

#### Two tracks separation resolution in 3D-IBL pixel modules \*

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\* This work is the qualification task assigned to me to become an ATLAS author

## Introduction

- Motivation
- Simulation studies
- ITk-Test beam
- \* FEI4 telescope Test beam. Uni-Geneva
- Analysis ongoing



#### Motivation

ATLAS track reconstruction efficiency (Run 1) High drop on efficiency in case of 'split' tracks



Two-track separation in long flying B Decays requires detailed characterisation of IBL clusters for closely spaced tracks (< 2.5 mm)



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# Beam test with interaction target

- Beam test with interaction target to study IBL and 3D pixel response to closely-spaced charged particles to:
  - \* Test two-track separation capability of IBL sensors
  - \* Optimise cluster reconstruction and validate response in simulation
  - Study unfolding of merged clusters
  - \* Test and validate algorithms to be applied to Run 2 data





## Simulation (By Marco Battaglia)

- \* G4 simulation of layout to determine track density on IBL plane
  - Standalone G4:
    - Telescope +DUT+Target
    - \* Beam size, divergence and energy spread
    - \* Simple track fit and extrapolation on DUT plane (perfect patrec)
    - Validated in SOIPIX beam tests with 150,200 and 300 GeV pion beam
  - Layout optimisation:
    - Target Thickness (3 mm)
    - Distance between target and downstream telescope layer (~3 cm)
    - \* Angle of incidence on DUT ( $80^\circ$ , acceptance ~50 %)
    - Beam Energy and event rate (~1/1000)



## ITk Test Beam October 2014

- ITk test beam at SPS facilities
- Resolution ~ 4 um
- 120 GeV pions
- \*  $\eta = 0$  and 1.3 ( $\theta = 90^{\circ}$  and  $60^{\circ}$ )
- \* 3 mm Cu-Target in between layer 2 and 3
- Non-irradiated 3D IBL module plus a planar reference sensors



#### **THANKS TO THE ITk CREW!**



The University of Manchester

### Correlations

ClusterX/ClusterXCorrelationHisto\_d20\_d22









### **Residuals and Cluster width**







## Hit Map





## Two tracks separation resolution







#### Test Beam FEI4 telescope - Uni Geneva November 2014

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#### MANY THANKS UNI GENEVA, BANE AND MATHIEU!

- \* FEI4-telescope Uni Geneva 26-27 Nov.
- Resolution ~ 10 um
- \* 180 GeV pions beam
- \* η ~ 0.2, 1, 1.7, 2.4
  - $\theta = 10^{\circ}, 50^{\circ}, 70^{\circ}, 80^{\circ}$  (20 mill events each)
- \* 3 mm Cu-Target in between layer 3 and 4

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Non irradiated 3D IBL module and planar sensor

DUT+PS

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Higher statistic





### **FUTURE PLAN**

- Development (modifying) of a specific analysis tool for both telescopes including the Cu-target.
  - Using straight tracks for alignment (~ 96 98%)
  - Look for High Multiplicity events
  - Tracks before the target projected to the target plane
  - Downstream layers tracks reconstruction
  - Look for the DUT efficiency (distinguishing close tracks)
- We hope to have two tracks separation resolution values for the next Telescope Workshop





#### THANK YOU !



