Endcap Studies

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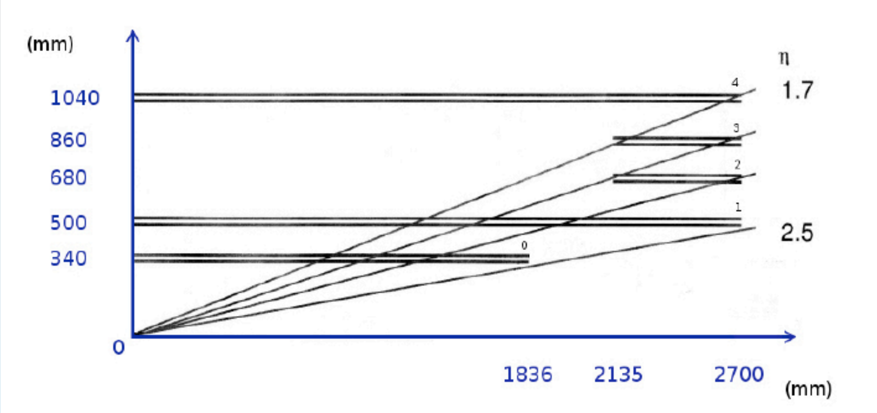
Overview

- Phase-2 mu+track trigger studies for endcap were also being intensely pursued through ~ early 2010
- Brief recap of the findings and status here (based on Muon Barrel Workshop presentation by Bobby Scurlock, Feb 2010)
- Outlook

CSCTT Algorithm

- SLHC conditions expected to yield very high single muon rate at Level 1
  - Combining Tracker data with CSC Track-Finder (CSCTF) data can help reduce fake rate due to noise, detector effects, and CSCTF mis-measurement
- CSC+Tracker Trigger (CSCTT) Algorithm:
  - Define regions of interest to help pre-sparsify tracker readout
  - Assume clustered stub information is read out from tracker
  - Define narrow roads in ϕ, z to further filter tracker readout
  - Tracker stubs have excellent positional resolution utilize internal correlation
  - Attempt fit using tracker-only information (best measurement at low momenta)
- Current CSCTT model developed in context of the Long barrel geometry developed by Tracker upgrade simulation group (2.2.6)
  - 100 micron x 1 mm pixels
  - 10 Layers ("stacks"), sensors ~ O(mm) ➞ Stubs
  - Grouped into 5 "double stacks", stacks ~ O(cm)
  - Our studies use FastSim, simHits Stubs

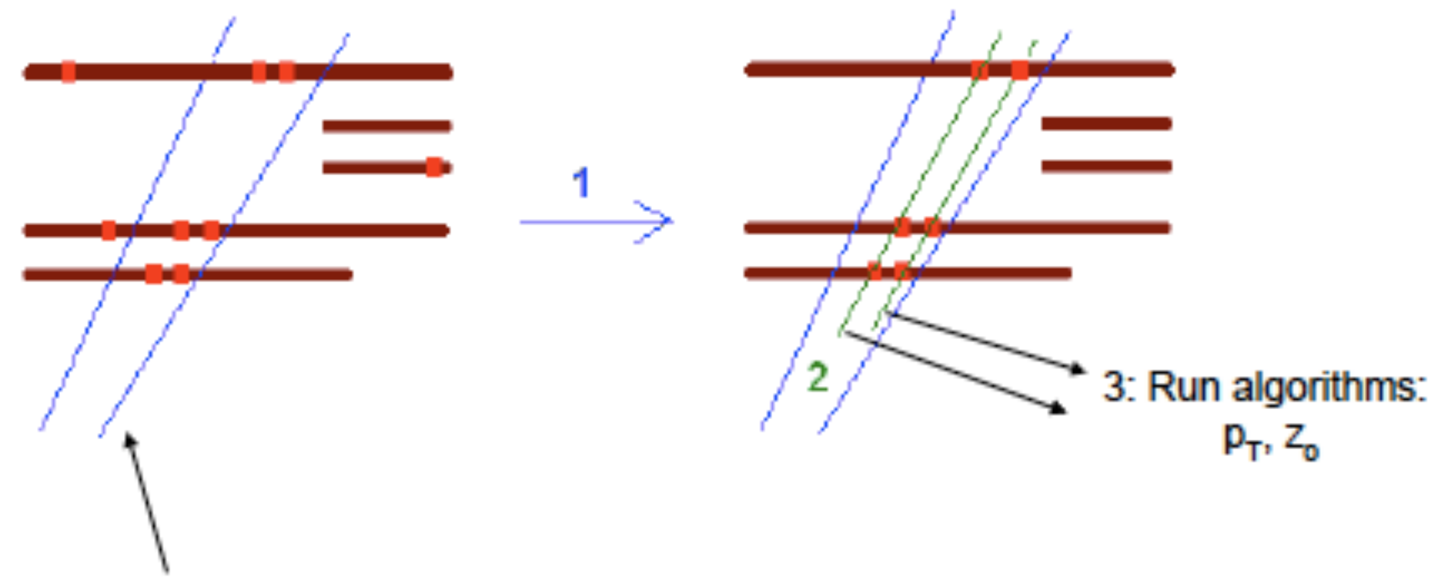


- CSCTT code lives in CVS.
- Results shown were presented in Oct. FNAL workshop. Draft TN was been written.

University of Florida, Feb. 2010. 2

CSCTT Algorithm

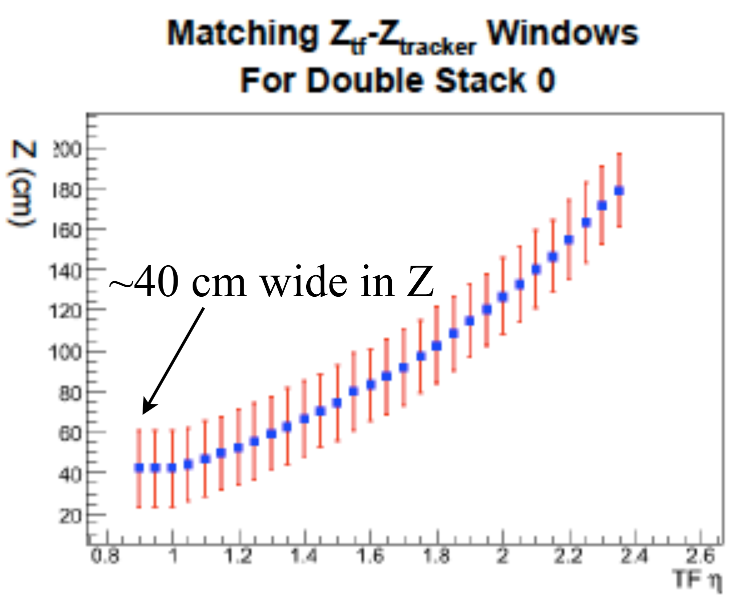
Illustration



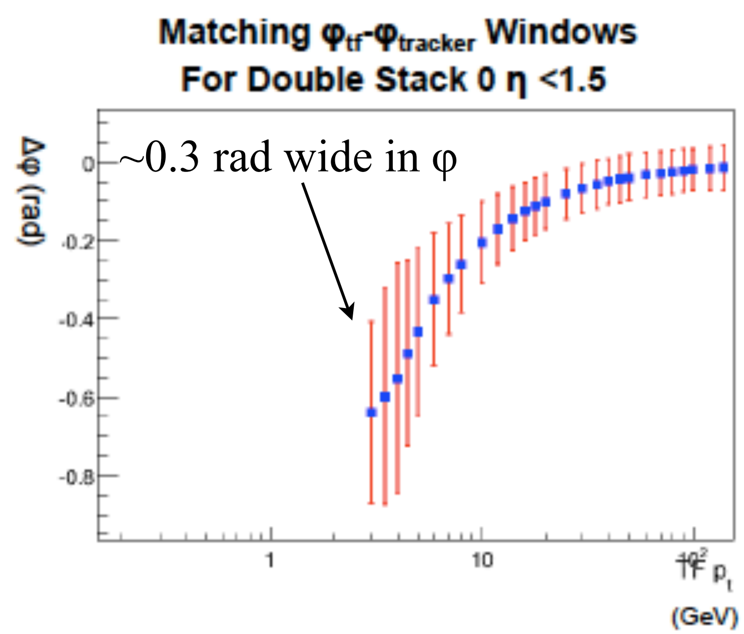
- Step 1: Use matching windows to cut stubs based on $\text{Trackfinder}_{z,\varphi}$ -$\text{Tracker}_{z,\varphi}$
- Step 2: Only keep stubs that are correlated in $\Delta\varphi$ & $\Delta\cot\theta$ (ie $\varphi_{dstack2} - \varphi_{dstack0}$)
- Step 3: Apply r–z algorithm → $\cot(\theta)$ & z_o and r–φ algorithm → p_T

Matching Windows

- Examples of **For Double Stack 0 :**



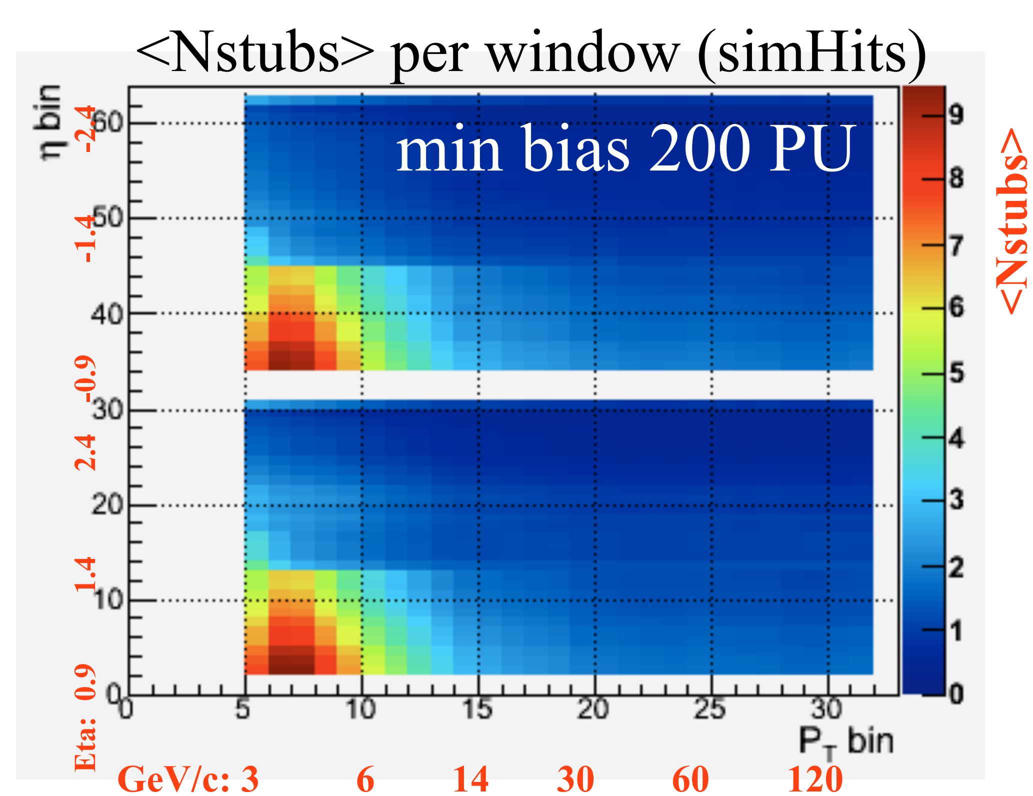
Widths ~ 6 cm



Widths =O(~0.1) - O(~0.01) rad
η dependence low p_T due to inhom. B-field
Can be tightened if necessary

Matching windows are defined for all possible CSCTF-P_T (5 bits) and CSCTF-η (5 bits per endcap) values. Average match-window-occupancy plots shown below are a function of these CSCTF bins and were made with min bias events (200 PU).

Largest (randomly sampled) CSCTF-Tracker matching windows yield ~10 tracks-stubs from accidentals.

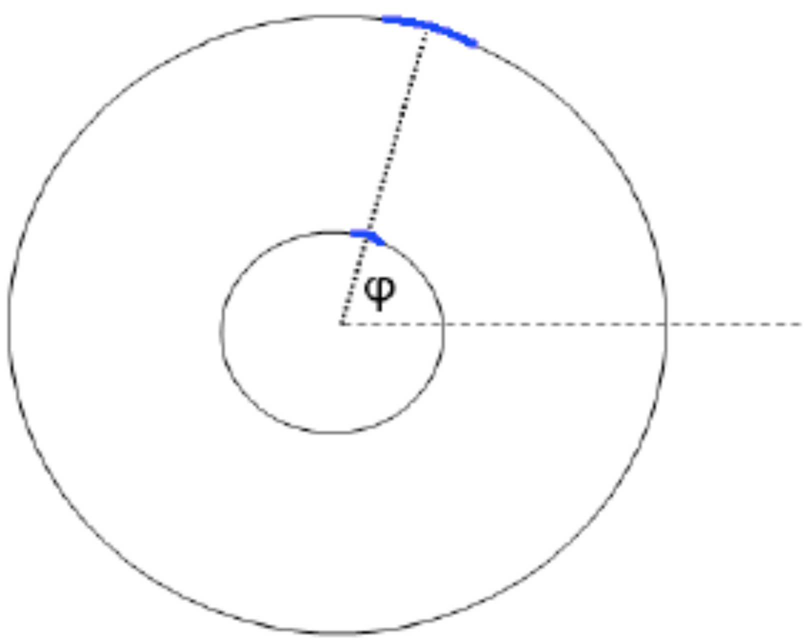


Important findings

- matching windows in r-φ (roads into the tracker, regardless of geometry) were very wide due to poor p_T resolution of the CSCTF
  - incidentally this uncovered an abysmal (40%) p_T resolution at that time (2009-2010)
- r-z windows are pretty much 100% driven by beam spot size - only marginal help from cot(θ) pointing

- CSCTF p_T resolution critical to both Phase 2 upgrades, post-LS1 and pt 5 runtime performance
- in the last 1.5 years significant focus on CSCTF

p_T estimate using $\Delta\varphi$



Circle Fit Approximation:

$\phi = \phi_0 + \arcsin(\zeta R / p_T)$

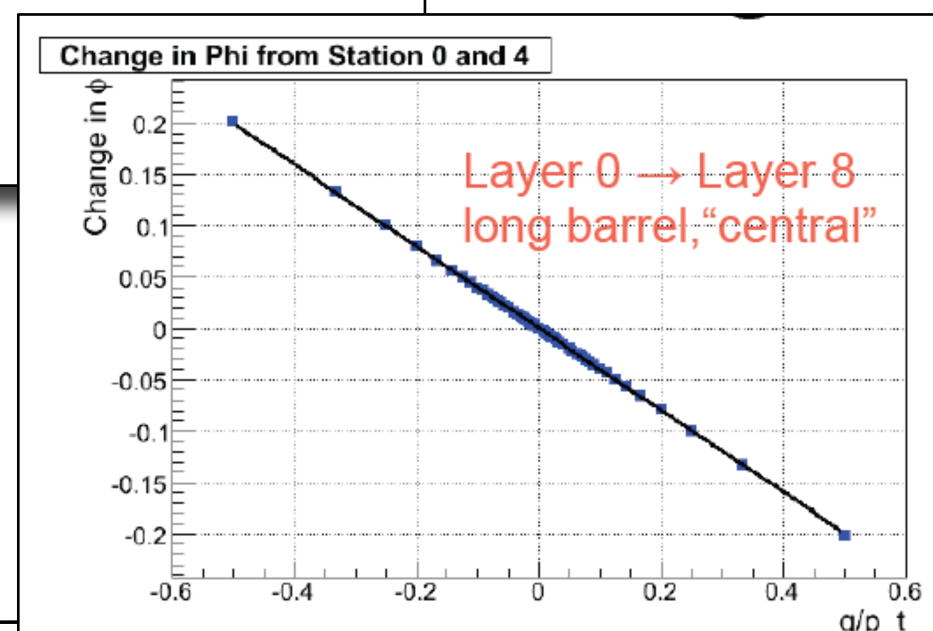
linear approximation:

$\Delta\phi \sim 1/p_T$

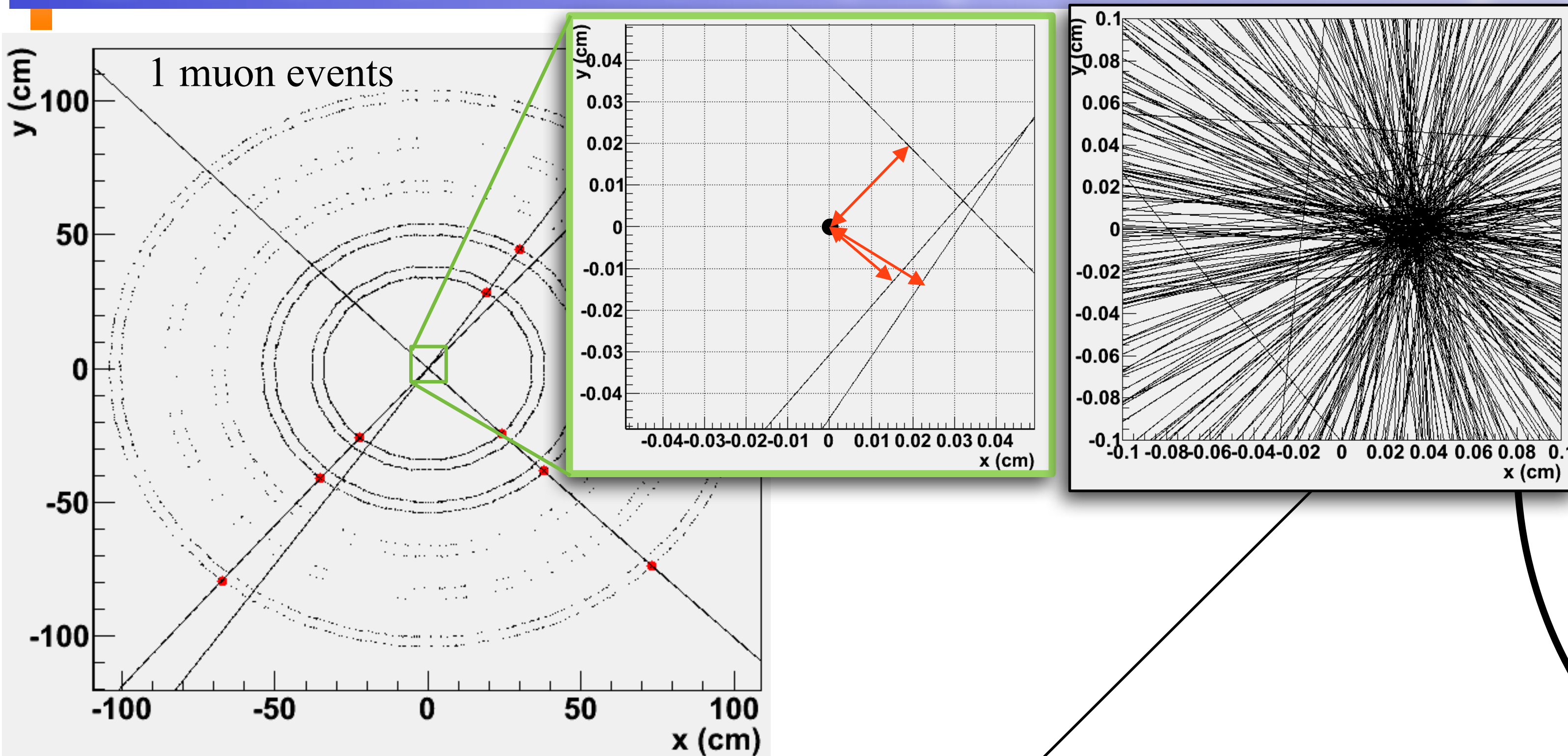
$\Delta\phi \sim \Delta R$

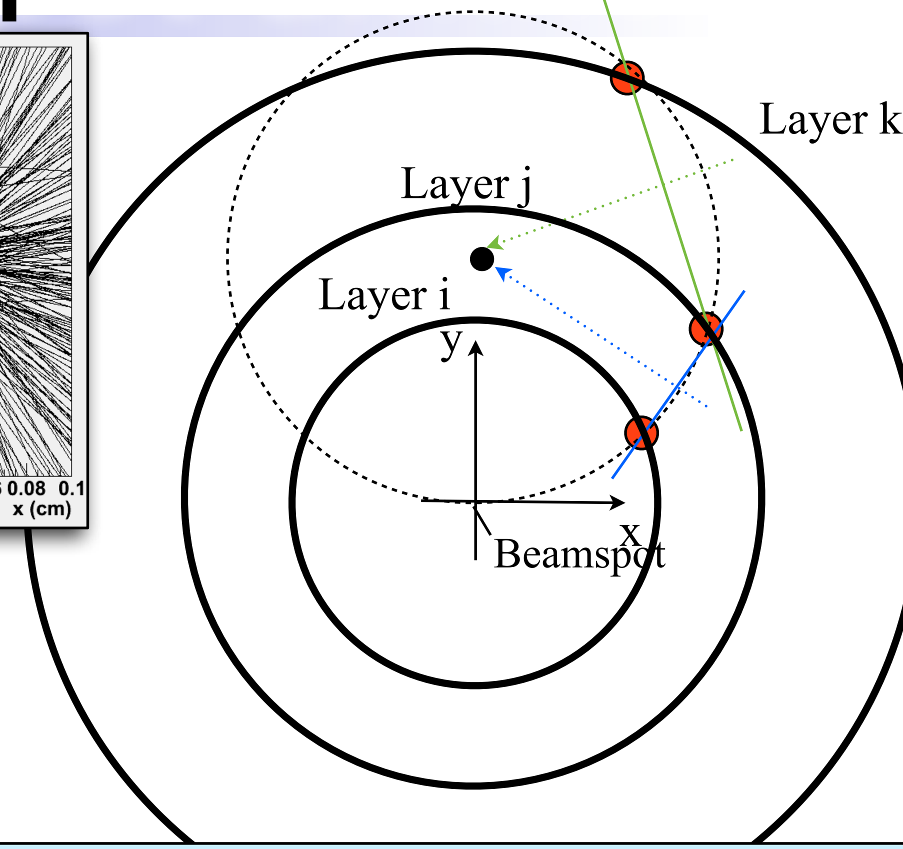
- sensors report local coordinate → global ϕ
- measure ϕ in 100 μm units of arc length at 104 cm
- $\Delta\phi_{09} = \Delta\phi_{ij} \cdot \Delta R_{09} / \Delta R_{ij}$
- $\Delta\varphi_{09} \rightarrow 1/p_T \rightarrow p_T$

Approach demonstrated to achieve 2% P_T resolution

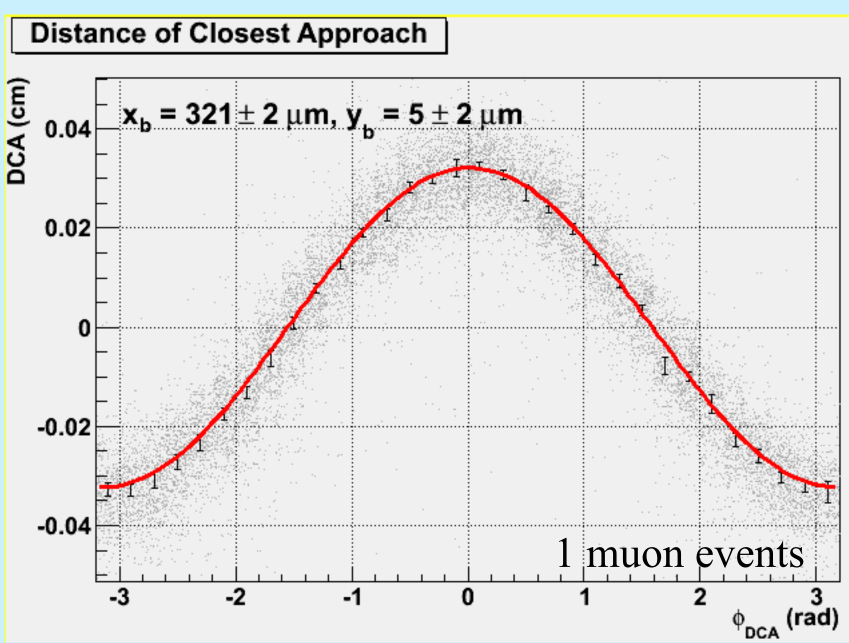


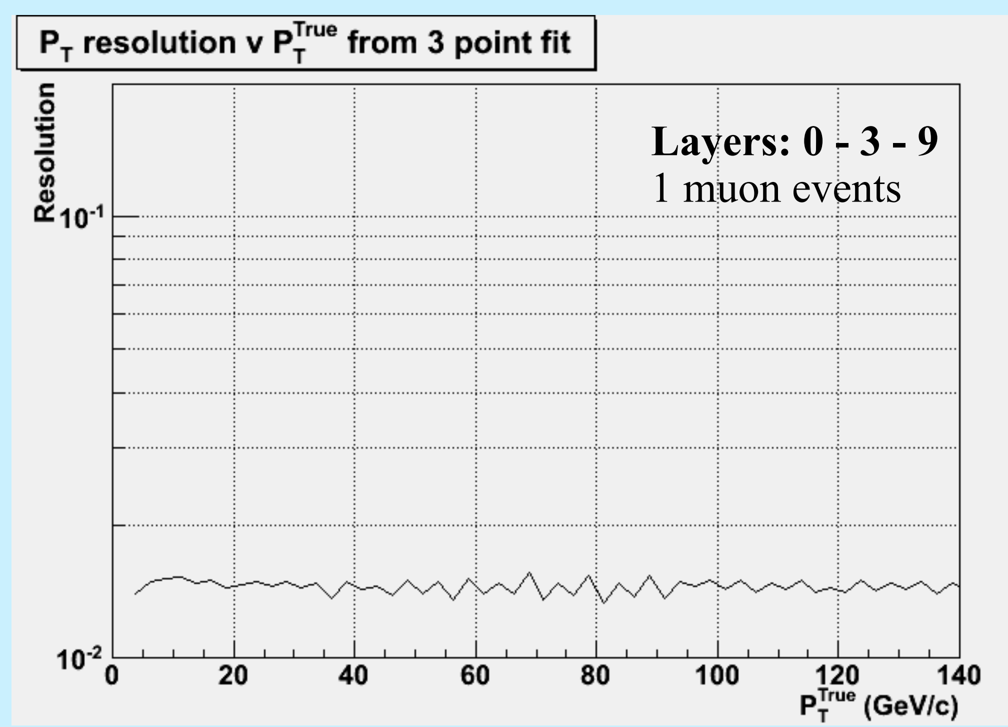
Circle-Fit P_T (beam spot unknown)





Estimate of beamspot using 3-point fit:
xbgen=0.0325 cm, ybgen=0.00506 cm

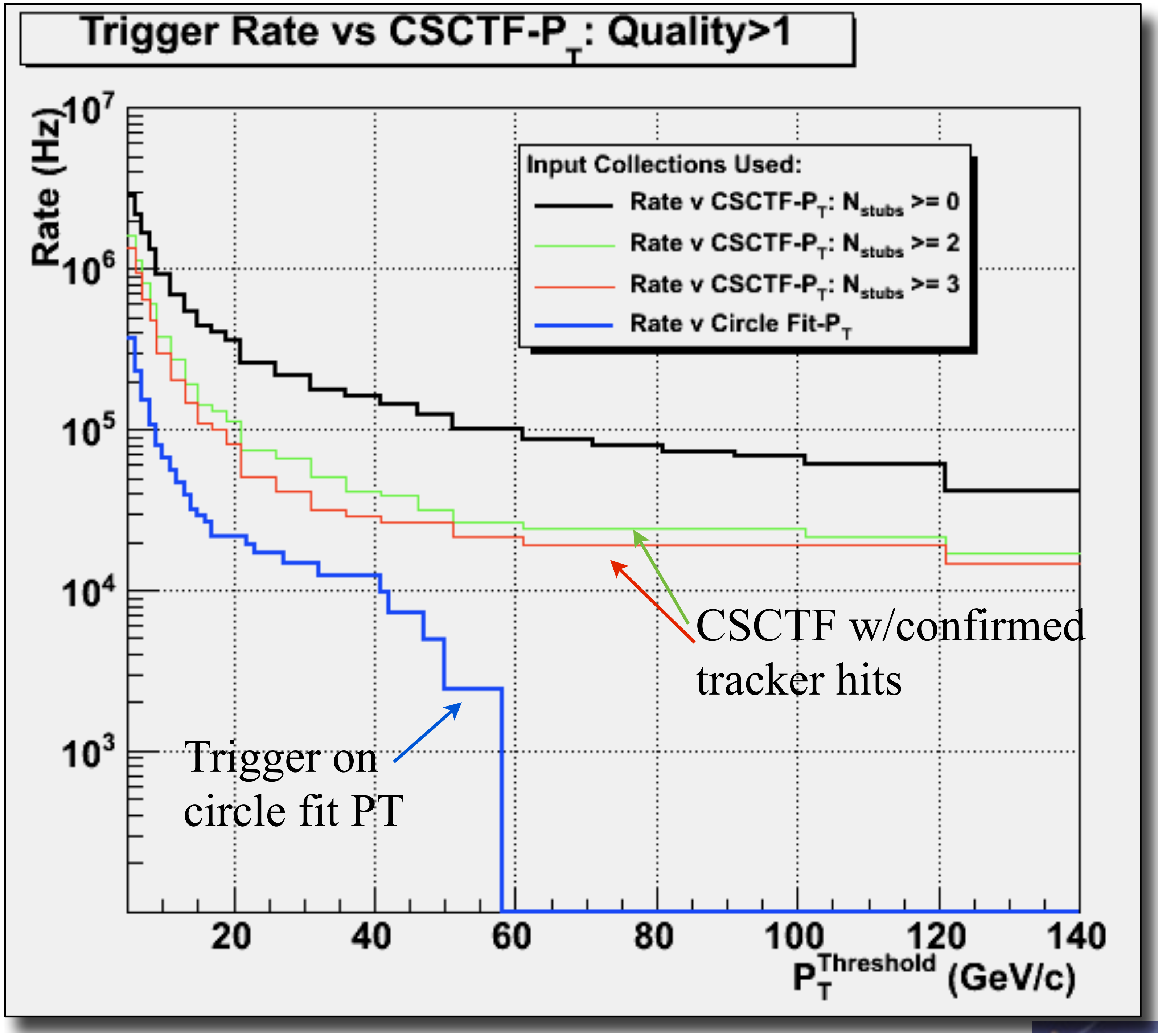




Flat P_T resolution when 3-Layer fit is used. We see resolution ~ 1.5%

Exercise: rate estimate with circle fit

Take either 2 OR 3 (preference to 3 Layer) Layer Circle fit, reevaluate rate



Summary

- cca mid 2010 we put CSC+TT studies on back burner:
- the r-φ roads were significantly limited by p_T assignment
- USCMS support shifted to Phase-1 upgrades

- consequence: singificant improvements to CSCTF performance, Phase 1 upgrade board + algorithm
- Conceptual Design Report presented, working on TDR (timeline ~ Jan 2013)
- interested to revive our studies and bring them up to date with our best understanding of CSCTF / GMT expected performance based on Phase 1 TDR information