Update on SADC readout for Proto60 @ Mainz

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for the PANDA Collaboration

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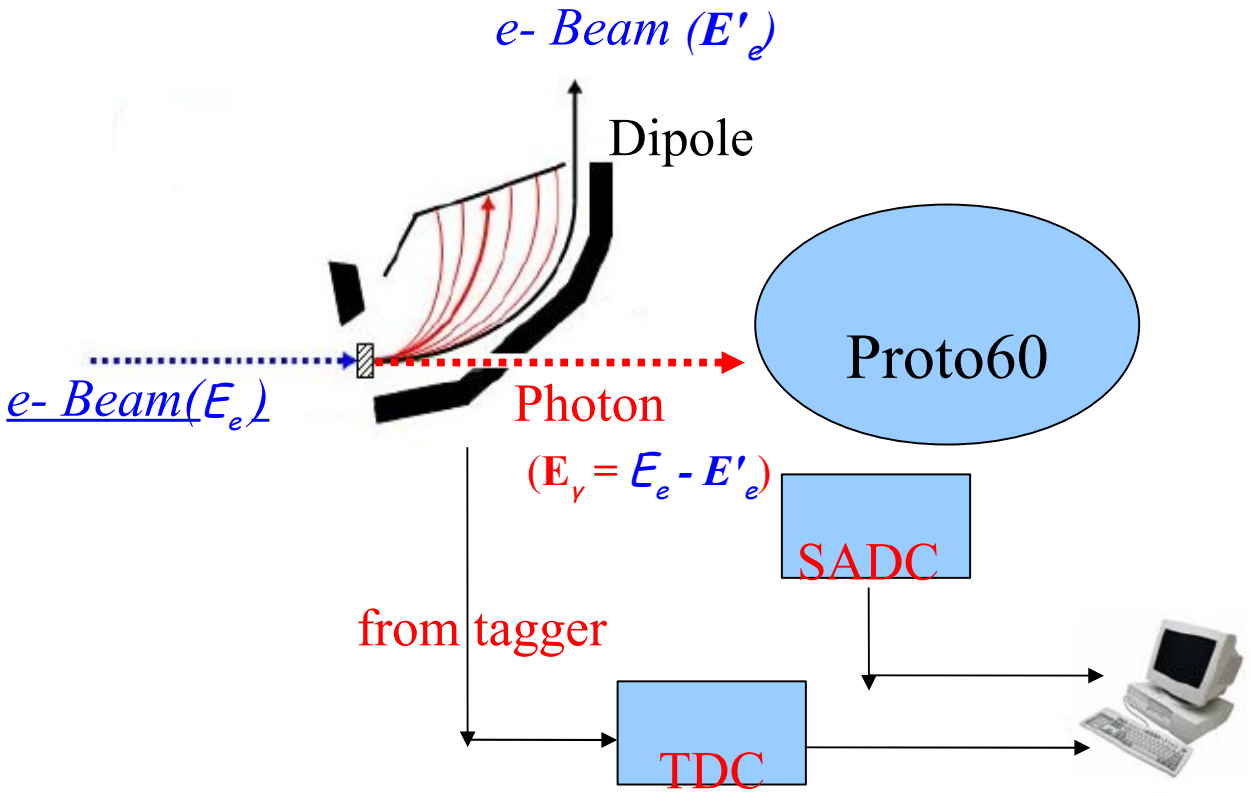
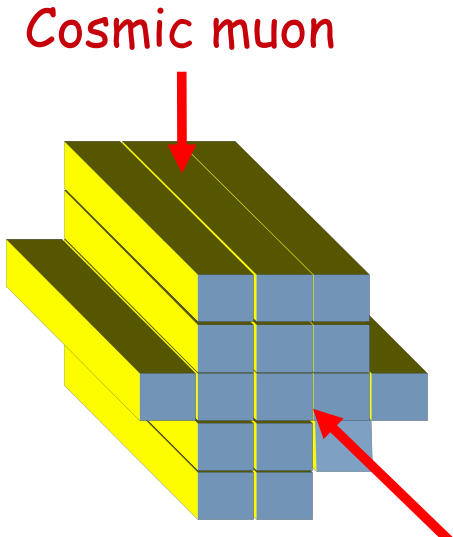
Experimental set-up



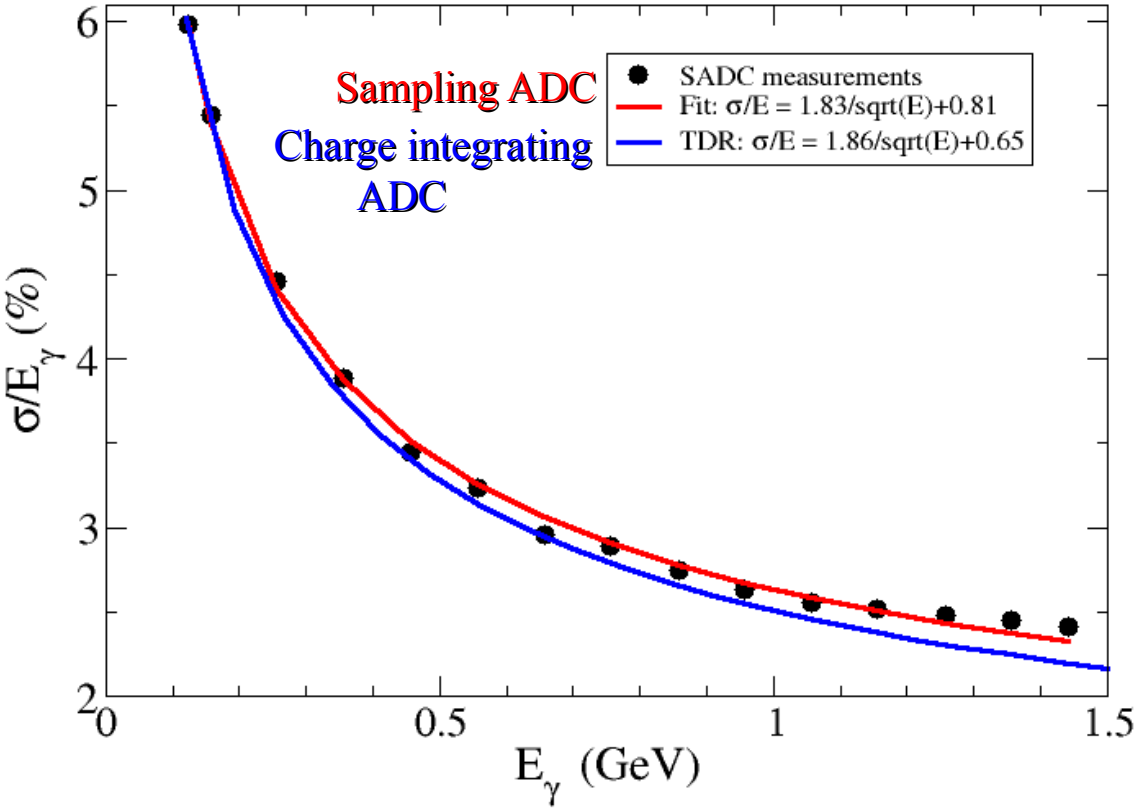


0.1 – 1.4 GeV

- Cosmic muon measurement used for calibration
- Tagged photon energy ~ 0.1 – 1.4 GeV

16 $PbWO_4$ crystals + LAAPD + Basel LNP Pre amp + SADC (100 MHz, 16 bit)

Previously determined energy resolution



Energy resolution:

$$\sigma/E = [a/\sqrt{E(GeV)}] + b$$

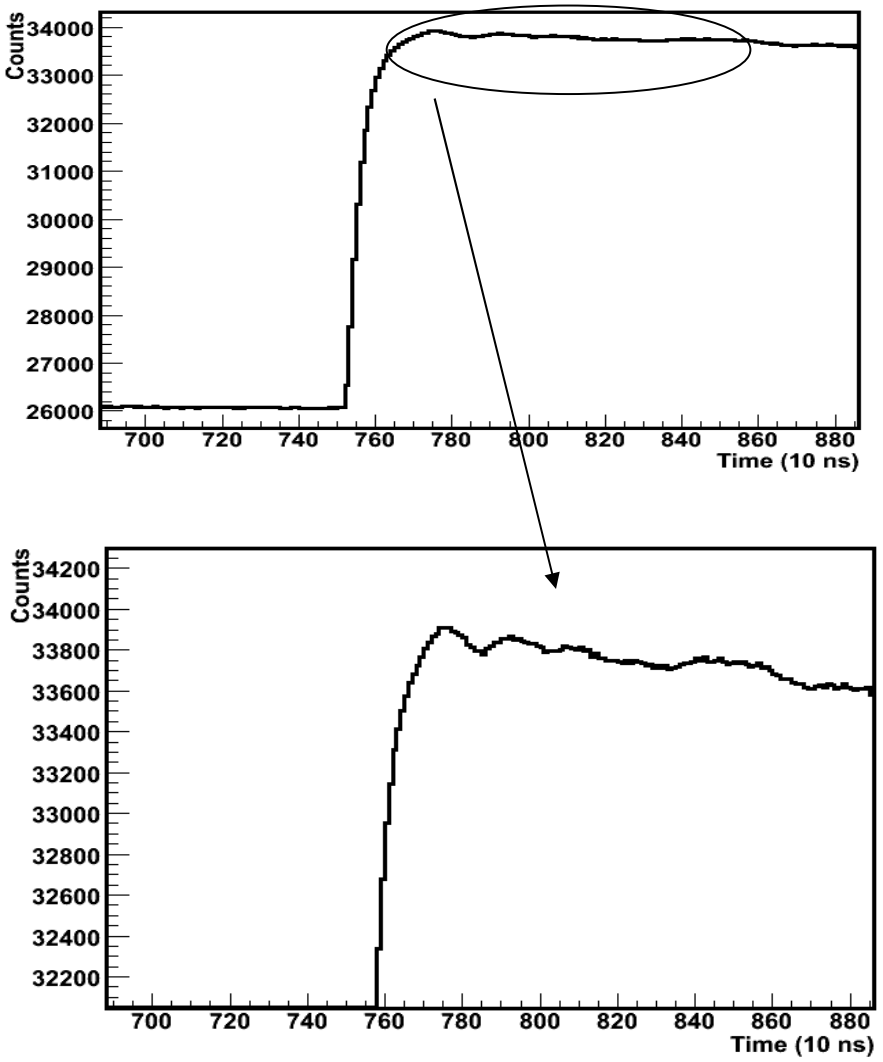
Where, a = 1.83; b = 0.81

5.1% @ 0.12 GeV

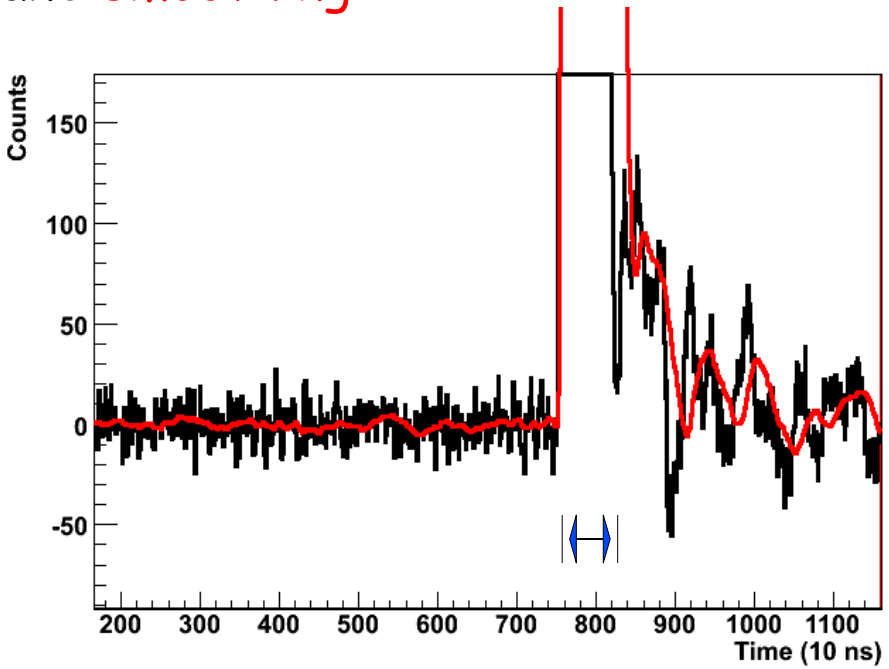
2.6% @ 1.0 GeV

During the trace analysis the threshold value was 5 MeV

Trace analysis



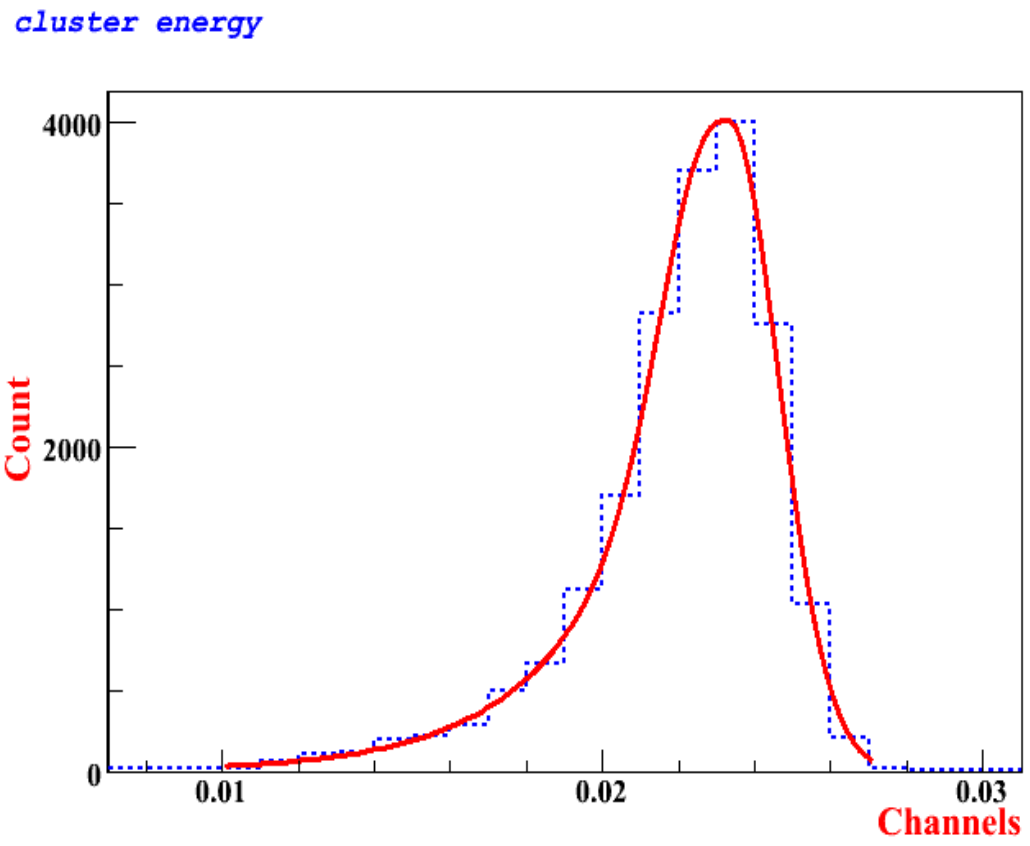
Resulting signal after Moving Window Deconvolution (MWD) filtering and smoothing :



Afterpulses are exceeding 1 MeV for large energy deposits ~ 1 GeV, contribute 0.5% of the main pulse and are excluded by time window

Energy response for photons @ 0.124 GeV

The asymmetric Gaussian function is used for fitting as,



$y = N\,G$ ..... for $E \geq E_p$

$y = N\,(G + \exp(E-E_{peak}/\lambda)\,(1-G)$ ..... for $E \leq E_p$

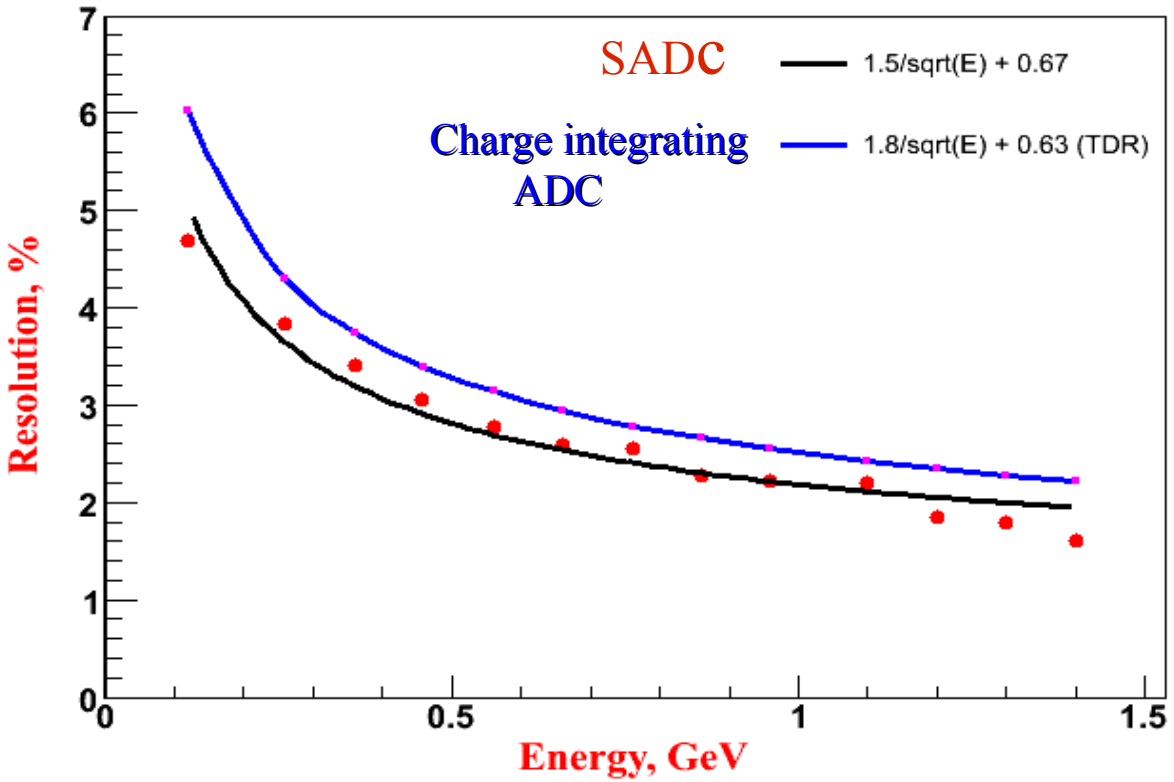
$G = \exp(-4 \ln 2\,(E-E_p)^2 / \Gamma^2)$

E_p - most probable energy
N - normalization
Γ - FWHM of the Gaussian
λ - FWHM for low energy tail

FWHM of the Gaussian is used for estimation of σ

A.R. Gabler et al. NIMA 346 (1994) 168-176

Improved Energy resolution



Energy resolution:

$\sigma/E = [a/\sqrt{E(GeV)}] + b$

Where, a = 1.5; b = 0.67

2.2% @ 1.0 GeV

1.6 % @ 1.4 GeV

Conclusion:

1. Energy response of PWO crystals to high energy photons has been measured
2. Energy resolution achieved by 3 x 3 matrix and SADC is

   2.2% @ 1.0 GeV

   1.6% @ 1.4 GeV
3. Problem of after-pulses was recognized during the analysis, removed by setting a proper time window.

Important to improve the LNP design.