

# Backward Electromagnetic Calorimeter study with PANDARoot

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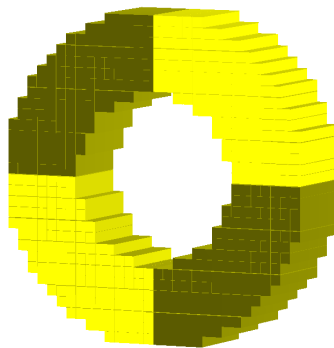
7 December, 2009



# Outline

- 1 What have been done
- 2 Results of simulation
- 3 Analysis
- 4 Conclusion and outlook

# Geometry



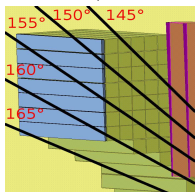
- Crystal size: 24.4 x 24.4 x 200 mm
- $\theta$  range:  $145.7^\circ - 167.1^\circ$
- Outer/innter diemeter: 812/364 mm

# Parameters

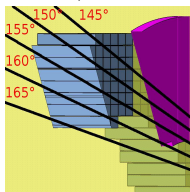
Single photons:

- Energy: 0.03, 0.1, 0.25, 0.5, 0.7 GeV
- $\phi$ :  $1^\circ$ ,  $22.5^\circ$ ,  $45^\circ$
- $\theta$ :  $145^\circ$ ,  $150^\circ$ ,  $155^\circ$ ,  $160^\circ$ ,  $165^\circ$
- Number of events: 50000
- Energy range: 3 GeV
- Number of bits: 14
- Bin size: 0.18 MeV

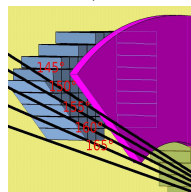
$\phi = 1^\circ$



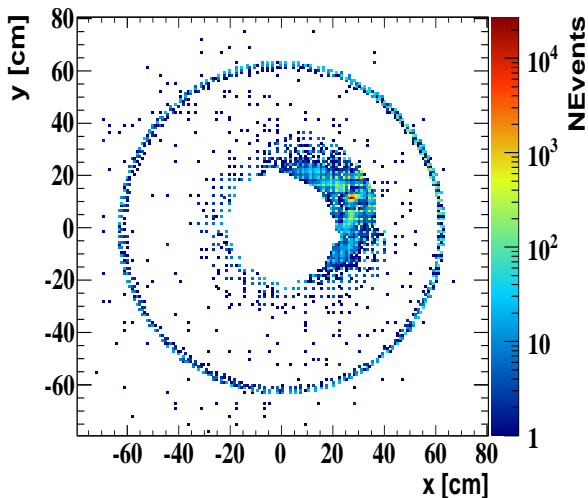
$\phi = 22.5^\circ$



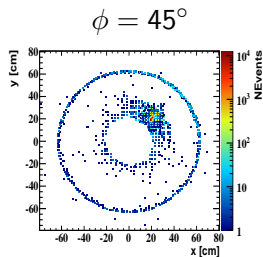
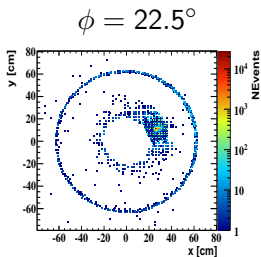
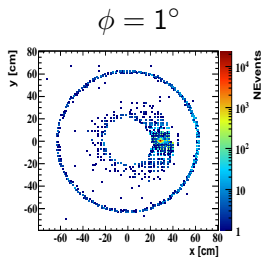
$\phi = 45^\circ$



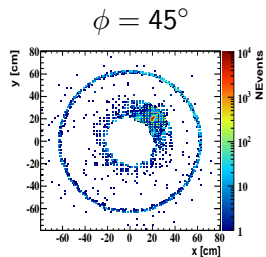
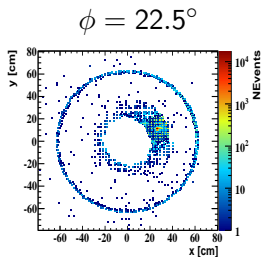
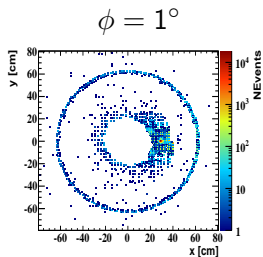
$$E = 0.25 \text{ GeV}, \phi = 22.5^\circ, \theta = 155^\circ$$



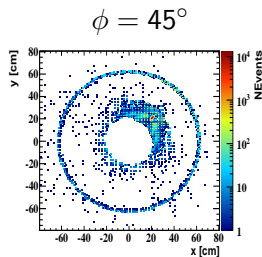
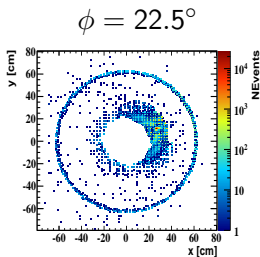
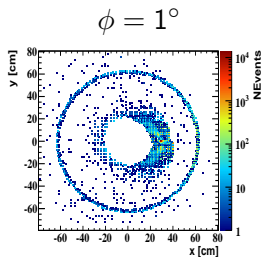
$$E = 0.03 \text{ GeV}, \theta = 155^\circ$$



$$E = 0.1 \text{ GeV}, \theta = 155^\circ$$

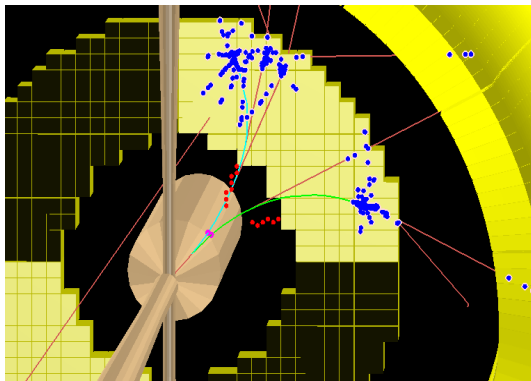


$$E = 0.25 \text{ GeV}, \theta = 155^\circ$$



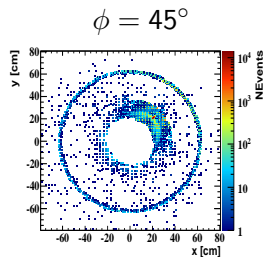
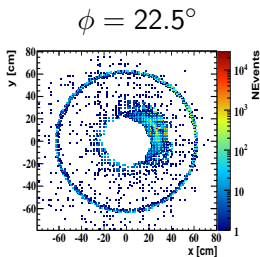
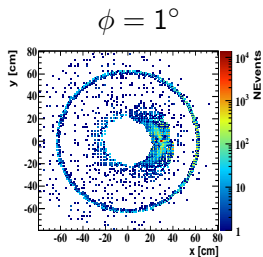


$$E = 0.25 \text{ GeV}, \phi = 45^\circ, \theta = 155^\circ$$

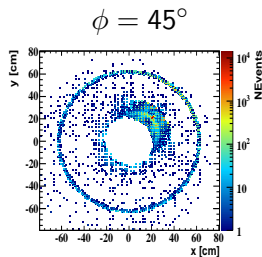
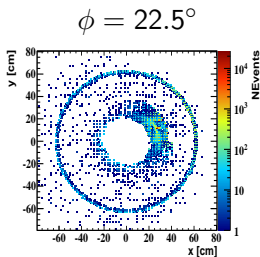
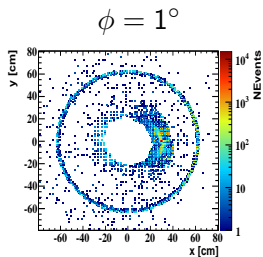


Red lines corresponds to photons track, blue line - electrons track and green line - positron. Pink points are hits in MVD, red points are hits in STT and blue points are EMC hits.

$$E = 0.5 \text{ GeV}, \theta = 155^\circ$$



$$E = 0.7 \text{ GeV}, \theta = 155^\circ$$



# Analysis

Novosibirsk function:

$$f(E) = A \cdot \exp\left\{-\frac{1}{2}\left[\frac{\ln^2(1+\Lambda\tau(E-E_0))}{\tau^2} + \tau^2\right]\right\}$$

with

$$\Lambda = \frac{\sinh(\tau\sqrt{\ln 4})}{\sigma\tau\sqrt{\ln 4}}$$

# Analysis

Cuts:

- Only one bump with highest energy per event

Analysis:

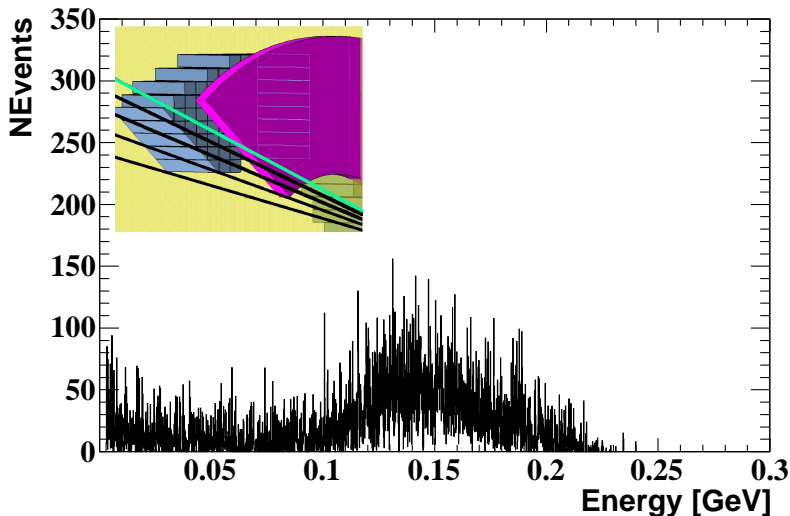
- Energy resolution:

$$E_{res} = 2\sigma\sqrt{\ln 4}/E$$

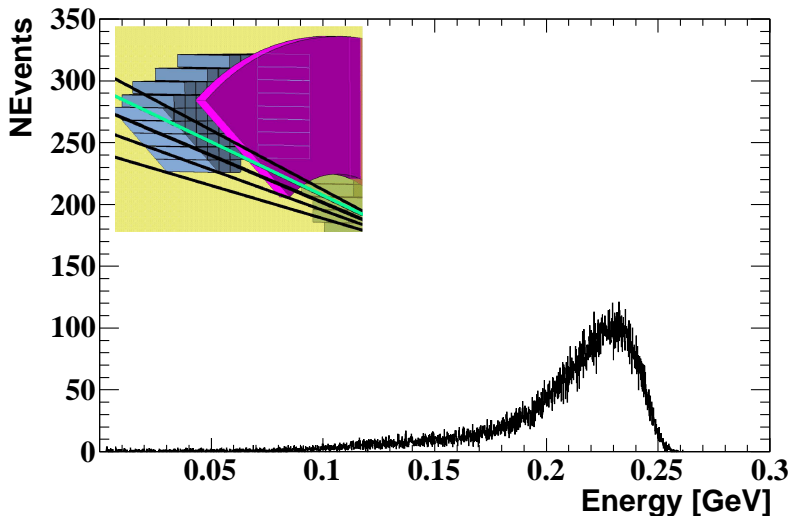
- Efficiency:

$$E_{eff} = \frac{\int_{\mu-3\sigma}^{\mu+2\sigma} f(E)dE}{50000}$$

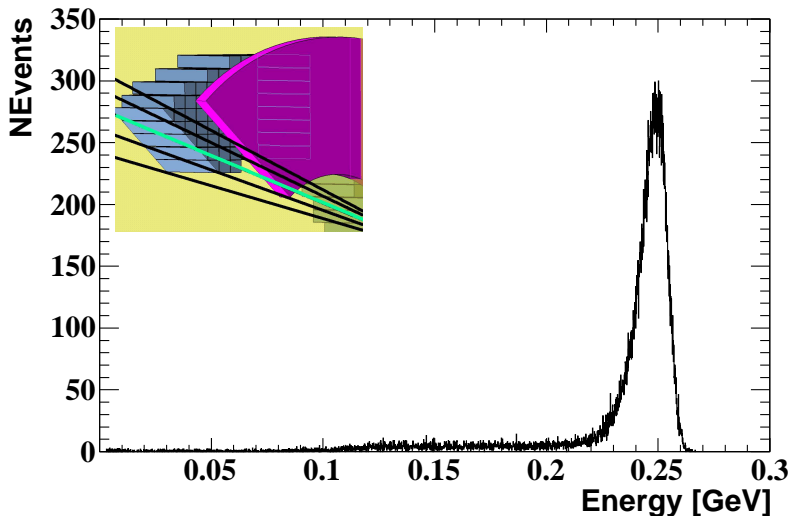
$$E = 0.25 \text{ GeV}, \phi = 45^\circ, \theta = 145^\circ$$



$$E = 0.25 \text{ GeV}, \phi = 45^\circ, \theta = 150^\circ$$

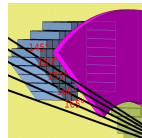
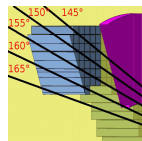
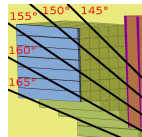
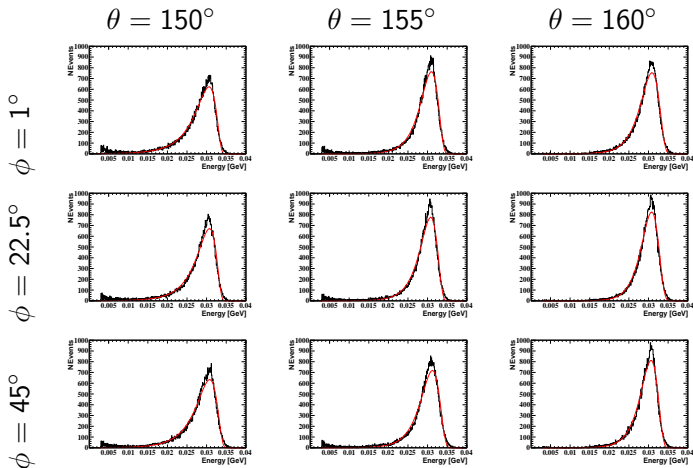


$$E = 0.25 \text{ GeV}, \phi = 45^\circ, \theta = 155^\circ$$

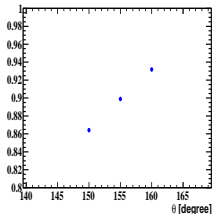
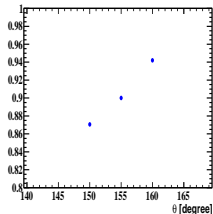
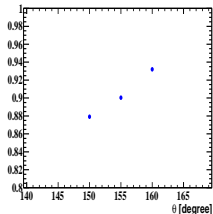




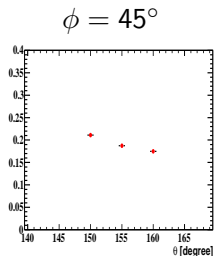
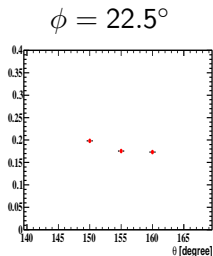
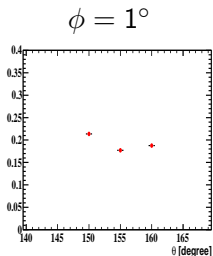
$$E = 0.03 \text{ GeV}$$



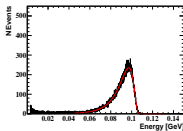
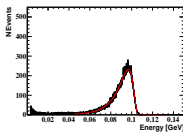
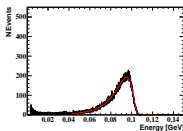
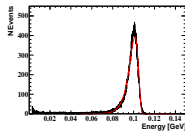
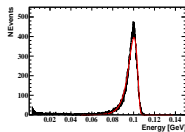
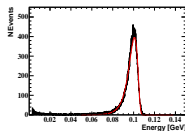
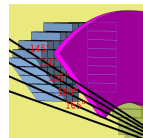
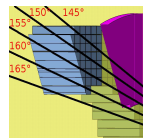
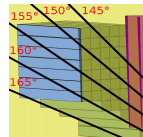
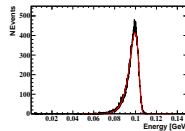
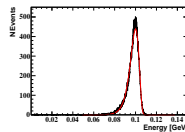
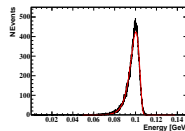
# Efficiency, $E = 0.03 \text{ GeV}$

 $\phi = 1^\circ$  $\phi = 22.5^\circ$  $\phi = 45^\circ$ 

# Resolution, $E = 0.03 \text{ GeV}$

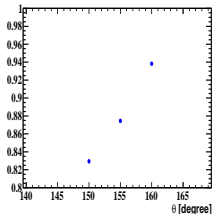


$$E = 0.1 \text{ GeV}$$

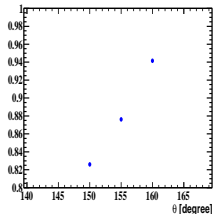
 $\phi = 1^\circ$ 
 $\phi = 22.5^\circ$ 
 $\phi = 45^\circ$ 
 $\theta = 150^\circ$ 

 $\theta = 155^\circ$ 

 $\theta = 160^\circ$ 


# Efficiency, $E = 0.1 \text{ GeV}$

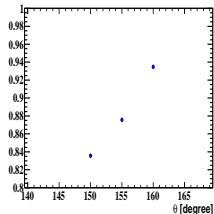
$$\phi = 1^\circ$$



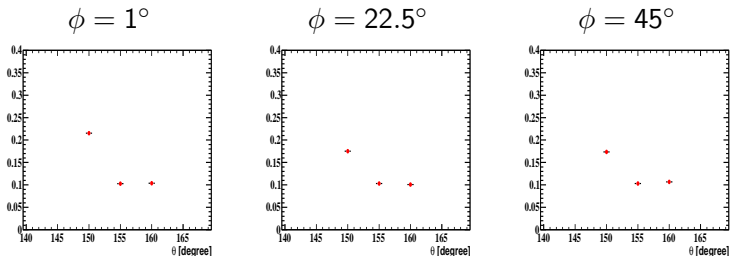
$$\phi = 22.5^\circ$$



$$\phi = 45^\circ$$



# Resolution, $E = 0.1 \text{ GeV}$



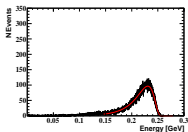
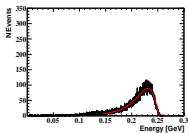
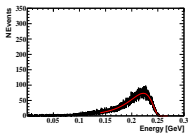
$$E = 0.25 \text{ GeV}$$

$$\phi = 1^\circ$$

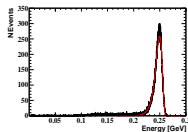
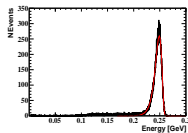
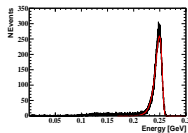
$$\phi = 22.5^\circ$$

$$\phi = 45^\circ$$

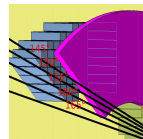
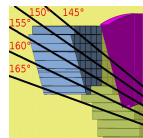
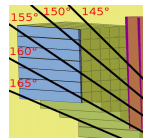
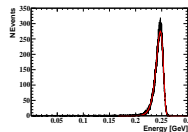
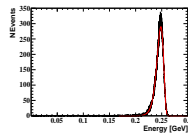
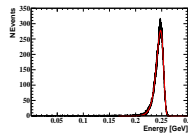
$$\theta = 150^\circ$$



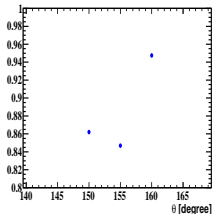
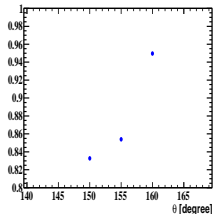
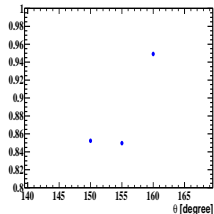
$$\theta = 155^\circ$$



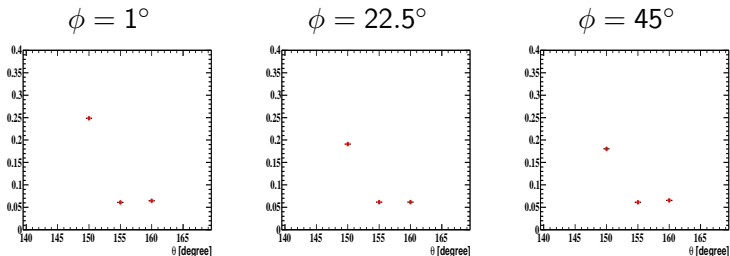
$$\theta = 160^\circ$$



# Efficiency, $E = 0.25 \text{ GeV}$

 $\phi = 1^\circ$  $\phi = 22.5^\circ$  $\phi = 45^\circ$ 

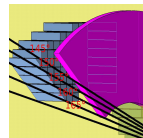
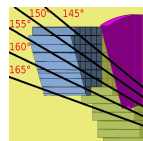
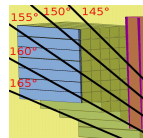
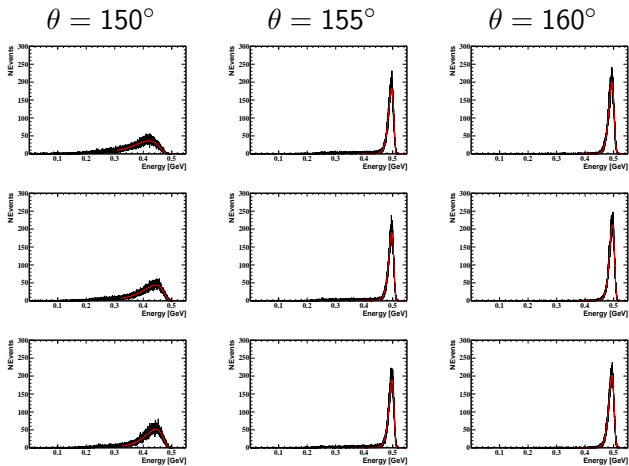


Resolution,  $E = 0.25 \text{ GeV}$ 

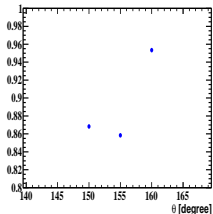
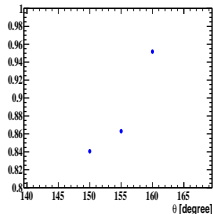
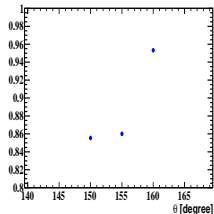
$$E = 0.5 \text{ GeV}$$

$$\phi = 1^\circ$$

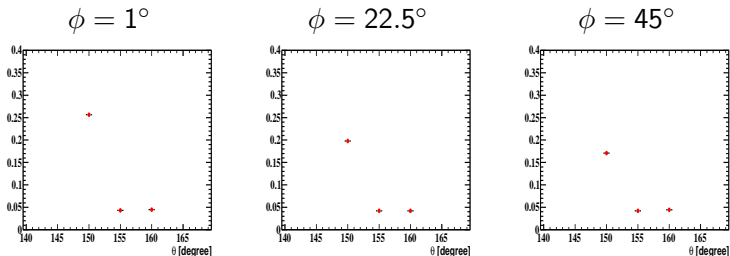
$$\phi = 22.5^\circ$$

$$\phi = 45^\circ$$


# Efficiency, $E = 0.5 \text{ GeV}$

 $\phi = 1^\circ$  $\phi = 22.5^\circ$  $\phi = 45^\circ$ 

# Resolution, $E = 0.5\text{GeV}$



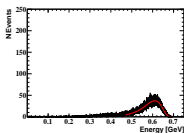
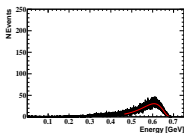
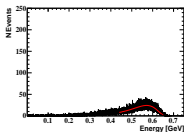
$$E = 0.7 \text{ GeV}$$

$$\phi = 1^\circ$$

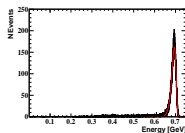
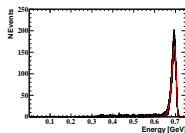
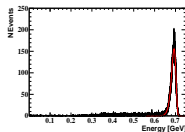
$$\phi = 22.5^\circ$$

$$\phi = 45^\circ$$

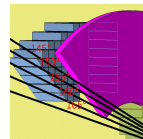
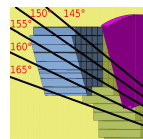
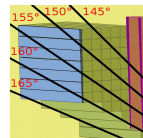
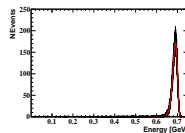
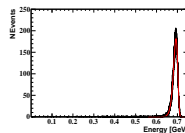
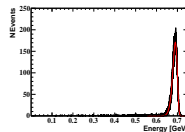
$$\theta = 150^\circ$$



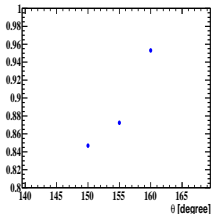
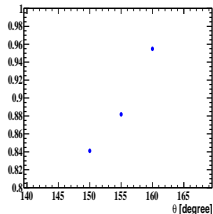
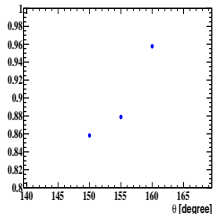
$$\theta = 155^\circ$$



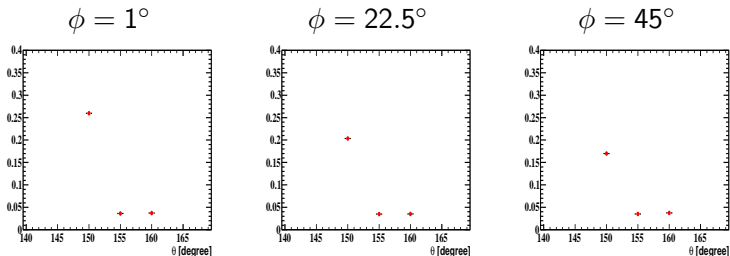
$$\theta = 160^\circ$$



# Efficiency, $E = 0.7 \text{ GeV}$

 $\phi = 1^\circ$  $\phi = 22.5^\circ$  $\phi = 45^\circ$ 

# Resolution, $E = 0.7\text{ GeV}$



## Conclusion

- First results of the efficiency and energy resolution of EMC BW endcap with PANDARoot are obtained
- The comparison of BaBar and PANDARoot results are made (talk of Maria Carmen Mora Espi)

## Outlook

- Repeat the simulation with dead material
- Study of single  $\pi^0$  and  $\bar{p}p \rightarrow e^+e^-\pi^0$  reaction