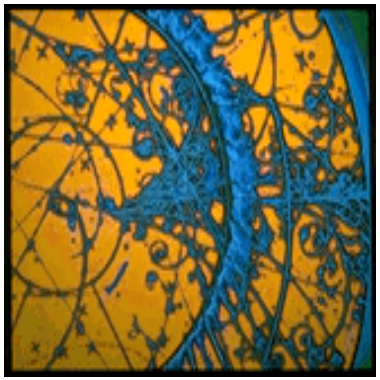


FTPC calibration status

Joern Putschke

for the STAR FTPC group

STAR Analysis Meeting 2002
October 22-24, 2002

Overview

The Forward-TPC layout

Laser Calibration

- **Residuals and momentum resolution**
- **Deflection angle**

Vertex reconstruction

“TimeStep problem”

DCA distribution

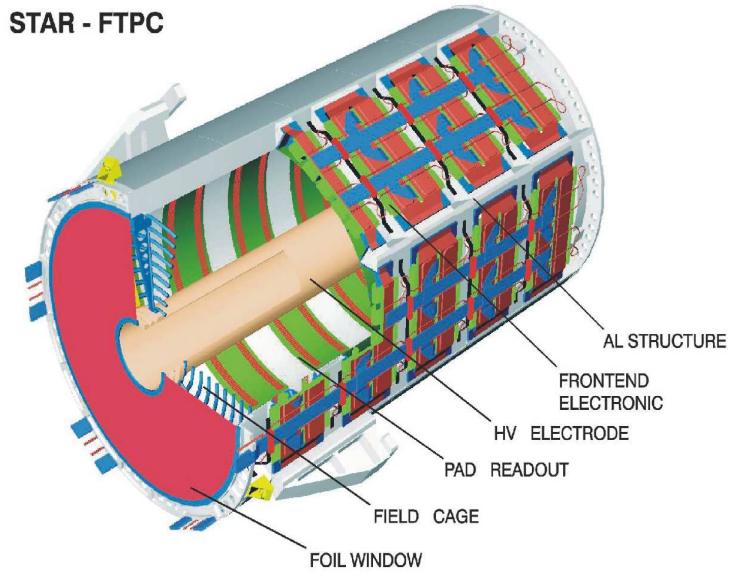
Multiplicity (raw)

- **FTPC vs. TPC/CTB**
- **FTPC minBias and Hijing**

Azimuthal angle Φ distribution

Plans for Y03

The Forward-TPC layout



inner radius	7.73 cm
outer radius	30.05 cm
chamber length	120 cm (|z| = 150 270 cm)
acceptance	η=2.5 4.0 (θ=2° - 9°)
drift cathode voltage	10-15 kV
drift electrical field	240-1400 V/cm (radial, $\perp$ beam)
Solenoid magnetic field	0.5 T (|| beam)
gas mixture	Ar(50%)-CO_2(50%)
drift velocity	0.3 2.0 cm/μs
trans. Diffusion DT	100-130 μ m/$\sqrt{}$cm
long. Diffusion DL	100-130 μ m/$\sqrt{}$cm
Lorentz angle	4 deg.

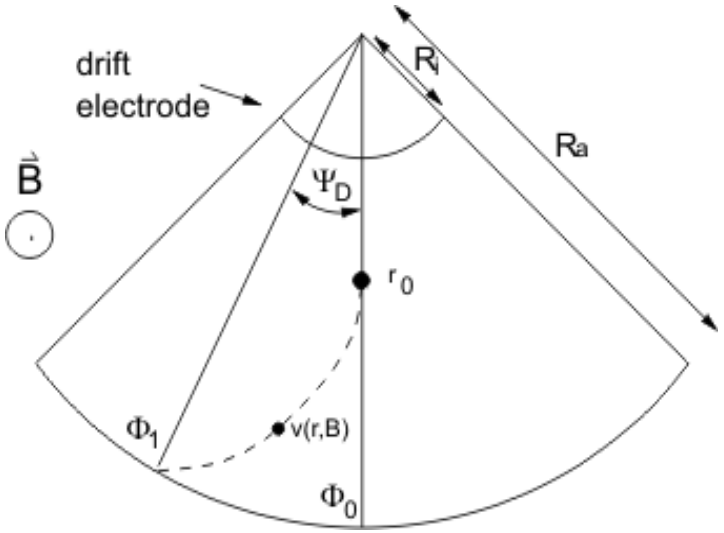
2 FTPCs

2.5 < $|\eta|$ < 4.0

6 azimuthal sectors (~60 deg.) with 5*2 rows in z- direction

electron drift ~1/r and $\perp$ to magnetic field

Radial drift / space point reconstruction



$$E \propto \frac{1}{r} \Rightarrow v_D \propto v_D(r) \propto \text{const}$$

$$E \perp B \Rightarrow F = q(v_D(r) \times B) \Rightarrow F(r) \propto \text{const}$$

$$T_D(r) = \int_{r_0}^{r} dt = \int_{r_0}^{r} \frac{dr}{v_D(r)} \Rightarrow r$$

$$\Psi_D = \int_{r_0}^{r} \frac{\omega_L(r)}{r} dr \Rightarrow \Psi$$

(ω_L = Lorentzangle)

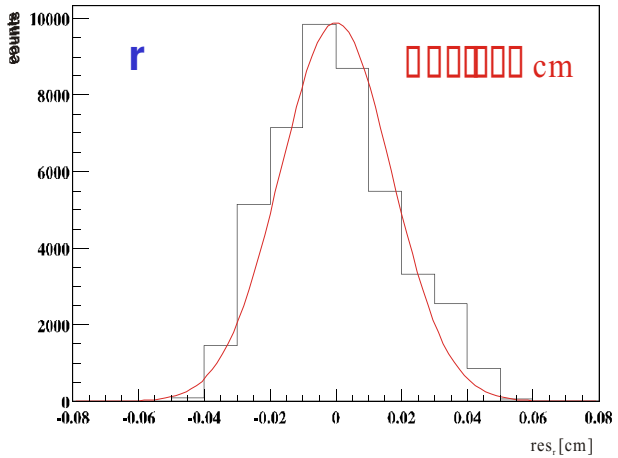
$v_D(r)$ and $\Psi_D(r)$ have to be known with high accuracy

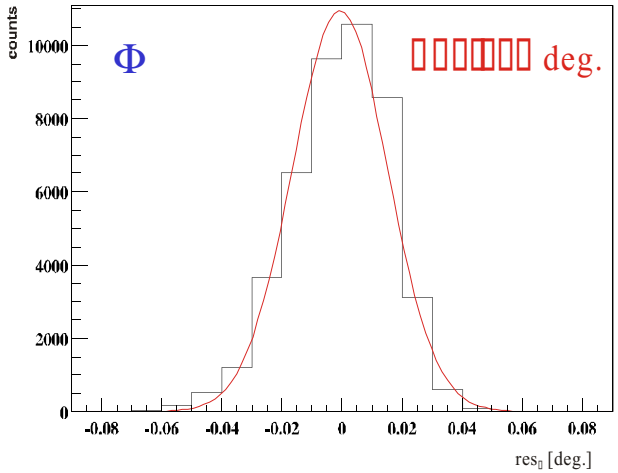
$\Rightarrow$ using MAGBOLTZ calculations

How to check ?

Laser residuals & momentum resolution

Residuals of the inclined laser tracks

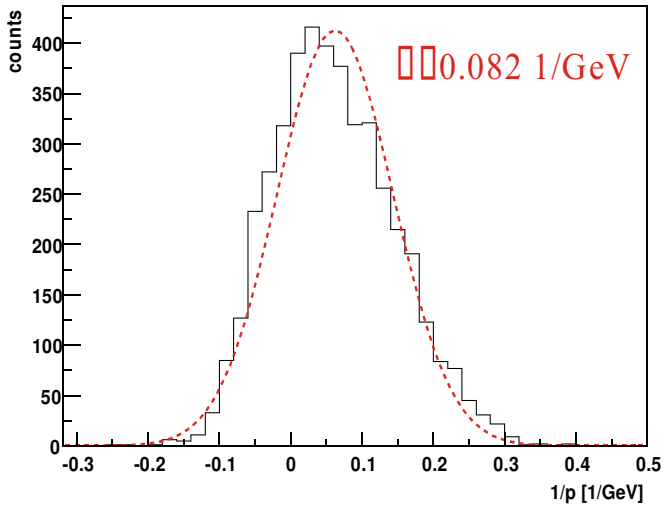




Momentum resolution

$$\frac{dp}{p} = \frac{A \cdot p}{B \cdot L^2}$$

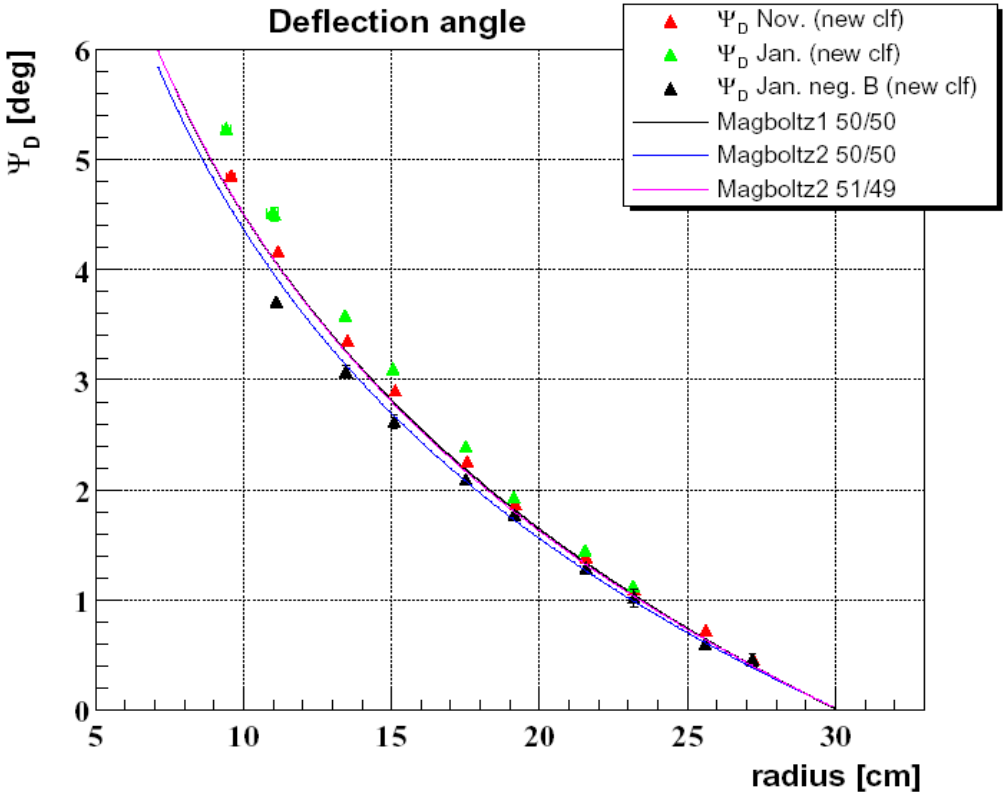
B : magnetic field
A : accuracy in point measurement and number of used points
L : track length
p : transverse momentum



⇒ momentum resolution and residuals in the designed accuracy !

Deflection angle

Comparsion of the measured deflection angle vs. raidus and MAGBOLTZ calculations



$$D,laser = |pad_{B,nofield} - pad_{B,fullfied}| \cdot RadiansPerPad$$

$$RadiansPerPad = 0.0062296 \text{ rad}$$

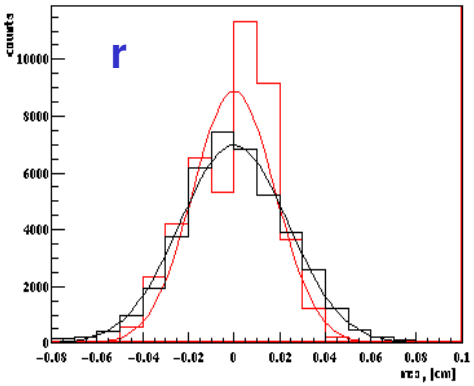
differences between different laser calibration sets in the azimuthal direction:

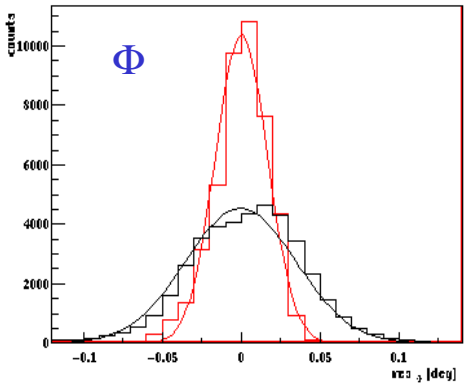
- **different laser intensities**
- **problem in azimuthal reproduction of laser tracks**

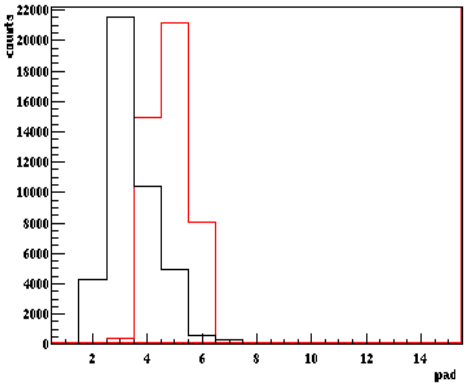
tool to compare different MAGBOLTZ versions calculations

Residuals of different intensity laser tracks

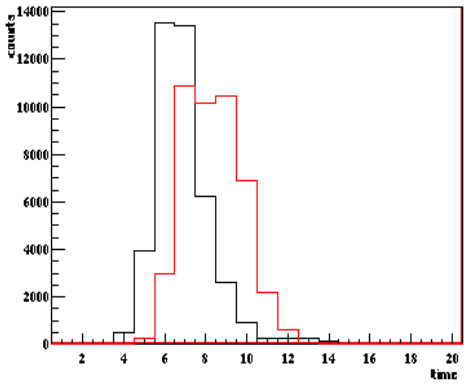
Residuals







padwidth

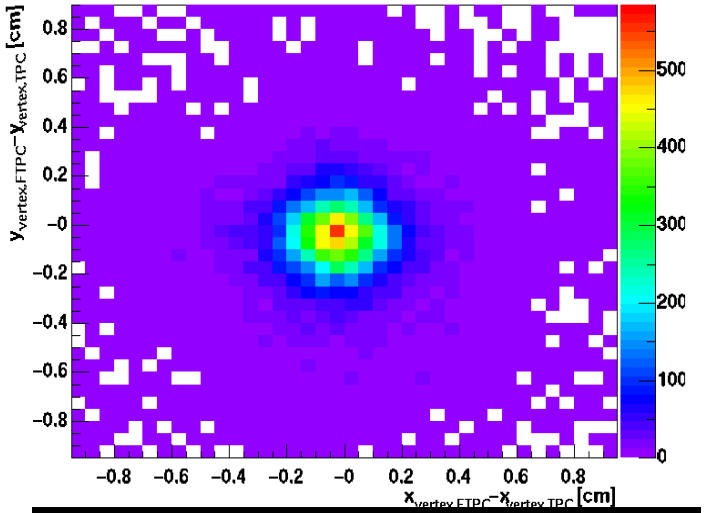


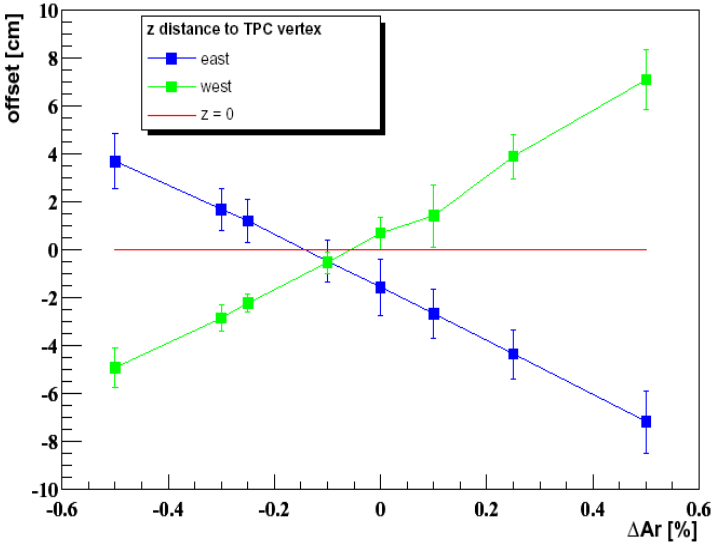
timewidth

selection of a low intensity laser track (black) with cluster geometry similar to physics data to compare with the high intensity laser track (red)

⇒ factor of 2 visible

Vertex reconstruction





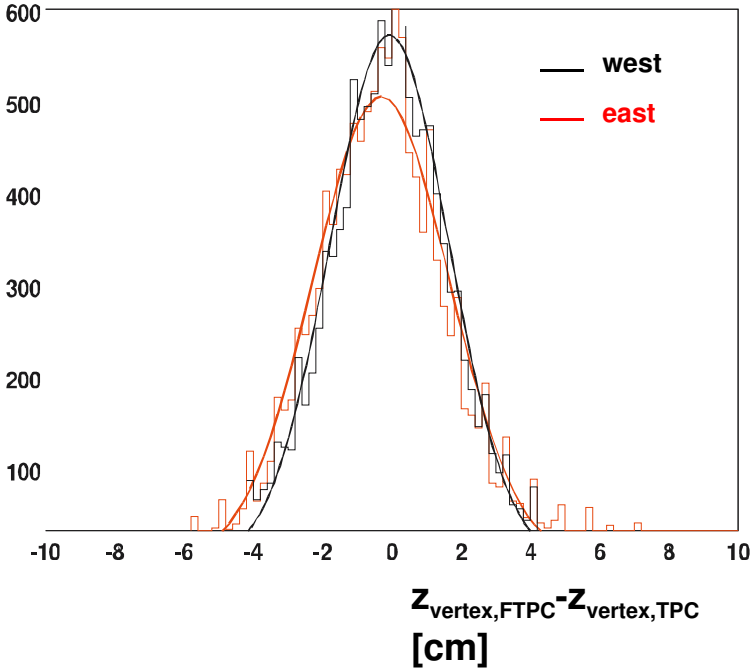
transform to STAR coordinate system

compare FTPC and TPC vertex pos.

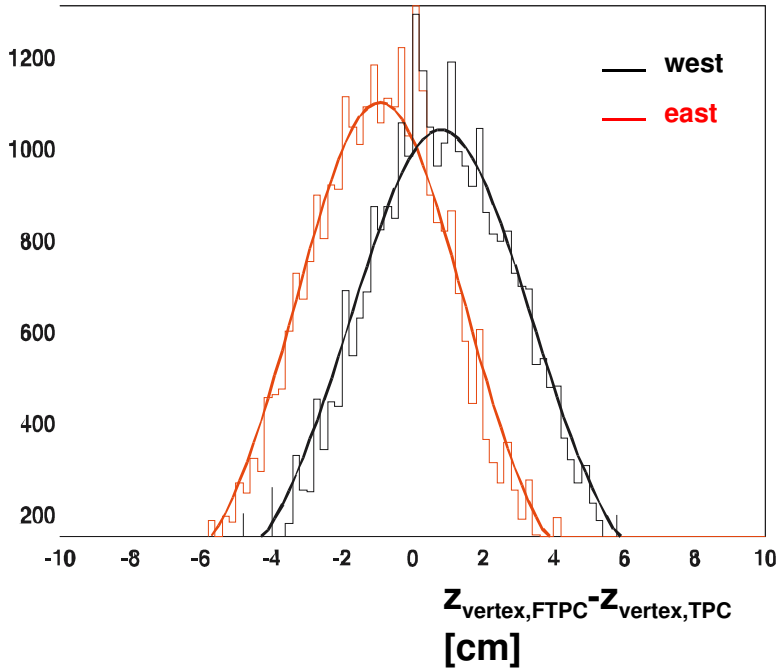
a tool to check our drift velocity with real data

Vertex reconstruction of minBias data

ReversedFullField Run 311



FullField Run 313

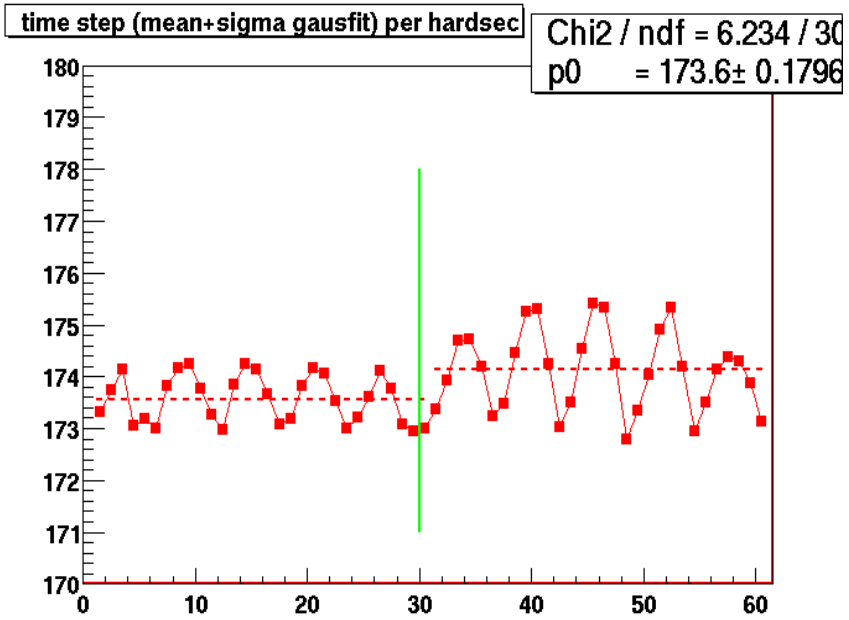


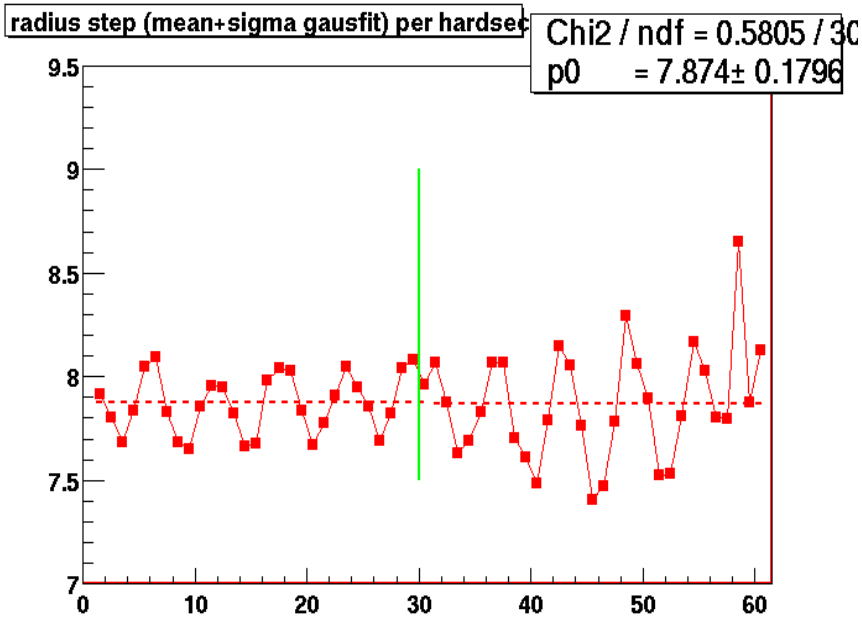
vertex-z reconstruction maybe depends on magnetic field setting

but could be also explained due to drift velocity change, wrong B-field distortion corrections …

⇒ effect could not be explained at current calibration level !

TimeStep problem





TimeStep (maximum drift time of the electrons) shows a

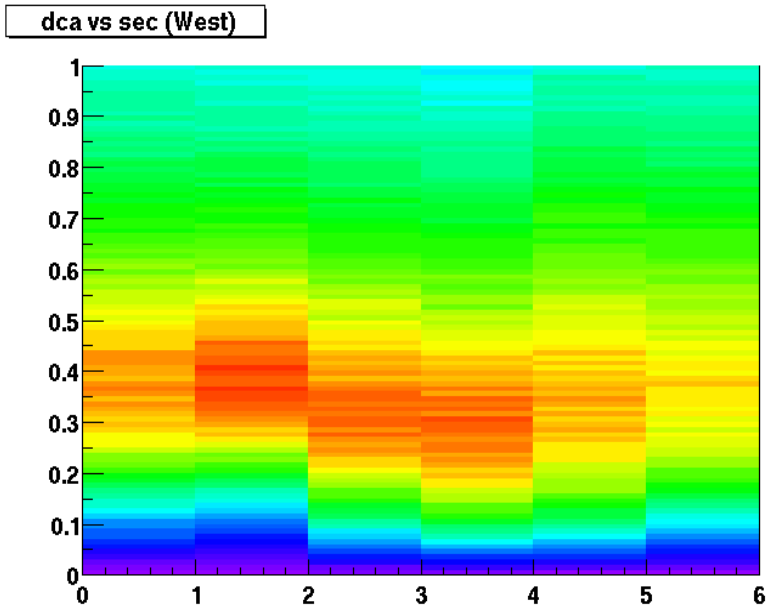
hardware sector wise structure !

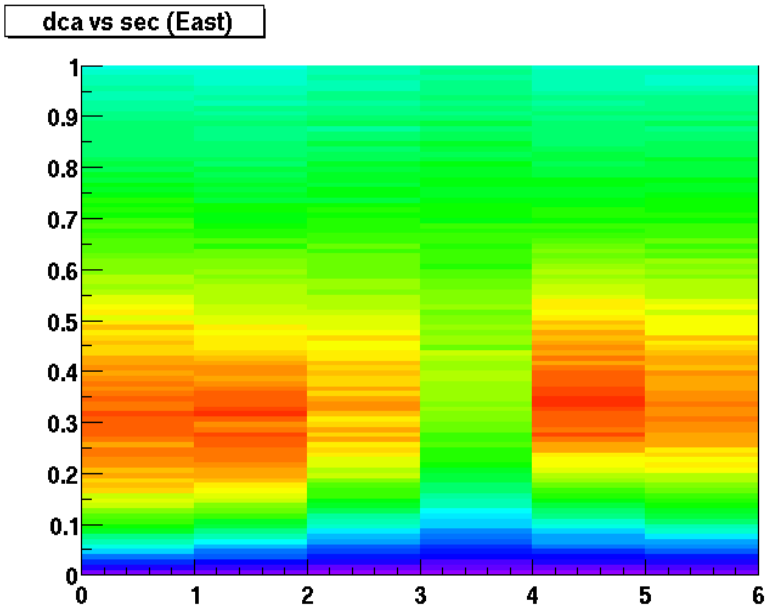
⇒ azimuthal dependence of the TimeStep/inner radius of reconstructed hits !

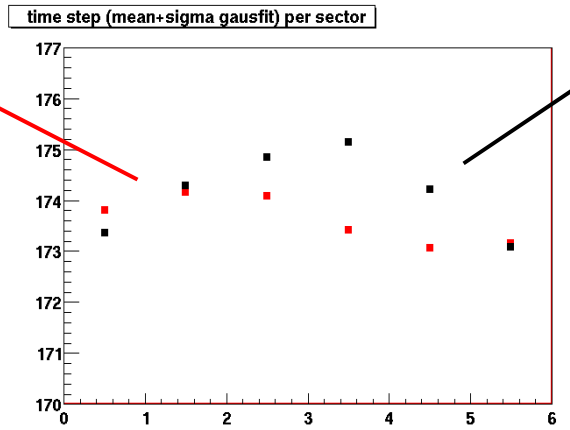
No idea where this structure came from ???

DCA distribution

(ReversedFullField Run313)





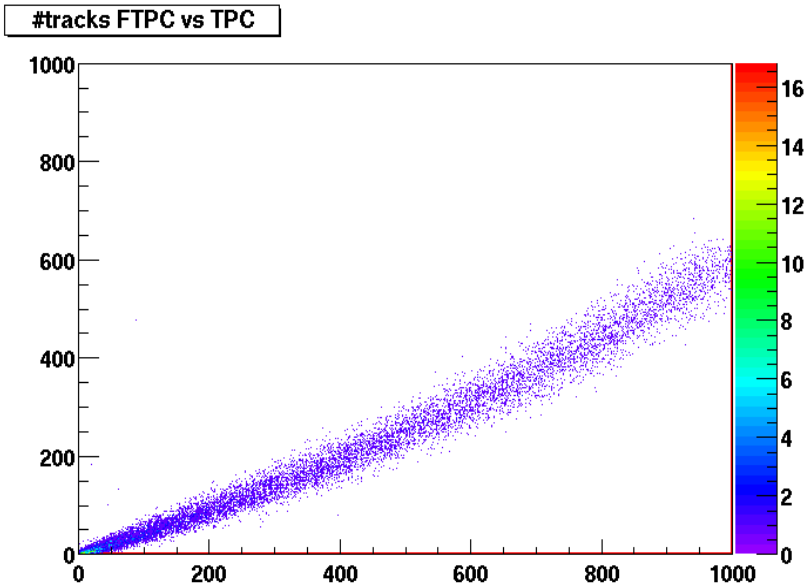


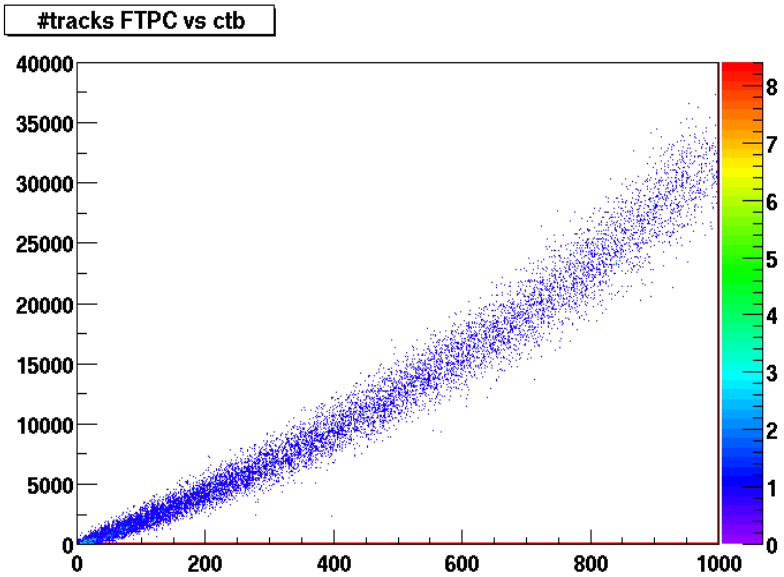
west

east

- dca distribution shape could be reproduce by simulations (with timeoffset)
- check with data needs a new round of calibration and reconstruction

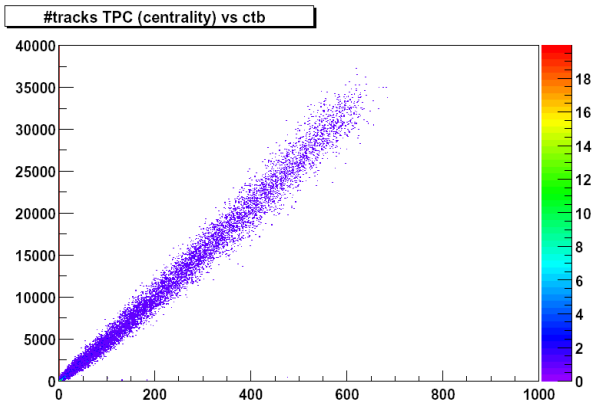
FTPC raw multiplicty vs. TPC/CTB



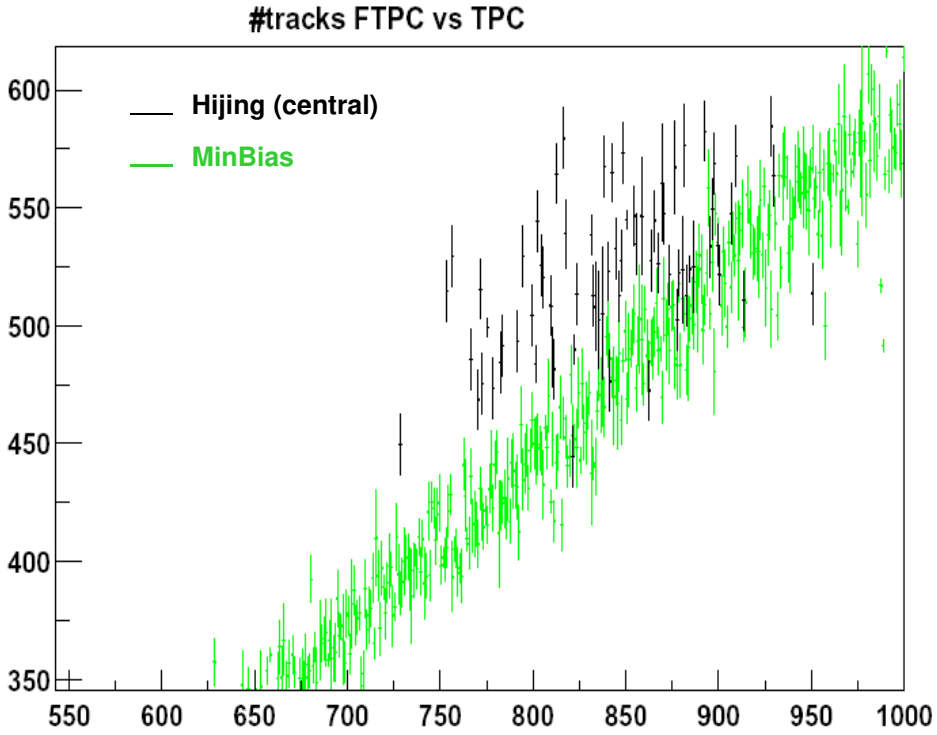


no quality cut applied on FTPC tracks (primary & secondaries)

but good correlation between FTPC and TPC / CTB multiplicity !



FTPC raw minBias and raw Hijing multiplicity

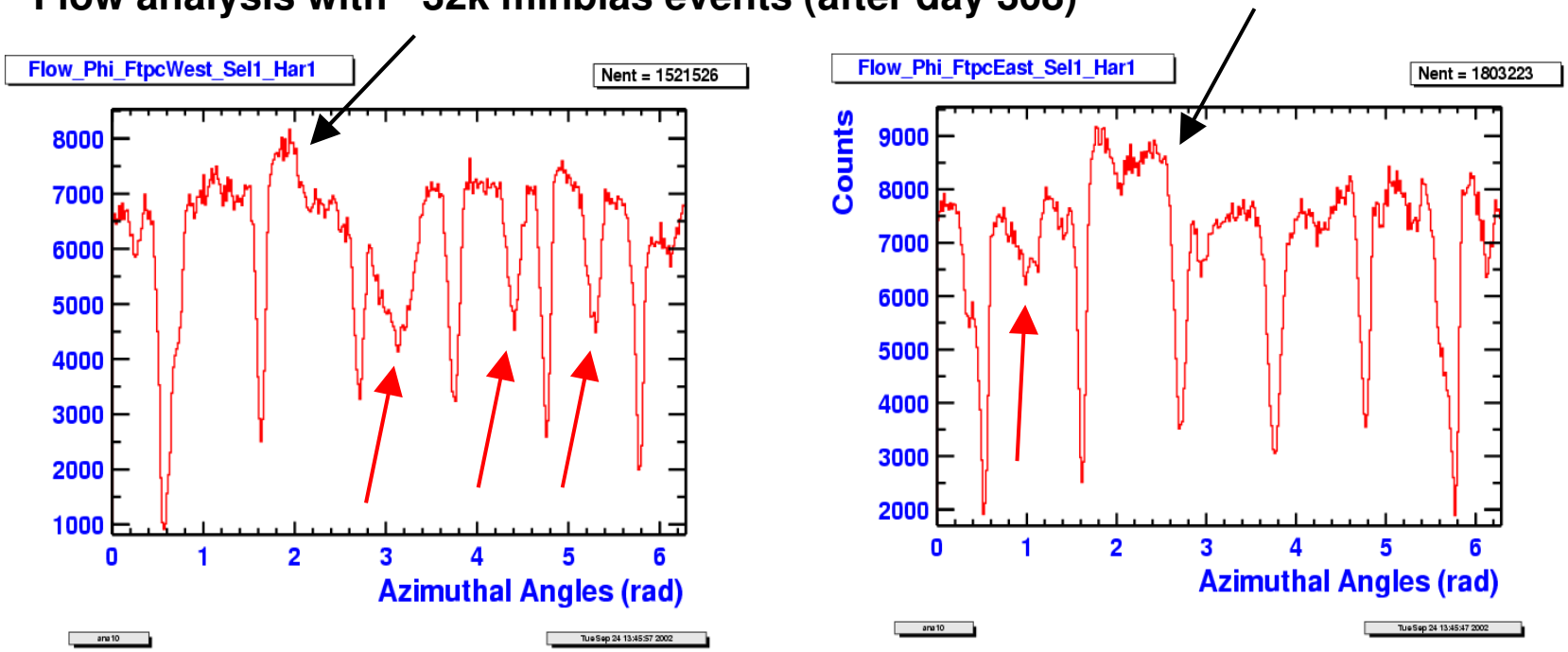


“good” agreement between Hijing and minBias data

more reconstructed tracks in data could be due to higher background and additional noise

Azimuthal angle distribution

Flow analysis with ~32k minbias events (after day 308)



6 fold structure reflects azimuthal FTPC sector design

additional holes ⇔ electronic loss

higher sector due to eta weighting (noise cluster on tracks)

Plans for Y03

1. **Laser Calibration (as soon as possible)**
   - gain scan → residuals (azimuthal laser track reproduction)
   - zero field laser ⇒ look at timeStep problem
   - zero field laser and drift velocity mointor
     ⇒ fix drift velocity and MAGBOLTZ
   - B-field scan → check ExB corrections
   - laser during data runs → spacecharge
2. **Data calibration runs**
   1. gain scan → cluster shapes and residuals
   2. B-field scan → solve vertex-z positon puzzle
   3. zero field run, laser and drift velocity mointor
      ⇒ fix drift velocity and MAGBOLTZ
3. **Pulser runs**
   1. check electronic exchange
   2. gain correction

Summary

We found more calibration problems :-(

- → **But, we have all the tools and we (hopefully) "know" now were we have to look for :-)**

TimeStep problem could be "solved" before Y03

- **more simulations studies**
- **reconstruction of central or minBias events to check corrections**

Multiplicity correlations and azimuthal angle (Flow) looks promisefull

- ⇒ **new calibration iteration (with corrected TimeStep) must be done !**
- ⇒ **reconstruction of minBias data set needed !**

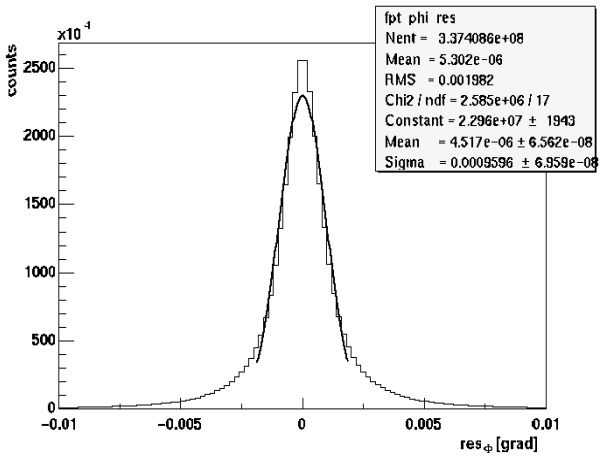
With our calibration plan for Y03 we hope to be ready for physics data taking before the run starts !

The STAR FTPC group

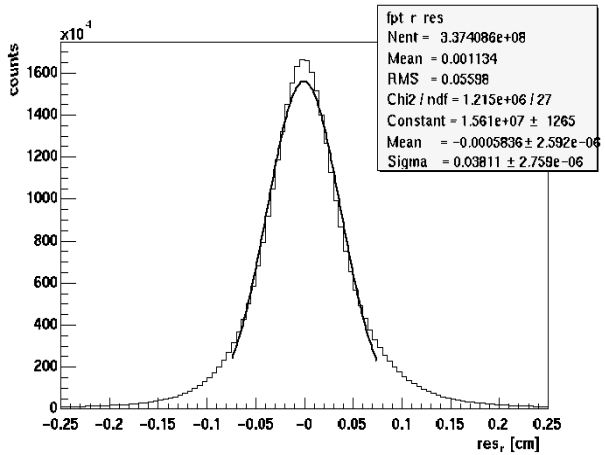
Volker Eckhardt
Maria Mora Corral
Markus Oldenburg
Joern Putschke
Janet Seyboth
Peter Seyboth
Frank Simon

Reconstruction quality

Residuals Φ



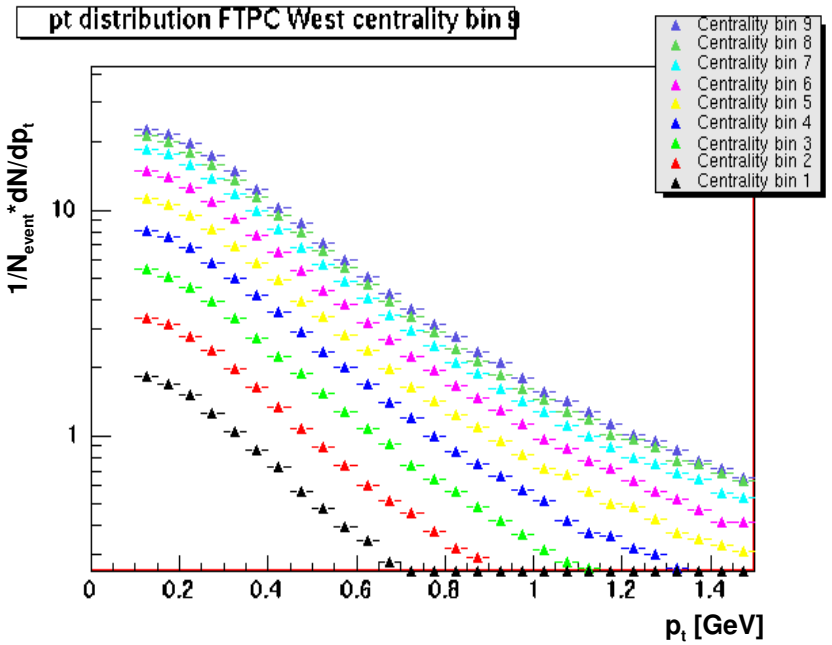
Residuals r

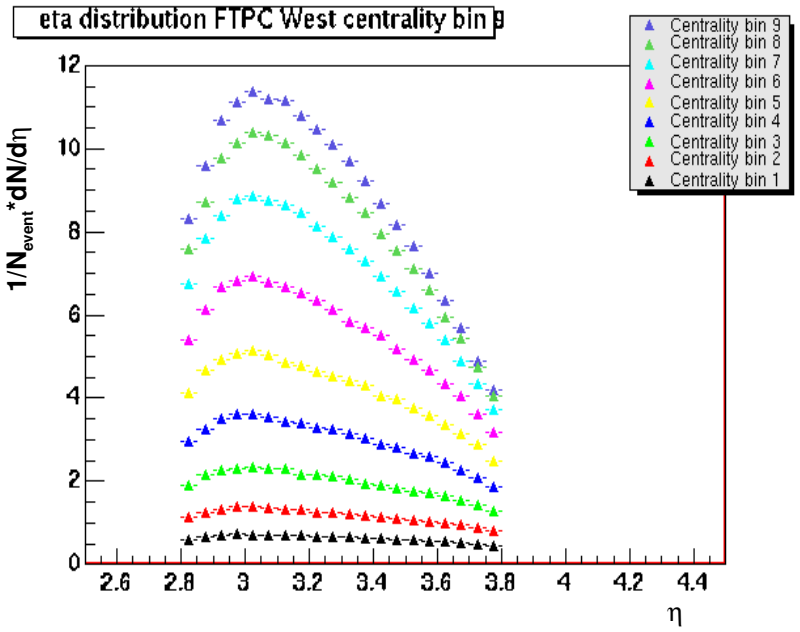


Cluster geometry (on track)

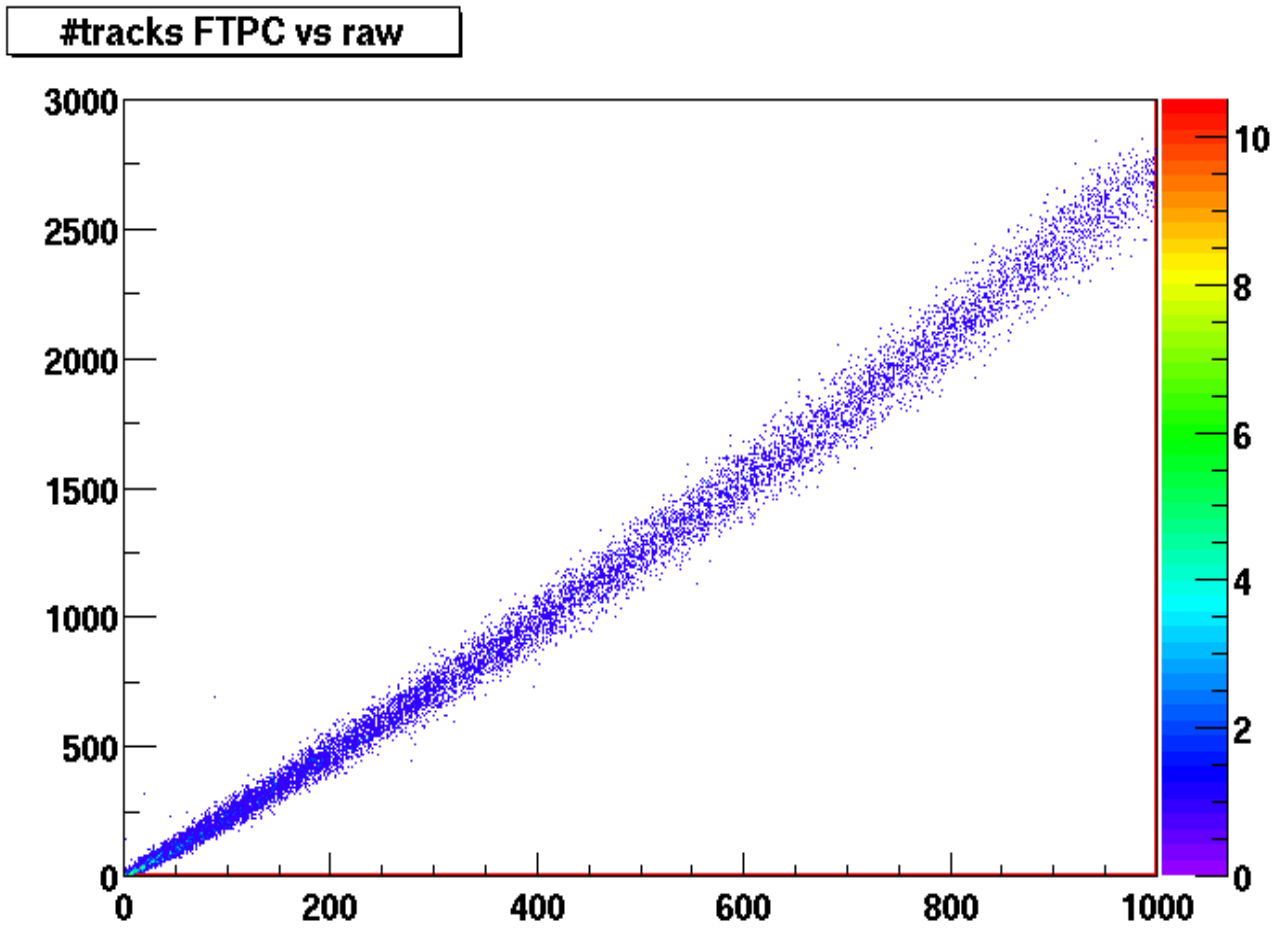
Why are the residuals a factor of 2 larger than expected ?

Raw charged particle spectra





Efficency and acceptance calculations have started

to extract corrected charged particle spectra !

Multiplicity FTPC vs. all primary