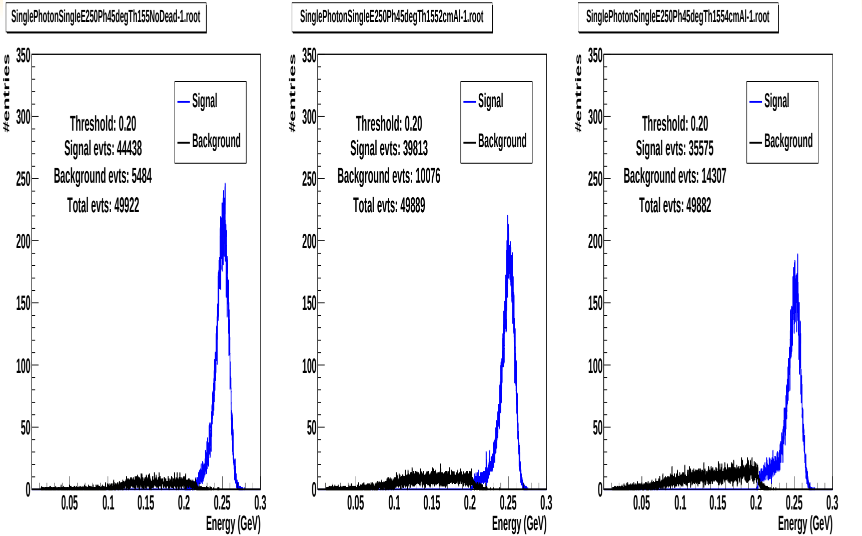


- There is a clear**discontinuity** between what it is selected as**signal** and what is selected as**background**.
- It is the**best cut** selecting the bump with highest energy?
- **What** to do?

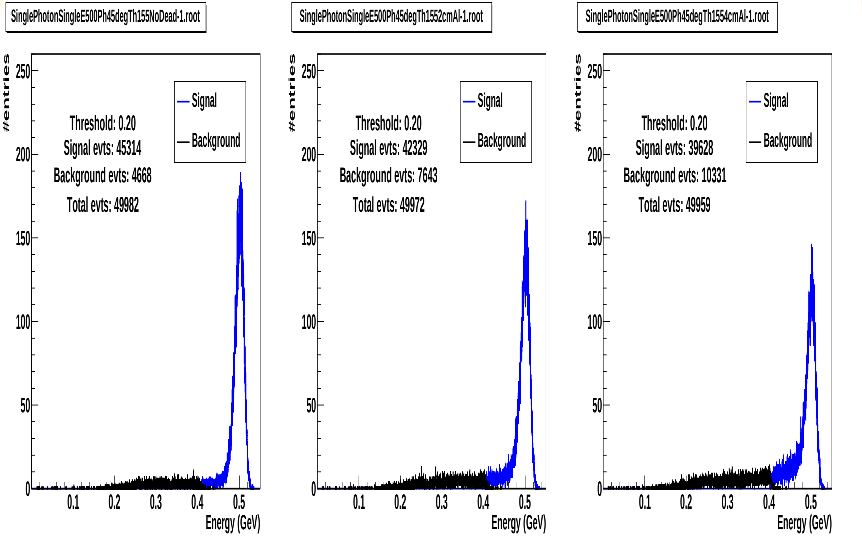
Plots 100 MeV, $\phi = 45°$, $\theta = 155°$, Th=30%, different materials.



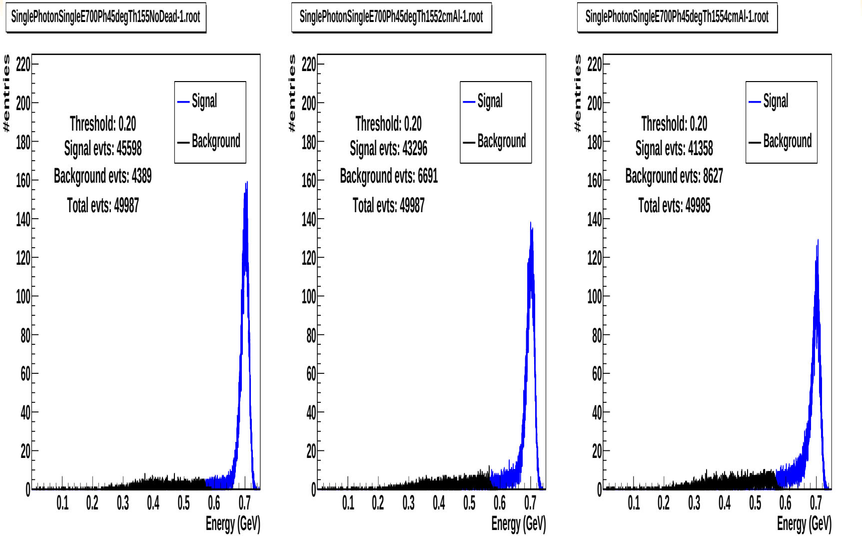
Plots 250 MeV, $\phi = 45°$, $\theta = 155°$, Th=30%, different materials.



Plots 500 MeV, $\phi = 45°$, $\theta = 155°$, Th=30%, different materials.



Plots 700 MeV, ϕ =45°, θ =155°, Th=30%, different materials.



MOMENTUM RECONSTRUCTION WITH THE BACKWARD ELECTROMAGNETIC CALORIMETER

Momentum reconstruction with BW EMC.

References:

- **Neutral Particle Identification in the $\bar{\text{P}}$ANDA Electromagnetic Calorimeter.** E. A. Dijck, December 2009.
- **A Shower Analysis for the Electro-Magnetic Calorimeter of $\bar{\text{P}}$ANDA.** Ch. Geldmann, 2009.
- **Pattern recognition for $\bar{\text{P}}$ANDA.** M. Babai, 2007.

Describe the methods used for the cluster positioning and bump splitting in an understandable way.

Modules in BaBar framework:

- **PARENT/EmcReco/EmcERatioLocMaxFinder.hh/cc**: Finds the local maxima.
- **PARENT/EmcReco/Emc2DLocMaxFinder.hh/cc**: Finds the local maxima, probably default module. Maybe not optimal for the straight crystals of BW EMC.
- **PARENT/EmcExpClusterSplitter.hh/cc**: Bump splitter, probably also not optimal but less important since the multiplicity in the BW end cap is lower.
- **PARENT/EmcData/EmcClusterLiloPos.hh/cc**: Has to be corrected for the BW end cap with corrected shower depth.

Ongoing:

- Understanding the modules from old BaBar framework.

What I understood from the thesis...

- Charged particles $\longrightarrow$ Tracking.
- Neutral particles $\longrightarrow$ No tracking. Shower shape and Zernike moments is used to separate γ and π^0.
- If $\gamma \longrightarrow \vec{p}$ is calculated by bump position and deposited energy.
- PROBLEM: We have NO Tracking System!!!

BACKUP SLIDES

Cluster position.

$$x_{cluster} = \frac{\sum_d W_d \cdot x_d}{\sum_d W_d}$$

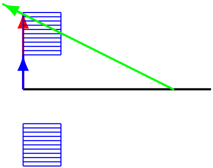
with

$$W_d = max\left\{0, A - B \cdot \exp - C \cdot E_{cluster} + \ln\left(\frac{E_d}{E_{cluster}}\right)\right\}$$

Parameters:

$$A = 3.6; B = 1.594; C = 2.543\ GeV^{-1}$$

Bump splitting.



Arrows