Performance results of a high-granularity electromagnetic calorimeter

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Summery

- **Forward Calorimeter** (FoCal) under discussion for Alice Upgrade (possible installation in LS3 (≈2024))
- A **high granularity** digital Si/W calorimeter **prototype** for FoCal has been built and tested.
- Very **small Molière radius** (11±0.5mm) has been measured.
- Unique **high resolution lateral shower profiles** have been obtained → two-shower separation.
- An additional **charge diffusion model** works well to improve the description in Geant 4 **simulations**.
- Sensor **sensitivities** and **dead area** have been **corrected** for.
- **Performance** of our prototype **agrees** reasonably well with the **simulation**.

Motivation

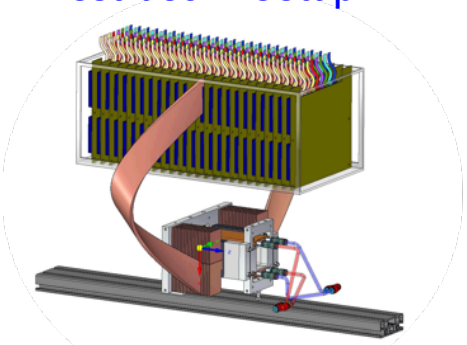
Measurement of direct photons at large rapidity as a signal of gluon saturation.

Requirements for the Focal detector
Gamma/π^0 discrimination

- 3D shower shape analysis
- Particle flow
- Energy measurement by particle counting: requires high granularity due to high density of shower particles (10^3 mm^{-2})

FoCal Prototype

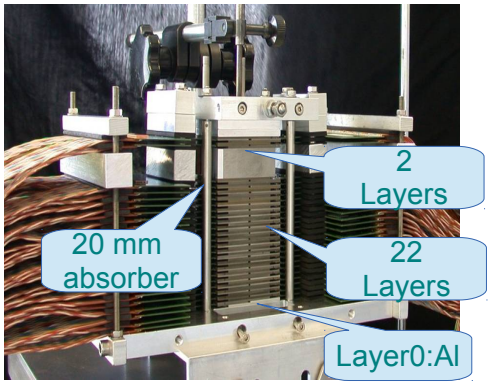
Test beam setup



A **unique** FoCal prototype:

- ~39 M pixels (pitch: 30μm)
- Small R_M ~ 11mm

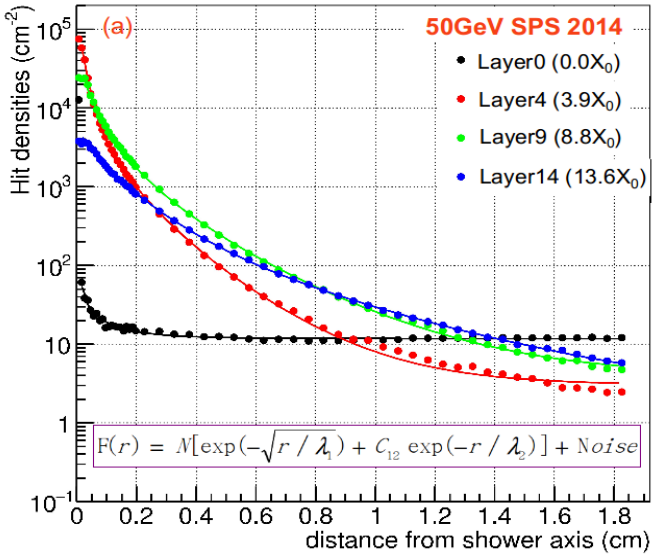
Stack of W and Si layers



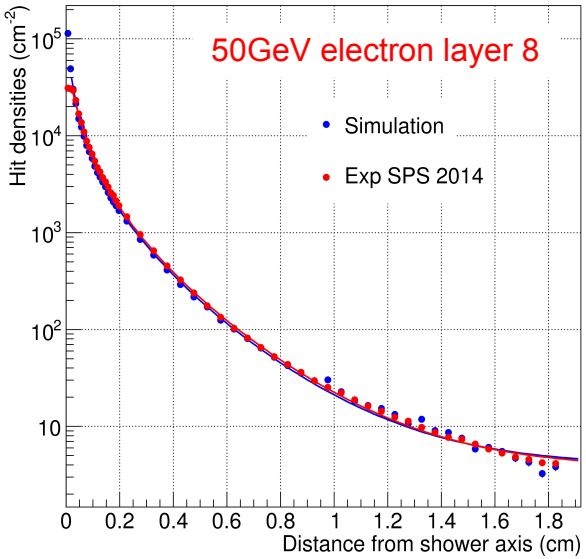
Results

Lateral profile

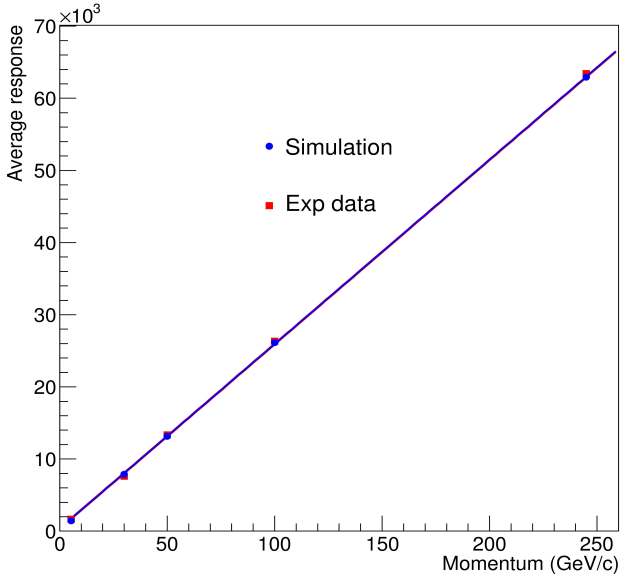
Experimental data



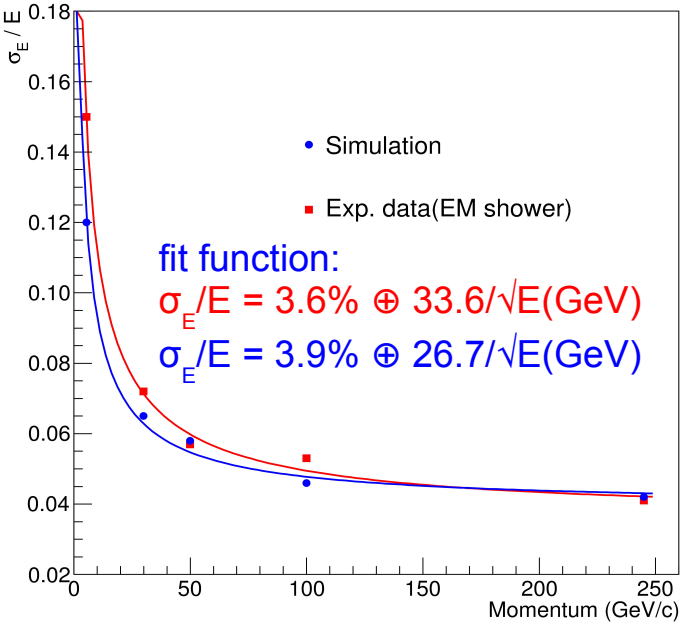
Comparison to simulation



linearity



Energy resolution



What was used in data analyses and simulation

Simulation

- A charge diffusion model was added to Geant 4 simulation

Experimental data

- Sensor sensitivity correction
- Dead area correction