

Convergence in Proton Reconstruction Algorithm and final reference tests of Roman pots before installation in LHC

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Outline

- Purpose of TOTEM
- Proton reconstruction
- Reconstruction results
- Roman pot detectors
- Tests:
 - Efficiency
 - Plane alignment
 - Cluster size
- Conclusions

TOTEM (TOTAL Elastic Measurement)



Purpose:

- Measure total p-p cross section to an accuracy of 1% based on Optical Theorem
- Measure elastic scattering in the range $10^{-3} < |t| < 8$ GeV²
- Deeper understanding of proton structure by studying elastic scattering with large momentum transfers



Proton Reconstruction

- Complicated software simulates pp and detector response and reconstructs the proton kinematics based on optical models

$$\vec{\Lambda} = \mathbf{T}(\vec{\Gamma})$$

$$\vec{\Gamma} = (x^*, y^*, z^*, \Theta_{x,1}^*, \Theta_{y,1}^*, \xi_1, \Theta_{x,2}^*, \Theta_{y,2}^*, \xi_2)$$

Initial
position

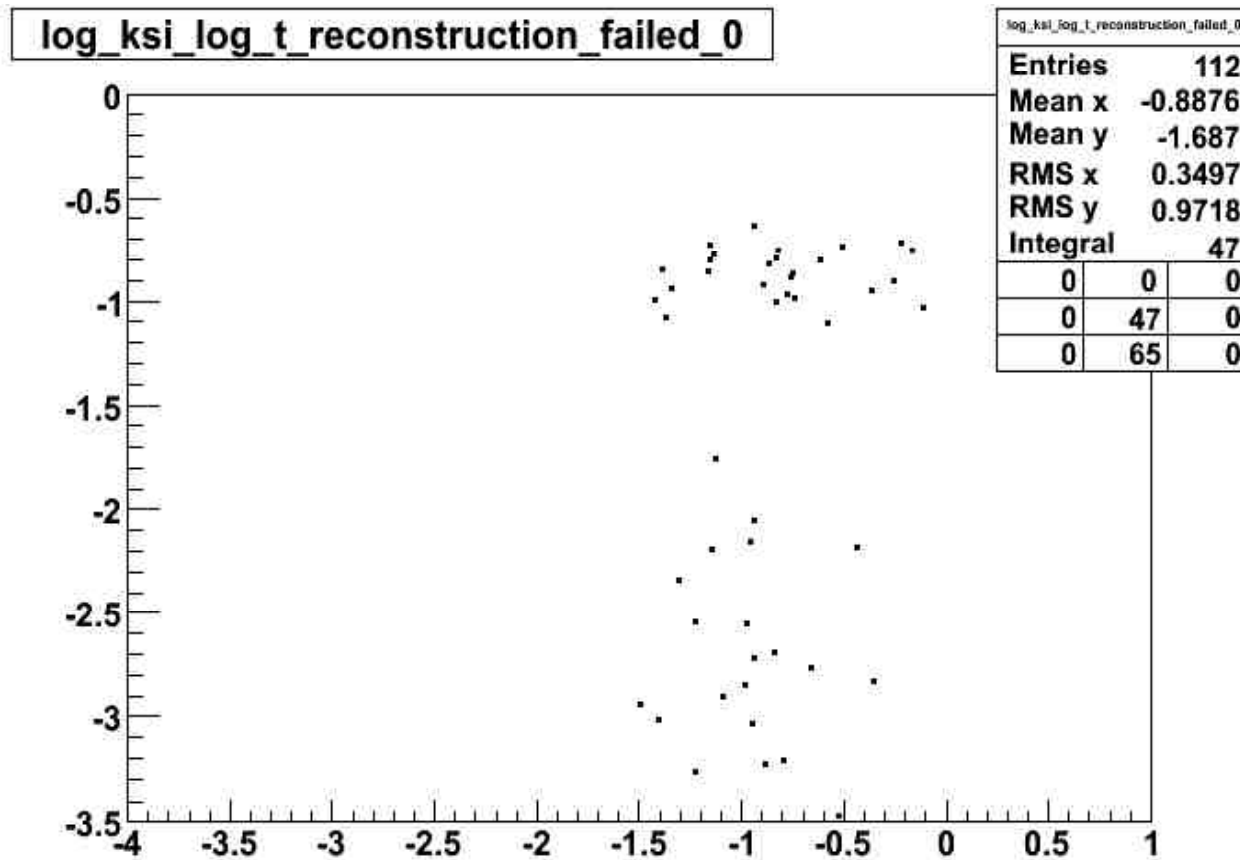
Horizontal and
vertical scattering
angles

Fractional
momentum change

- Since Λ is measured and need to find Γ , a minimization algorithm is implemented
- My task is to figure out what conditions lead to these divergences and minimize error



Reconstruction results





Conclusions

- Within the t -acceptance range, diffractively scattered protons are detected independent on their momentum loss
- For high momentum loss ($-k_{\text{SI}} > 0.11$), due to machine dispersion, diffractively scattered protons can be observed independently of their t -value
- Failure occurs in large t independent of k_{SI}

TOTEM

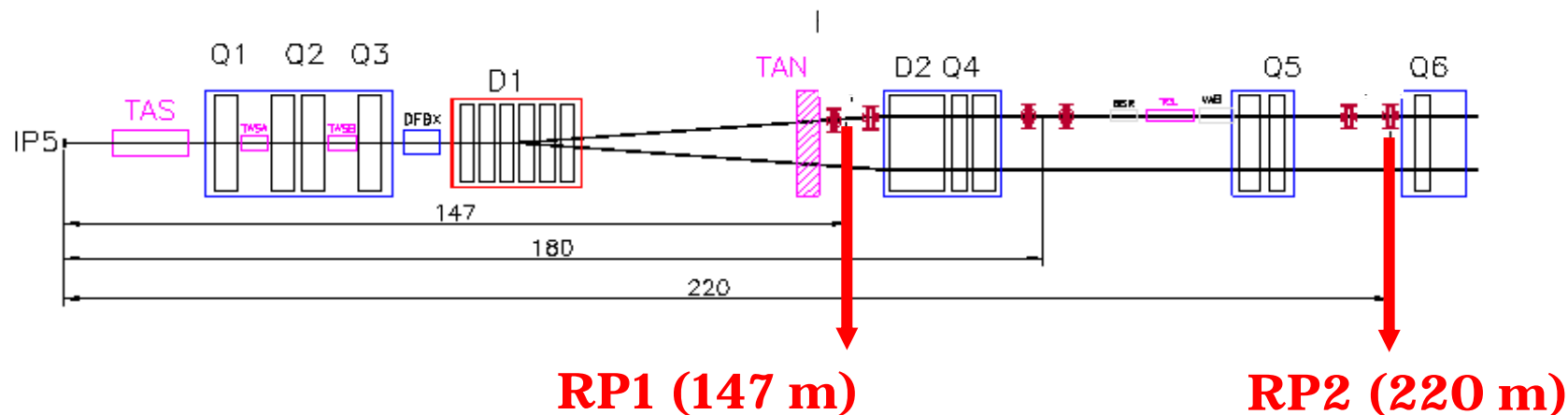


Reference tests of Roman pot
detectors before installation in LHC



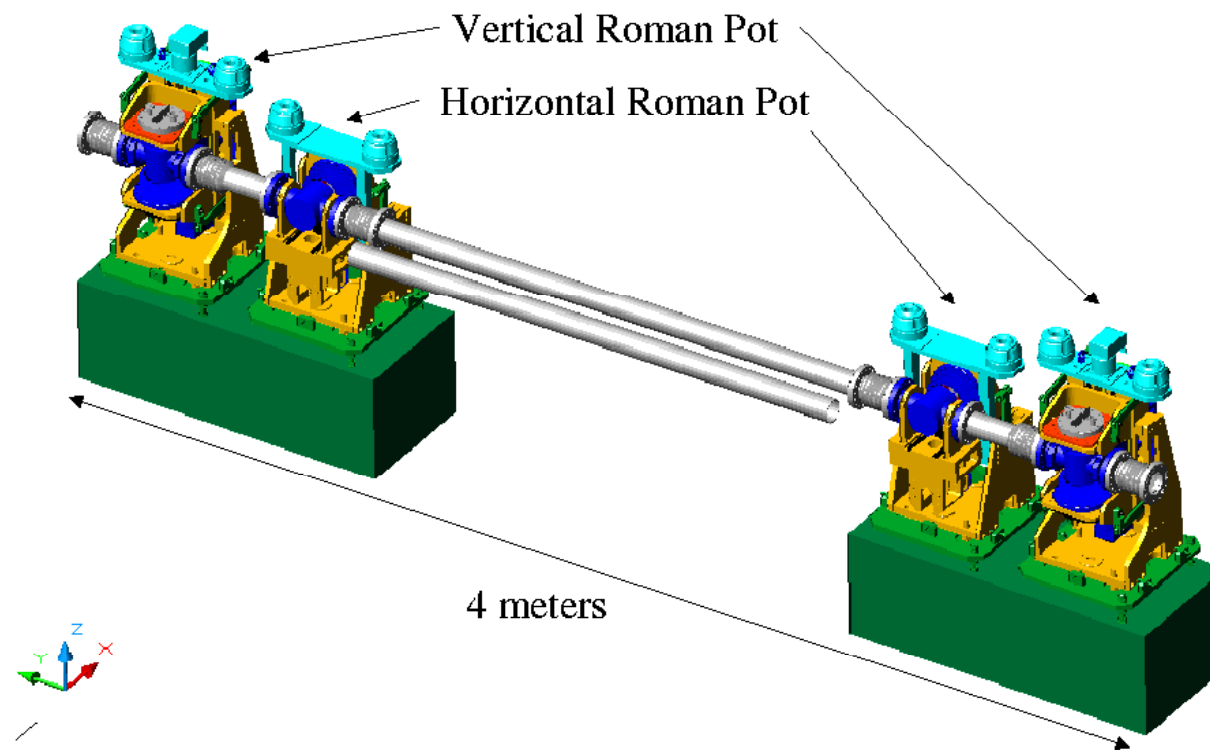
Roman Pot detectors

- Used in detection of very forward protons in movable beam insertions
- Each RP unit consists of 3 pots: 2 approaching the beam vertically and 1 approaching it horizontally





Roman Pot detectors



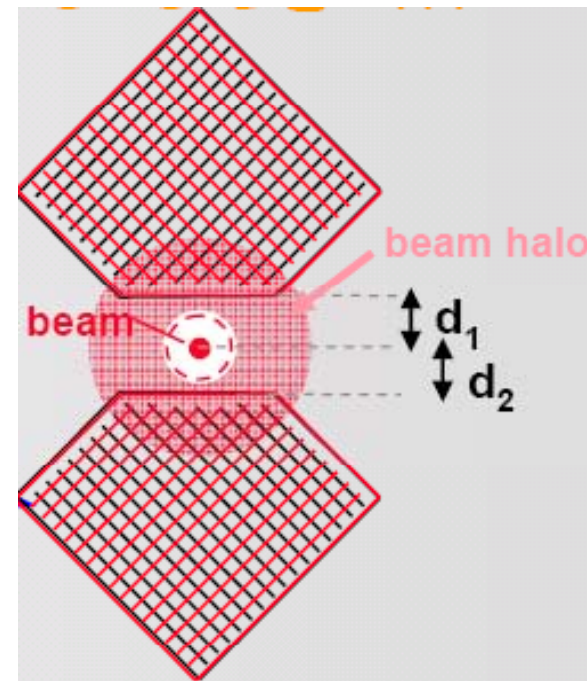
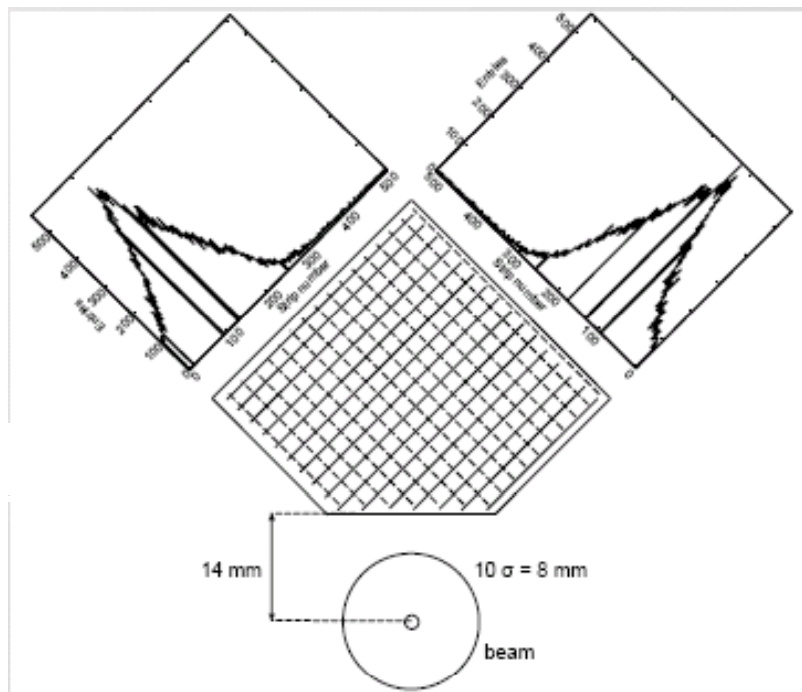


Edgeless silicon detector

- Each pot consists of a stack of 10 planes of 512 silicon microstrips allowing detection up to 50 μm from their physical edge
- This is achieved by a voltage terminating structure that controls the potential distribution between the detector's sensitive area and the cut edge to have a vanishing potential drop.
- Every 8 strips are connected to a VFAT chip that reads the hits.



Edgeless silicon detector



Selection algorithm of reference tracks



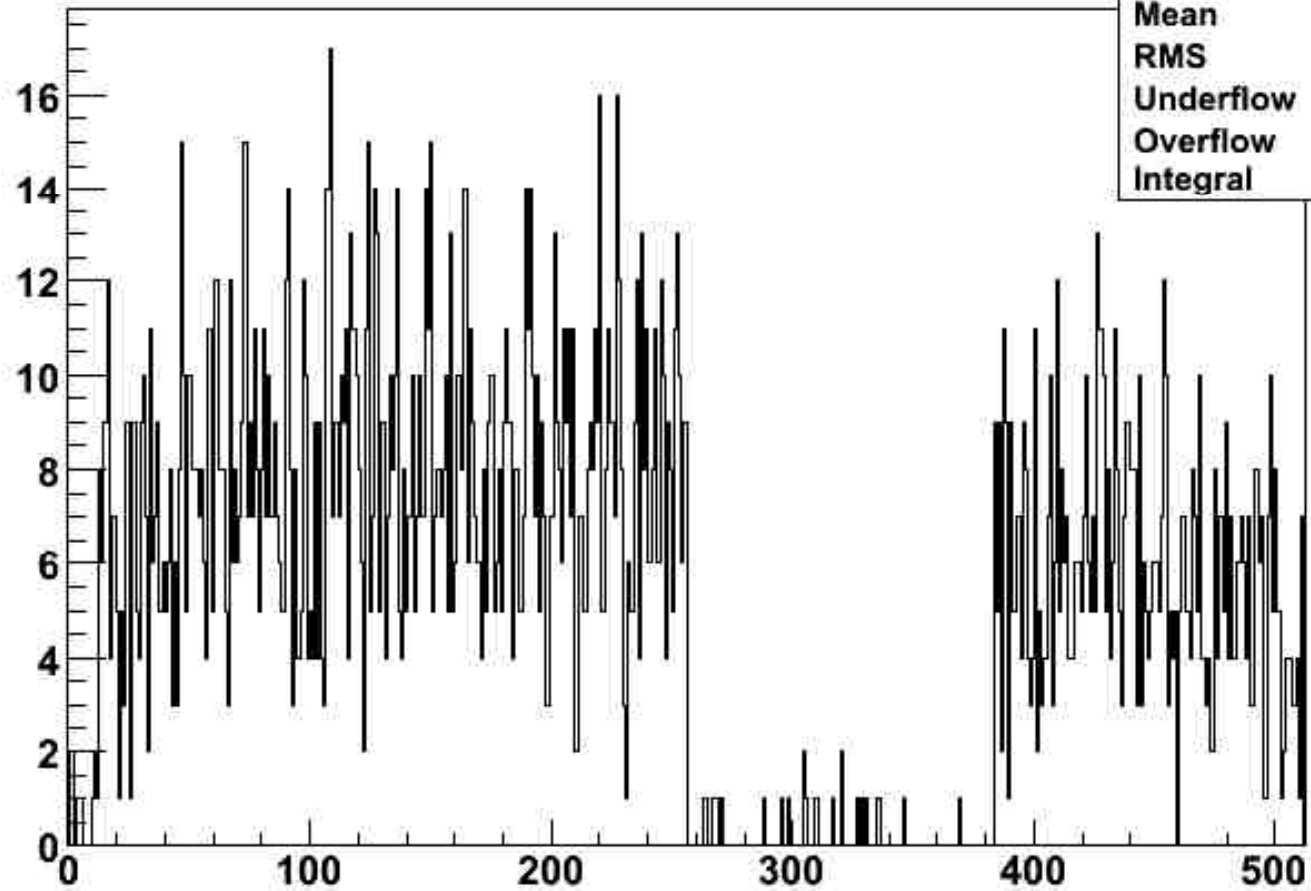
- dat file is generated by VFAT chips are hex numbers of each event
- xml file clusters strip position, detector id, strip number for each event
- I wrote scripts to select events with 7 or more different detector hits and evaluate the position of hit in each plane
- This roughly signifies a reference track through the planes

RP1

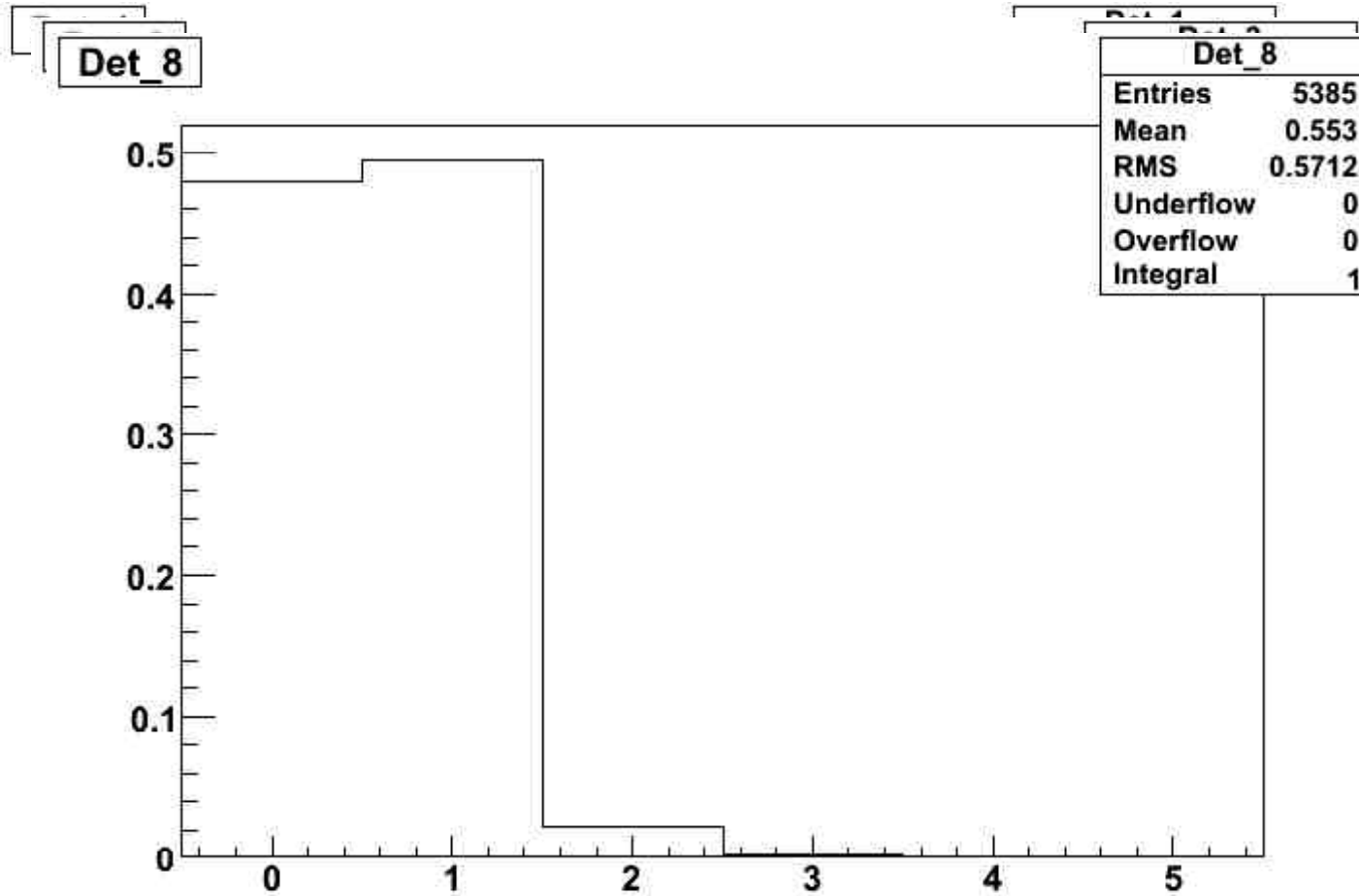
Total events in each detector

det_8a

det_8a	
Entries	2717
Mean	223.9
RMS	150.6
Underflow	0
Overflow	0
Integral	2717



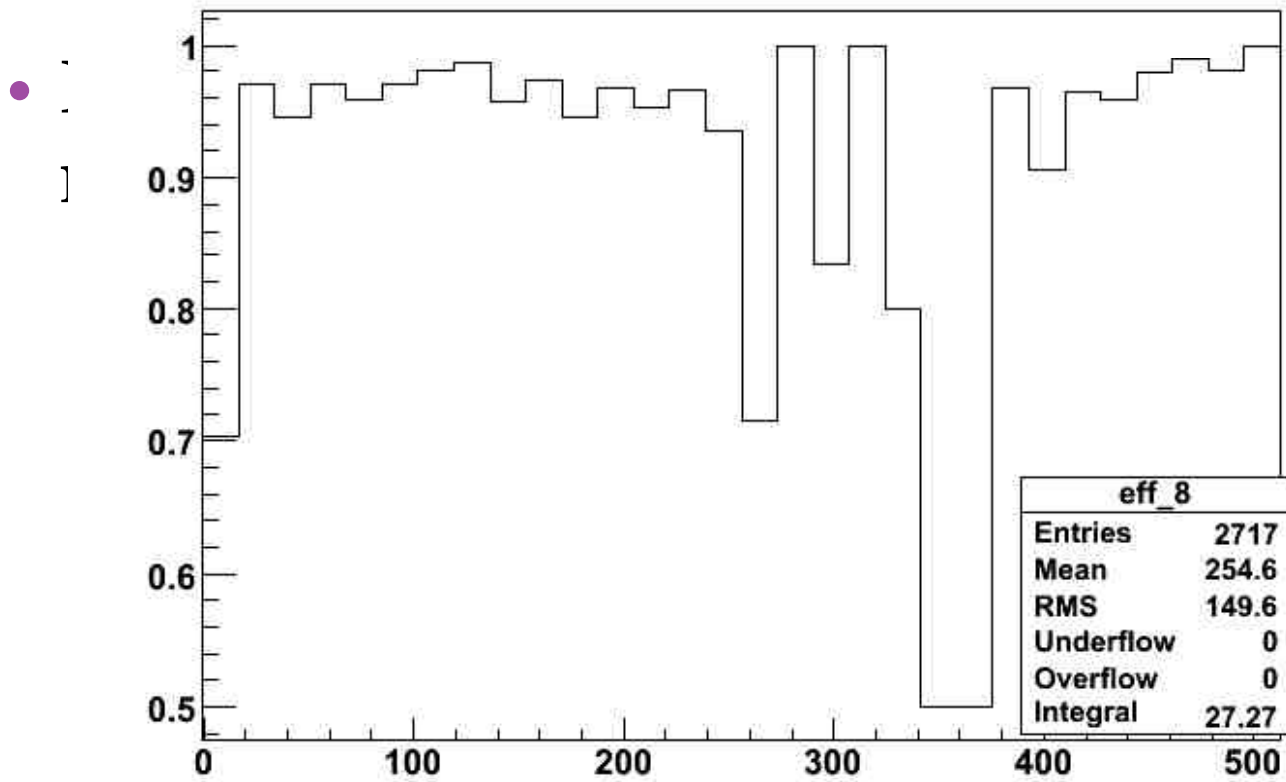
RP1: Hit multiplicity in each cluster





RP1 Efficiency

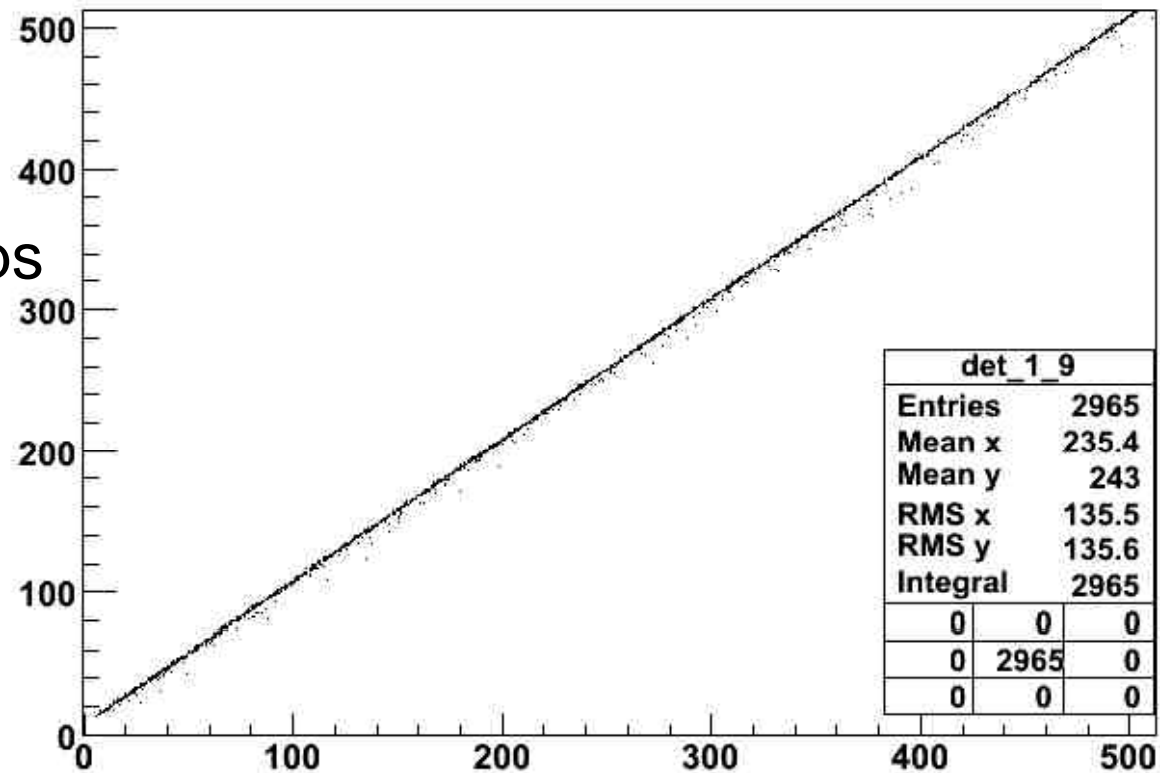
eff_8



RP1: Alignment

det_1_9

Offset: 3 strips
Slope: 1.02

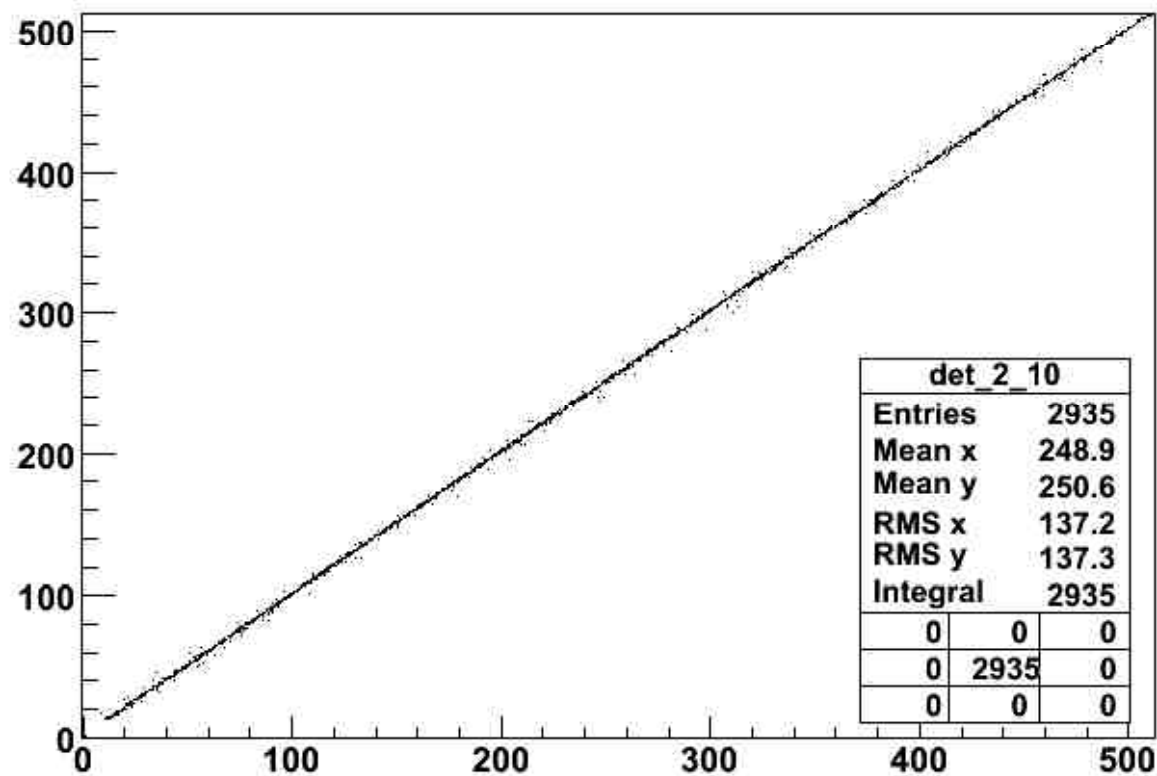




RP1: Alignment

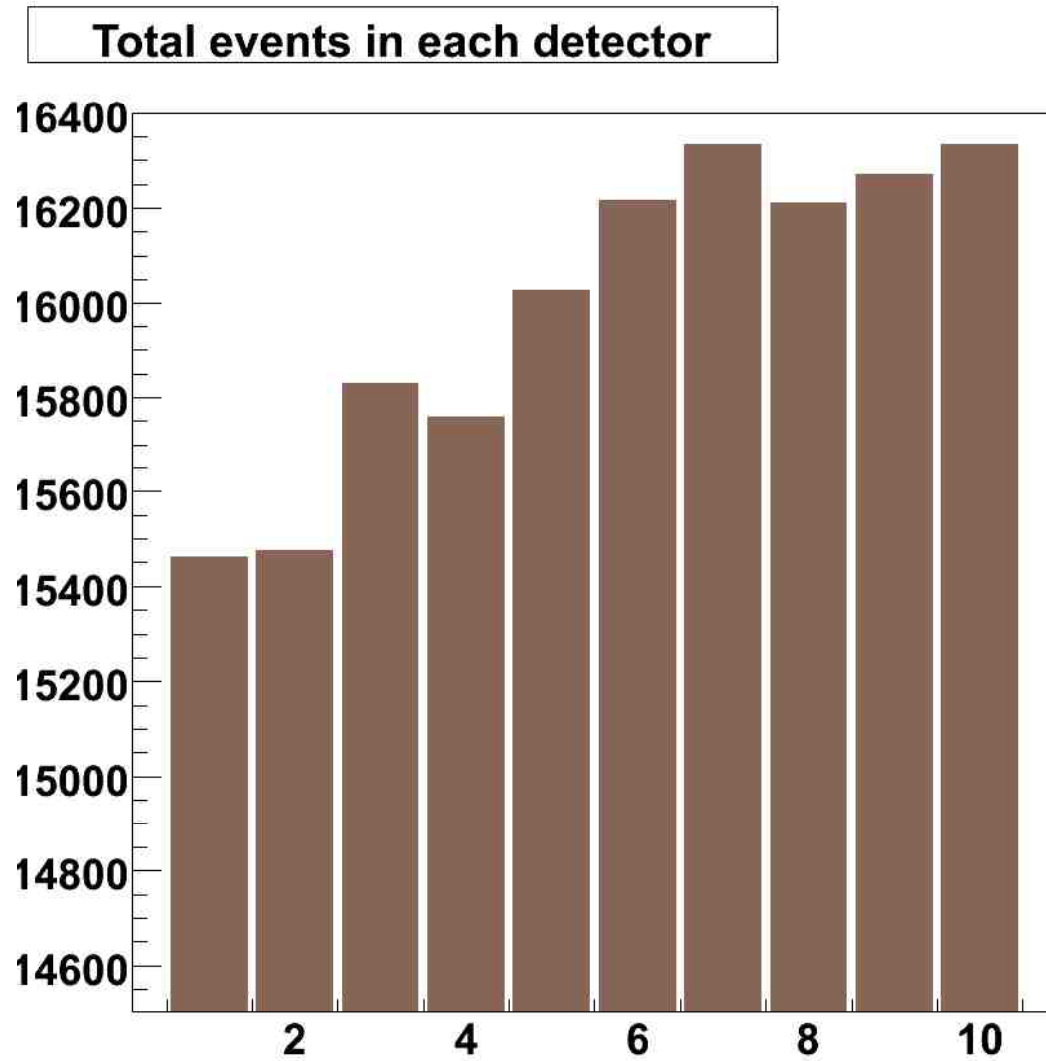
det_2_10

Offset: 5 strips
Slope: 0.99





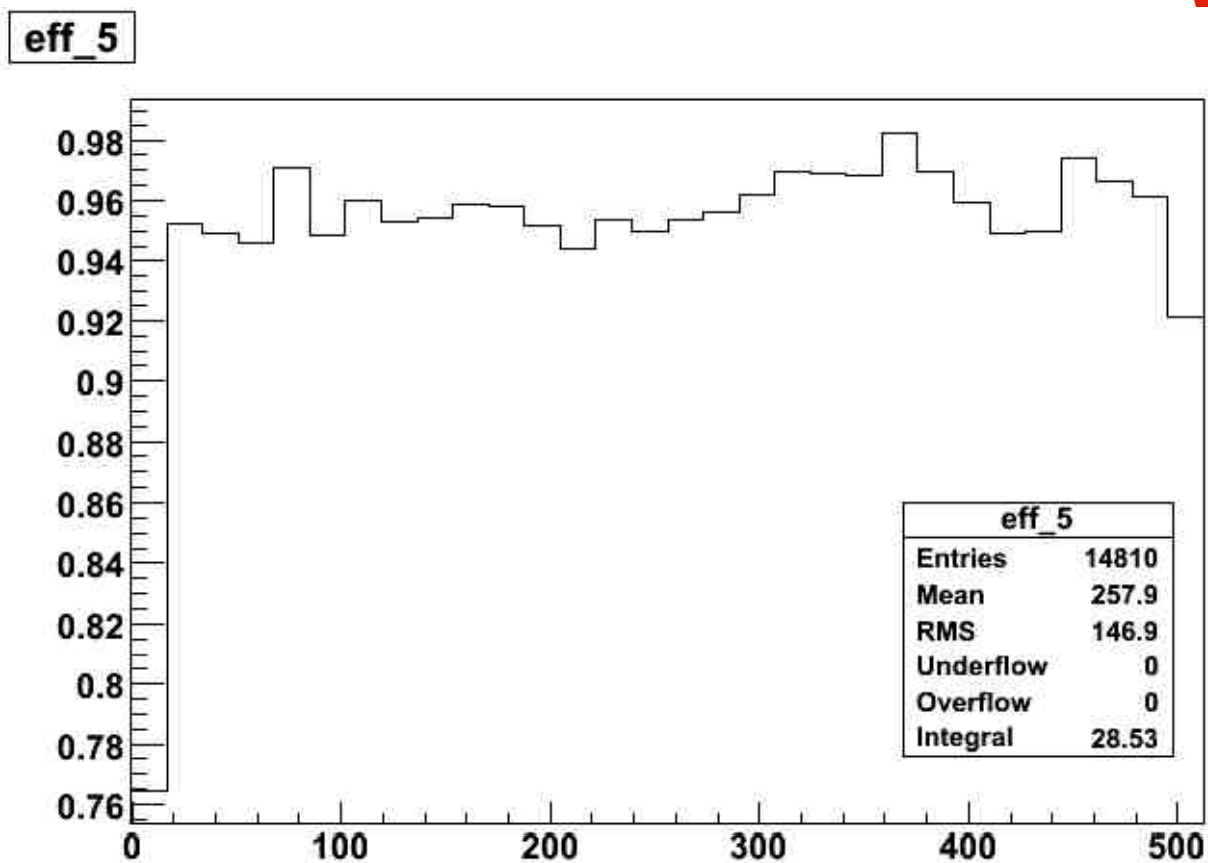
RP2





RP2: Efficiency

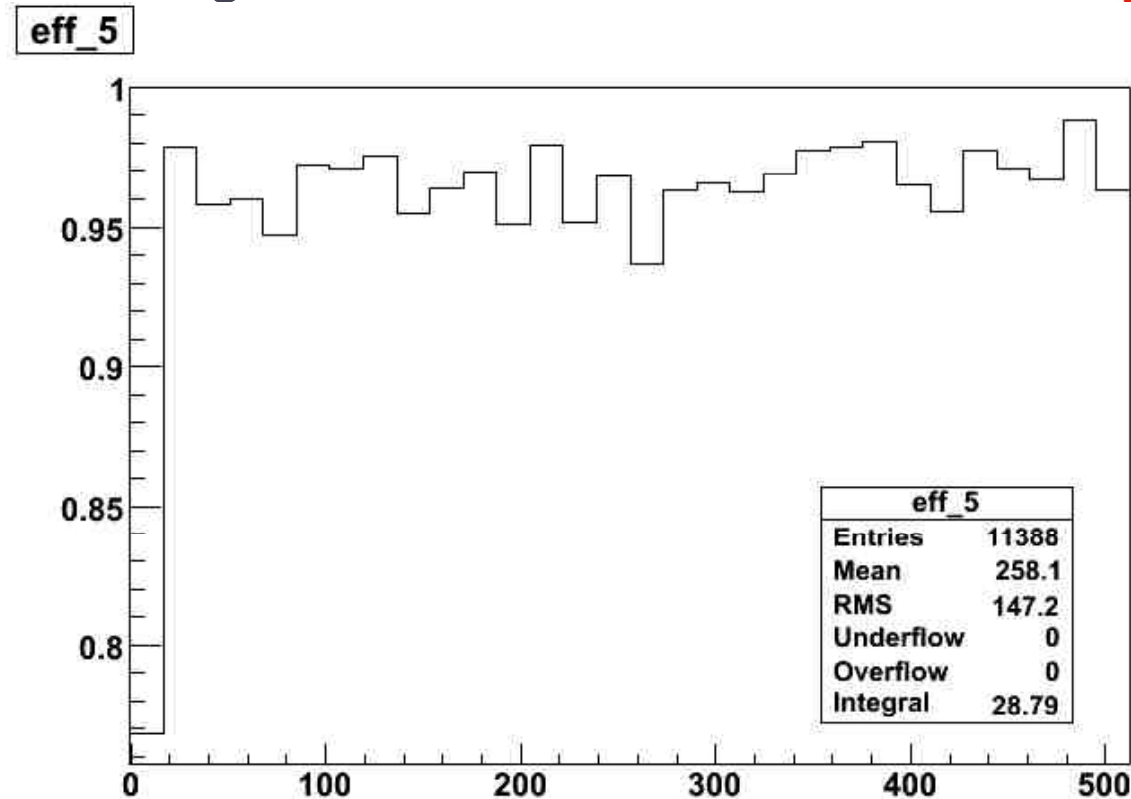
Threshold=15





RP2: Efficiency

Threshold=10



- A lower threshold improves the efficiency slightly but increases noise



Conclusions

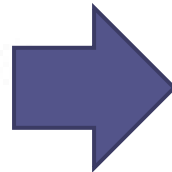
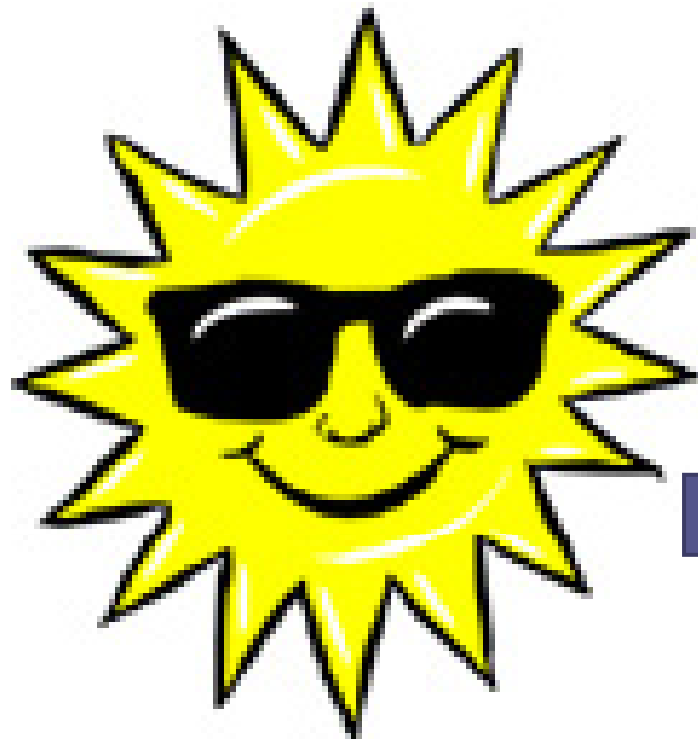
- Defects in planes 3,6,8 in RP1 that will be put into consideration when using proton reconstruction and testing
- RP2 detectors are working properly under two different thresholds
- Detector efficiency is within range of 95%
- Alignment in detector planes are in order of 2-5 strips



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summer is over



applying to grad school

