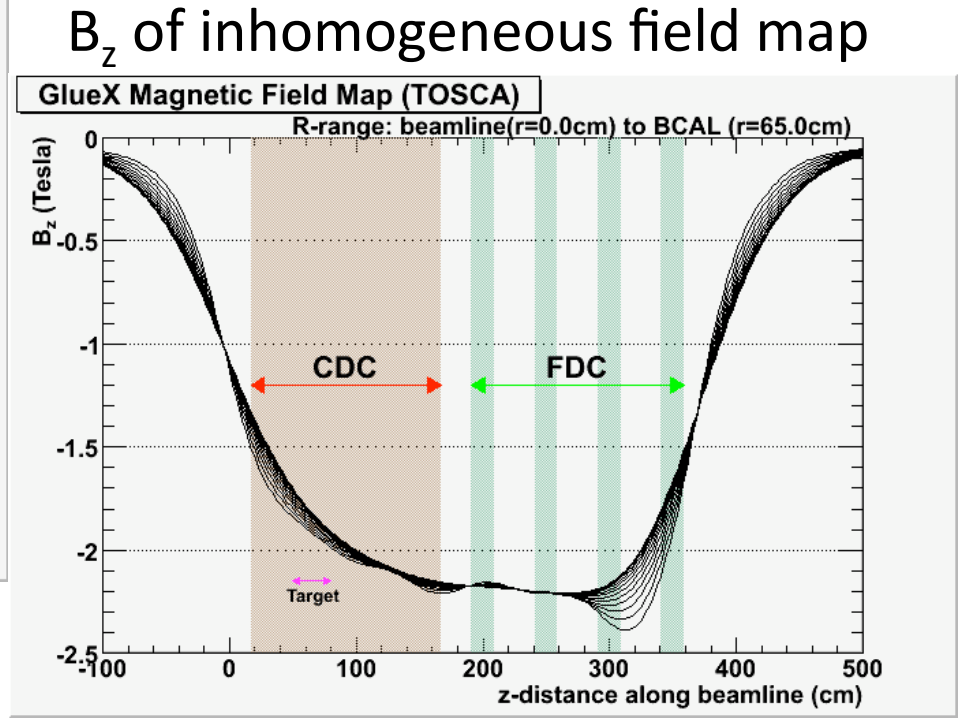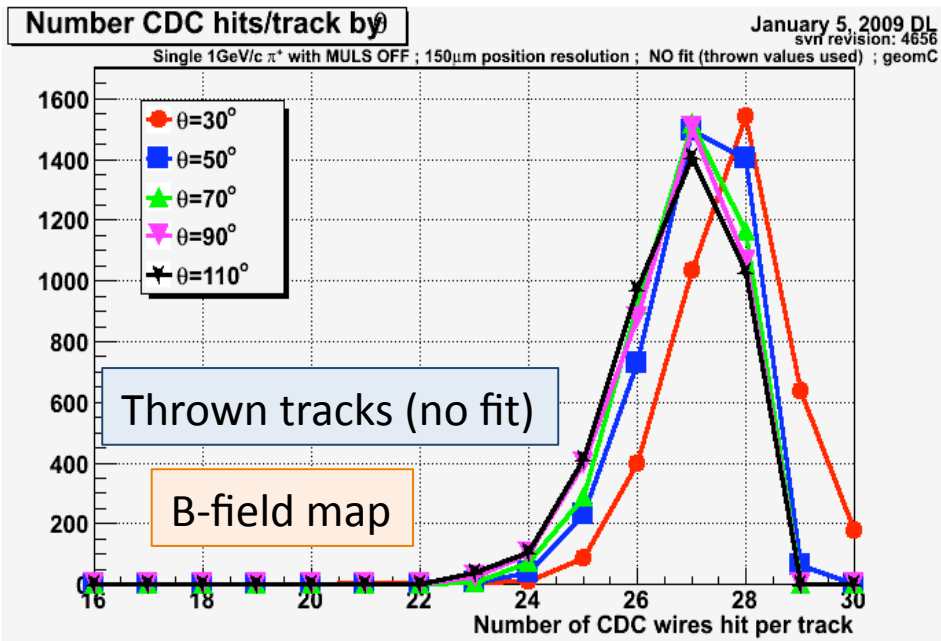# CDC and FDC Track Fitting

Jan. 21, 2009

David Lawrence JLab

CDC Number of hits per track

Number CDC hits/track by θ
January 5, 2009 DL
svn revision: 4656
Single 1GeV/c π⁺ with MULS OFF ; 150μm position resolution ; NO fit (thrown values used) ; geomC

- θ=30°
- θ=50°
- θ=70°
- θ=90°
- θ=110°

Thrown tracks (no fit)

B-field map

Number of CDC wires hit per track

Number CDC hits/track by θ
January 5, 2009 DL
svn revision: 4656
Single 1GeV/c π⁺ with MULS OFF ; 150μm position resolution ; Candidates from FINDER ; geomC

- θ=30°
- θ=50°
- θ=70°
- θ=90°
- θ=110°

Found and fit tracks

B-field map

Number of CDC wires hit per track

B_z of inhomogeneous field map

GlueX Magnetic Field Map (TOSCA)
R-range: beamline(r=0.0cm) to BCAL (r=65.0cm)

B_z (Tesla)

CDC   FDC

Target

z-distance along beamline (cm)

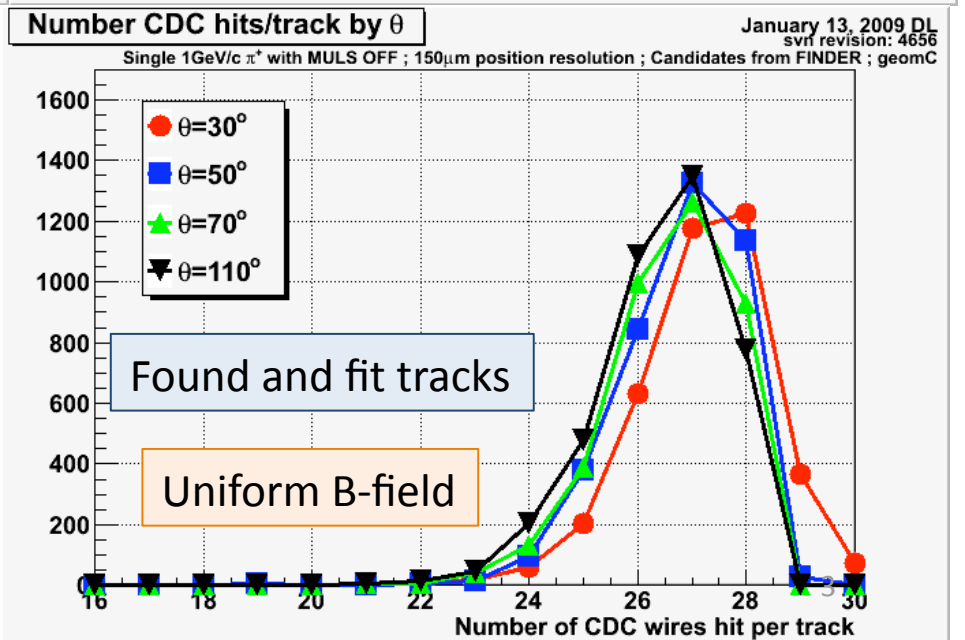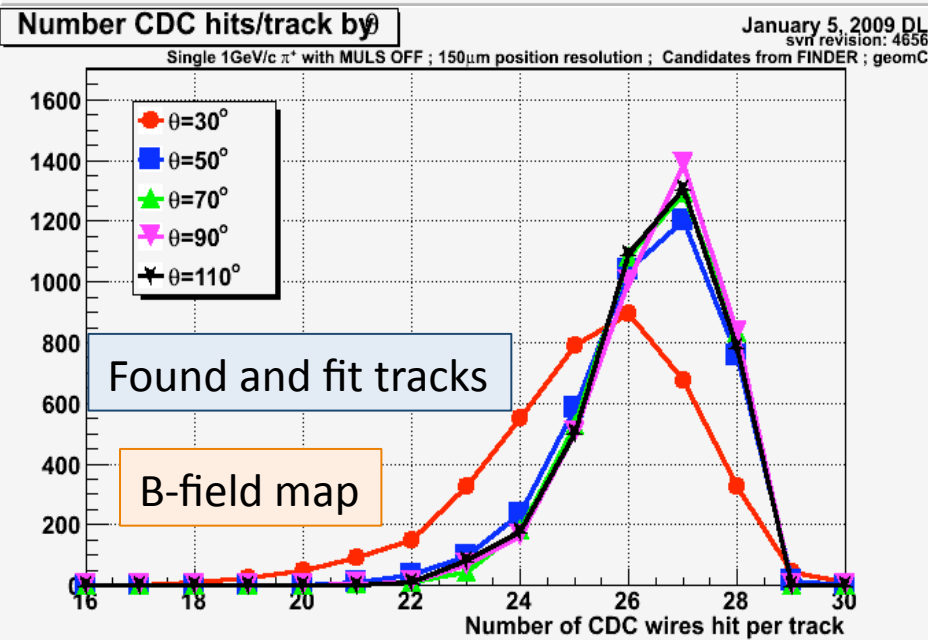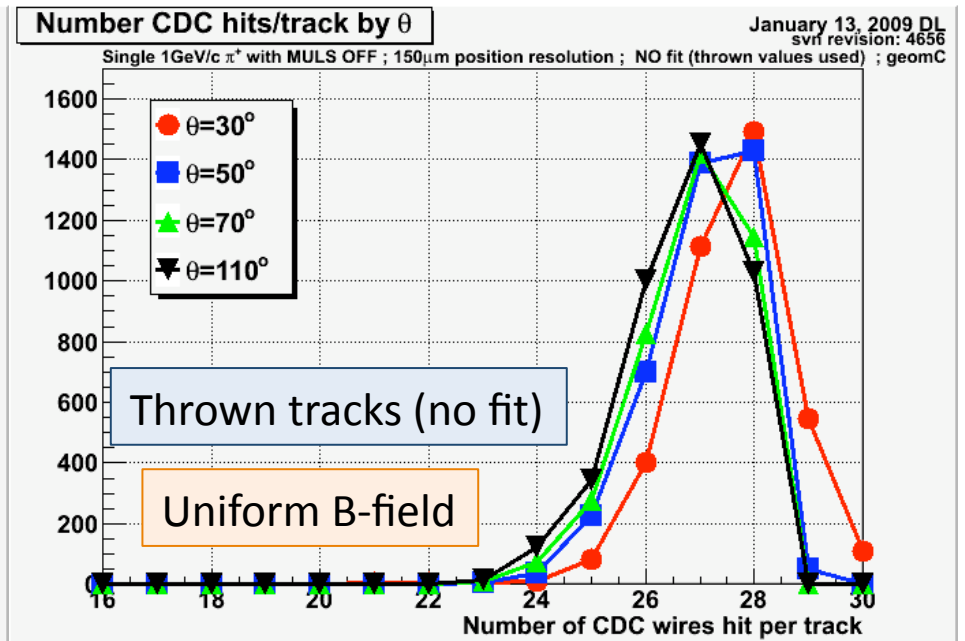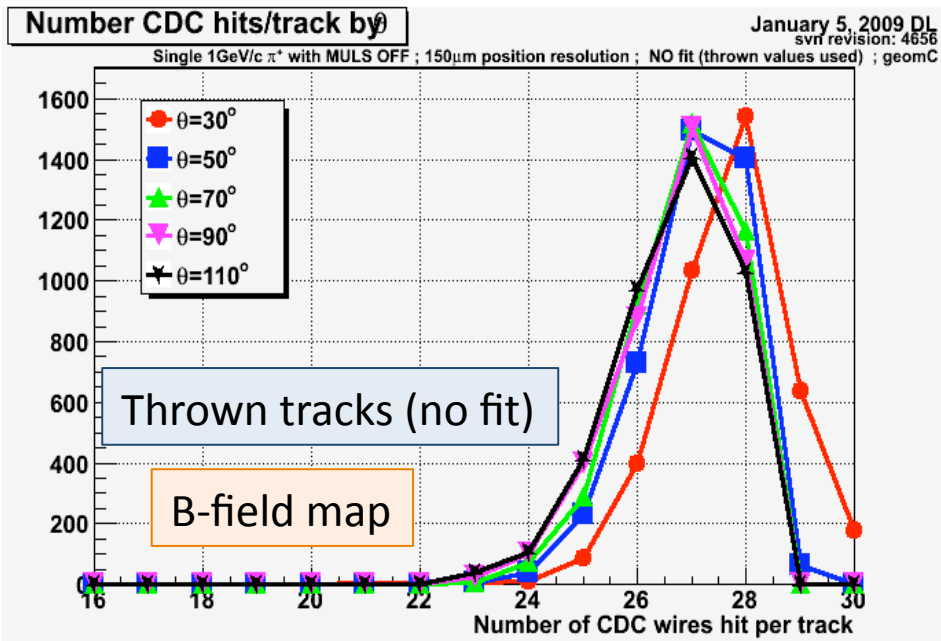**Target Center: $B_z \approx 1.8$T**
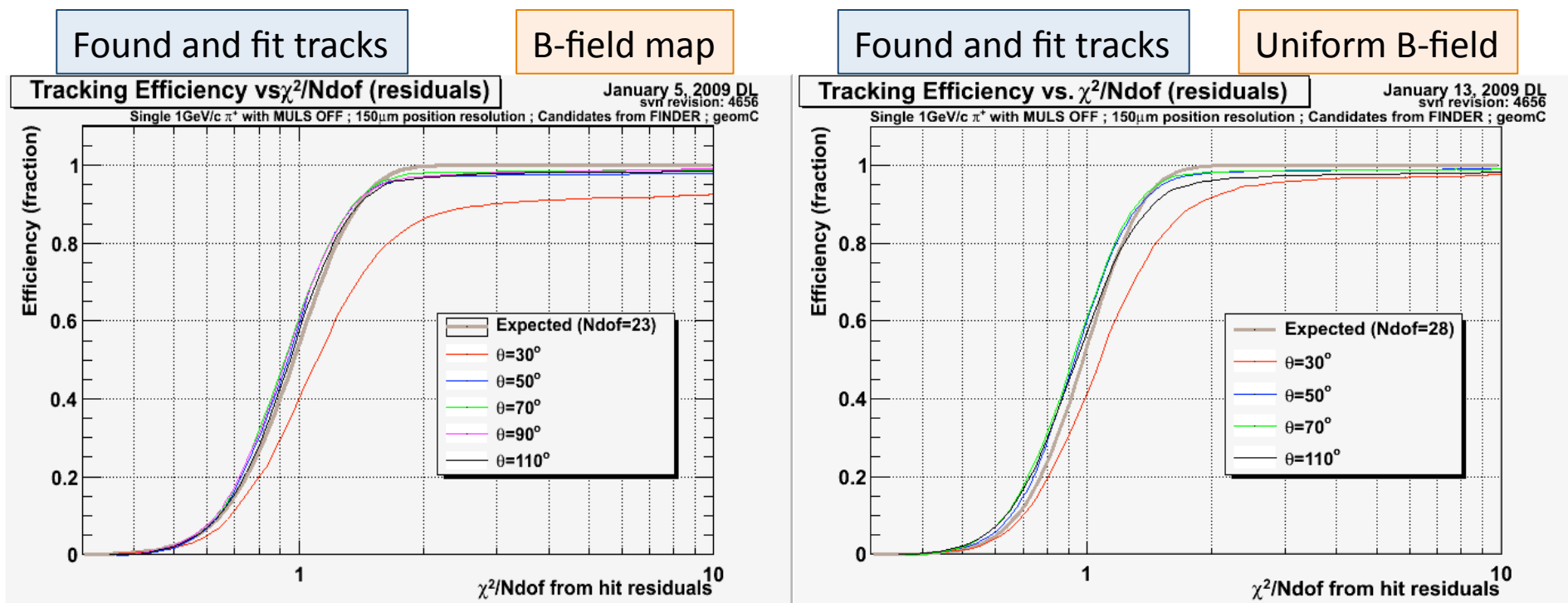
CDC downstream end: $B_z \approx 2.2$T

field changes by more than 20% for tracks going forward through the CDC

2
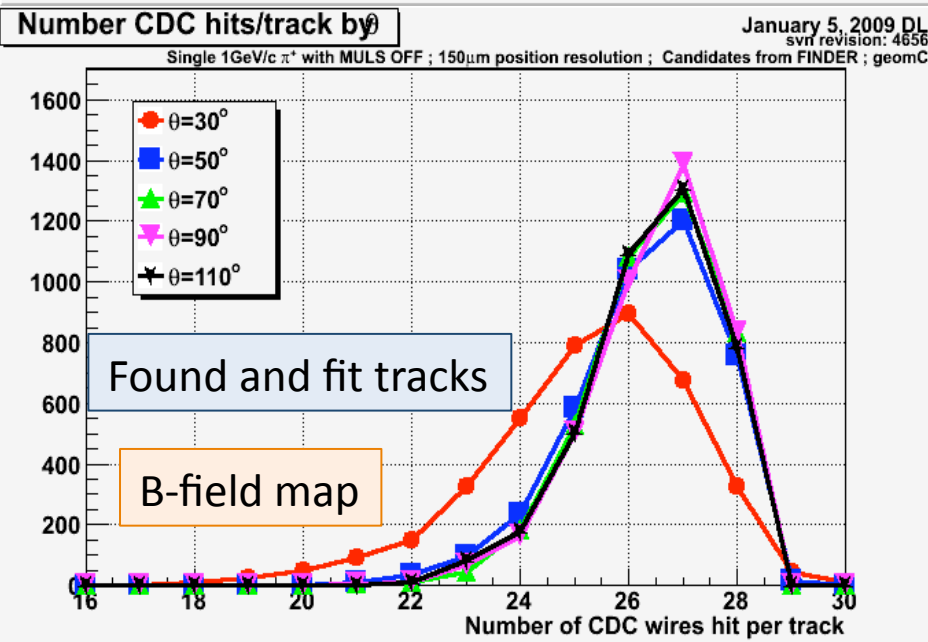
CDC Number of hits per track

Cumulative χ^2 distributions with uniform and non-uniform Magnetic fields

Found and fit tracks   B-field map

Found and fit tracks   Uniform B-field

30° tracks still stand out a little with the uniform field but the difference is greatly reduced from the non-uniform case.

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# Angular dependence of FDC residual width along wire

The width of the residual distribution for distance along the wire (from cathode reconstruction) has a dependence on the incident angle.

This dependence was determined as a function of the thrown θ angle of the track by fitting a 3rd order polynomial. The results of the fit were used to determine the error on the measurement along the wires for the FDC as a function of thrown θ.
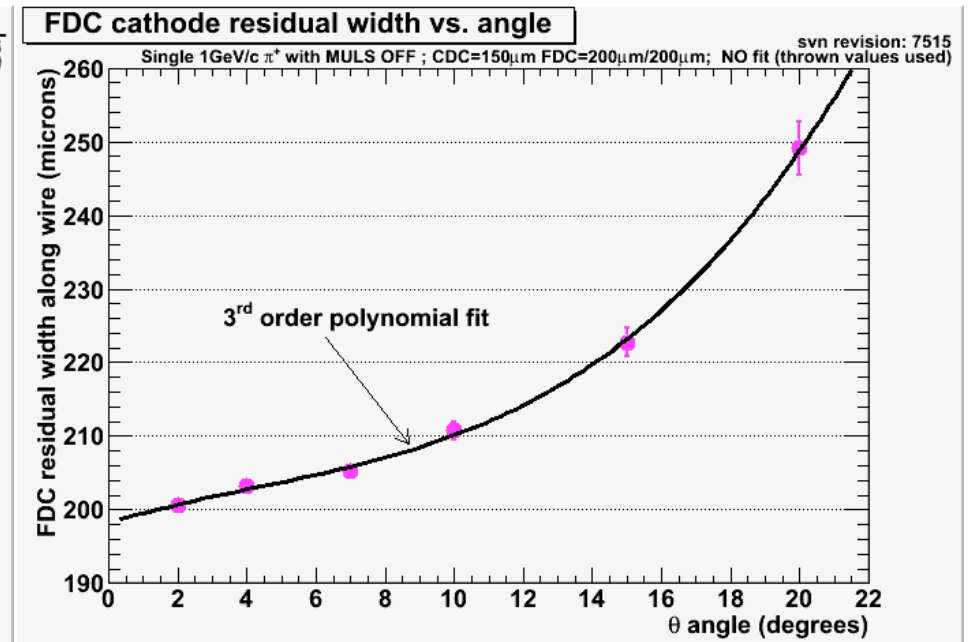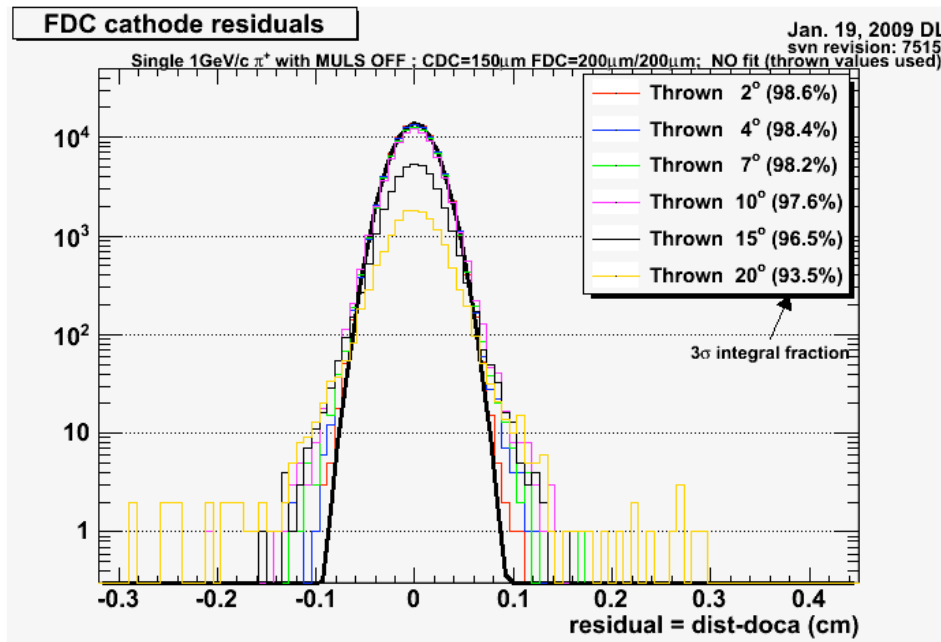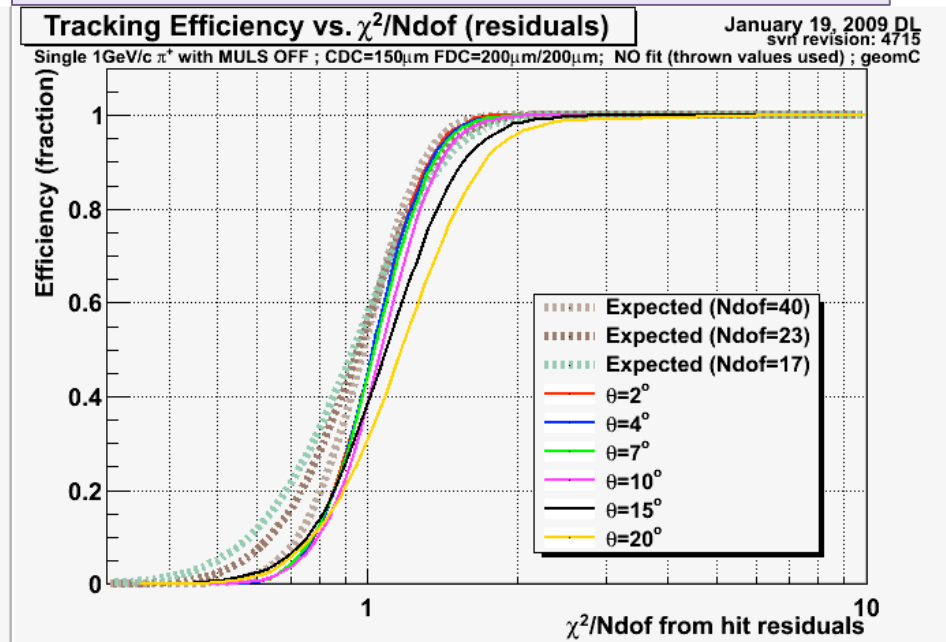
Cumulative χ^2 with and without angle dependent position resolution along FDC wire

Fixed position resolution along wire
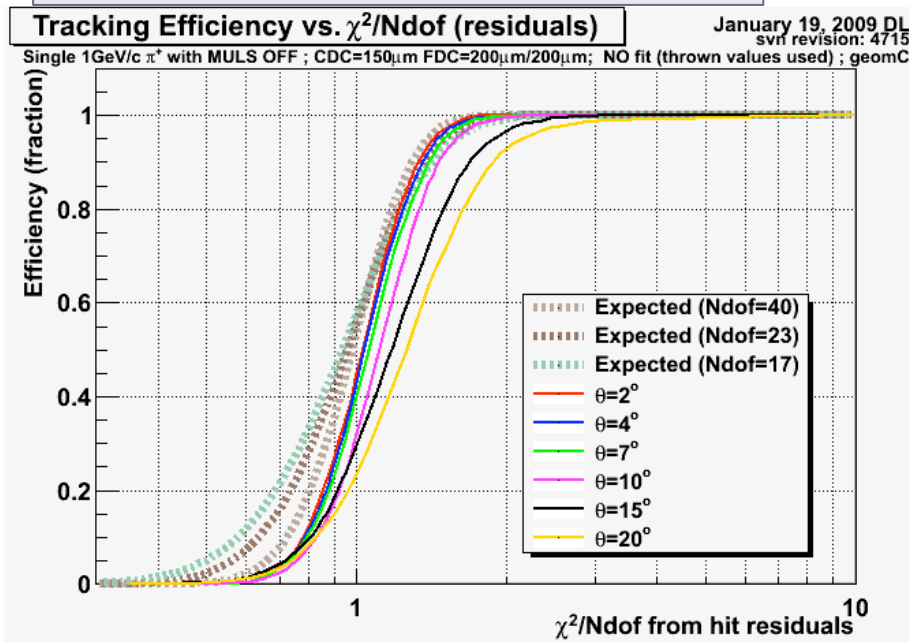
θ dependent position resolution along wire

Improvement in cumulative c2 is relatively modest for forward going angles

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Additional Geometries

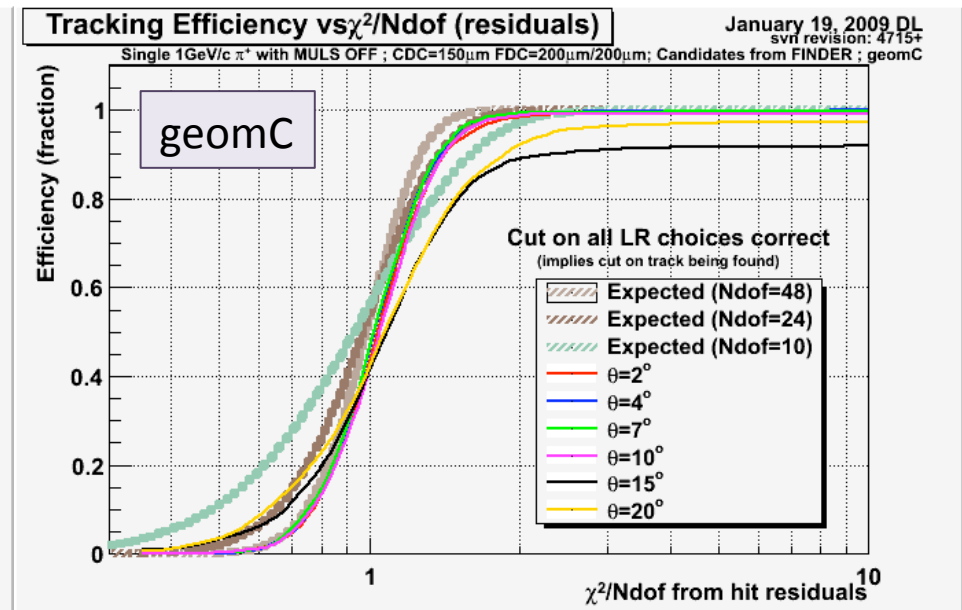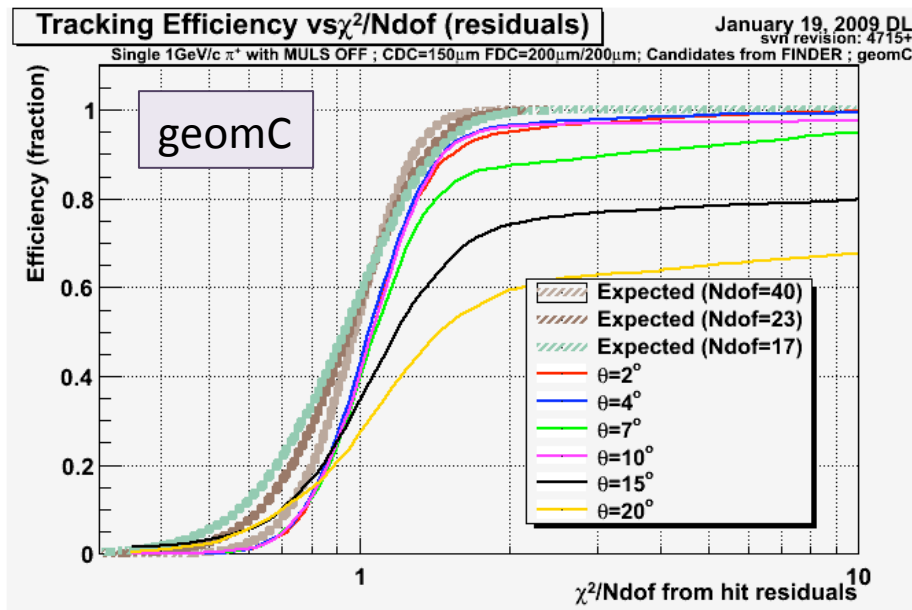| Name	CDC length
geomL	175 cm
geomC*	150 cm
geomJ	125 cm
geomK	100 cm

*geomC is the baseline geometry

Upstream end of CDC and position of last FDC package held fixed. Upstream FDC package positions adjusted to maintain equal spacing and spacing from CDC downstream end.


```
The following values must be changed in the XML in order to change the length of the CDC to Lcdc.
Note that this will keep the upstream end of the CDC fixed at L=17cm in the lab system. Also, it
is assumed that the FDC package spacing will be adjusted so that the downstream end stays fixed
at z=190.0+83.5+76+4.5+3 = 357cm in the lab frame.

The width spanned by the FDC packages will then be Lfdc = 357 - (Lcdc+40.0)

fdc1 = (Lfdc -2*(4.5+3))/2
fdc2 = fdc1/3

This does not change the cable positions or cooling meshes.


main_HDDS.xml:
----------------------

line 68: ForwardDC should have z value of 17+Lcdc+23


CentralDC_HDDS.xml:
----------------------

line 46: centralDC_option-1 should be Lcdc/2

line 48: CDBD should be Lcdc+1.5

line 49: CDGD should be Lcdc+10.5

line 67: CDPU should be -(Lcdc/2+0.45)
line 68: CDPD should be +(Lcdc/2+0.20)

line 82: CDPU should be -(Lcdc/2+0.45)
line 83: CDPD should be +(Lcdc/2+0.20)

line 95: CDPU should be -(Lcdc/2+0.45)
line 96: CDPD should be +(Lcdc/2+0.20)

line 143: CDPU should be -(Lcdc/2+0.45)
line 144: CDPD should be +(Lcdc/2+0.20)

line 156: CDPU should be -(Lcdc/2+0.45)
line 157: CDPD should be +(Lcdc/2+0.20)

line 169: CDPU should be -(Lcdc/2+0.45)
line 170: CDPD should be +(Lcdc/2+0.20)

line 221: CDPU should be -(Lcdc/2+0.45)
line 222: CDPD should be +(Lcdc/2+0.20)

line 236: CDPU should be -(Lcdc/2+0.45)
```

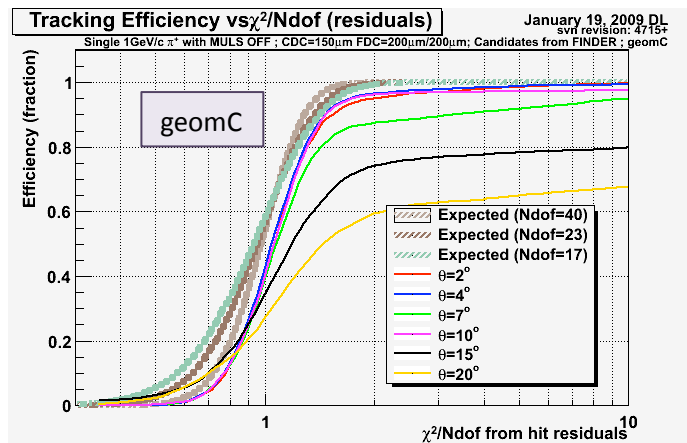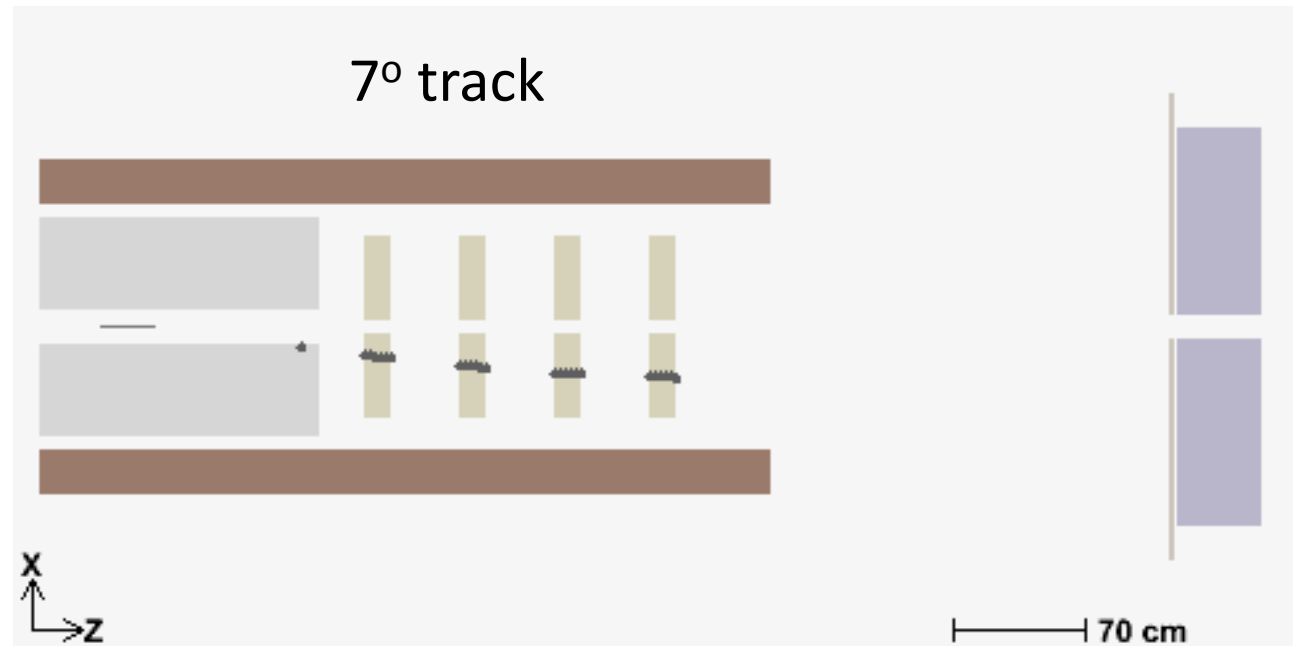*71 changes required in 3 XML files to modify CDC length!*

Locking in the LR choice

The current studies use a fitter that locks in the left-right choice based on the results of fitting to the wire positions. Looking only at tracks that were found **and** had the correct L-R choice made for all hits gives a limit on what might be achieved with a better algorithm.

Single hit in CDC can cause big problems when LR choice is locked

A single wire hit has only a little influence on the fit which leads to a higher rate of incorrect LR choices from the wire-based fit.


7º track

Tracking Efficiency vs χ²/Ndof (residuals)

January 19, 2009 DL
svn revision: 4715+

Single 1GeV/c π⁺ with MULS OFF ; CDC=150μm FDC=200μm/200μm; Candidates from FINDER ; geomC

geomC

Legend:
- Expected (Ndof=40)
- Expected (Ndof=23)
- Expected (Ndof=17)
- $\theta=2°$
- $\theta=4°$
- $\theta=7°$
- $\theta=10°$
- $\theta=15°$
- $\theta=20°$

Efficiency (fraction)

χ^2/Ndof from hit residuals

Tracking Efficiency for various CDC lengths
(FDC finder used Hough transform and wire-intersection points)
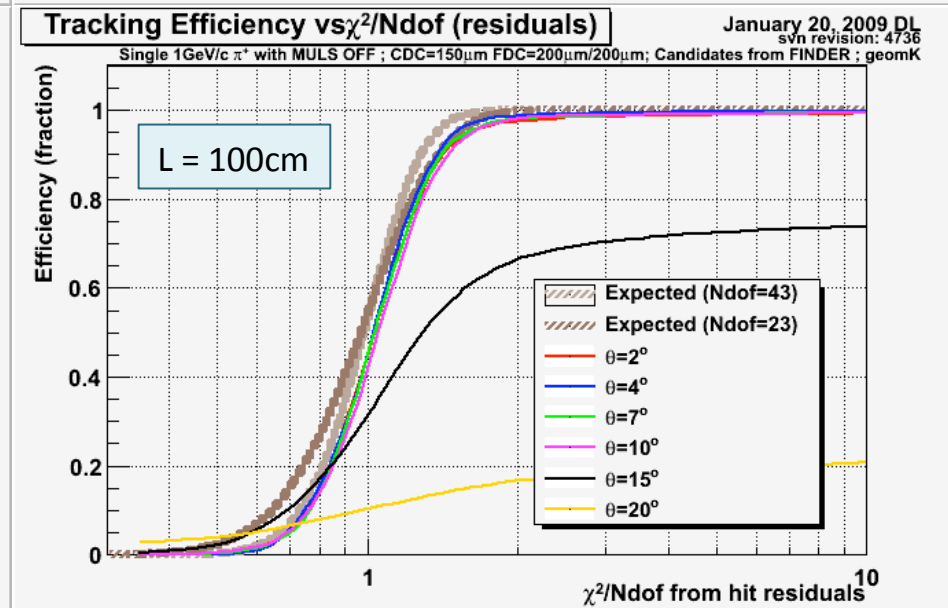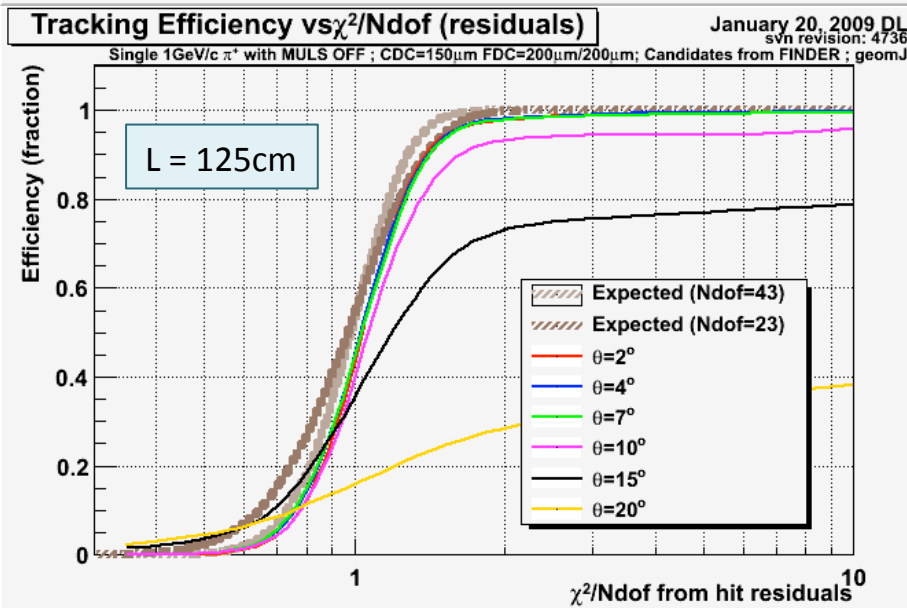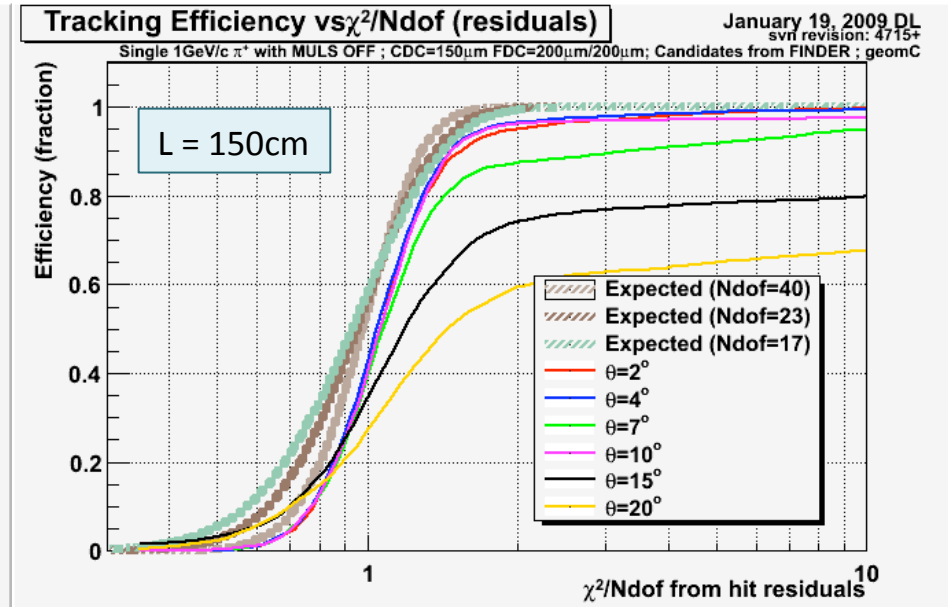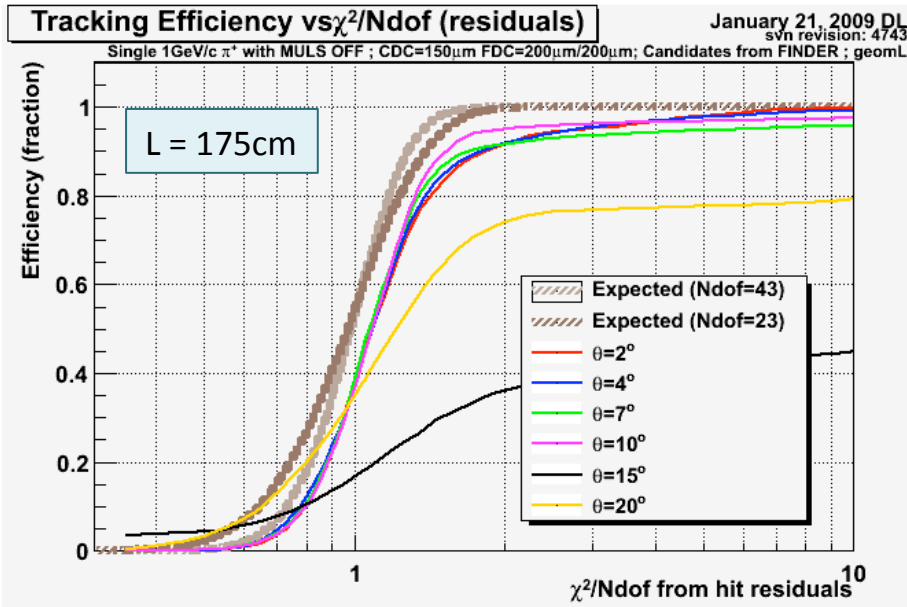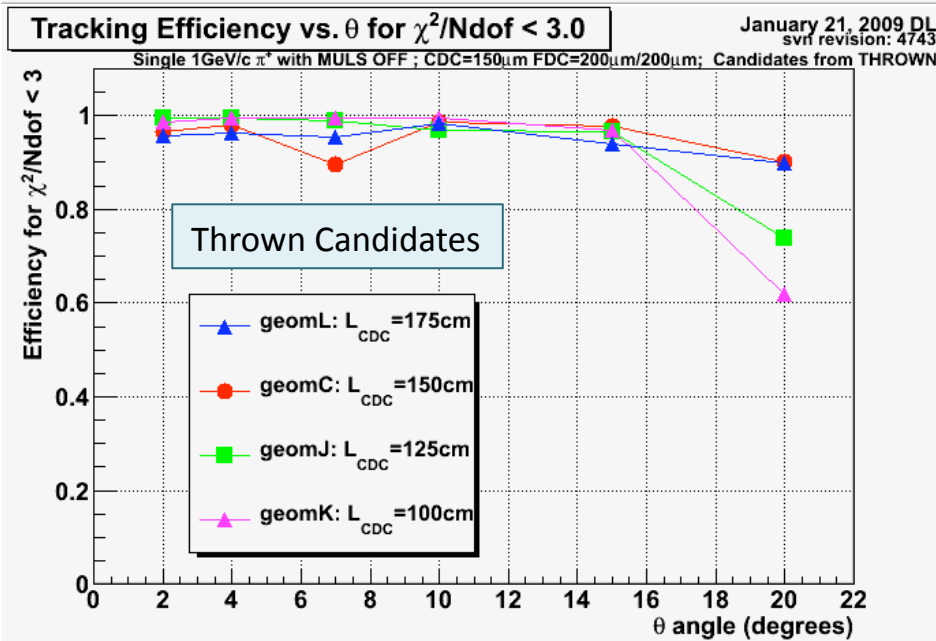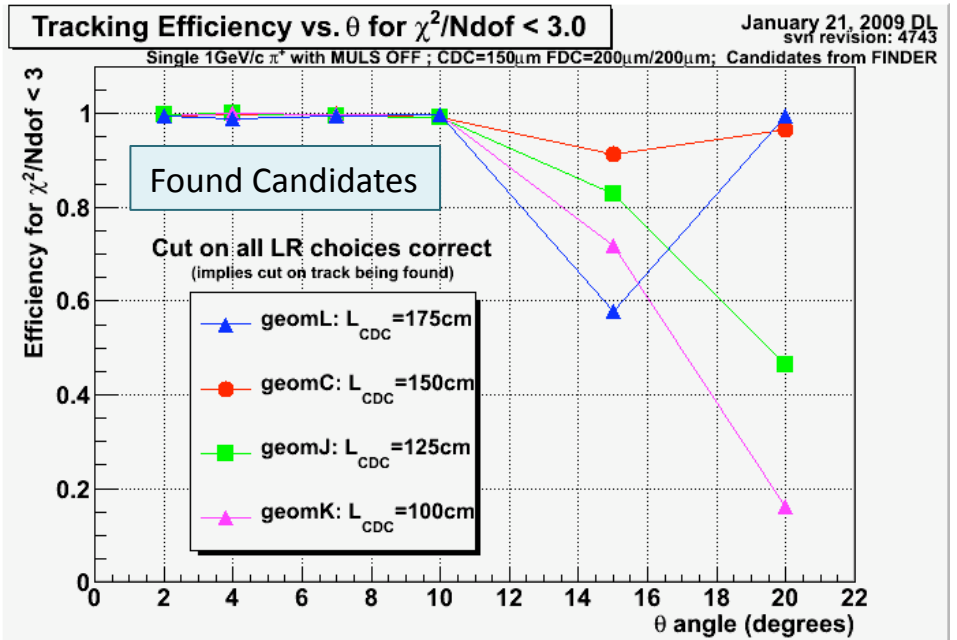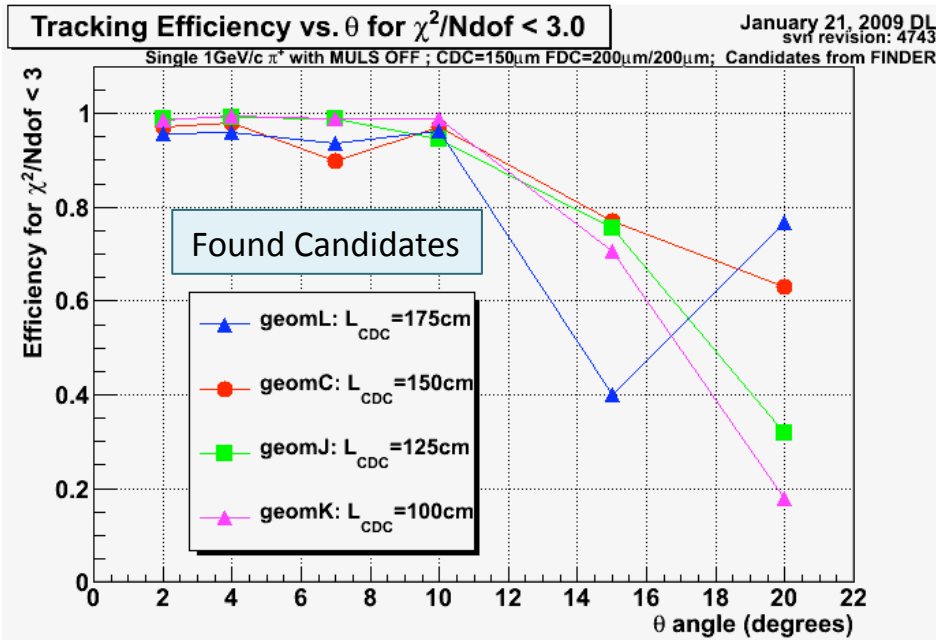
Tracking Efficiency for various CDC lengths

(THROWN tracks used for candidates)
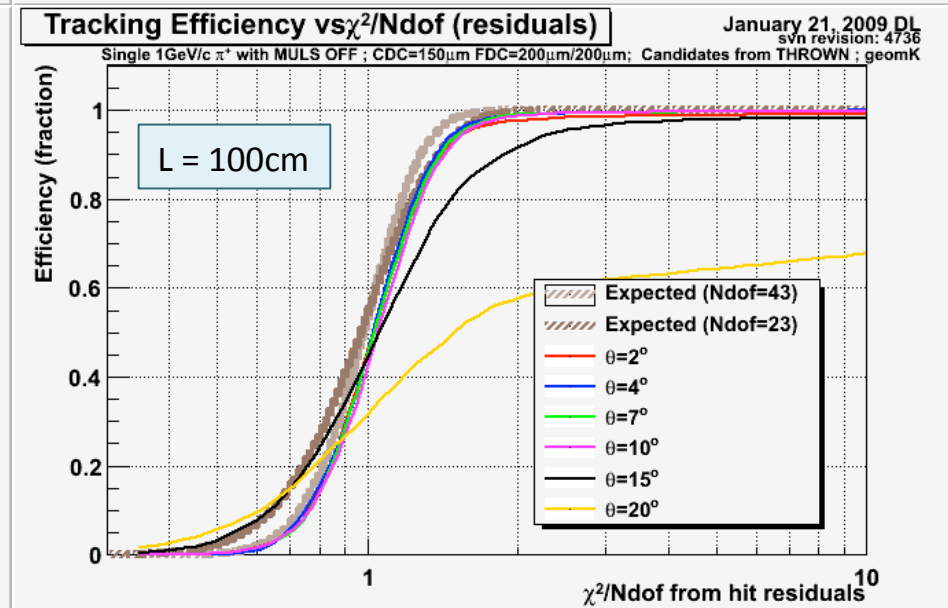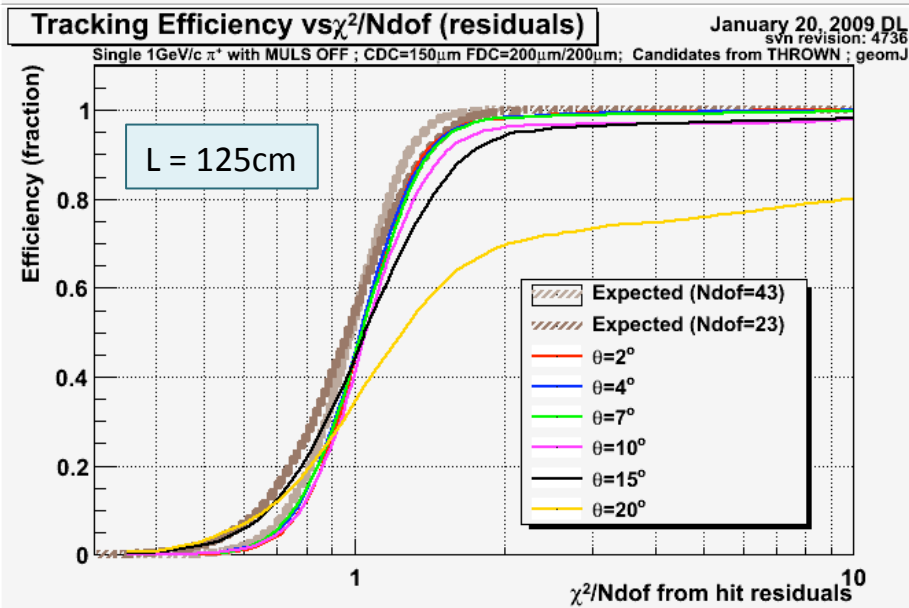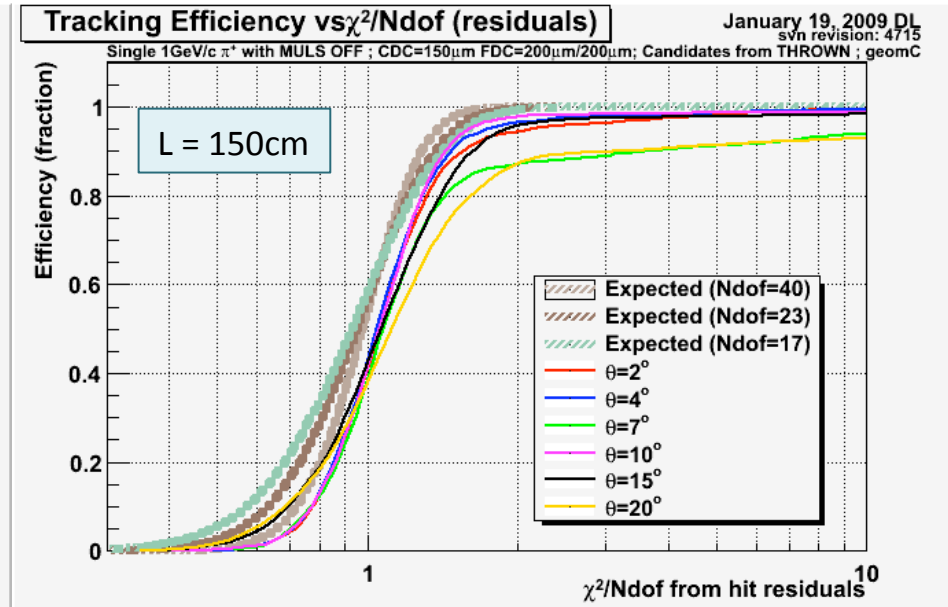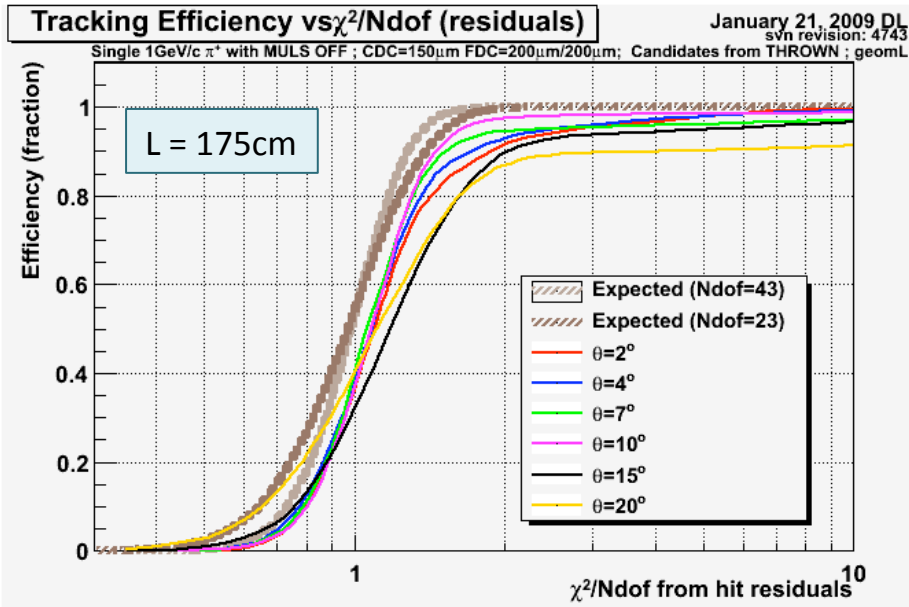
Efficiency vs. angle

Some of the inefficiencies are due to poorly defined track candidates.

Some are due to locking in a poor LR choice after wire-based fitting.

Summary

- Fitting of FDC tracks with old ALT1 least-squares fitter is more or less working again

- Results of this method depend heavily on quality of candidates and the inability to try alternate LR choices in the fit

- No conclusions can really be drawn at this time

Outlook

- Transition region finder needs to be re-activated

- FDC needs to be moved closer to CDC to close off gap which may be important at smaller CDC lengths

- 1° ,1GeV/c π^+ tracks do not appear to be passing through the active volume of FDC like they should