SCT Offline Monitor Measuring Module Hit Efficiencies

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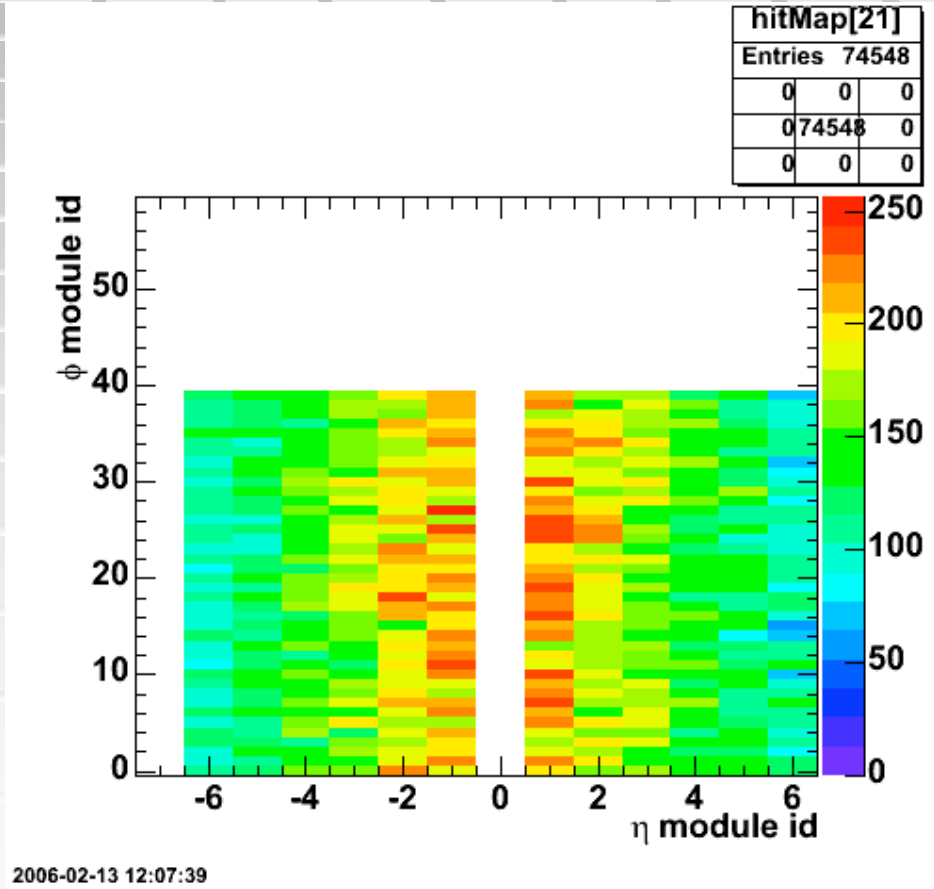
Aims

- Demonstrate/verify proper functioning of SCT modules by tracking particles through the detector and comparing the hits found to those predicted
  - Measure hit efficiency on a per module level
- Looking at Barrel and forward Regions
- Code should be versatile enough to be used for commisioning and long term
- Be able to read and write results to database
- Using ~18,000 minbias events,
- Software version 10.0.2

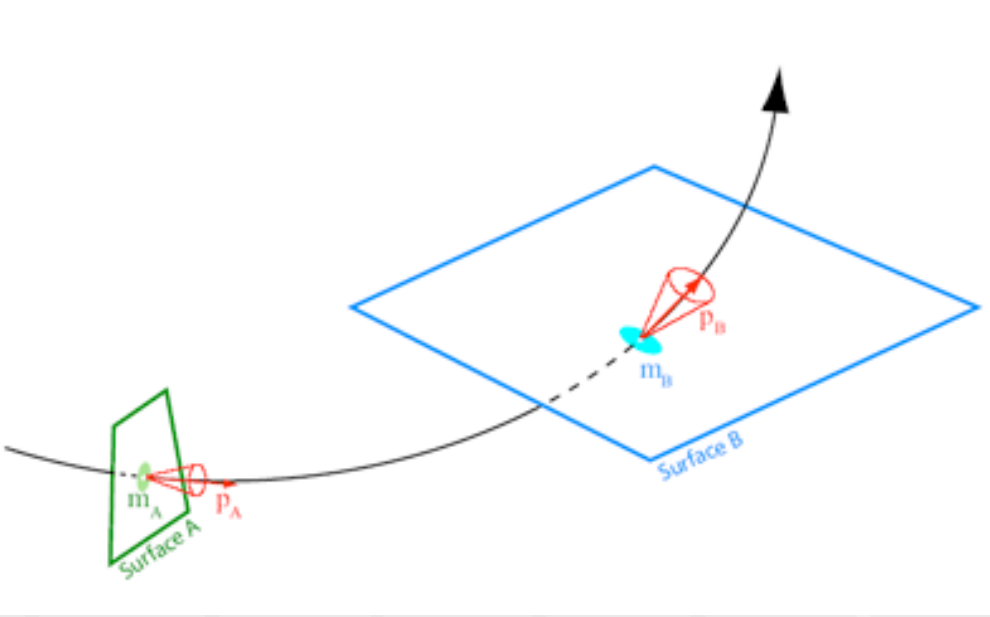
Hits On Track (Numerator)

- For a given module:
  - Eff = #hits Observed / #Hits Expected
- Numerator:
  - A simple map of all hits associated with the reconstructed tracks
- Plot is for 2nd barrel layer



PredictedHits (Denominator)

- For a given track intersecting a given layer/disk:
  - Remove hits (if present) from i^{th} disk and refit track
    - (using xkalman)
  - Extrapolate refitted track to i^{th} disk and find intersection point
    - (Using TrkExtrapolation)
  - Predict a hit should have been found at this point
- This prediction becomes the denominator

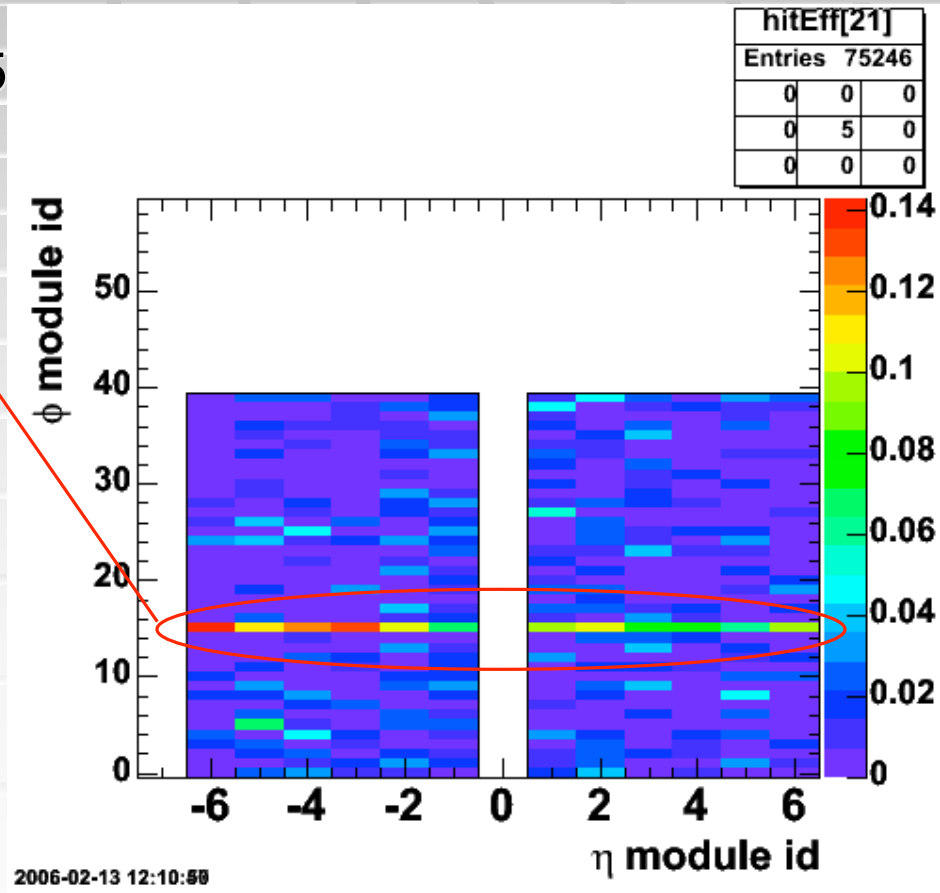


- Can now calculate efficiency ……

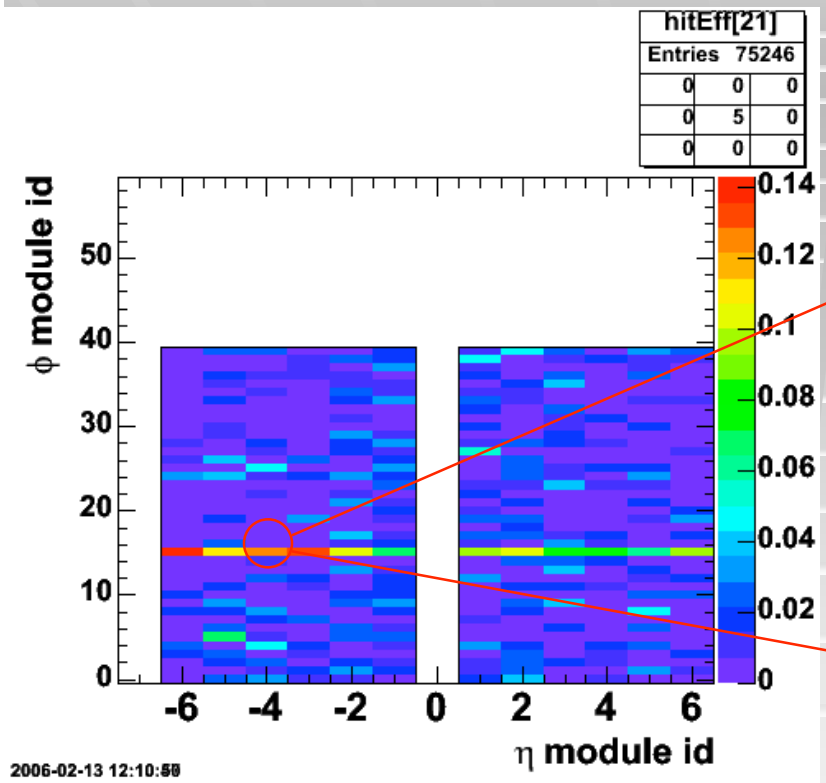
Inefficiency Plots

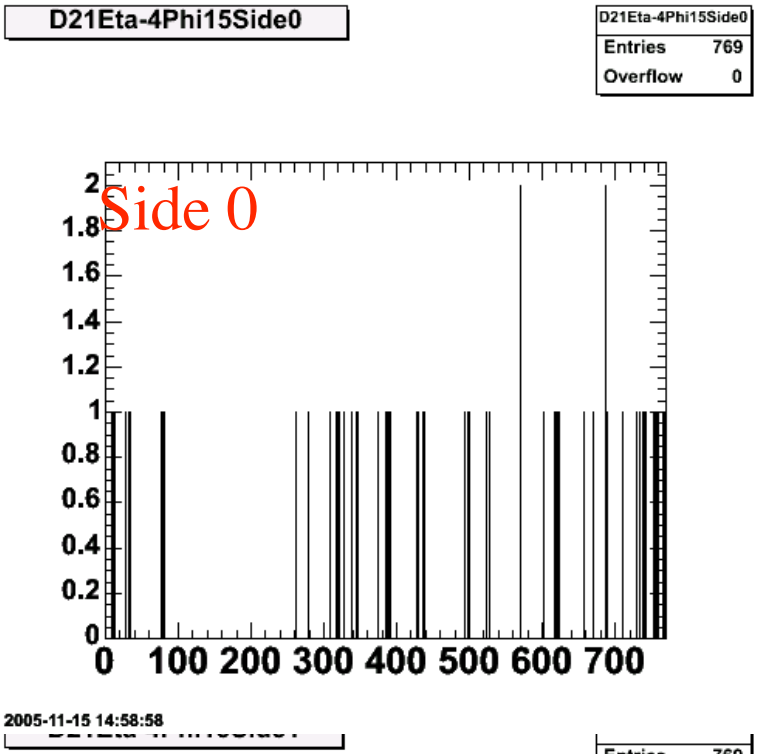
- 1-efficiency plots
- In this example, I have introduced some inefficiencies:
  - one chip on side 0 (128 strips) have been turned off in the phi=15 modules.
- Theoretically they should have an inefficiency of 8%
- Some 100% efficient modules have been measured as being ~2% inefficient

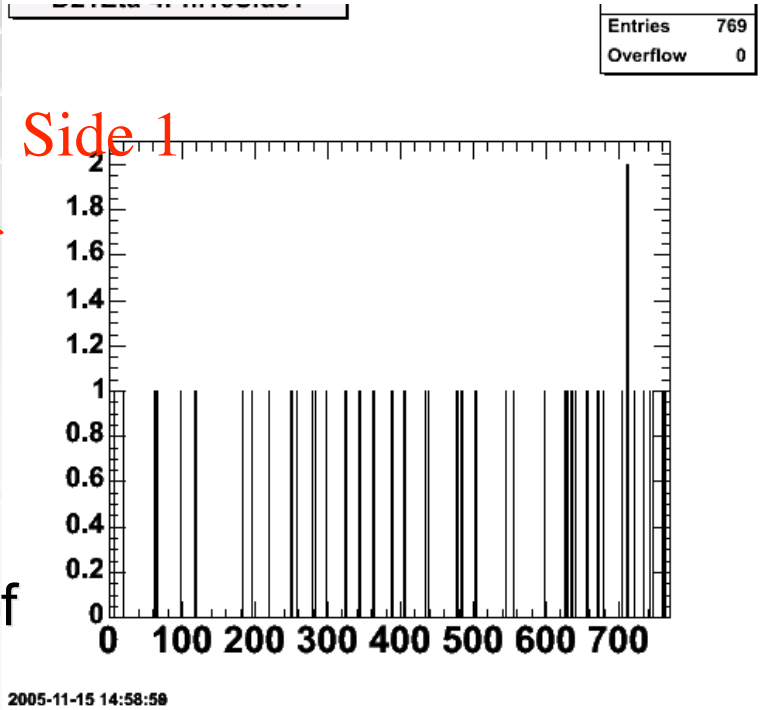
- Plot is for 2nd barrel layer



More Detail







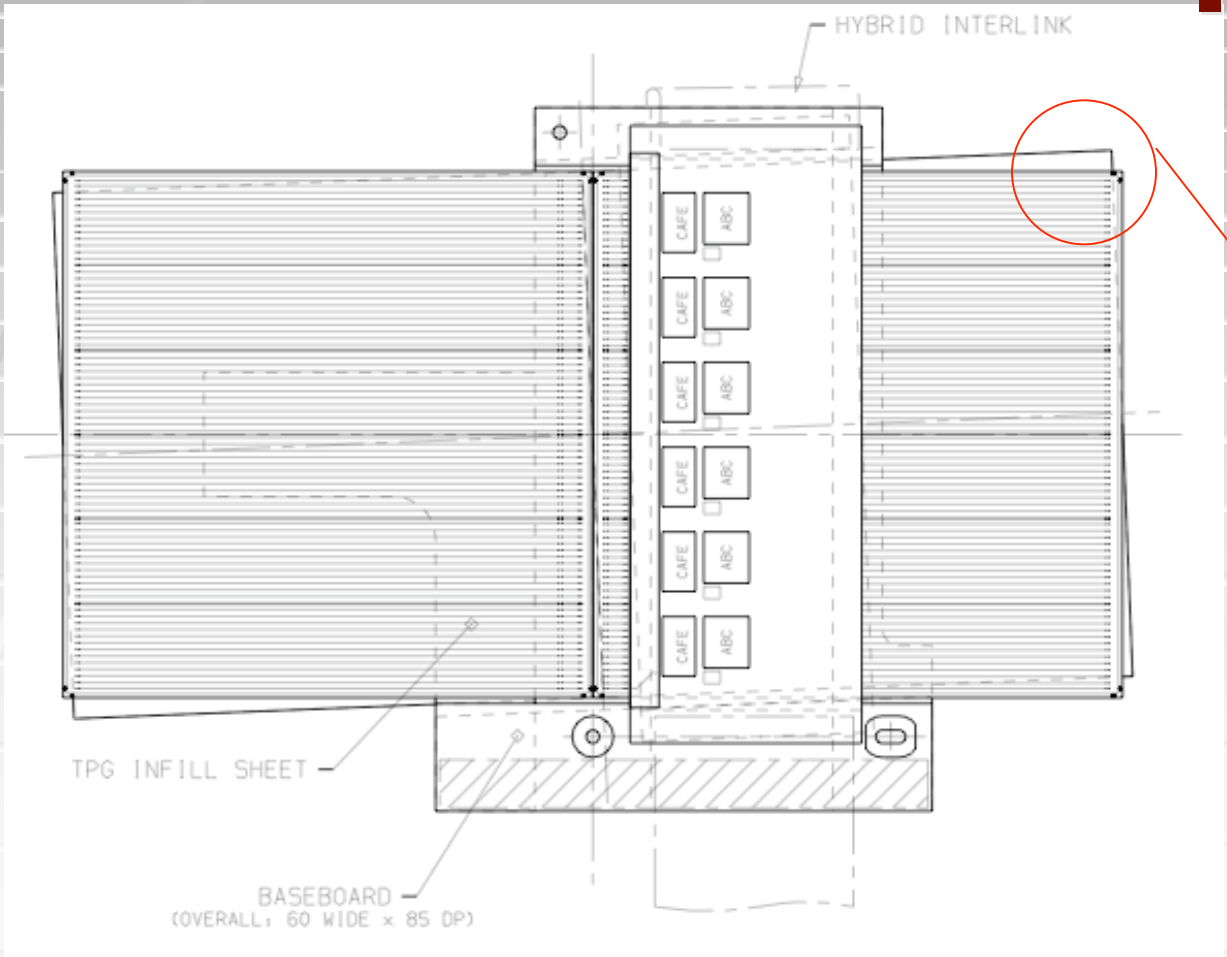
- For any module with an efficiency less than x (value set by user), strip detail is recorded.
  - X=95% in these examples.
- Can look at Strip map to look for cause of inefficiency

Summary table

- Efficiency per layer for barrel SCT:

Layer	Number measured	Number Predicted	Eff measured	Eff input
0	85878	87058	0.986±0.005	0.995
1	74548	75253	0.991±0.005	1.000
2	65792	66376	0.991±0.006	0.997
3	58116	58157	0.999±0.006	0.999

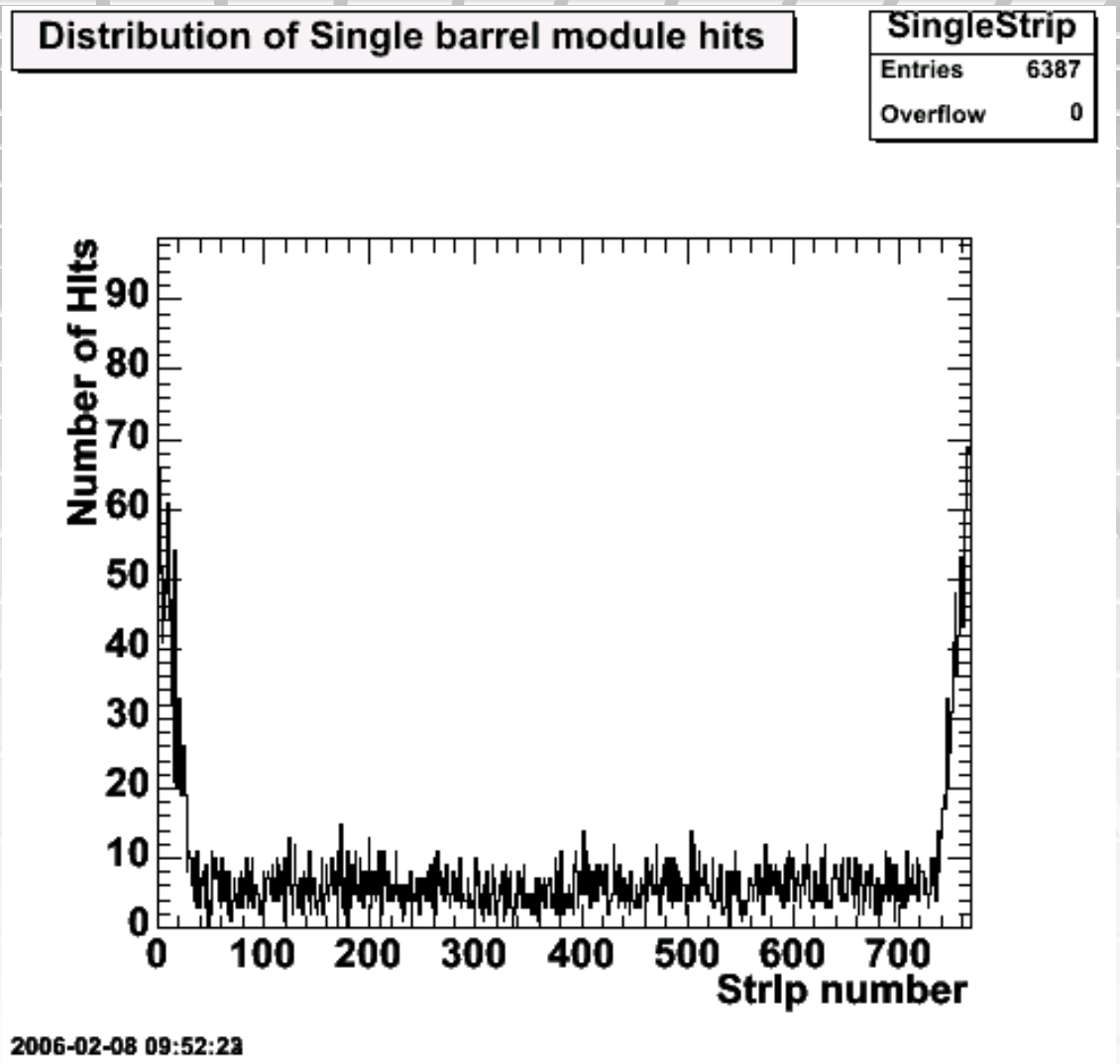
Source of Mismeasurement?



- Appears to occur when only one hit is measured, yet two are predicted
  - Edge of Module?
  - Do original and refitted tracks have similar paths?.

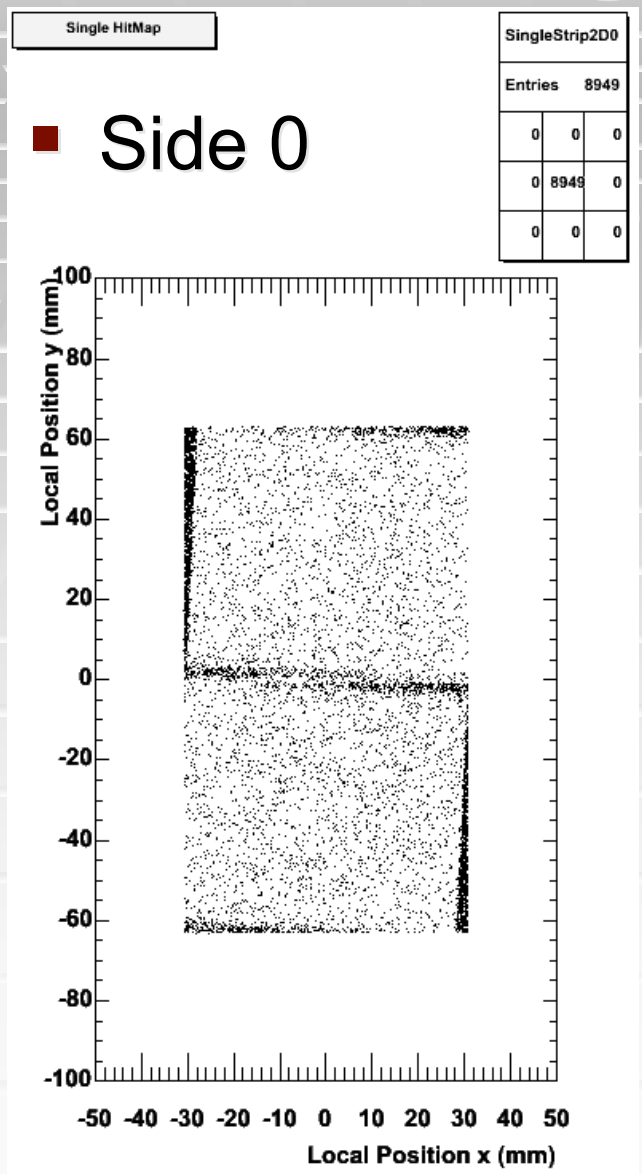
Measured Single Strip

- Plotted is the distribution of all observed single hits (on either side) of the barrel modules
- As expected most are found at the edge of the module

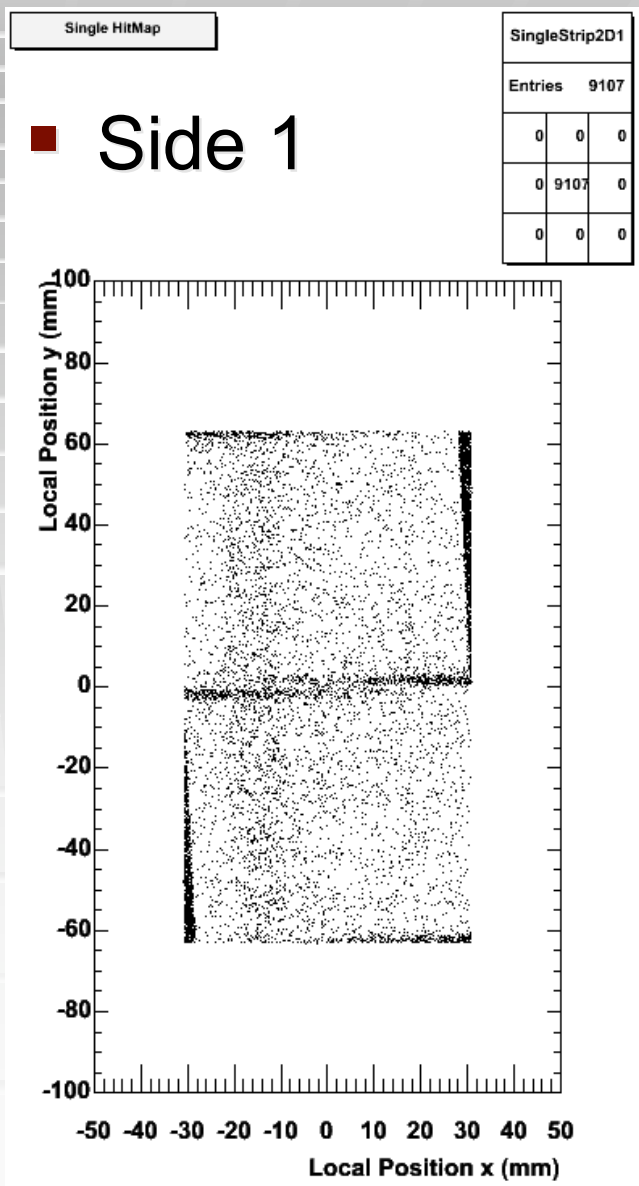


Single HitMap

- Side 0



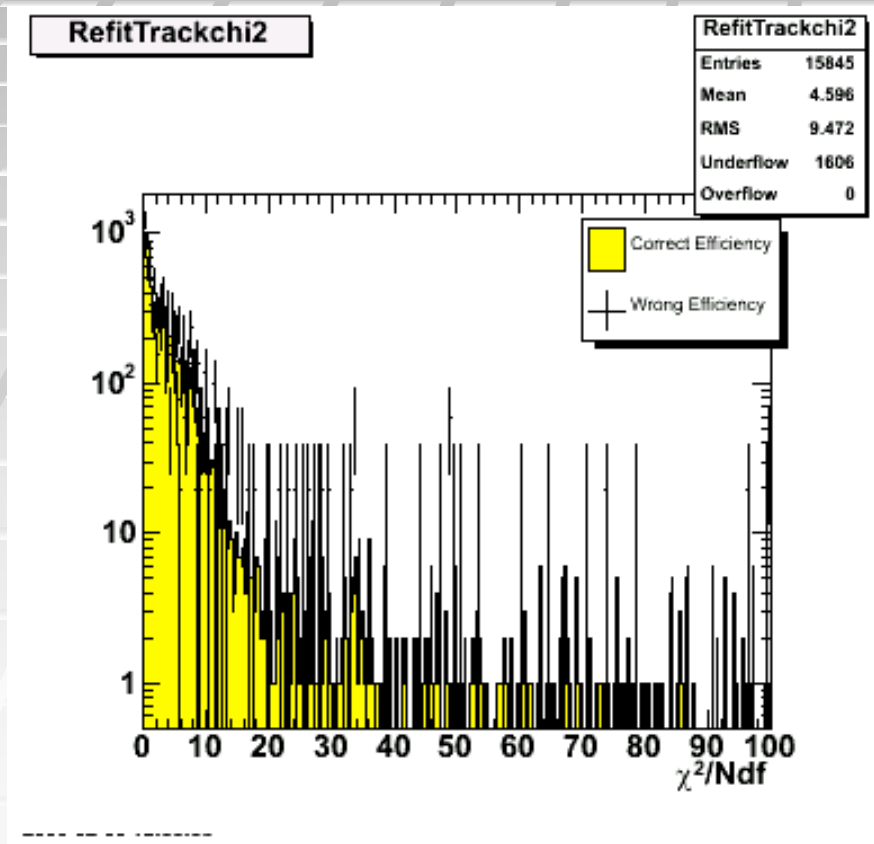
- Side 1

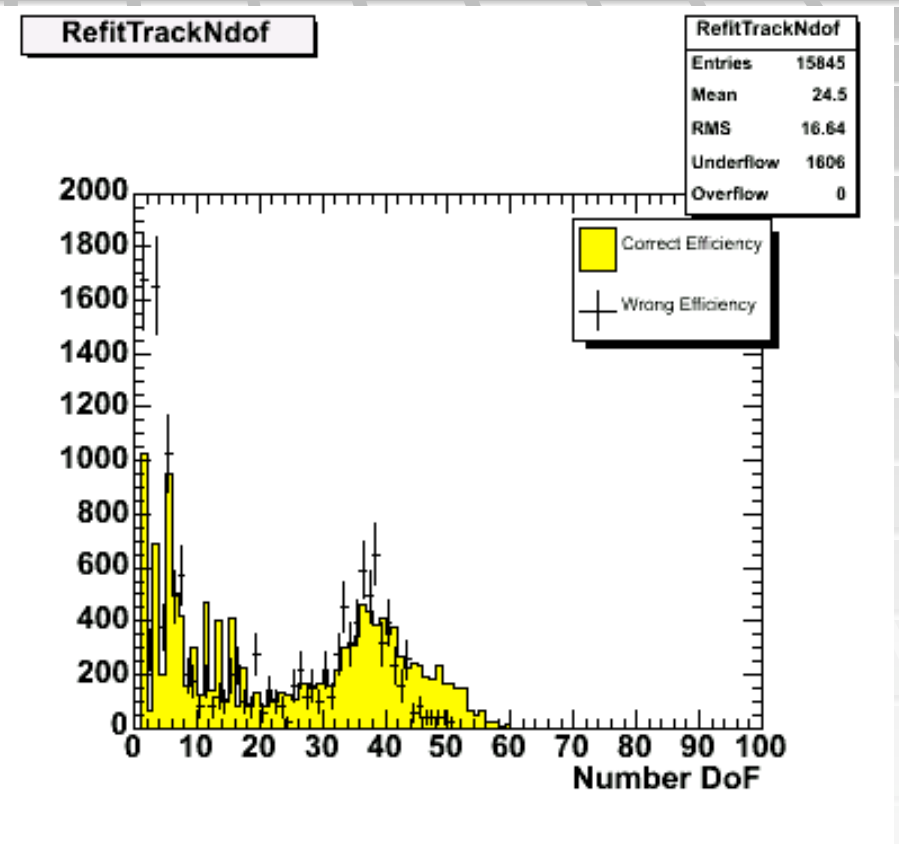


Any Track quality effects?

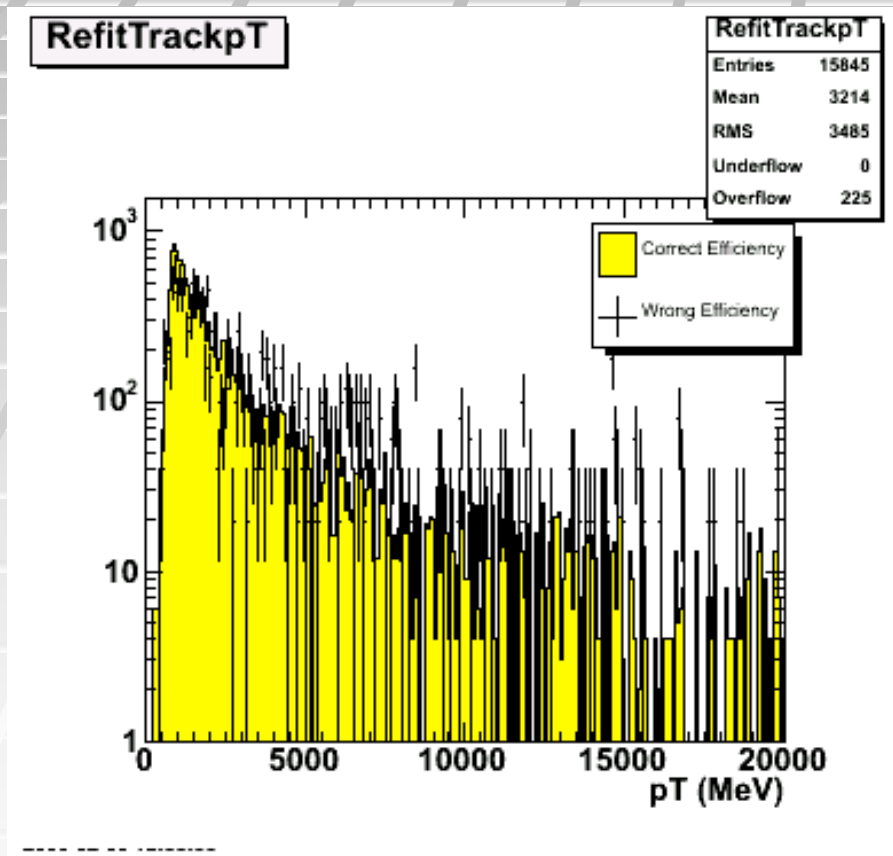
- Conceivable that poorly fitted tracks, or very soft tracks could cause problems efficiency calculation
- For each hit:
  - Classify according to whether the efficiency has been correctly or incorrectly measured
  - Plot various track quantities

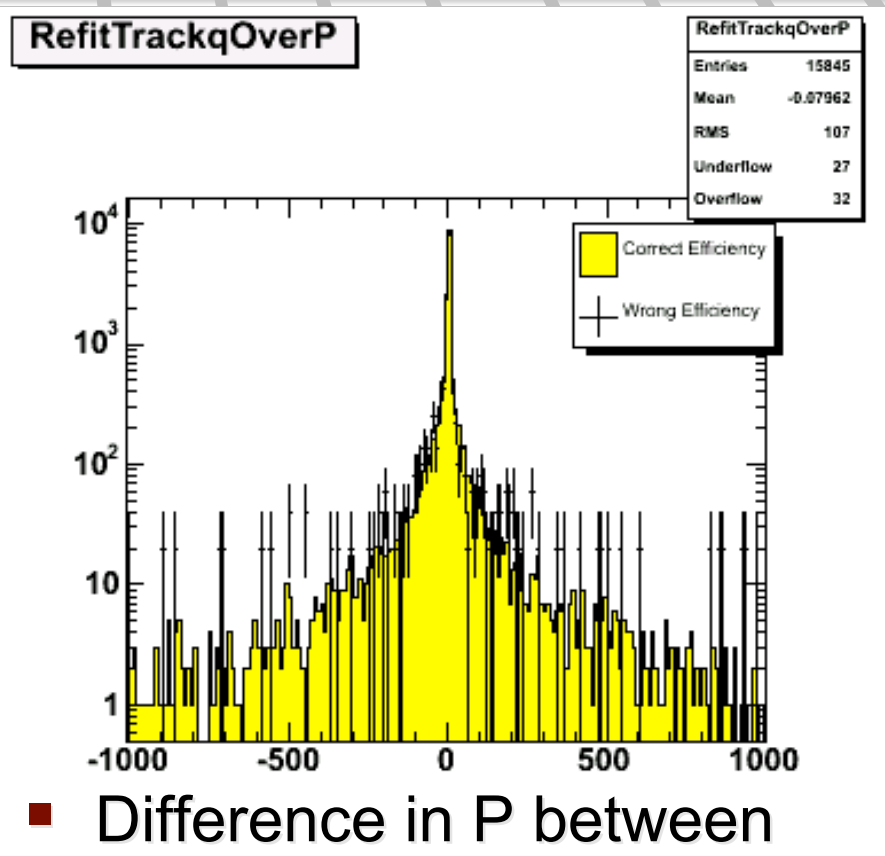
TrackQuality I





TrackQuality II

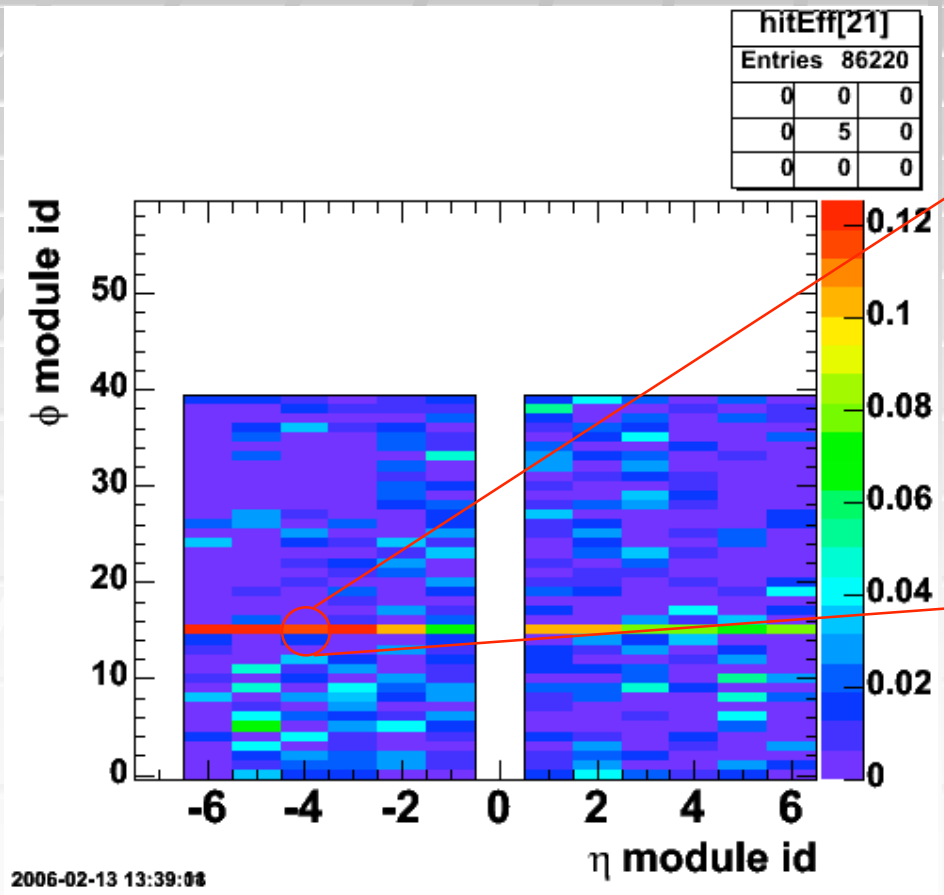


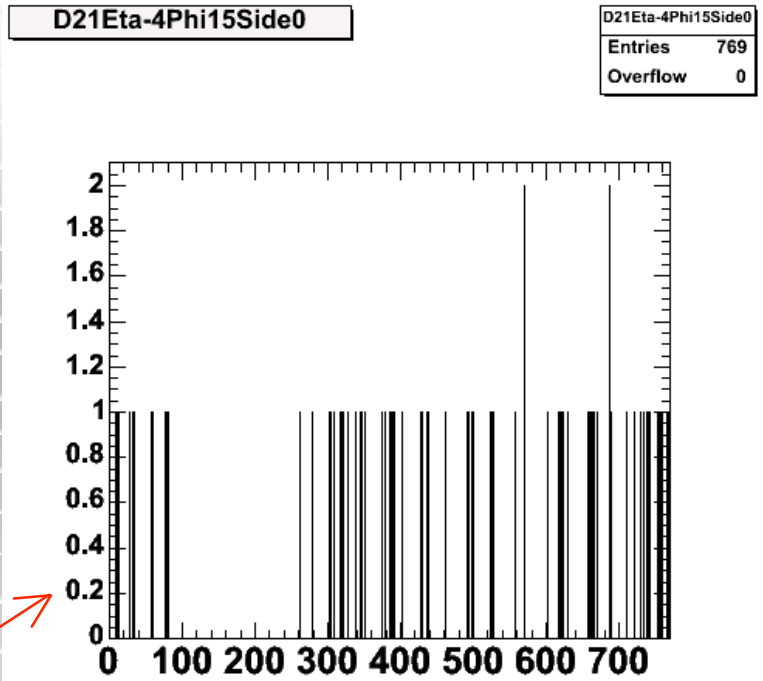


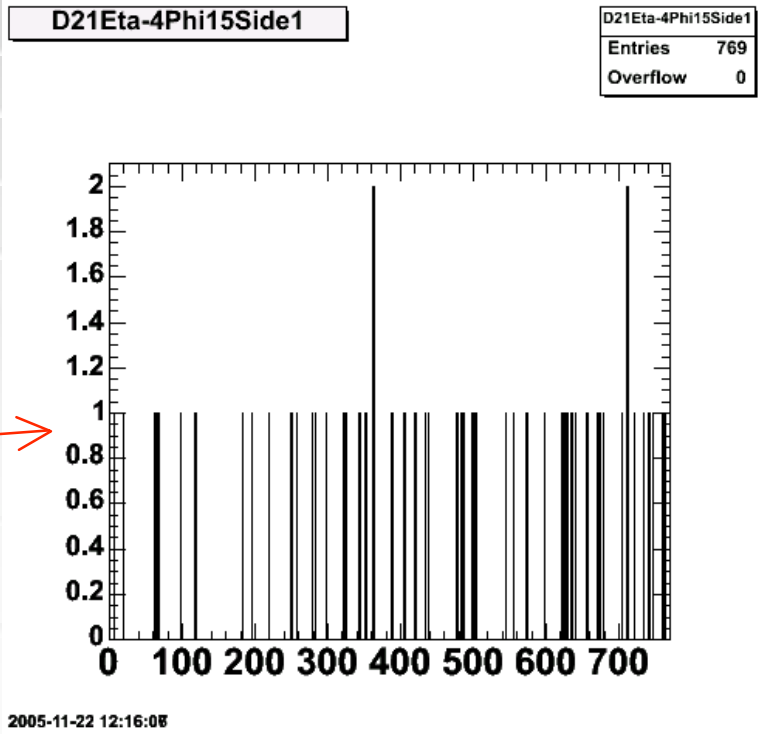
- Difference in P between original and refitted track

SCT standalone

- Initially, monitoring with SCT alone?







Link to Database

- Once decided that strip is inefficient or dead, need to record it to database.
- Have written some code in 11.0.x developed from:
  - DatabaseTest/IOVDbTestAlg/IOVDbTestAlg.cxx
  - Can read and write to database in execute or finalize.
- Information written:

Channel	Barrel_ec	Layer_disk	Eta	Phi	Side	Strip	Comment
Int	Int	Int	Int	Int	Int	Int	String
…	…	…	…	…	…	…	…

- Also writing of monitoring histograms/files to Database on finalise?
- Convert algorithm to an AlgTool so can be used by anyone.
- Would like to be able to read from database initially to remove from efficiency calculation any tracks intercepting known dead channels?

Summary

- Measuring hit efficiency per module
- Enough statistics to see chip-level effects
- Hit Efficiency working well in central region
- Need to work out strategy for calculation near edges
  - Fiducial cut->loss of information
- Requirement on minimum number of hits on track
- Appears to be robust enough to work with SCT standalone tracks

Coming Soon….

- Work on reducing mis-measurements….
  - Optimise TrackQuality/Module Fiduciality
- Look at separate “edge strategy”
- Update to 11.0.x
- Study effect of misalignments on code
  - Outliers
  - Sensitive to mis-alignments?
- Replace denominator with “truth track” to see how my results compare
- Look at Cosmic data from forthcoming run
  - Real data with real issues
  - Write to database (code available for online monitoring aswell)
- Other Samples: di-jet, high Pt muon samples,

TrackQuality I