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MIMOSA5 Results

Response (cluster shape) for different incident angles: preliminary results from dedicated beam tests and simulation

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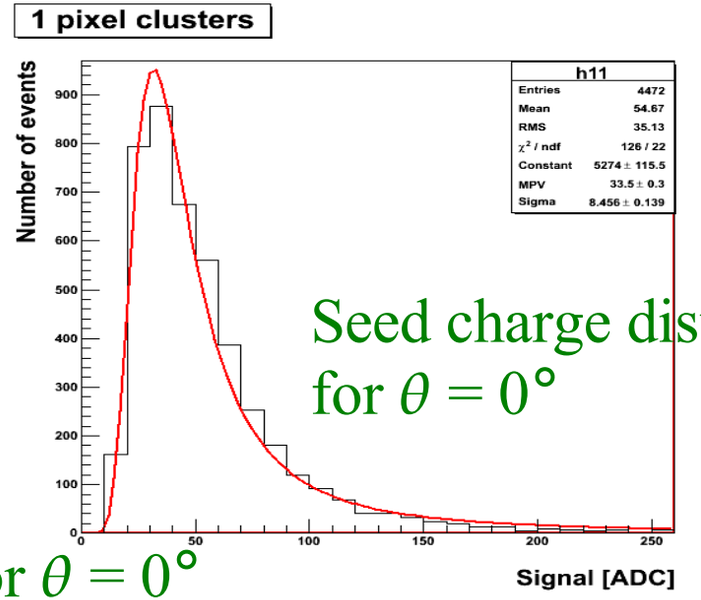
Introduction

- Development of the MAPS response parametrisation for the Geant4 simulations see presentations at JRA1 meeting in March and LCWS'07
- New measurements of the MIMOSA5 response for different incident angles (17 – 30 September 2007)
  - Dedicated 2D support for MIMOSA5 φ_x ,$\varphi_y \in (0°,75°)$

- Determination of incident angles from cluster characteristics – in progress

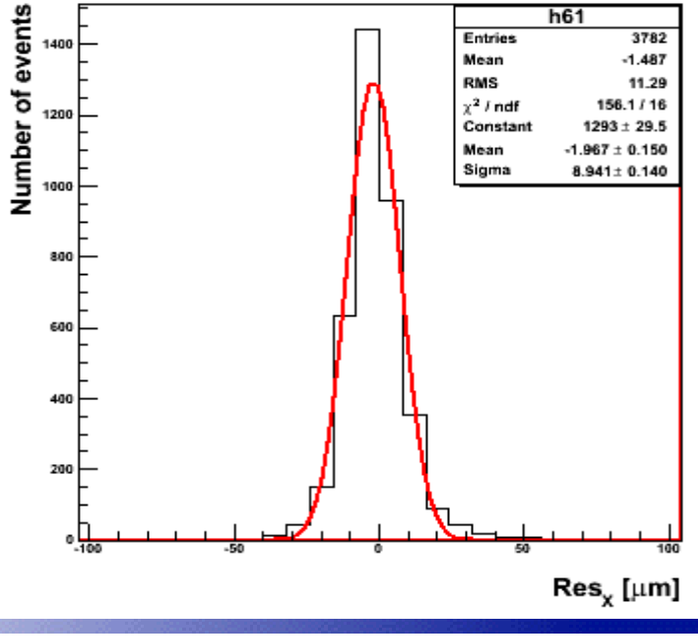
MIMOSA5 – MAPS prototype

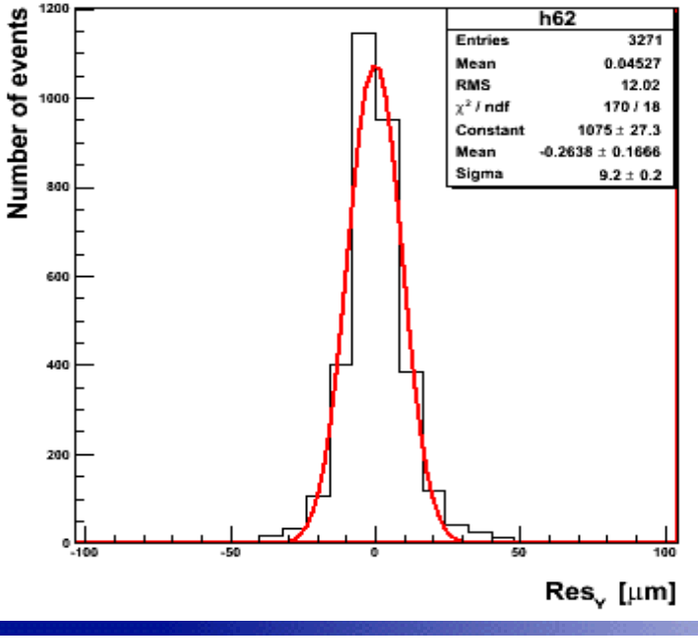
- MIMOSA5 measurements
  - Pixel size: 17μm × 17μm
  - Epitaxial layer: 14μm
  - Thickness: 120μm
  - 6.5 GeV electrons



Seed charge distribution for $\theta = 0°$

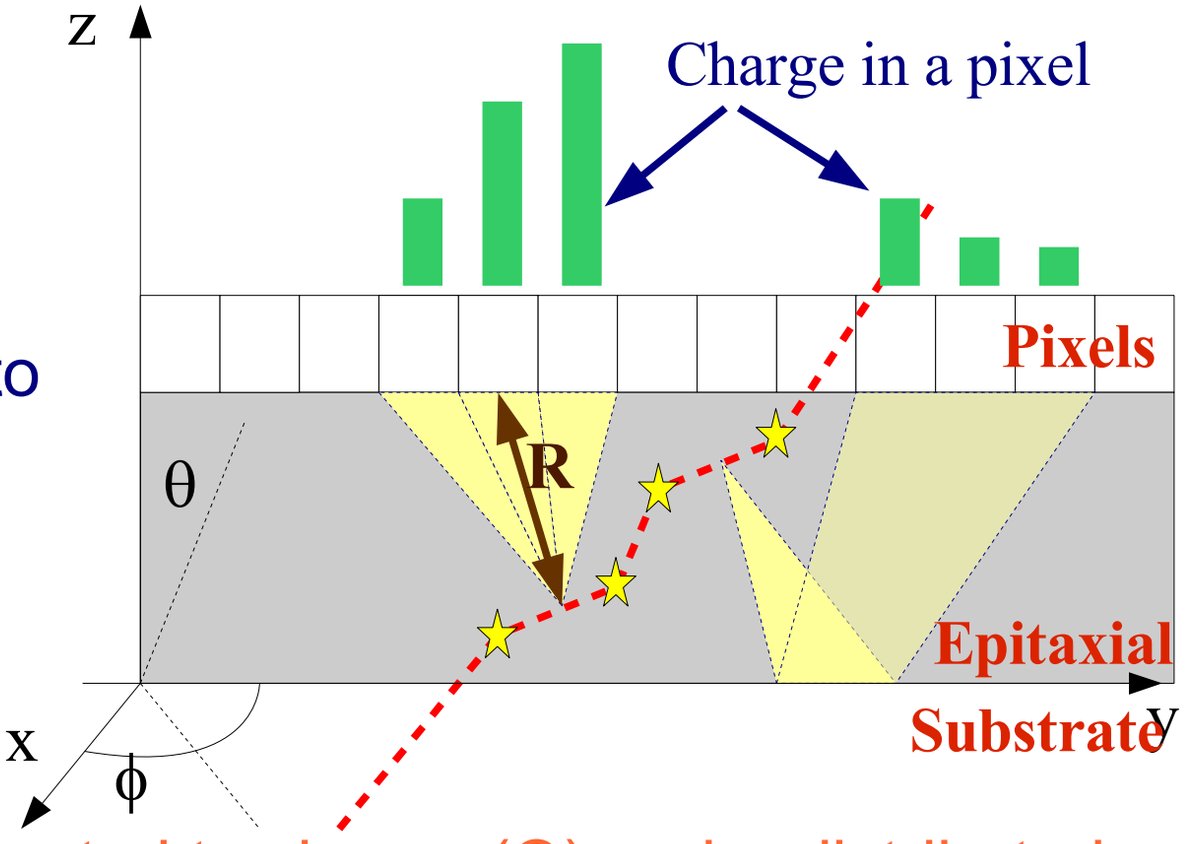
Spatial resolution for $\theta = 0°$





A simple model of charge diffusion

- Isotropic thermal diffusion leads to charge spread into adjacent pixels – cluster formation



- Deposited energy is converted to charge (Q) and redistributed into pixels according to the formula:

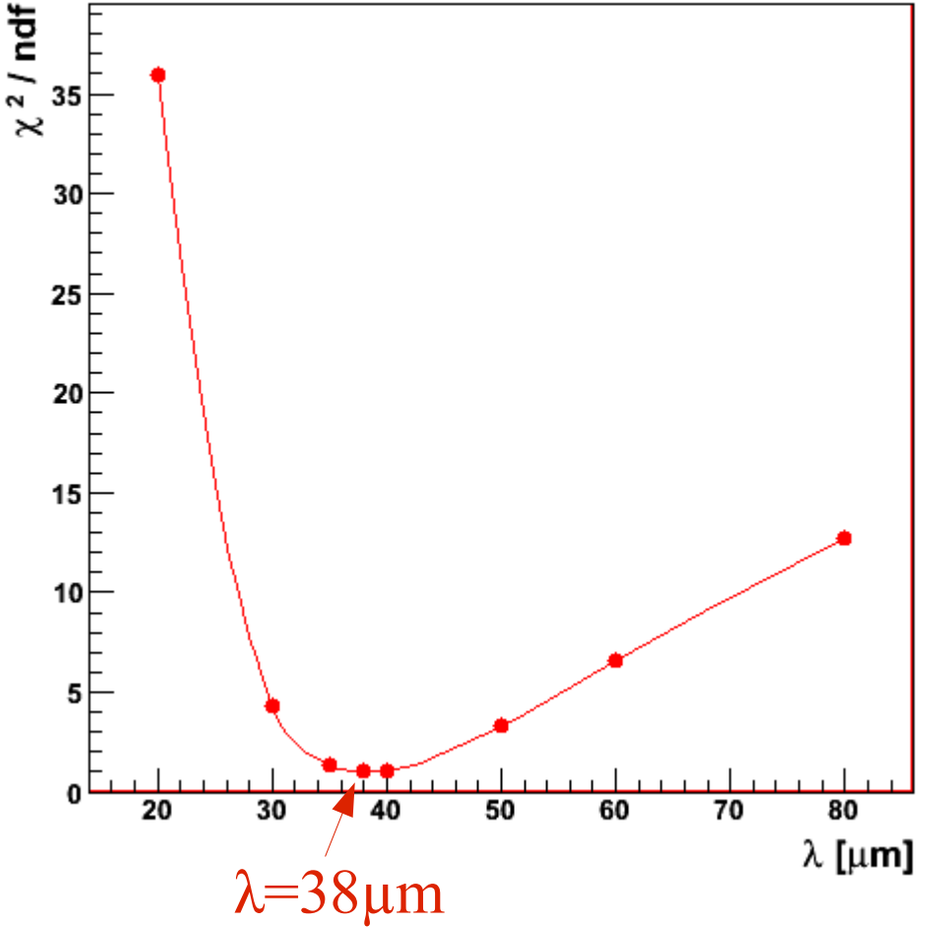
Isotropic diffusion

Attenuation term

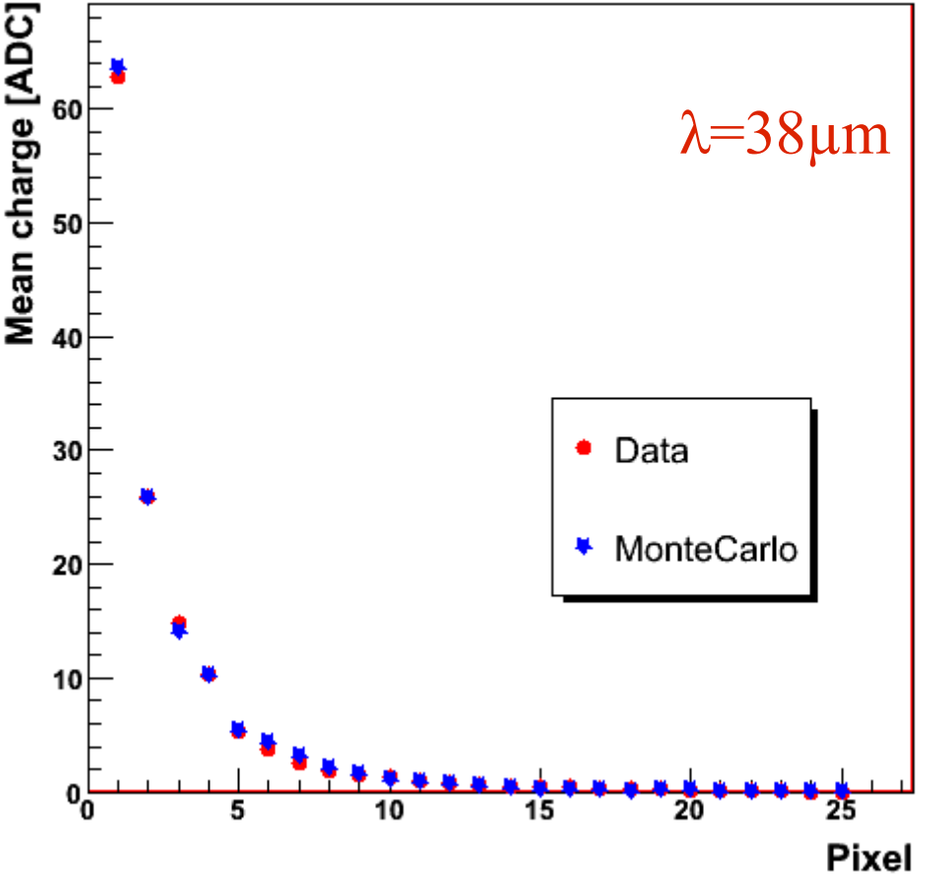
$$q(R) = Q \frac{d\Omega}{(4\pi)} \exp\left(\frac{-R}{\lambda}\right)$$

λ to be determined

Fitting λ for $\theta = 0°$



5x5 pixel cluster



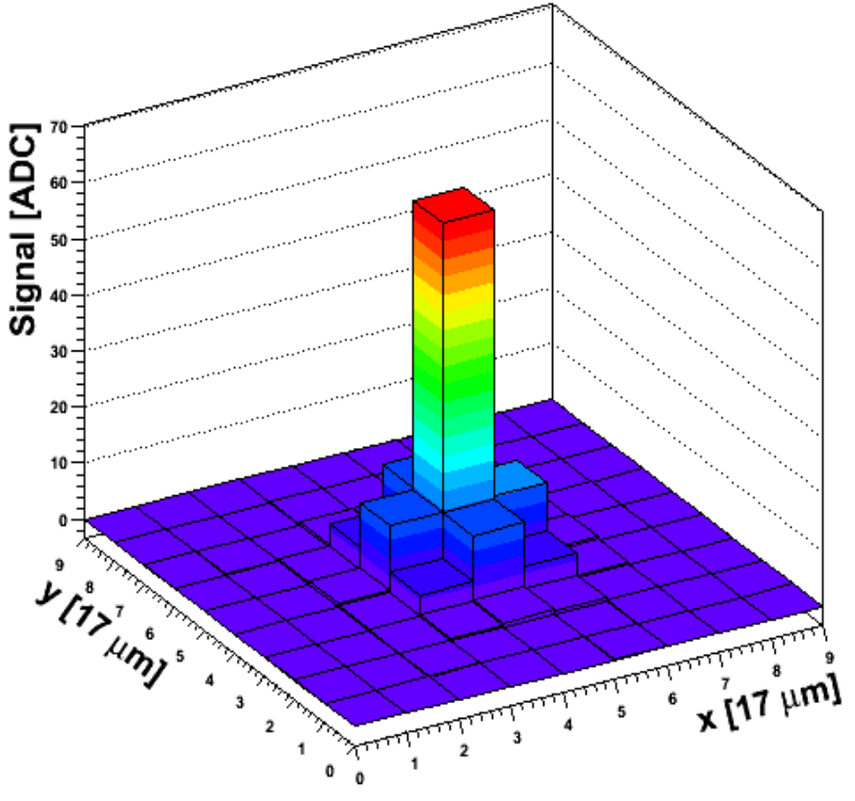
- The best fit for λ=38μm (noise related to electronics has been added to Monte Carlo)

Mean cluster shape – data versus MC

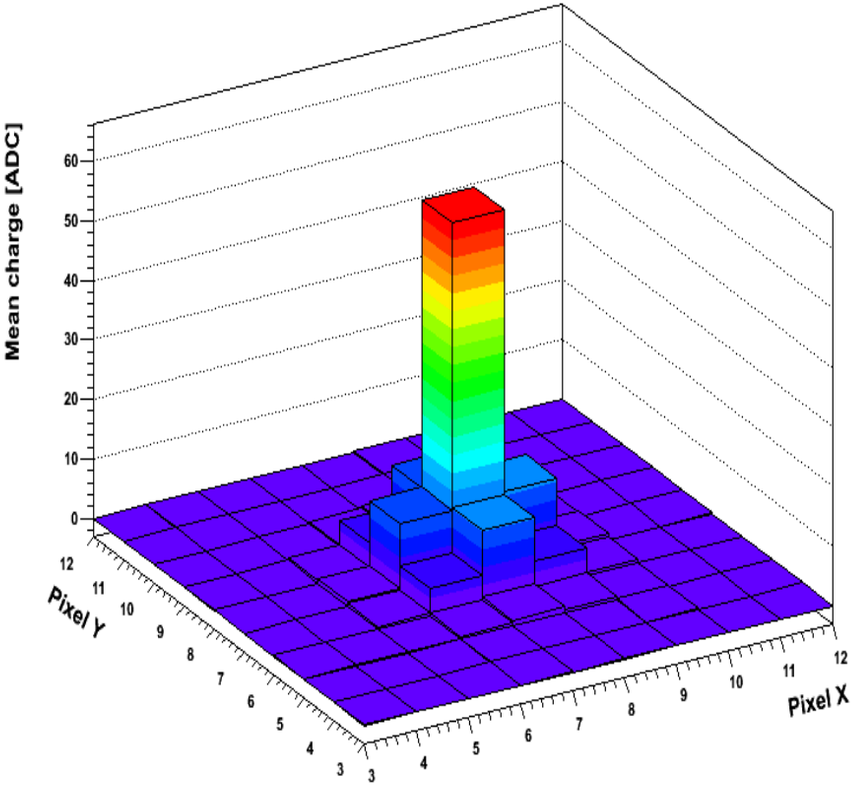
Track traversing at θ = 0°

Mean cluster

Monte Carlo

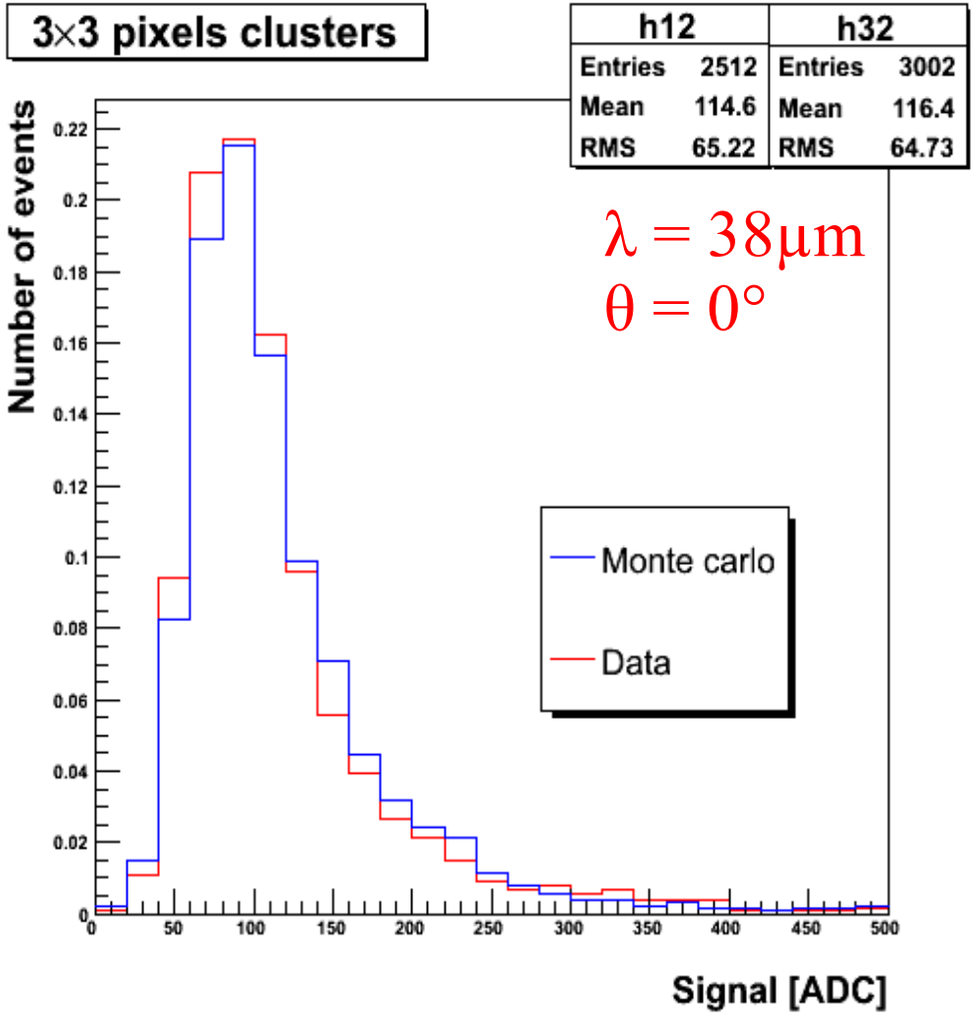


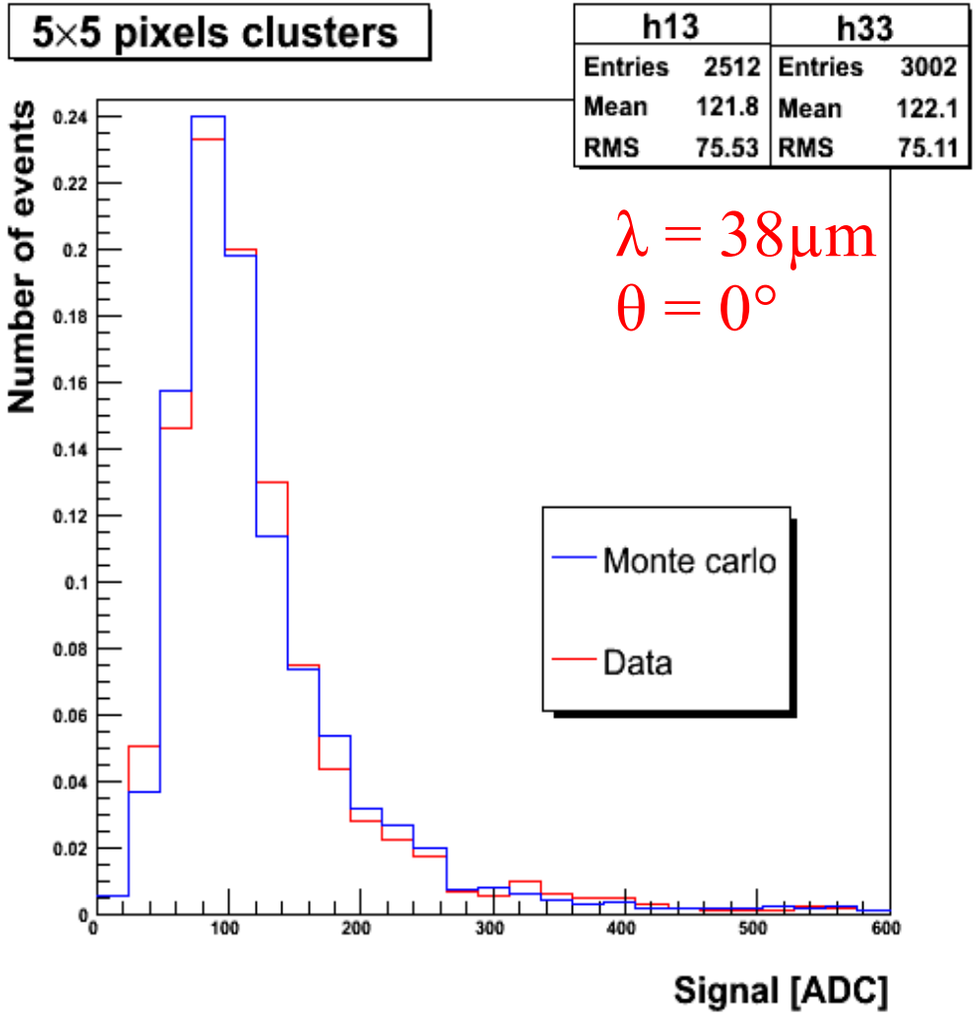
Measurements



Monte Carlo in a good agreement with data

Comparison of Geant4 clusters with data clusters





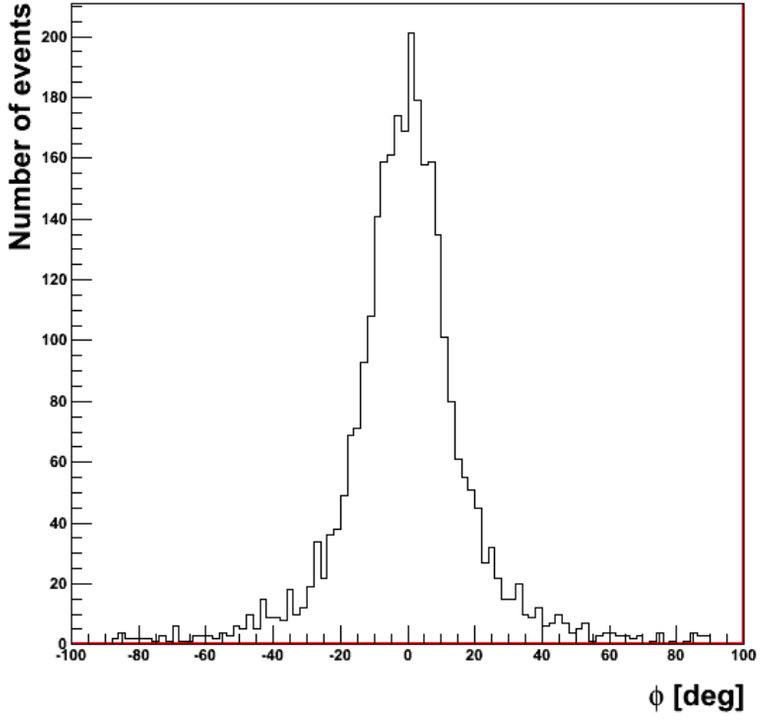
- Charge collected in symmetrical clusters formed around a seed pixel (3x3 and 5x5 pixel clusters)

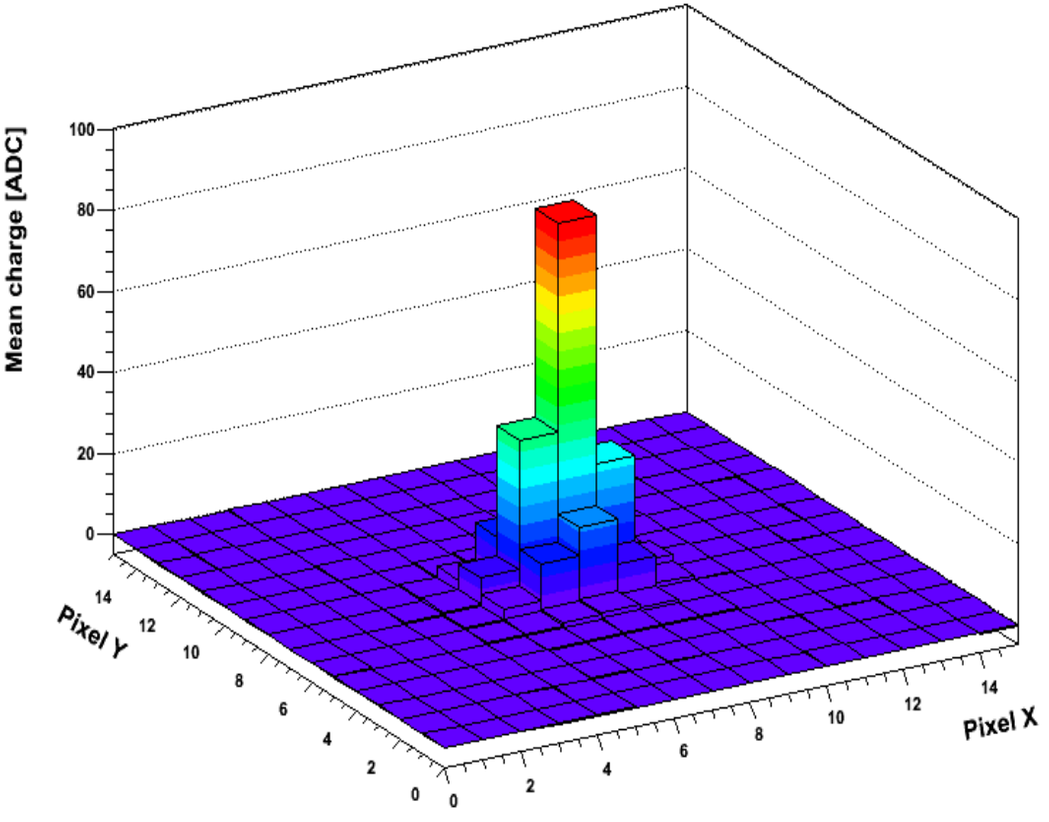
Cluster shapes - measurements

New test beam results

Beam: $\theta = 60^\circ \quad \varphi = 0^\circ$

reconstructed angle:





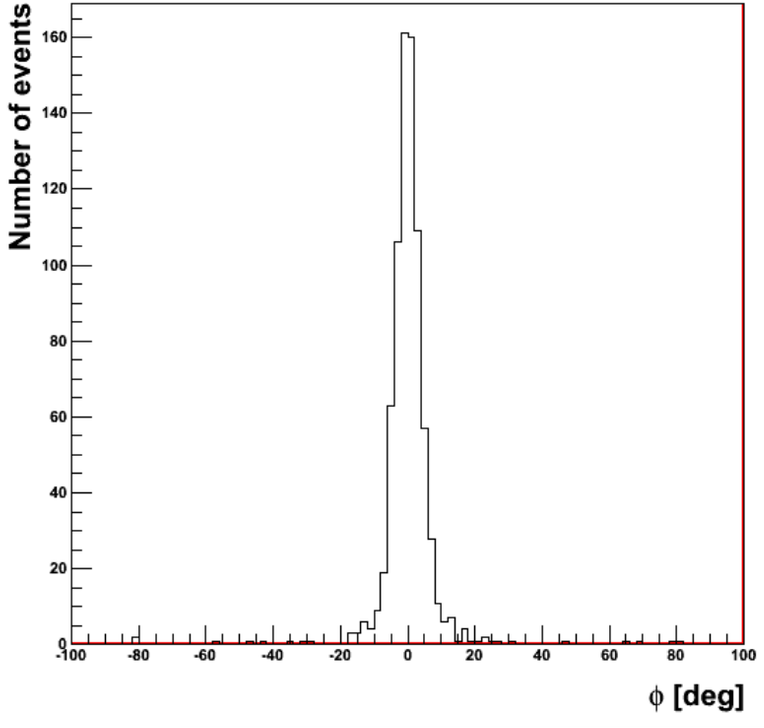
Mean cluster

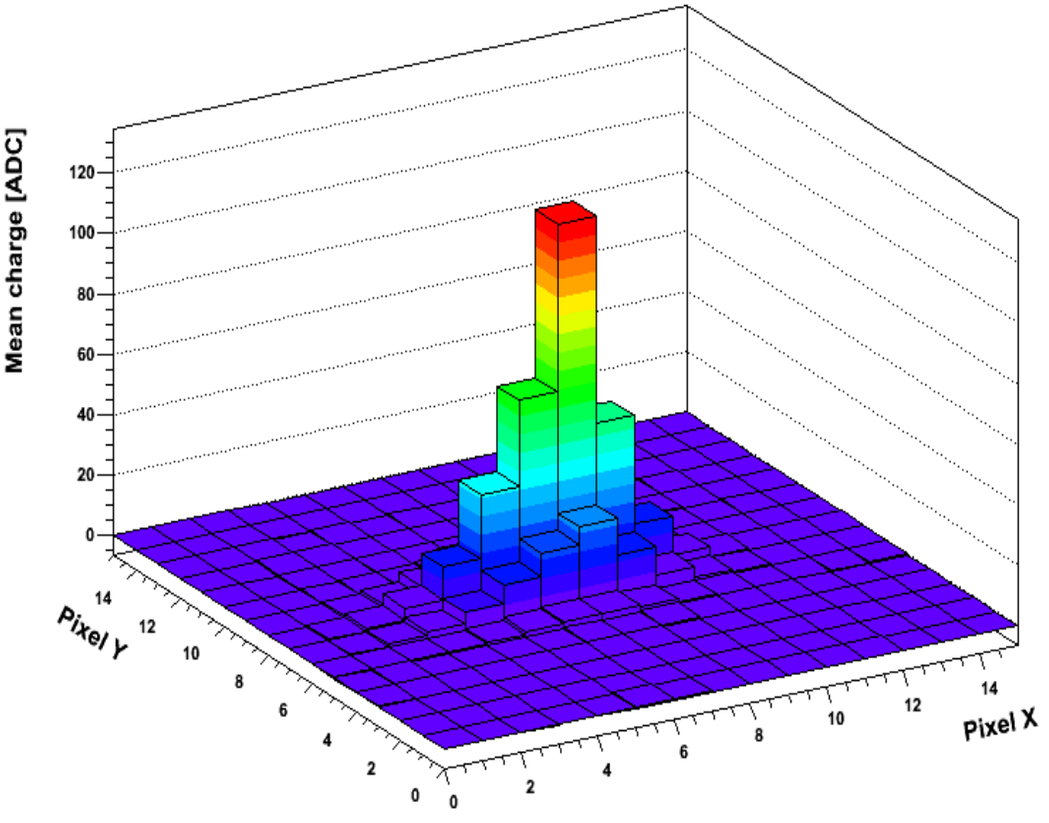
Cluster shapes - measurements

New test beam results

Beam: $\theta = 75^\circ \quad \varphi = 0^\circ$

reconstructed angle:





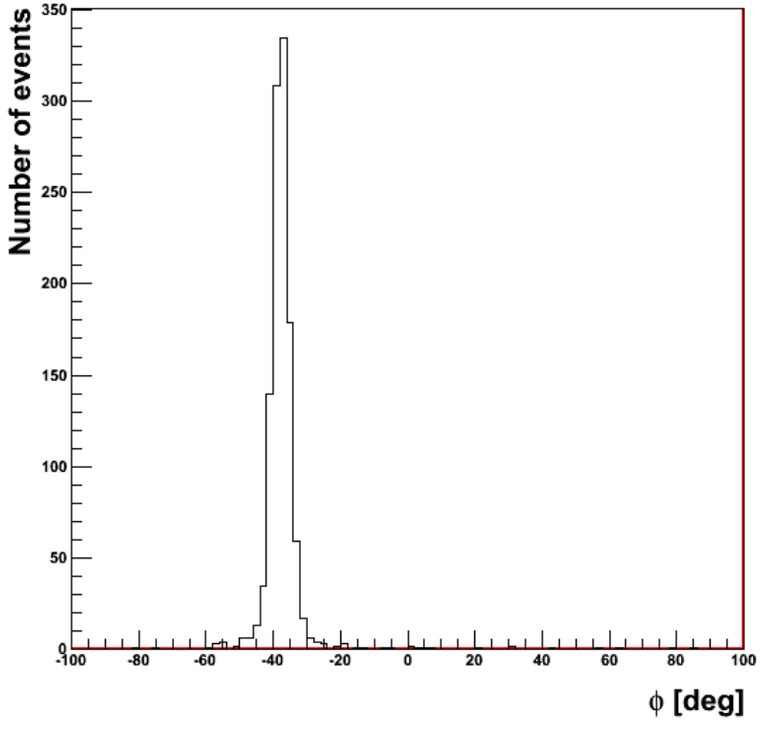
Mean cluster

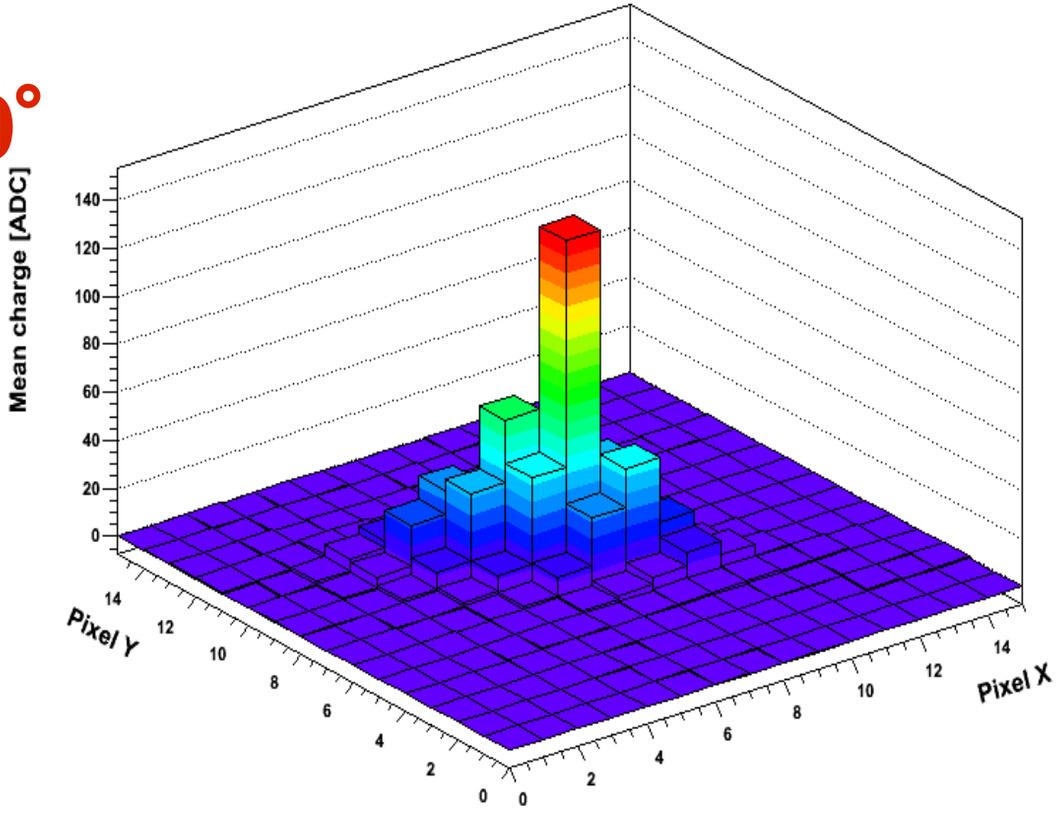
Cluster shapes - measurements

New test beam results

Beam: $\theta = 75^\circ$ $\varphi = -40^\circ$

reconstructed angle:

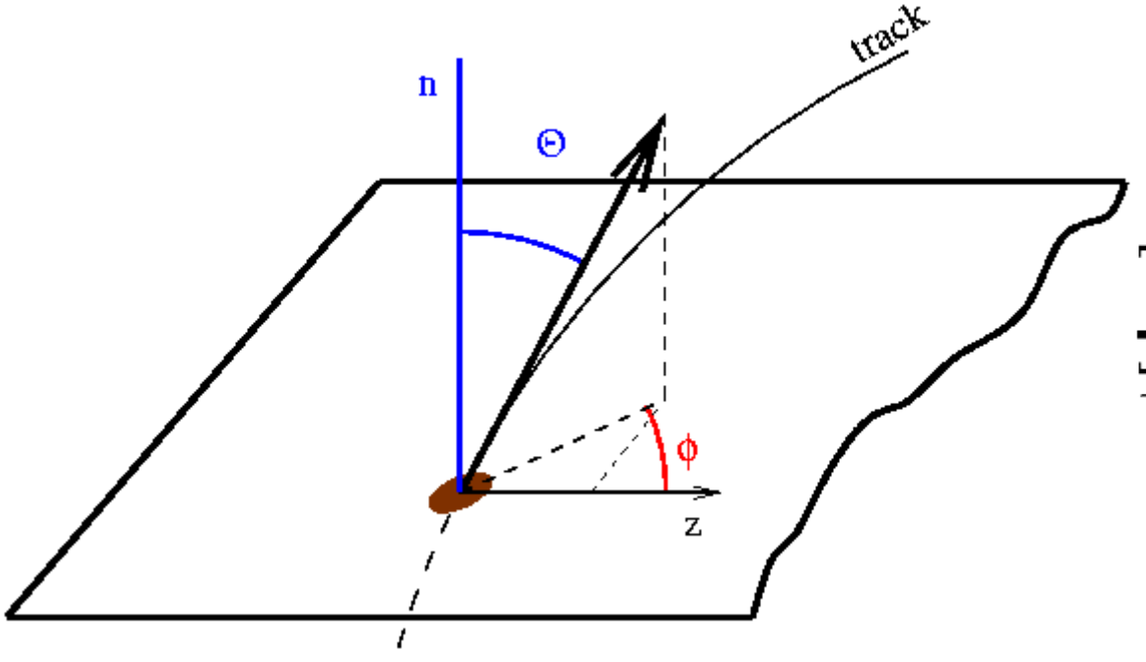




Mean cluster

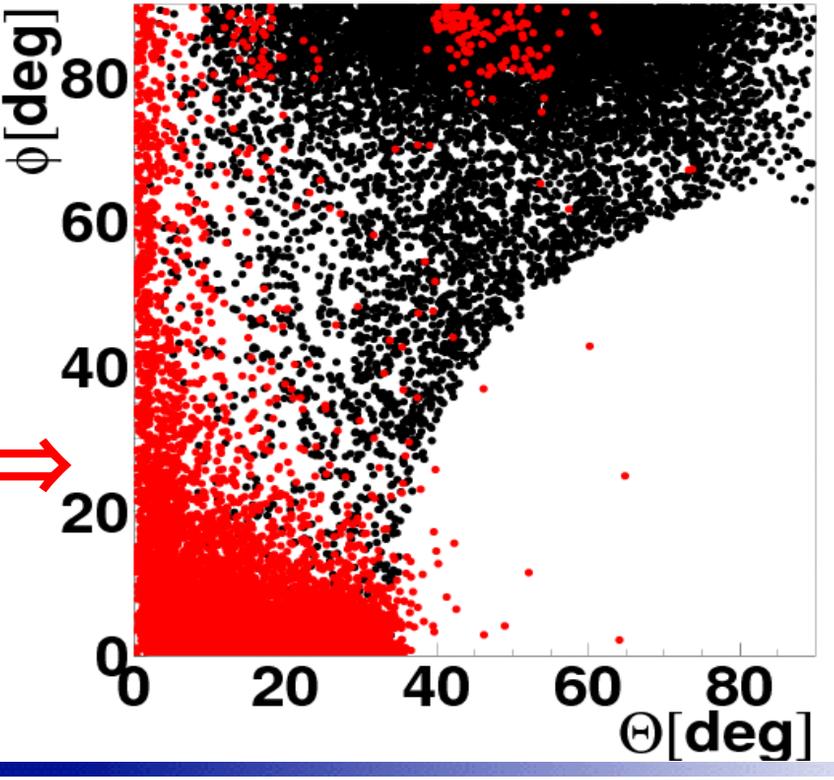
Beamstrahlung background rejection

- Cluster shape measurement can be an important tool to discriminate between **beamstrahlung** and **physics hits** at ILC



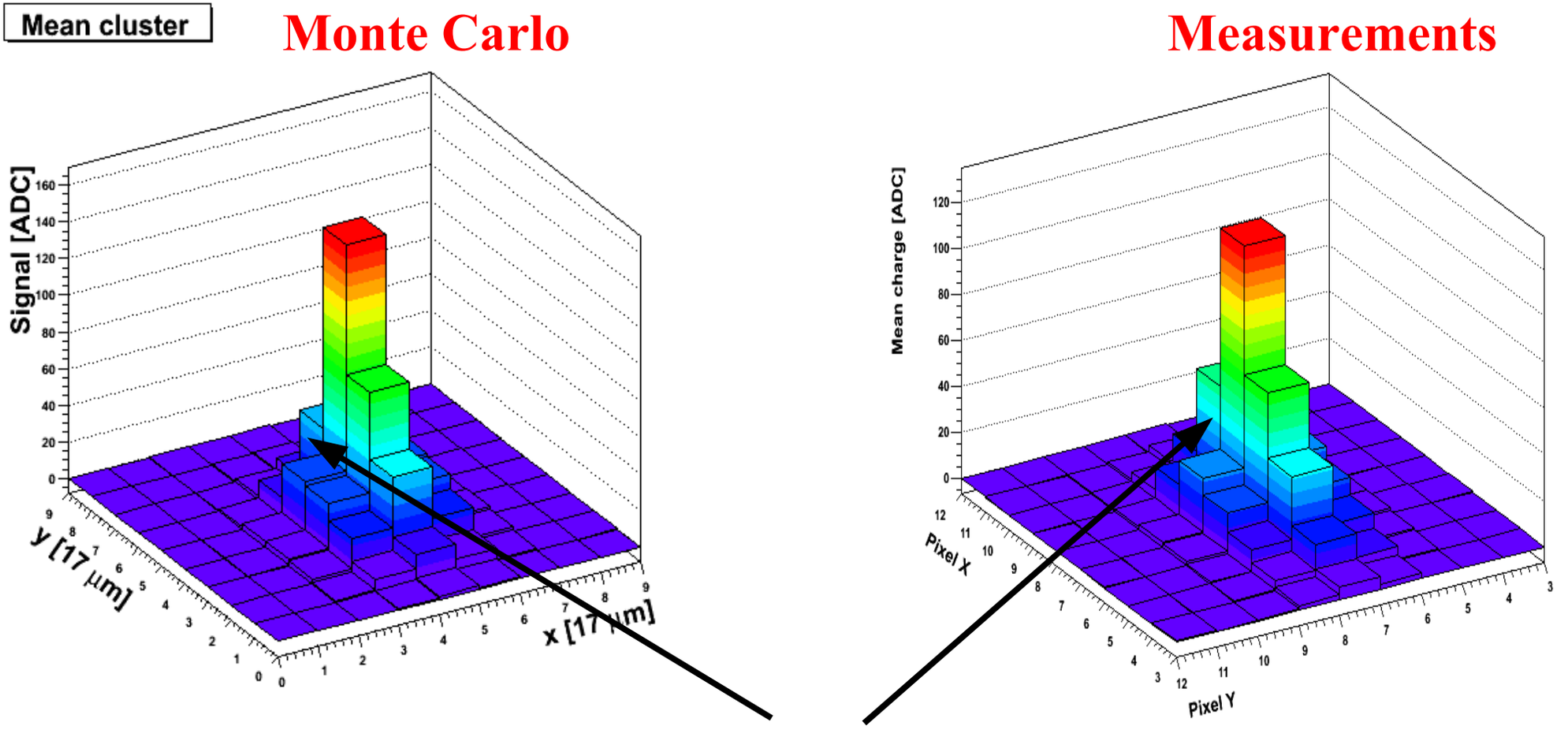
- physics hits
- baemstrahlung

Hits in the first VTX layer ⇒
(simulation by P.Luzniak)



Mean cluster shape – data versus MC

Track traversing at θ = 75°



Parametrisation of MAPS response needs improvement – in progress

Summary

- New results from dedicated MIMOSA5 tests at DESY
- Measurements at different incident angles show cluster elongation
  - Significant cluster elongation for $\theta > 45°$ allows for φ determination
- Parametrisation of MAPS detector works for $\theta = 0°$,
  but it has to be improved in order to reproduce results for large angles – work in progress