

First use of the Allpix framework and preliminary results



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Overview

- Motivation
- The Alpix Framework
- Simulation
- Results
- Comparison to Testbeam data
- Summary and Outlook





Motivation

- We are currently testing pixel sensor for the ATLAS Itk
- This simulation can give insights to the analysis we are currently doing
 - resolution
 - material effects
 - fake hits, multiple scattering etc.
- Justification of cuts in the analysis e.g windows and thresholds
- Allpix seems to also offer detailed simulation of the sensor response





The Allpix Framework

- Based on Geant4
- Easy to use:
 - xml file to setup sensor
 - macro file for setting up the models used for the simulation
- Difficulties for the local installation
- problems converting ASCII output into .Icio format for the EUTelescope software

```
<detectors>
<!-- RMS022 -->
<pixelid id="300,301,302,303,304,305">
<digitizer/mimosa26/>digitizer</digitizer>

<apix x="1125"/>apix_x</apix_x>
<apix y="576"/>apix_y</apix_y>
<apix z="0"/>apix_z</apix_z>
<pixsize_x units="um">9.25/>pixsize_x</pixsize_x>
<pixsize_y units="um">9.25/>pixsize_y</pixsize_y>
<pixsize_z units="um">25/>pixsize_z</pixsize_z>

<chip_hx units="um">10656.0/>chip_hx</chip_hx>
<chip_hy units="um">5328.0/>chip_hy</chip_hy>
<chip_hx units="um">0.0/>chip_hx</chip_hx>

<chip_pass units="um">0/>chip_pass</chip_pass>
<chip_pass units="um">0/>chip_pass</chip_pass>
<chip_pass units="um">0/>chip_pass</chip_pass>

<sensor_hx units="um">10656.0/>sensor_hx</sensor_hx>
<sensor_hy units="um">5328.0/>sensor_hy</sensor_hy>
<sensor_hx units="um">0.0/>sensor_hx</sensor_hx>

<sensor_gr_excess_top units="um">375.0/>sensor_gr_excess_top</sensor_gr_excess_top>
<sensor_gr_excess_bottom units="um">375.0/>sensor_gr_excess_bottom</sensor_gr_excess_bottom>
<sensor_gr_excess_right units="um">475.0/>sensor_gr_excess_right</sensor_gr_excess_right>
<sensor_gr_excess_left units="um">475.0/>sensor_gr_excess_left</sensor_gr_excess_left>
```

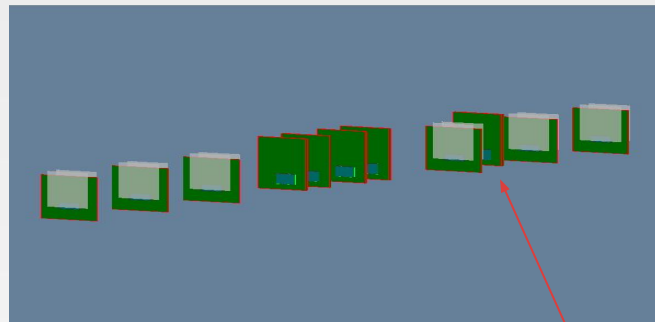




Simulation

Setup:

- FE-I4 SINTEF sensors
 - 80x336 pixels
 - 250x50 μm pixel size
 - Simulated as planar sensors although they are 3D
- EUTelescope
 - 18,5 μm pitch Mimosa26 sensors



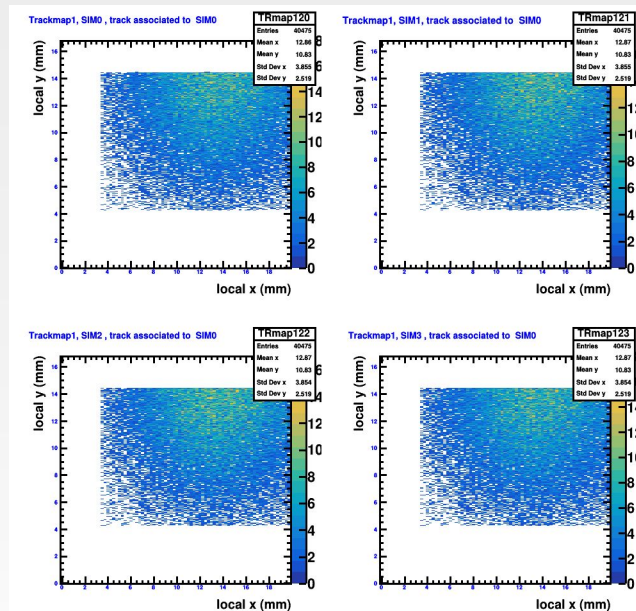
Simulation 'equivalent'
of SINTEF 12 sensor





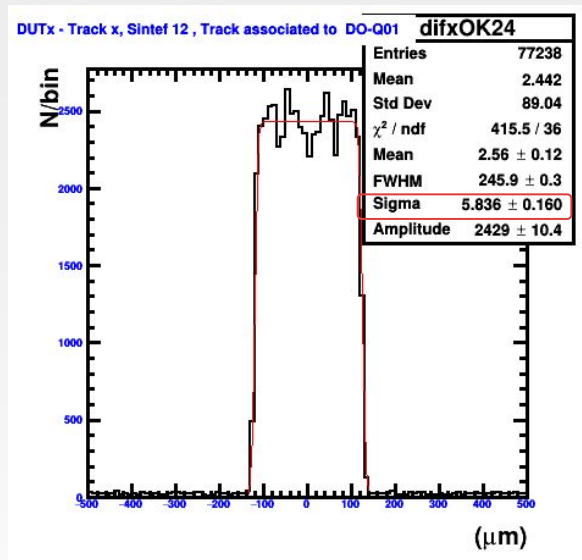
Simulation

- π^- beam @ 120GeV
- 100k events
- 1 part./event
- output as ASCII files
- ➔ reconstruction software
- ➔ impact points and reconstructed tracks





Results

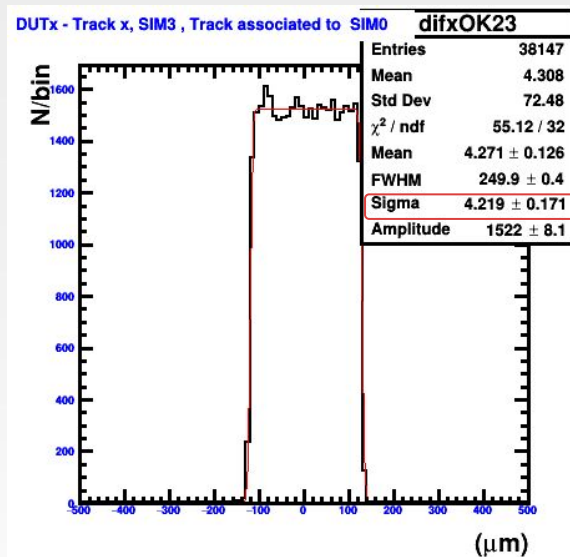


Testbeam data

$$\sigma = 5.836 \pm 0.16 \mu\text{m}$$

Residuals in
x-direction

- comparable
spatial
resolution!



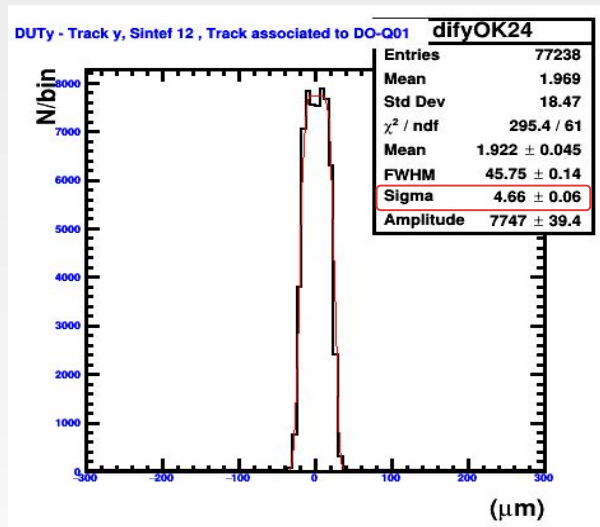
Simulated data

$$\sigma = 4.219 \pm 0.171 \mu\text{m}$$



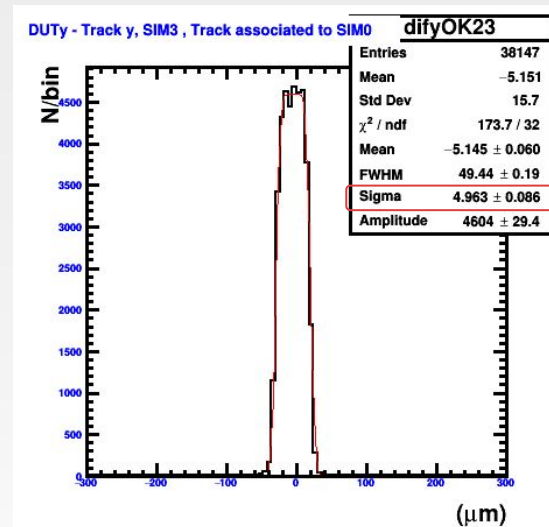


Results



Testbeam data:
 $\sigma = 4.66 \pm 0.06 \mu\text{m}$

Residuals in
y-direction



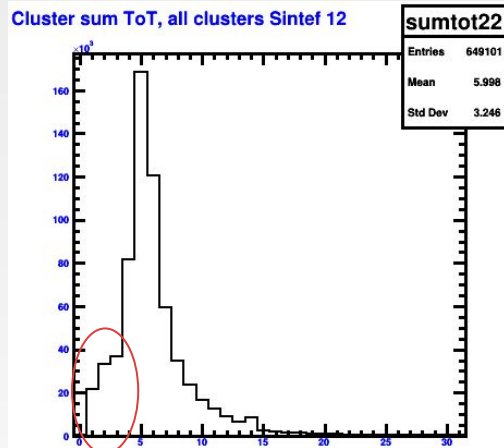
Simulated data:
 $\sigma = 4.963 \pm 0.086 \mu\text{m}$





Results

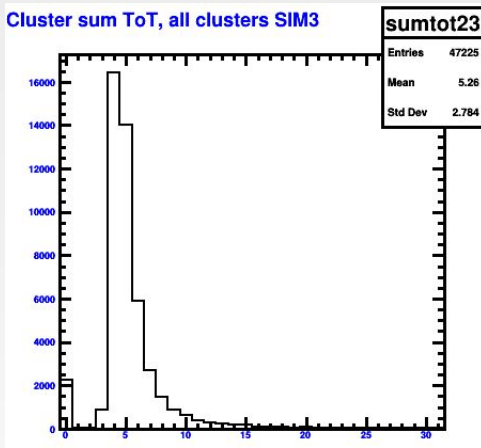
Cluster sum ToT, all clusters Sintef 12



Testbeam data:

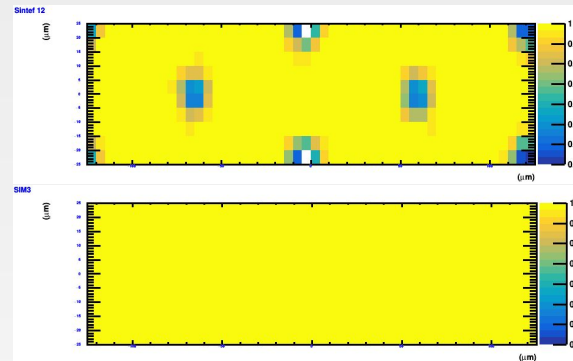
- tail due to holes

Cluster sum ToT, all clusters SIM3



Simulated data:

- no tail
- Some hits got 0 ToT

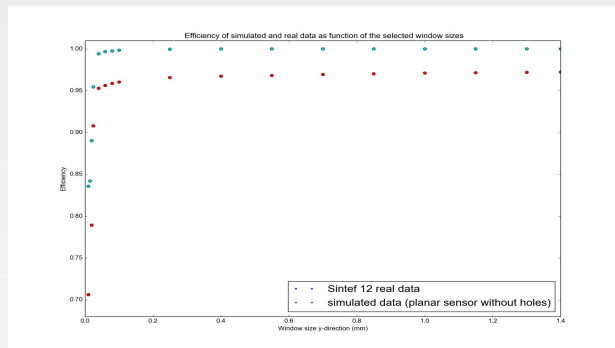


efficiency maps for the real 3D
SINTEF sensor and for the simulated
planar one

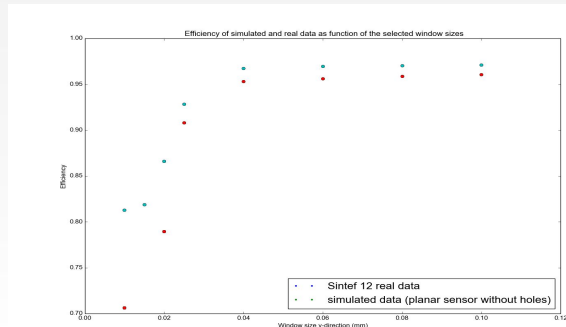




Comparison to testbeam data



plots shows efficiency as function of window size (Δy) for track-hit association



Zoomed view

- Simulated efficiency higher, no holes
- normalized to the SINTEF12 highest efficiency
- SINTEF12 shows a slope in the platou - could be due to systematics
- shows a somewhat similar response to the cuts, difference at low cuts not yet completely understood





Summary

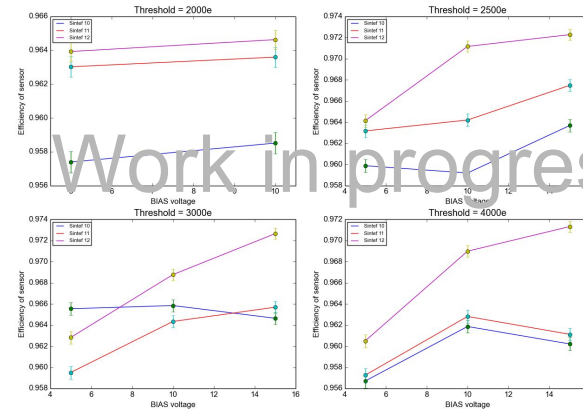
- we have a running simulation that can be used for comparison to testbeam data
- Some features are still not implemented
 - In particular we would benefit from a 3D simulation
 - more material around the telescope
- Allpix is a very nice tool to use





Outlook

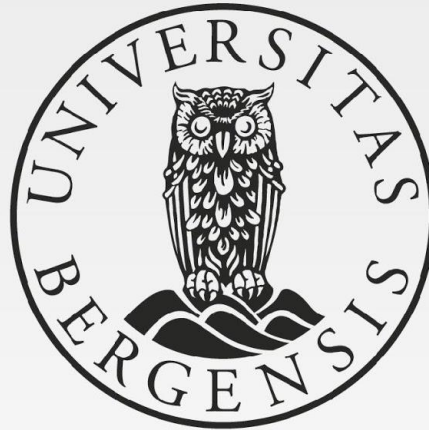
- Compare detailed studies of efficiencies for different thresholds and biases
- Plot shows data from testbeam september 2015
 - Analysis of all data taken for all thresholds and biases





THANK YOU!





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