PANDA Collaboration Meeting - Juelich

**09. December 2014**

# Simulations of the Shashlik EMC Prototype

## - Length of the Modules

## - Energy Resolution


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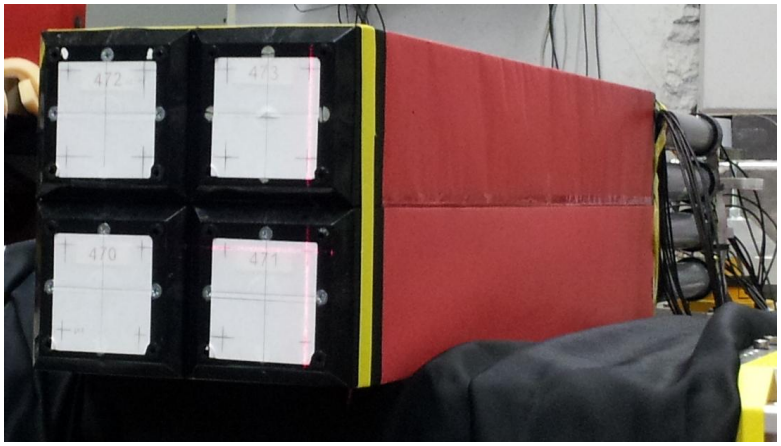
# Introduction

- Shashlik modules have been modified to achieve a better homogeneity
  - Scintillator tiles for each sub module are produced separately
  - New fibers from KURARAY
  - **TYVEK inbetween lead and scintillator tiles**
  - …



**Each submodule consits of:**

- 380 layers of scintillator tiles - 1.5 mm each
- 380 layers of lead plates - 275 µm each
- 760 layers of TYVEK - 175 µm each
- air gaps - ~ 12.5 µm each

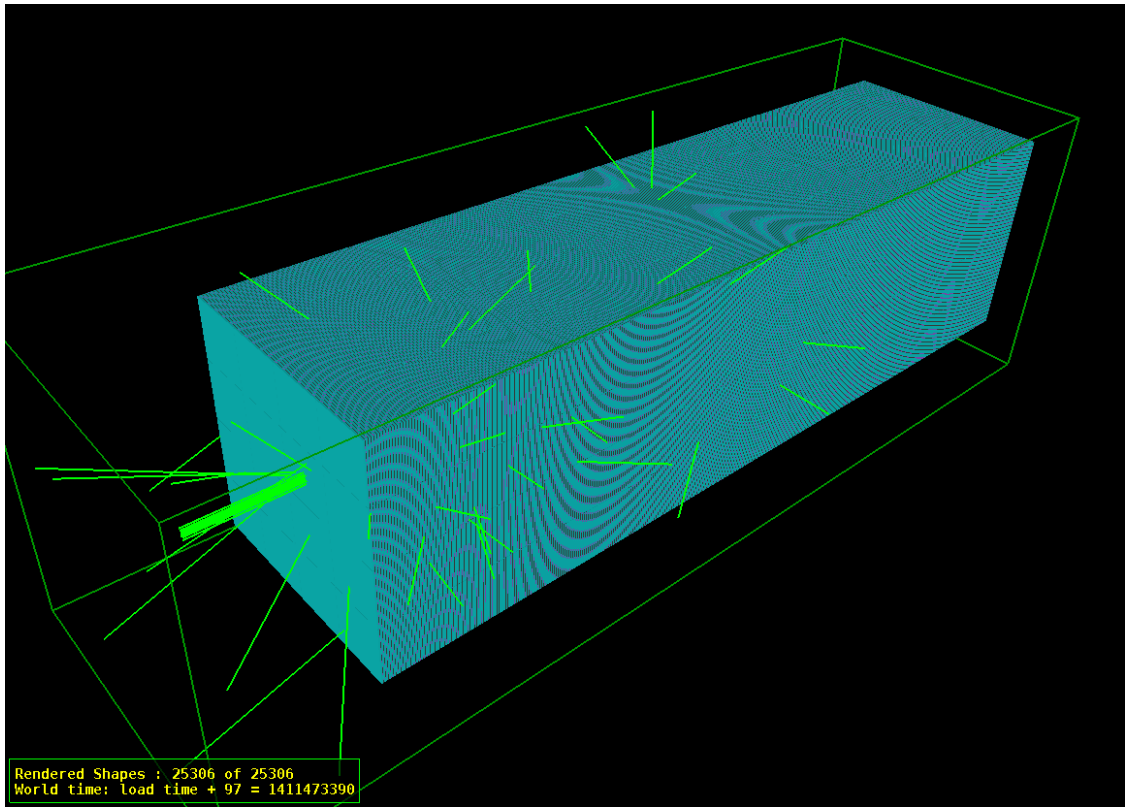
**design length of the active part: ~ 68 cm**

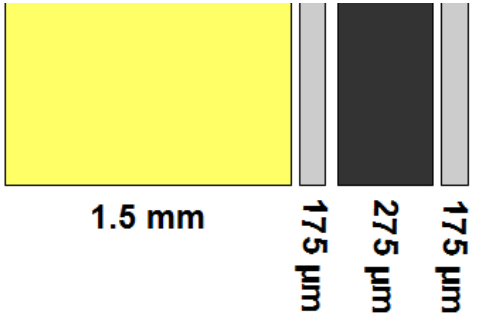
**actual active module length: ~ 81 cm**

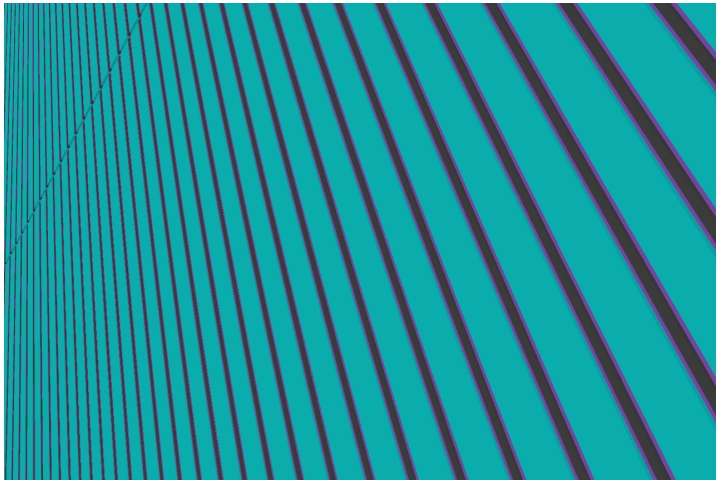
**modules are too long**

# Introduction

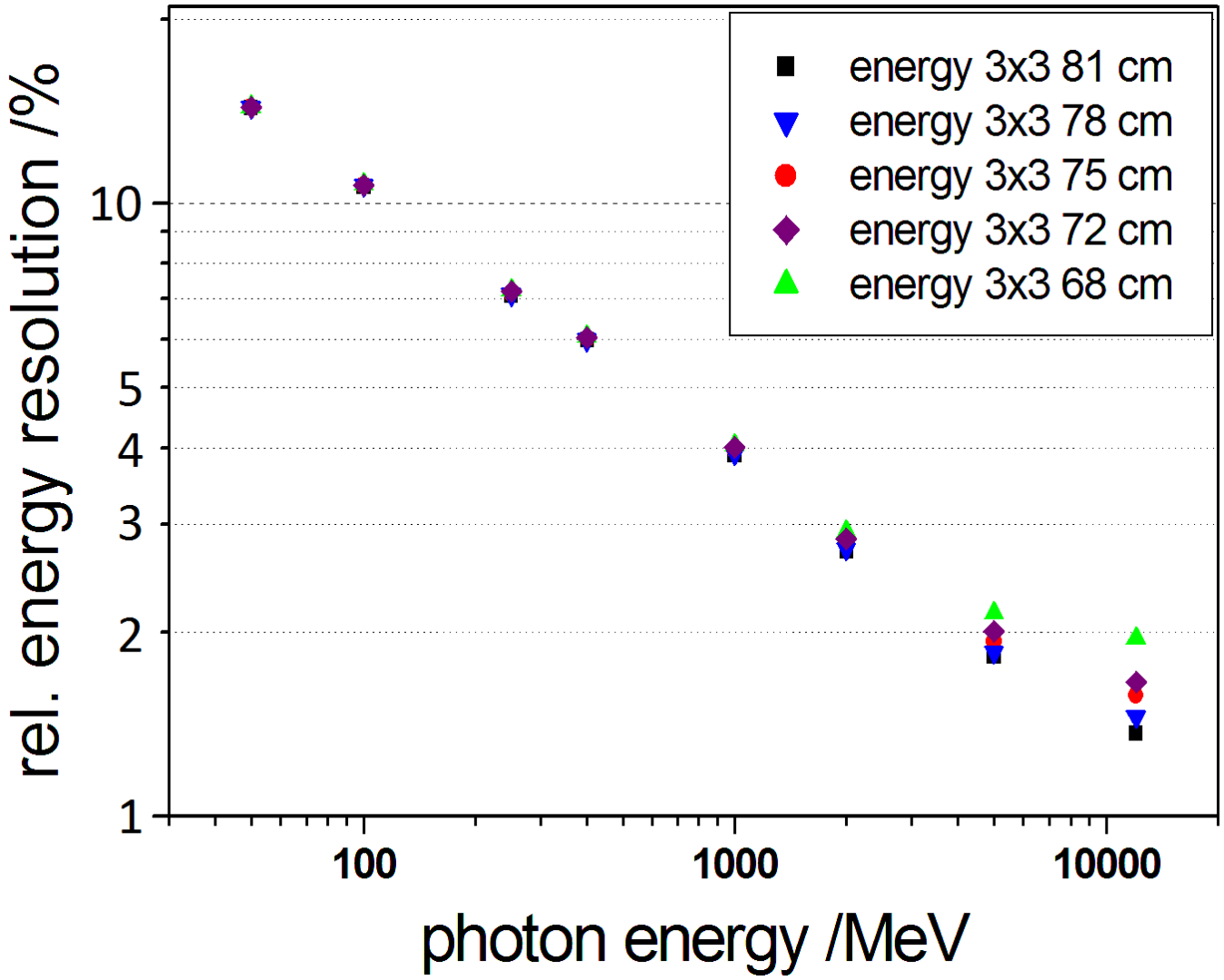
- The shashlyk prototype has been implemented in GEANT 4
- A photon beam with the experimental characteristics has been used to study the performance



# Energy resolution for different module lengths




**Only energy deposition in scintillator tiles**

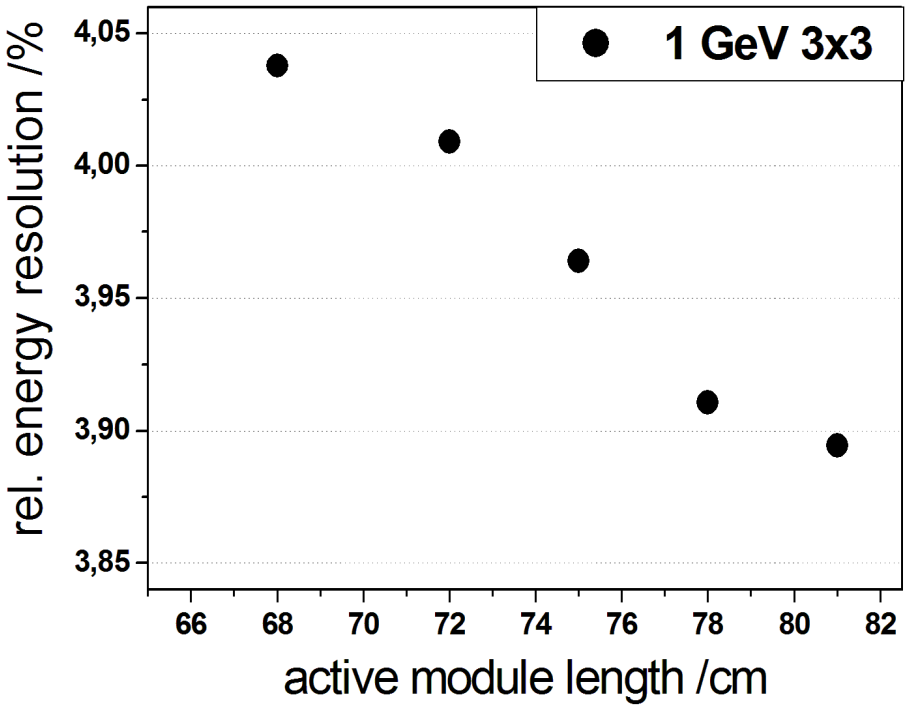
**actual module length**

**~ 81 cm**

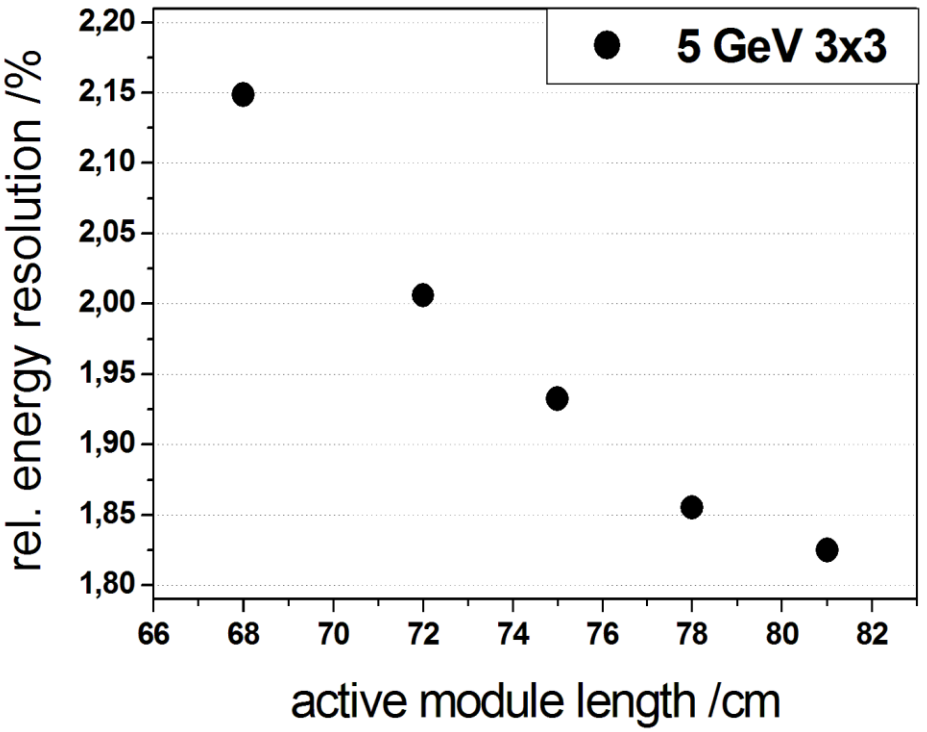
**design length**

**~ 68 cm**

# Energy resolution vs module lengths

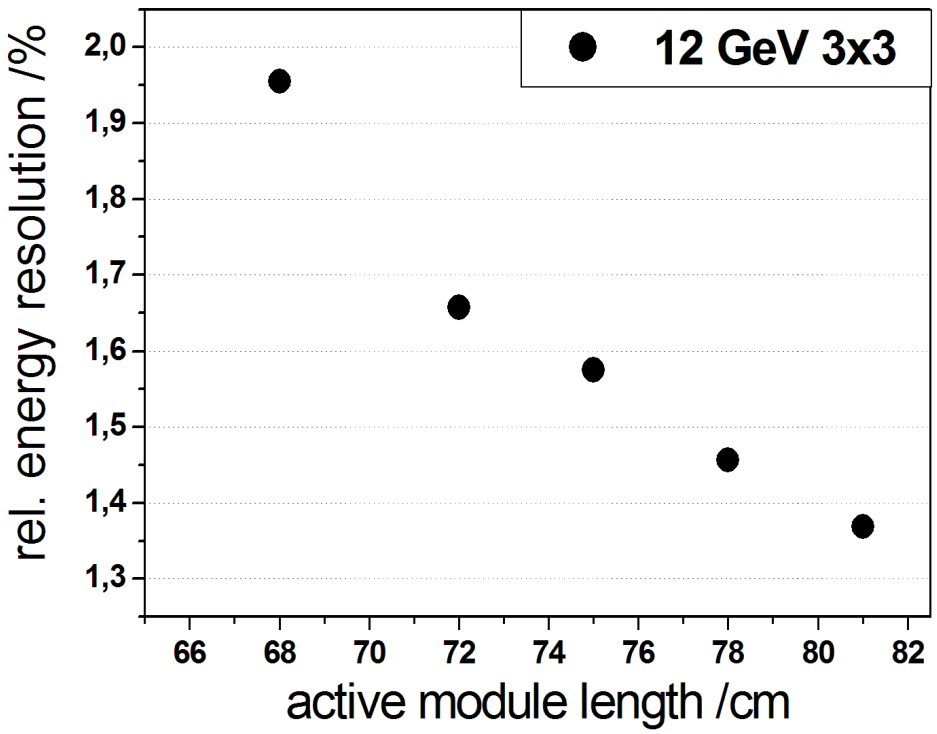



**σ/E – 0.15 %**




**σ/E – 0.33 %**

# Energy resolution vs module lengths




**σ/E – 0.58 %**

- Significant loss in resolution!

- Modules have to be 13 cm shorter to fit in the design!
- Cutting means a reduction of 3.7 $X_0$
  → **Not acceptable**

**Solutions:**

- Thinner TYVEK sheets
  → 100 µm instead of 175 µm
  → modules 5.7 cm shorter
- Shorter Cockroft Walton HV units
  → 8 cm (LHCb) instead of 15 cm (current design)
  → modules 7 cm shorter

# Reproduction of the experimental energy resolution

- Energy deposition has been simulated with GEANT4
- A light attenuation of 10 % over the complete 81cm has been implemented
  → 0.12 % / cm *(based on measurements)*
- $\sigma_{Noise}$ = 0.3 MeV *(value from beamtime)*

**Two methods to reproduce the experimental values:**

**a)** Gaussian smearing of the sim. energy by 3.6 %

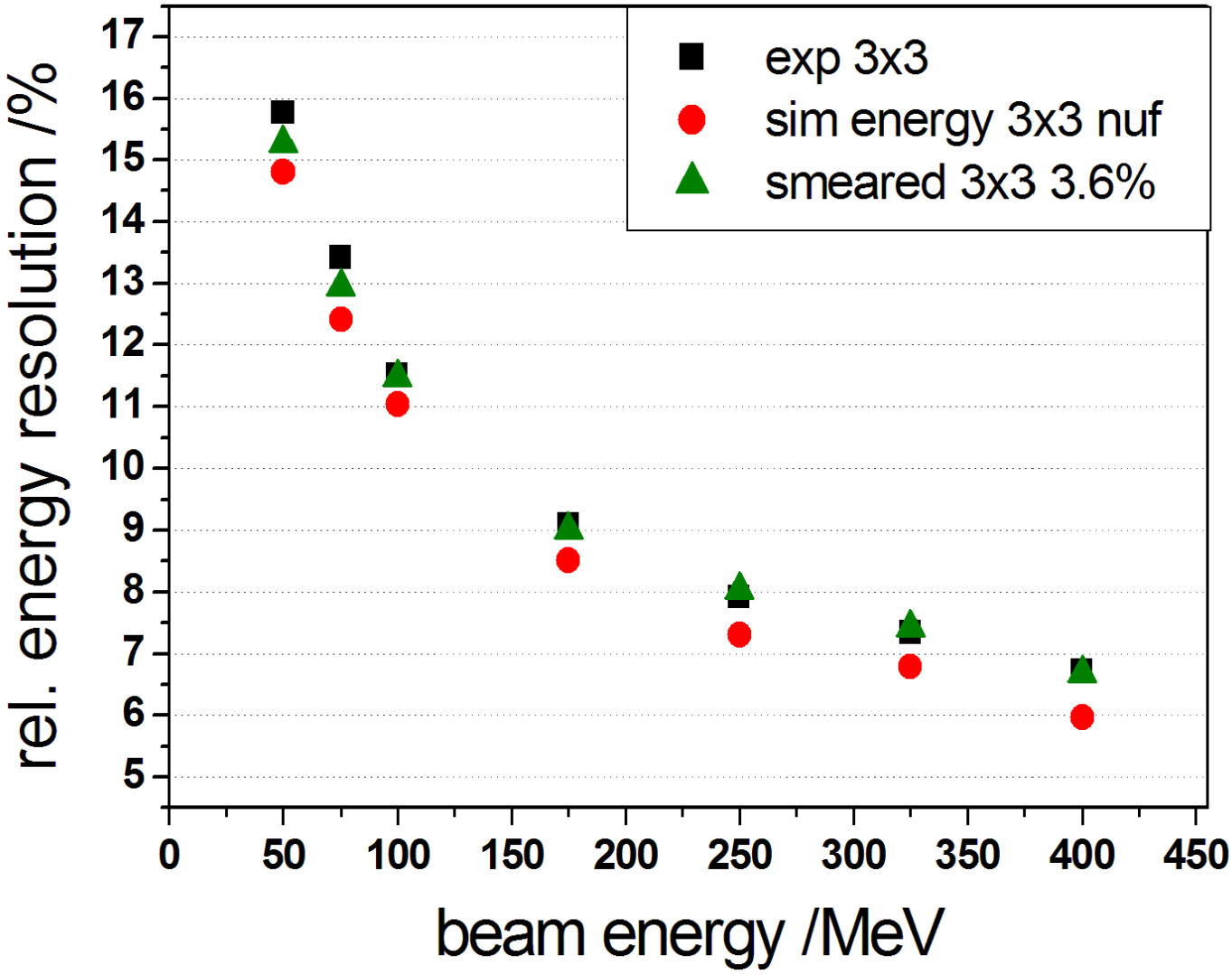
$$E_{smeared} = Gaus(E_{scint},\quad 0.036 \cdot E_{scint}) + Gaus(0,\quad 0.3)$$

**b)** Calculation of the light yield and ist statistical error based on empirical values

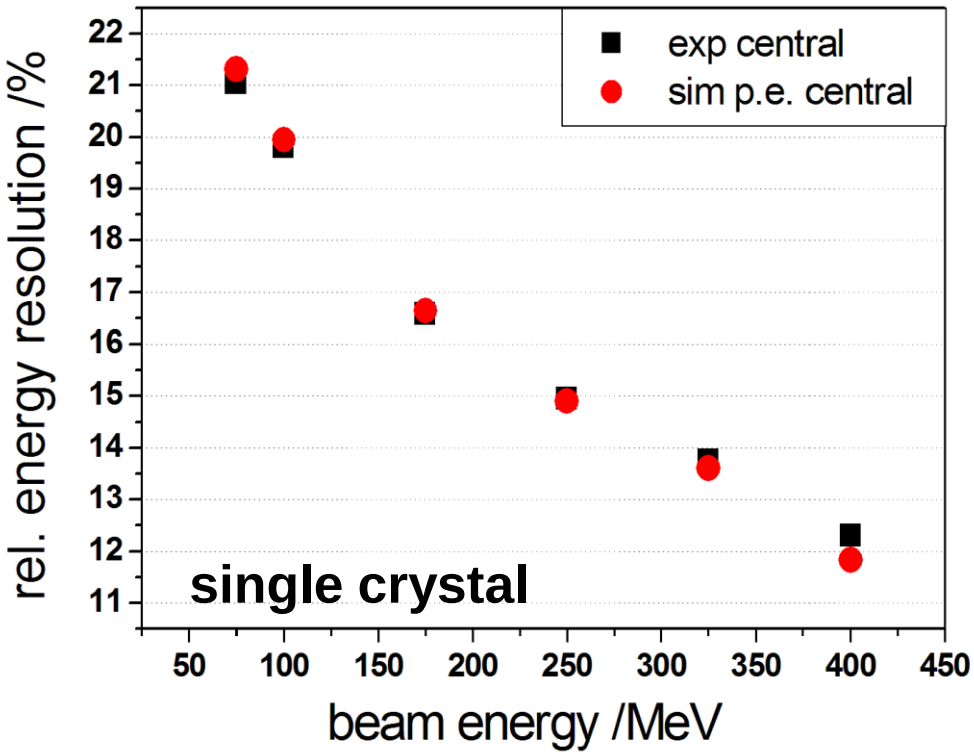
$$LY = Gaus(E_{scint} \cdot pe/MeV_{scint},\quad \sqrt{E_{scint} \cdot pe/MeV_{scint}}) + Gaus(0,\quad 0.3MeV \cdot pe/MeV_{scint})$$

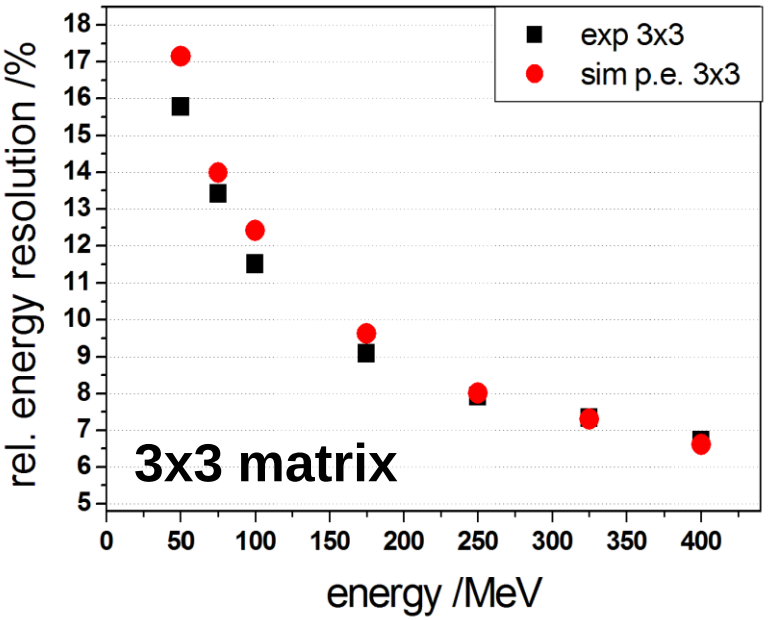
$$pe/MeV_{scint} = \frac{pe_{corr}}{\%E_{dep.scint.}} = \frac{3.875}{0.37} = 10.5 \qquad pe_{corr} = pe_{measured} \cdot \frac{QE_{PMT1}}{QE_{PMT2}} = (2.8+0.3) \cdot \frac{25\%}{20\%} = 3.875$$

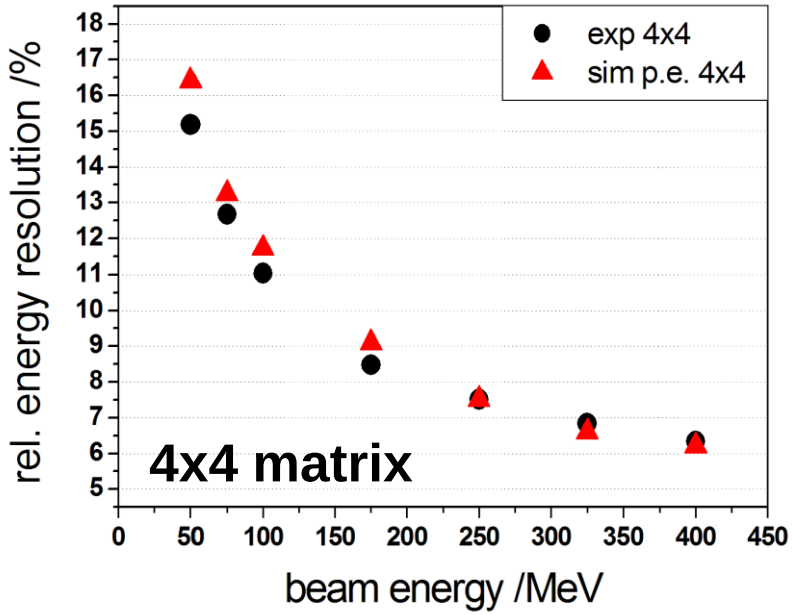
# Gaussian smearing of the sim. energy by 3.6 %



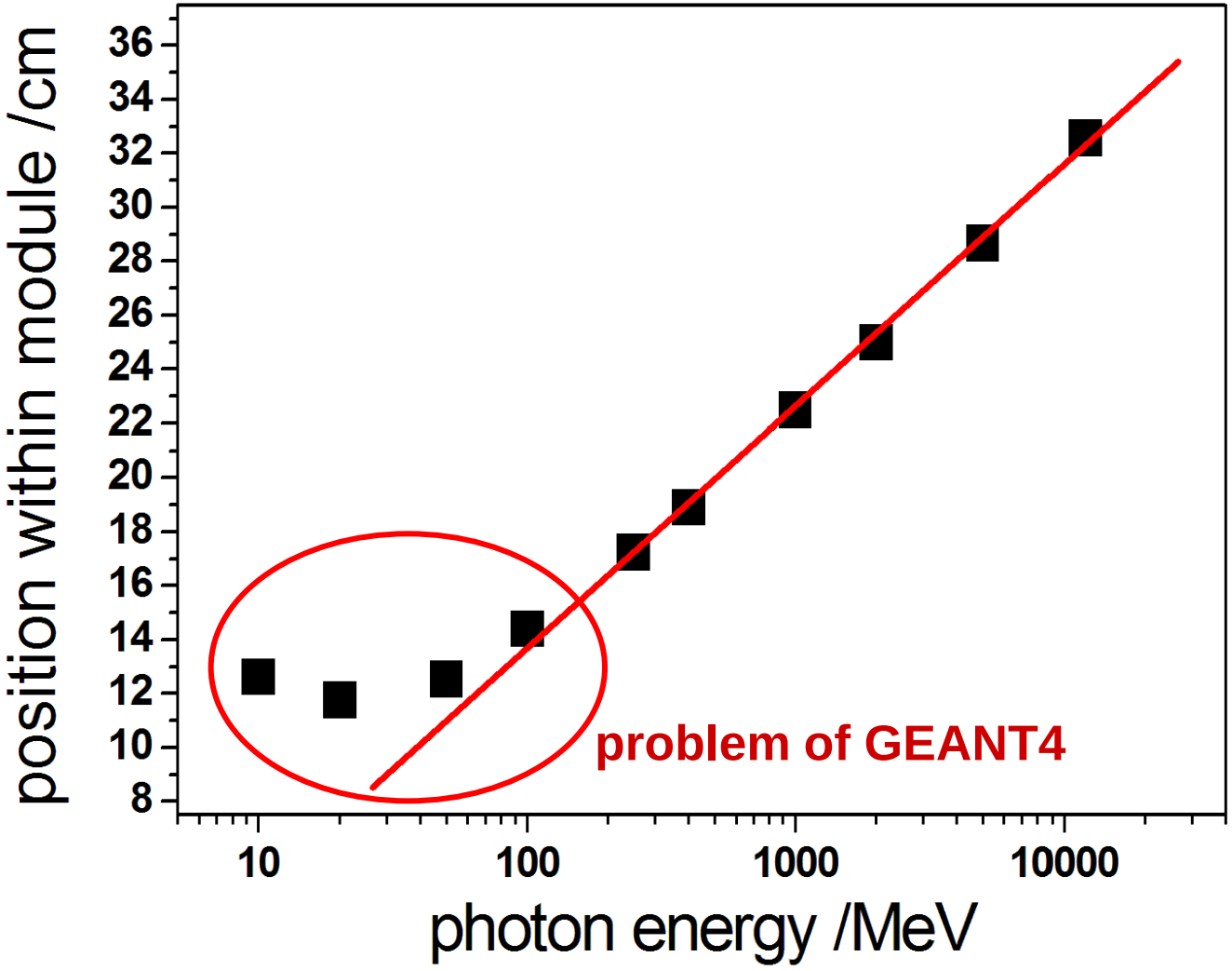
# Calculation of the light yield



# Shower scaling (mean value of the shower distribution)



# Thank you for your attention!

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