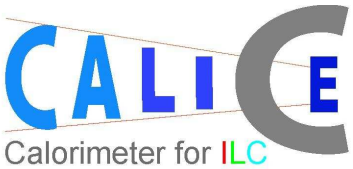


Tracking System

at CERN 06 and 07 test beams

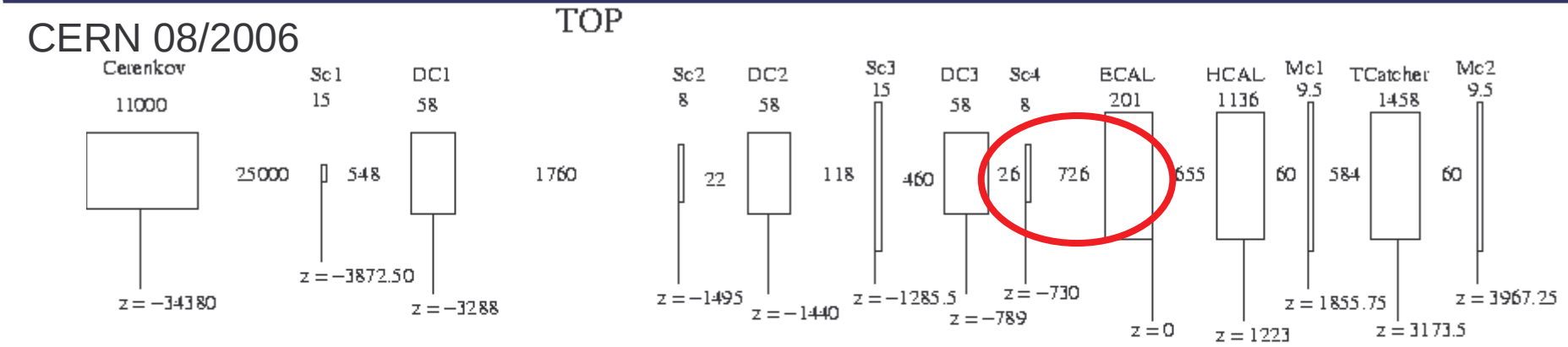
Michele Faucci Giannelli

Outline

- Tracking:
  - Setup of test beam lines
  - 2007 improvements (survey, calibration)
  - Alignment
  - DC and tracking efficiency
- Ecal resolution:
  - Position resolution
  - Tracking contribution
  - Angular resolution

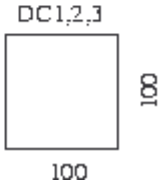
Beam lines

CERN 08/2006



FRONT

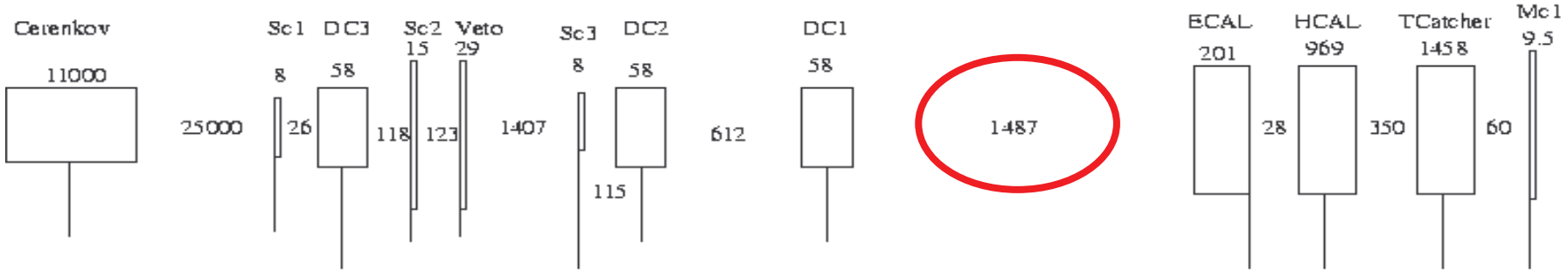
Sc1 is 30x30
Sc2 and Sc4 are 100x100
Sc3 is 200x200



Mc1 and Mc2 are 1000x1000

All distances are in mm

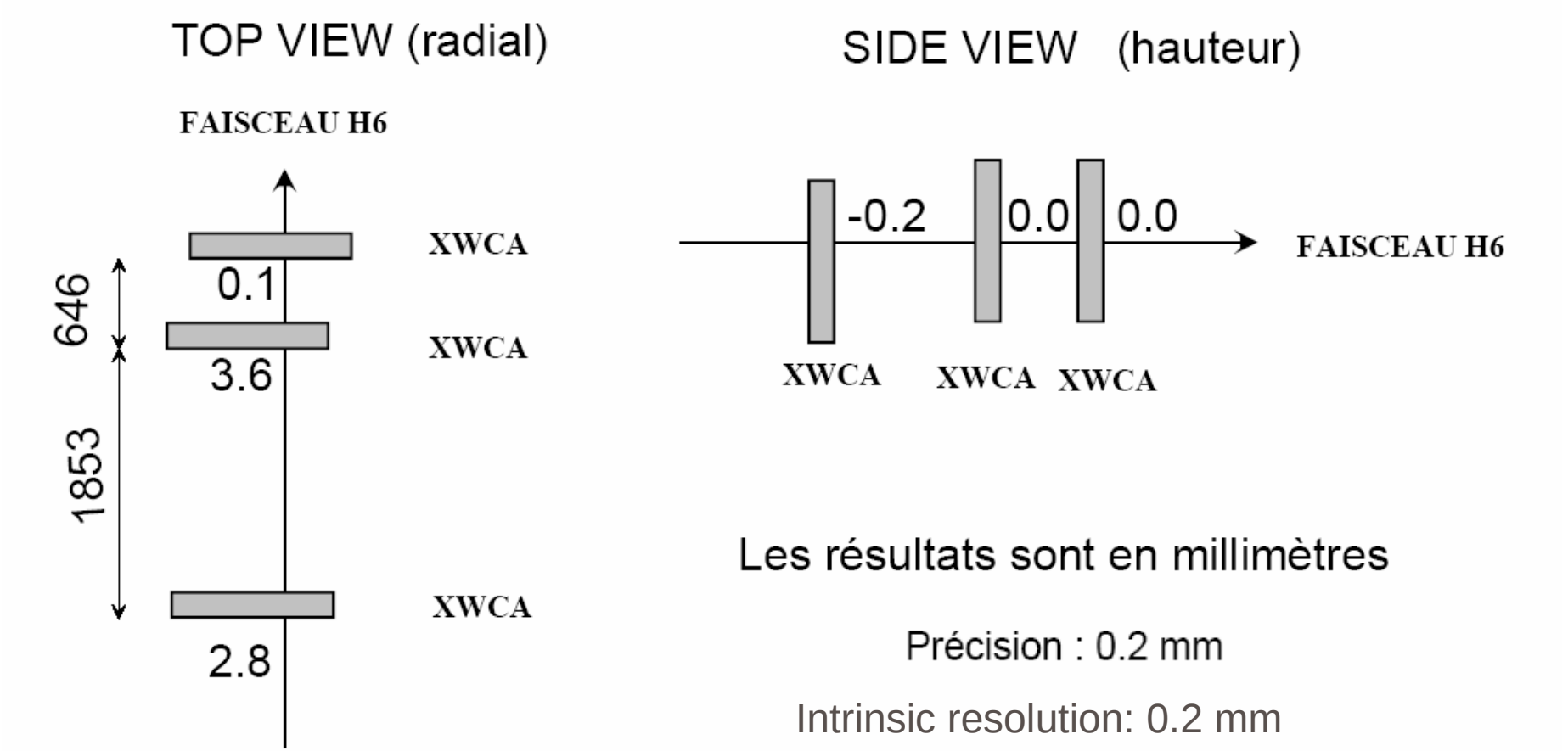
CERN 07/2007



CERN 10/2006 Ecal – DC1 distance is 2054 mm

Survey

The survey was performed at the beginning of the test beam so it is valid for all data

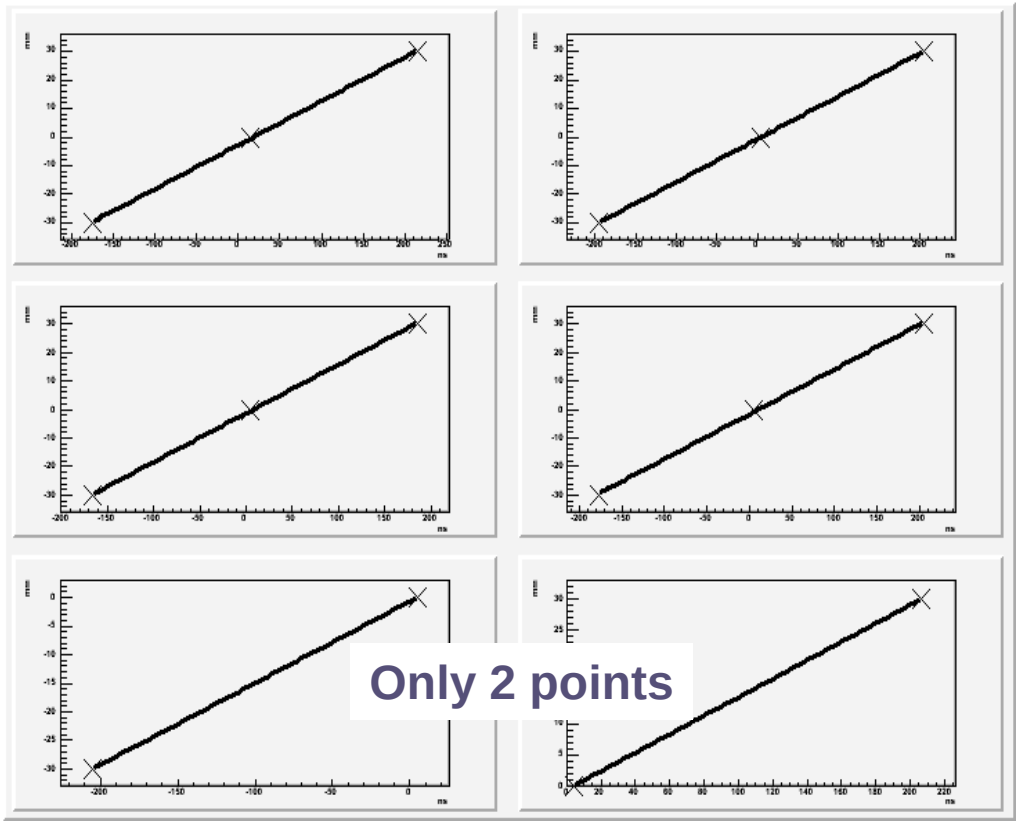


With this good precision, misalignment should not be relevant for tracking resolution

Calibration

Fabrizio and I followed the procedure described in the documentation (http://sl.web.cern.ch/SL/Publications/bi98-023.pdf).

For both directions of each chamber, a signal was injected in a specific wire and it was readout through the DAQ. The reconstructed position is plotted as function of the real position, this gives a slope (the propagation velocity) and an electronic offset.

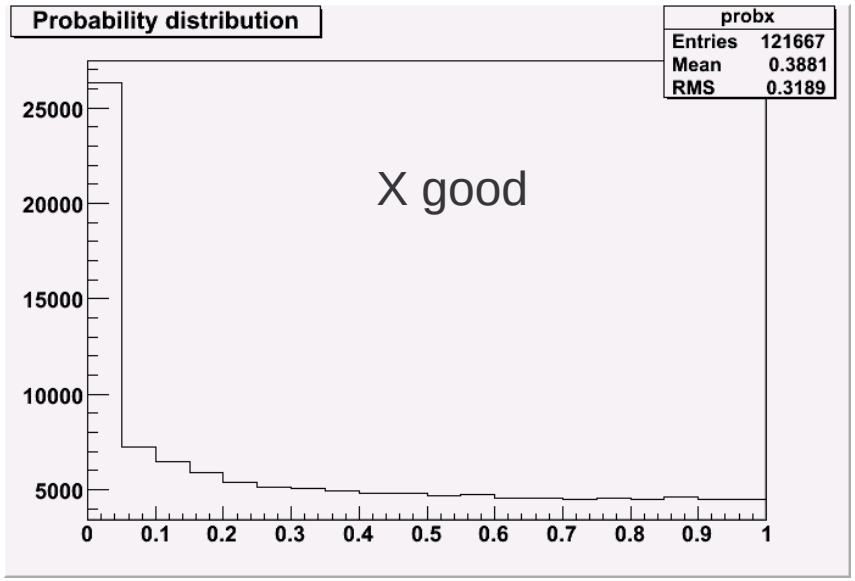


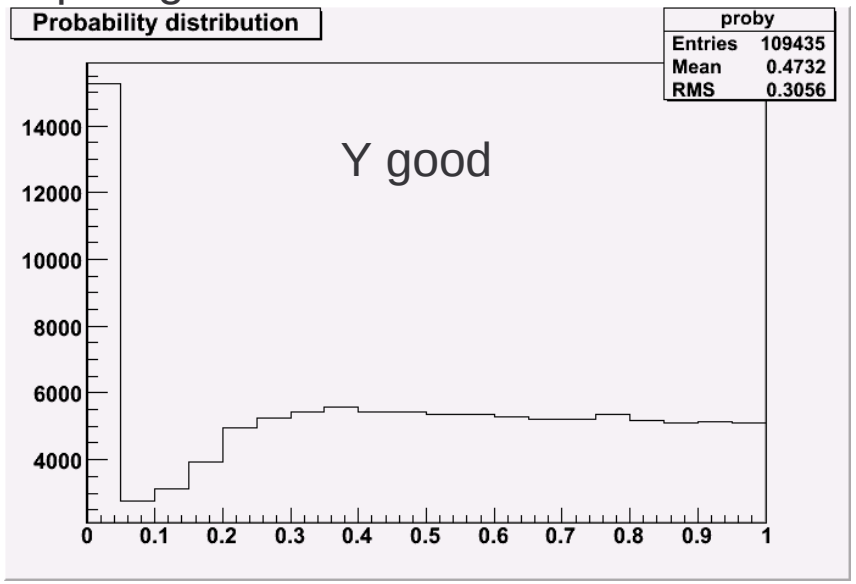
Wire	Slope (mm/ns)	Offset (mm)
dc1x	0.154±0.004	-2.8±0.6
dc1y	0.150±0.004	-0.7±0.6
dc2x	0.171±0.004	-1.4±0.6
dc2y	0.173±0.004	-1.7±0.6
dc3x	0,143	-0.7
dc3y	0,148	-0.6

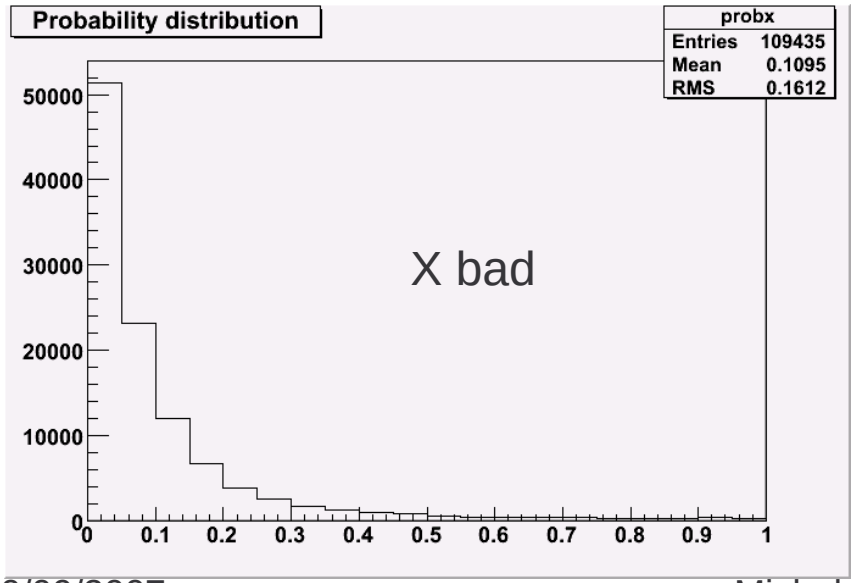
Propagation velocity used also for 2006

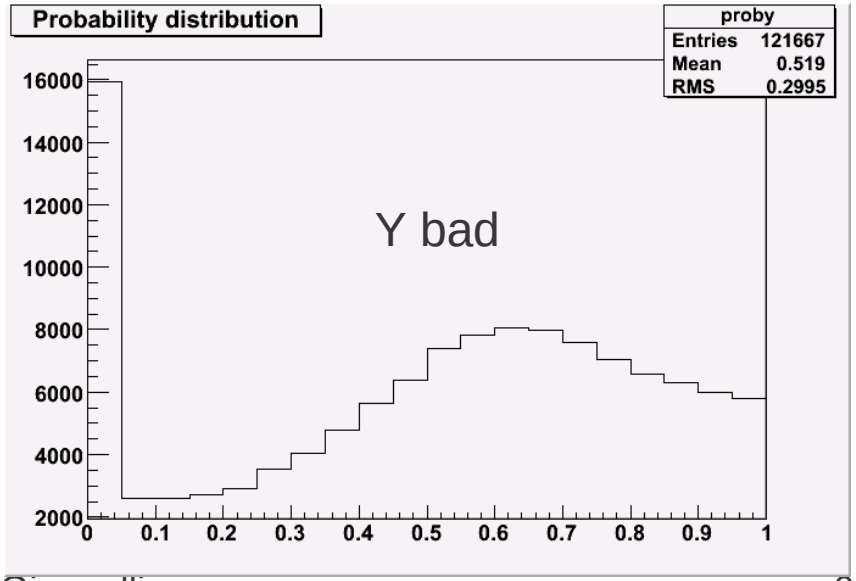
Propagation velocity in DC3

Evaluated using the χ probability, requiring to be flat from 0.5 to 1



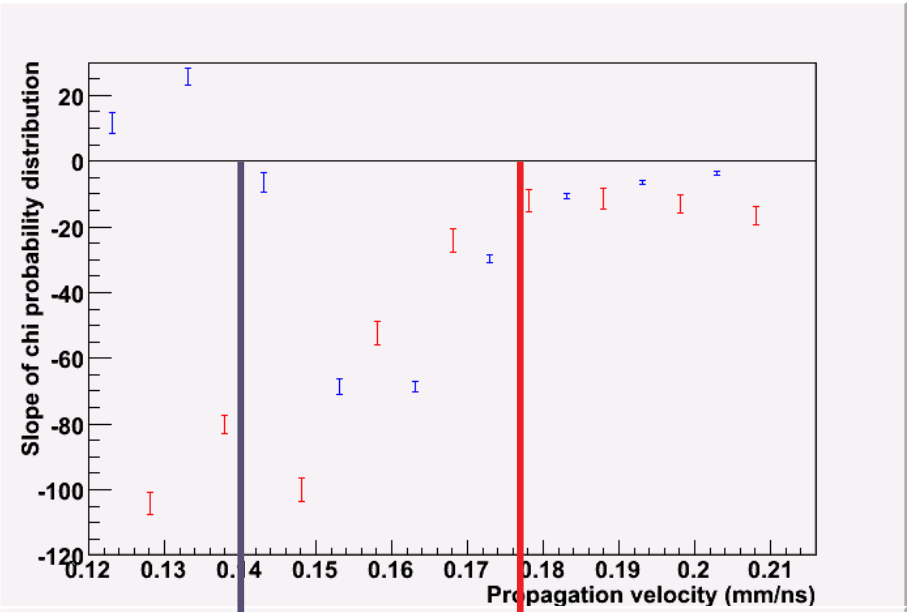




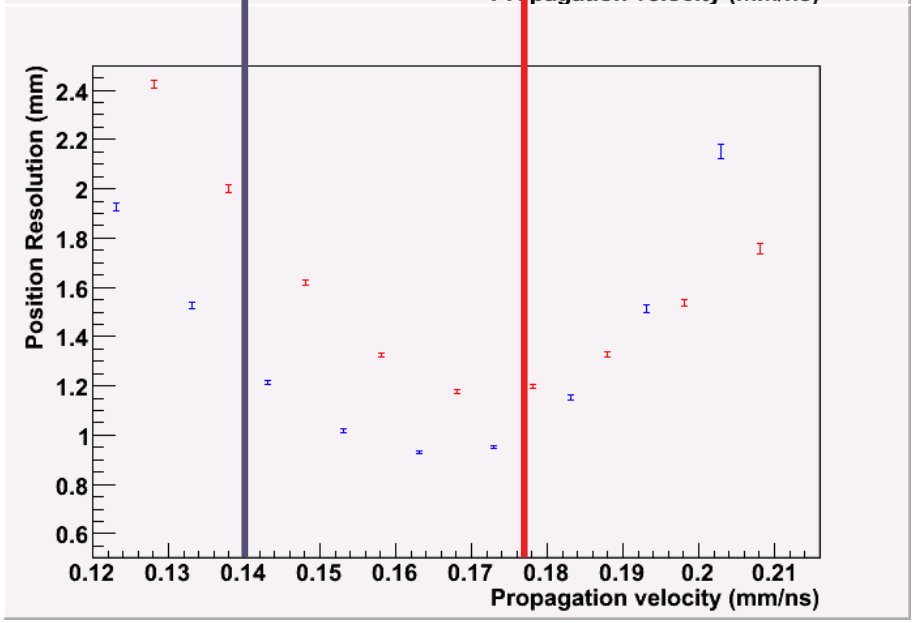


Propagation velocity in DC3

X



Y



Y is ok, the best slope gives also the best resolution

For X the best slope gives a resolution of 1.2 mm while the best resolution achievable is 0.9mm (+30%!!!)

This will need to be checked with the new tracking

Y tracks are reconstructed with high efficiency while X tracks have much lower efficiency. It should be due to a wider beam on X axis.

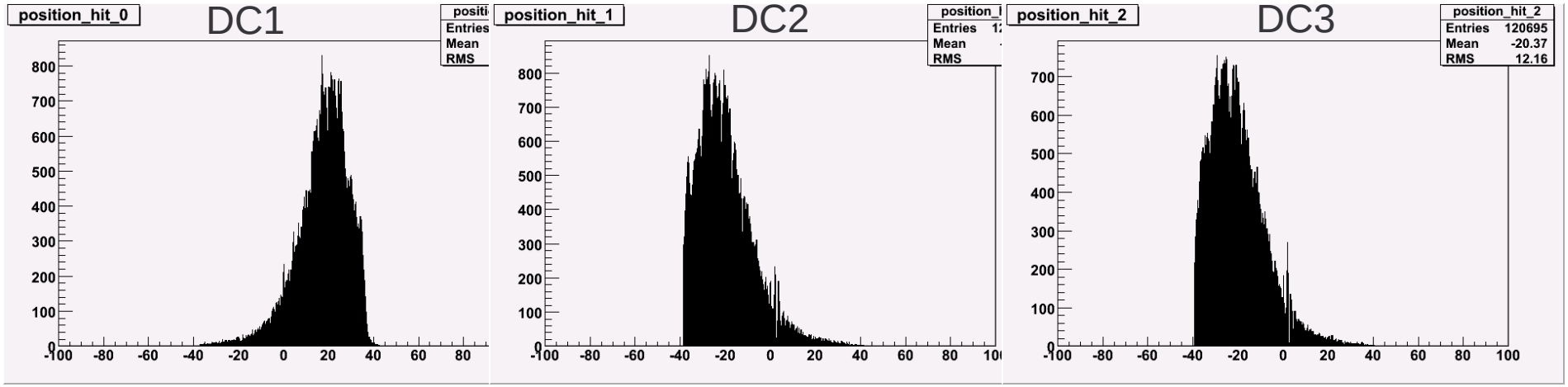
Left-Right, Up-Down

Reconstruction of each chamber is done using following formulas:
X Position = (timeRight – timeLeft) x Horizontal velocity + Electronic X offset + DC X offset
Y Position = (timeUp – timeDown) x Vertical velocity + Electronic Y offset + DC Y offset

DC1 is rotated by 180° so right and left are switched

A cut is placed to use only the linear region of the chambers (-40mm < x < 40mm)

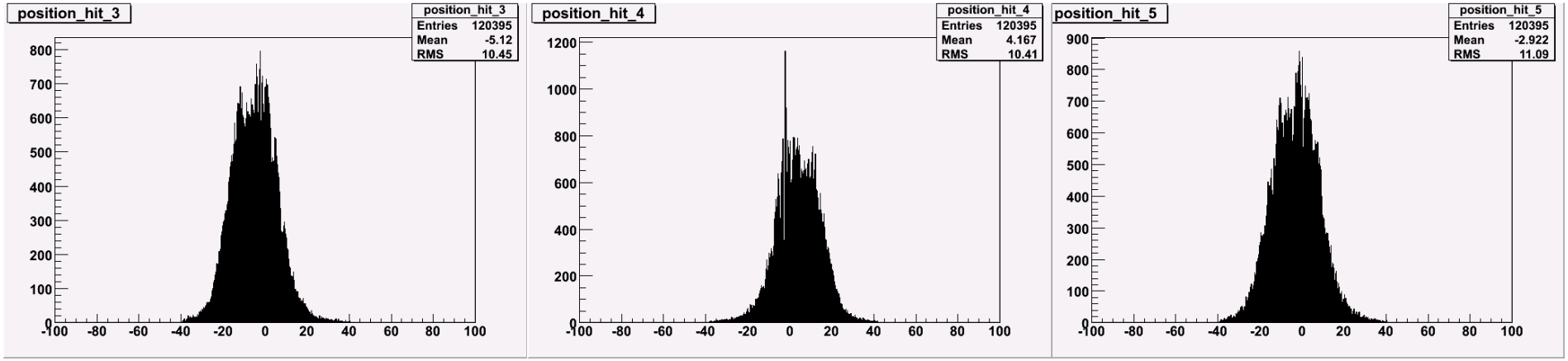
Run 330430 was NOT centered in X of the DC. This is what was reconstructed



The Left and Right are swapped in DC1, probably it is internal to the chamber

Correct DC reconstruction

A similar problem was spotted for Y coordinate of DC2



The correct reconstruction should be the following

Wire	TDC channels
dc1x	**tdc1.ch0 - tdc1.ch1**
dc1y	tdc1.ch4 - tdc1.ch3
dc2x	tdc1.ch4 - tdc1.ch5
dc2y	**tdc2.ch0 - tdc2.ch1**
dc3x	tdc2.ch2 - tdc2.ch3
dc3y	tdc2.ch5 - tdc2.ch4

Mapping for this year and last year confirmed with correlation plots

Alignment 06

•This year propagation velocity was used since the chamber are operating under the same conditions.

•For the off set an ad-hoc solution is needed since there was no survey last year.

•The offset is the sum of the electrical offset and chamber displacement, so the electric offset is not used for last year data.

•To evaluate the sum of all offsets I used the mean values of the distribution of the position for all 6 wires taken from a high energy run (300192).

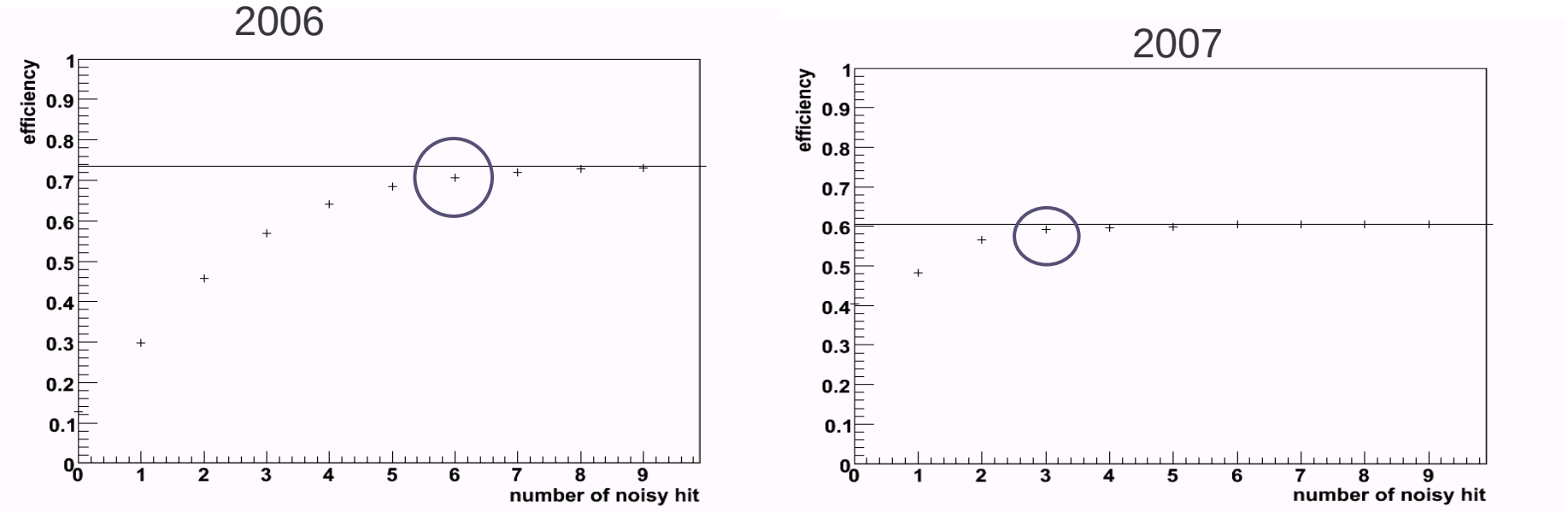
Wire	Offset (mm)
dc1x	-3.7
dc1y	-9.4
dc2x	-18.6
dc2y	-18.1
dc3x	-2.3
dc3y	-19.3

Be aware: this values are different from those presented at Prague having used the new drift velocities for DC3

Track efficiency

Different thresholds have been used in the discriminators leading to a different efficiency of the wires

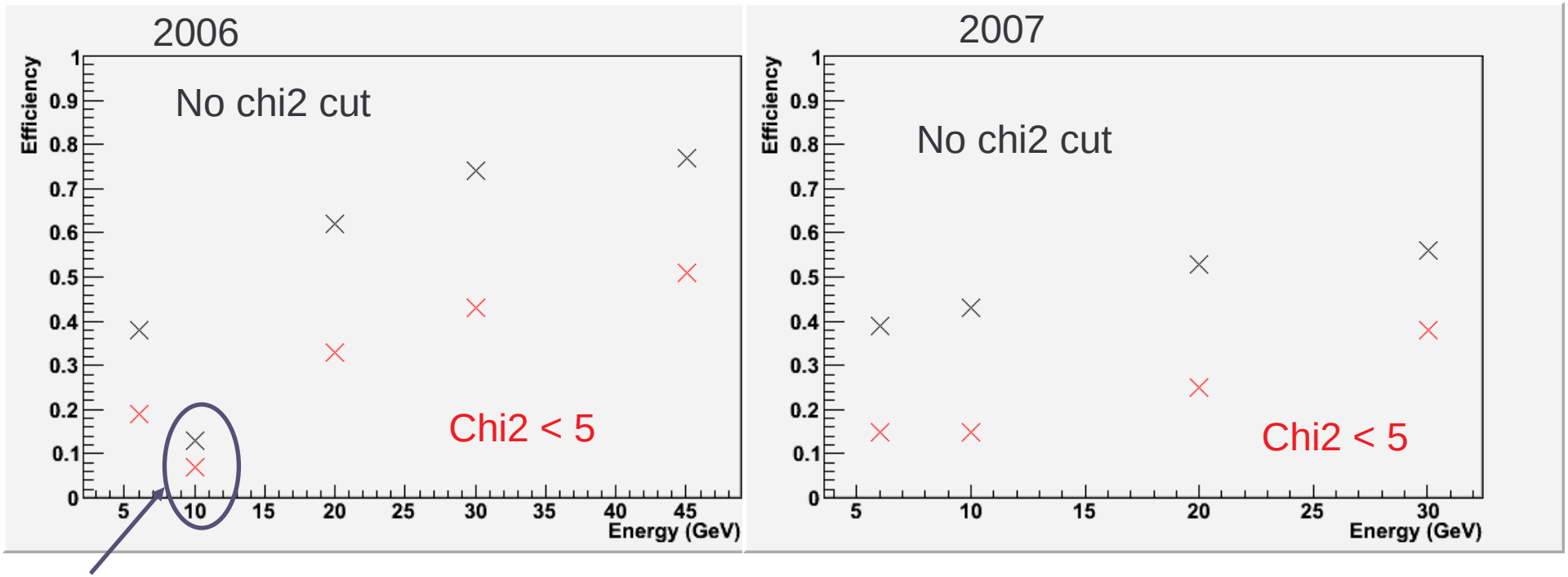
More important is the overall tracking efficiency, the requirement is to have at least a good hit in all chambers and no more than a total amount of hits.
The line represent the limit of no cut on total number of hits.



Track efficiency

Once the limit on the total number of hits has been chosen, the track efficiency is effected by the cut on χ^2 (linear fit of 3 points on both projections)

Overall the tracking efficiency depends on the energy since at higher energies the beam is more collimated.

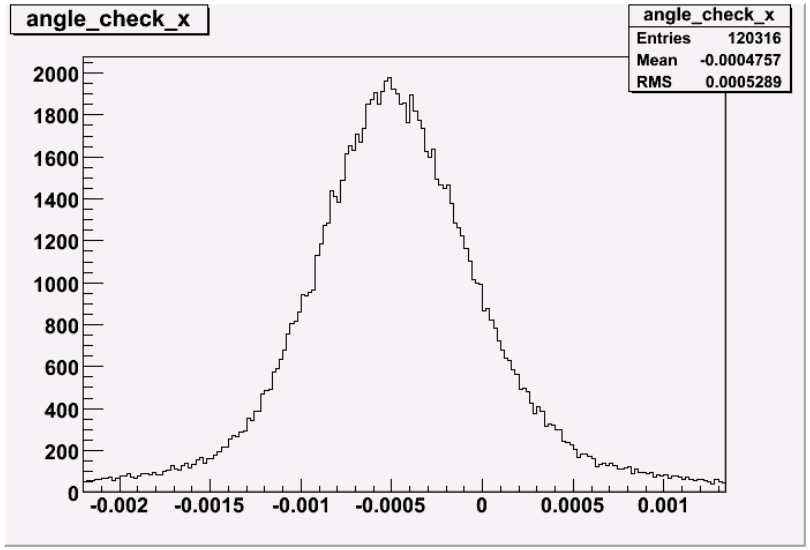


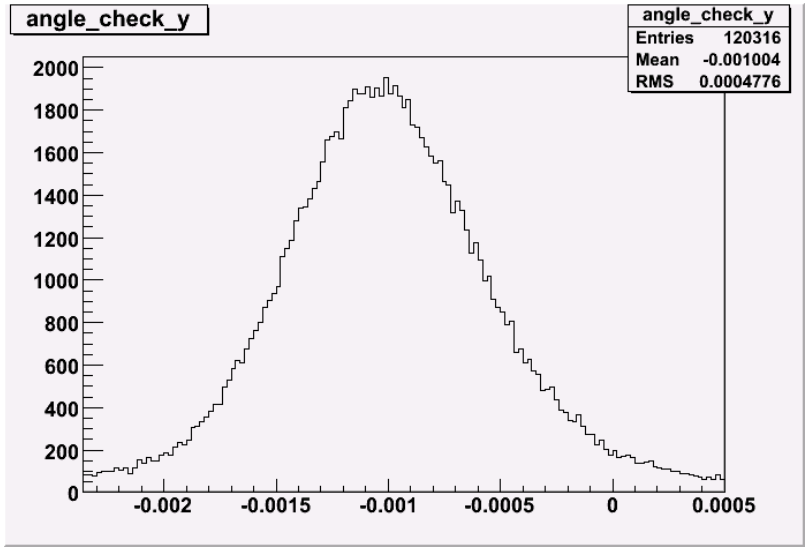
TDC2 had communication problem, not a tracking problem

After run 331453 the efficiency is closer to the one of last year

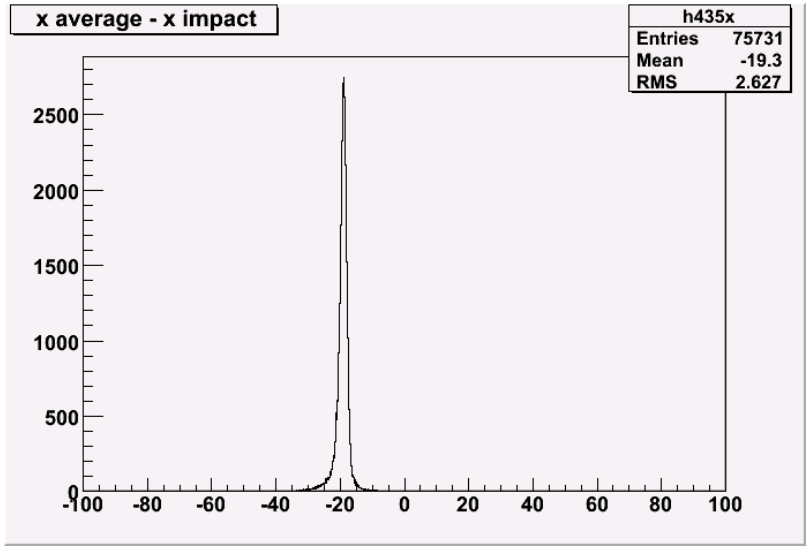
2007 Beam

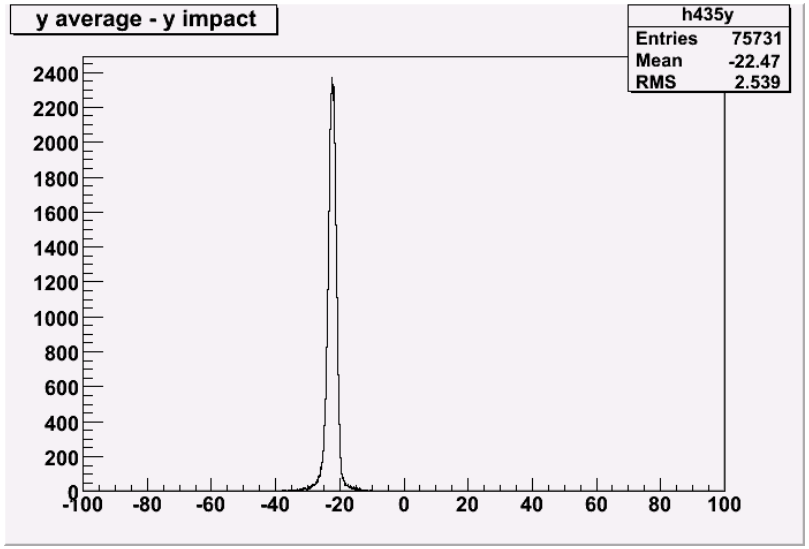
Beam is not parallel to the beam line





ECAL has an offset of 2 cm both in X and Y





Analysis

- List of cuts applied to tracks using DriftChambertoTrack Processor:
  - At least one good hit per chamber
  - Less than 18 (2006) or 15 (2007) hits
  - χ^2 less than 5
- Energy cuts on ECAL to remove bad events

2006 Rec 0402

Run	Energy (GeV)	Min	Max
300670	6	1000	1800
300672	10	1600	2200
300236	20	4200	5200
300207	30	6000	7300
300208	45	9400	11000

2007

Run	Energy (GeV)	Min	Max
330914	6	1200	1800
330944	10	2200	3000
330432	20	4700	5800
330430	30	7200	8500

Min and Max are number are MIP

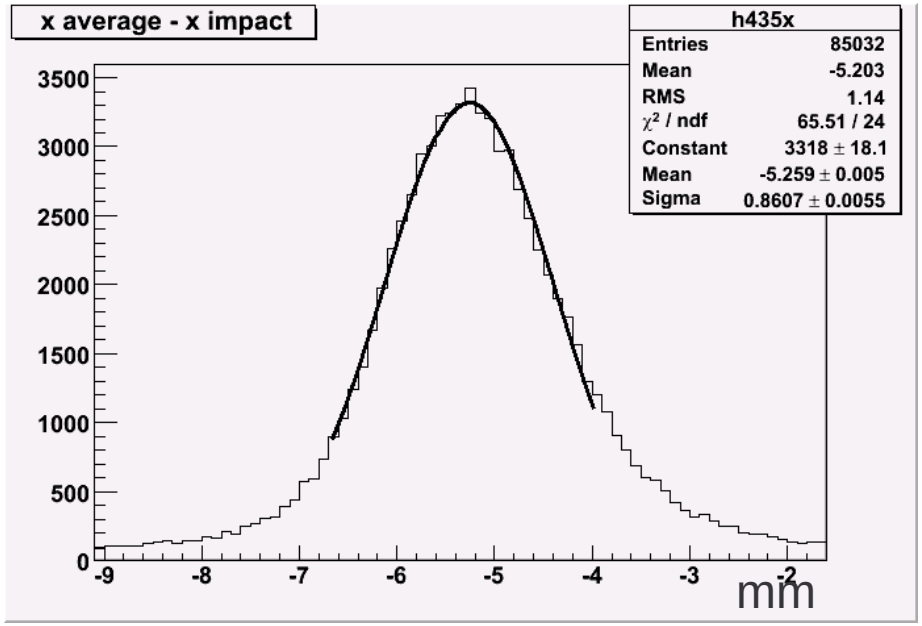
Position resolution

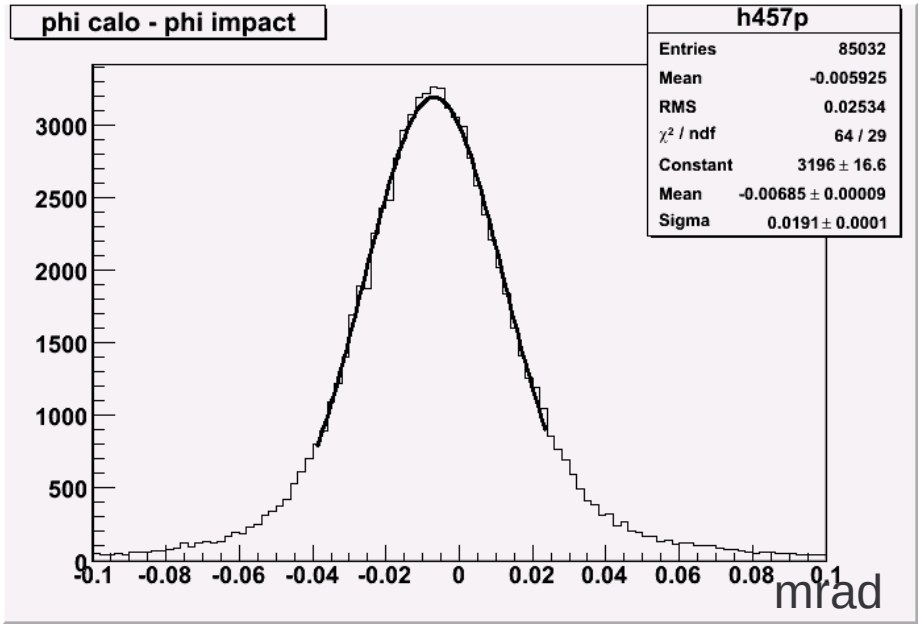
The position resolution is evaluated from the width of the distribution of

X_ECAL – X_Track

The same is done for the angles along the planes X-Z and Y-Z

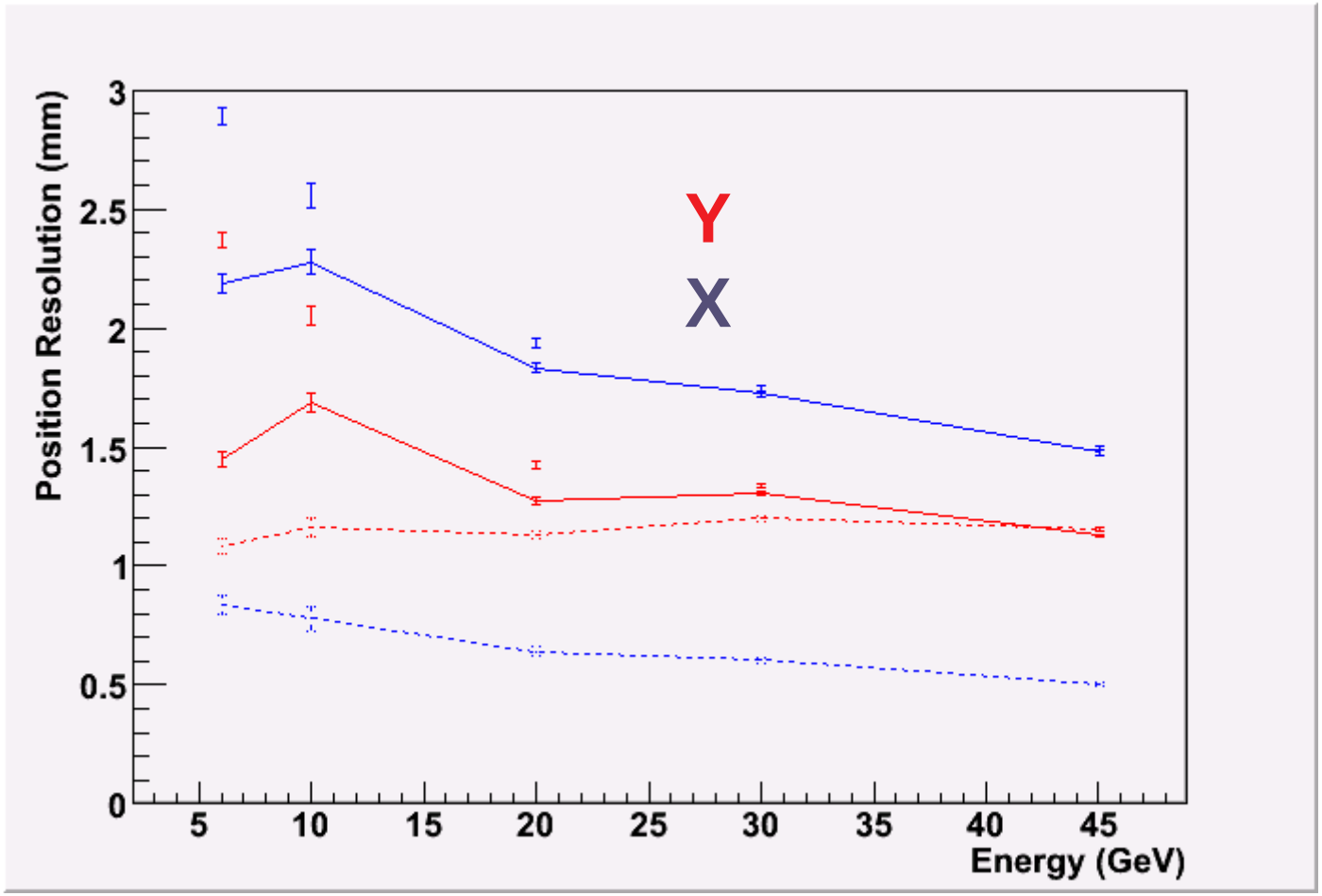
Angle_ECAL – Angle_Track





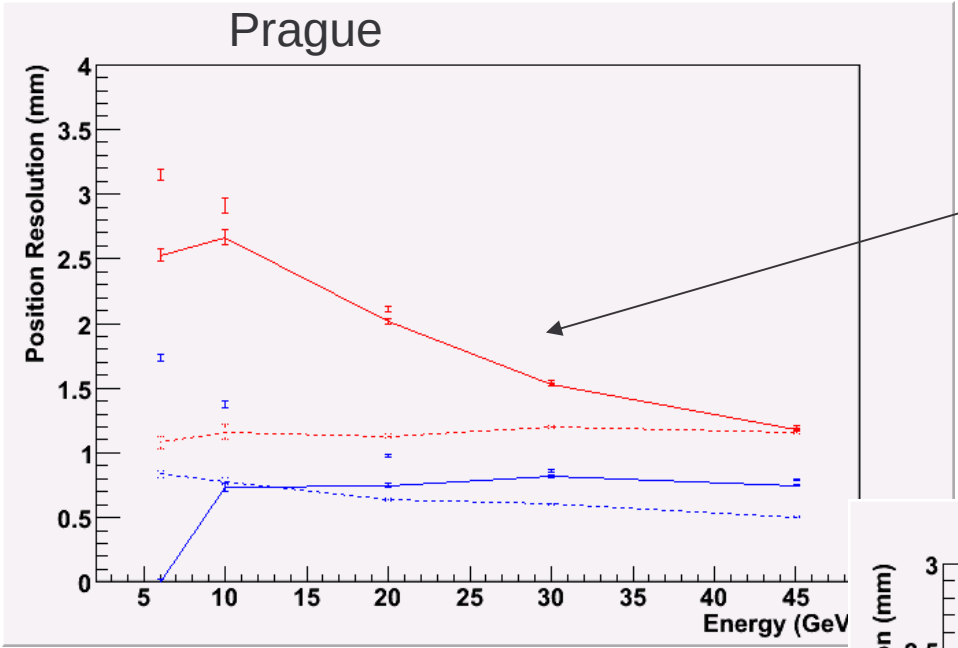
The track contribution evaluated from the MC is then subtracted

Position resolution 06

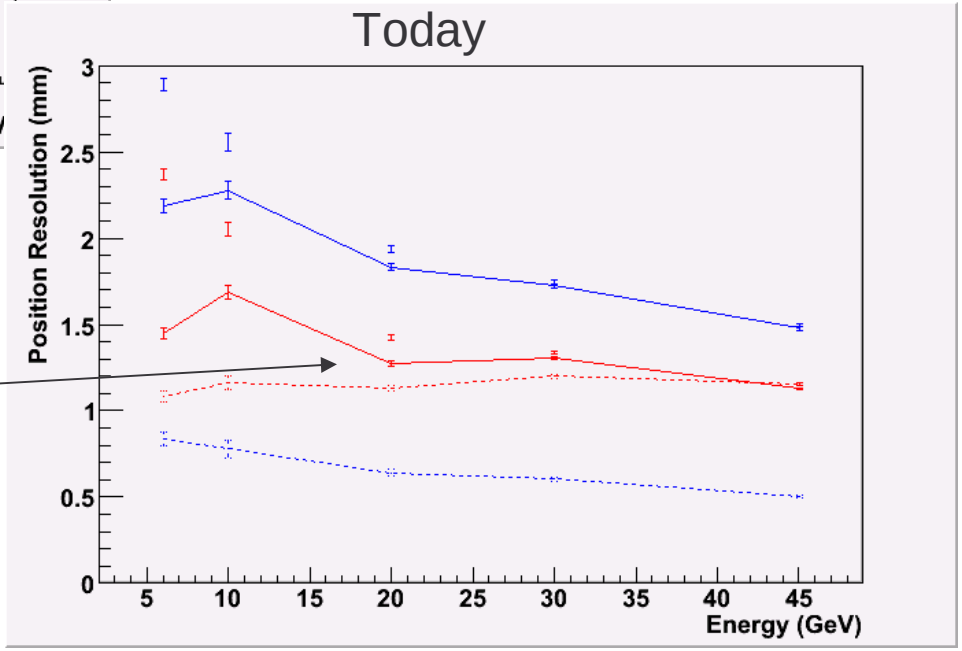


X is centered on wafer
Y is centered on gap

Effect of drift velocity

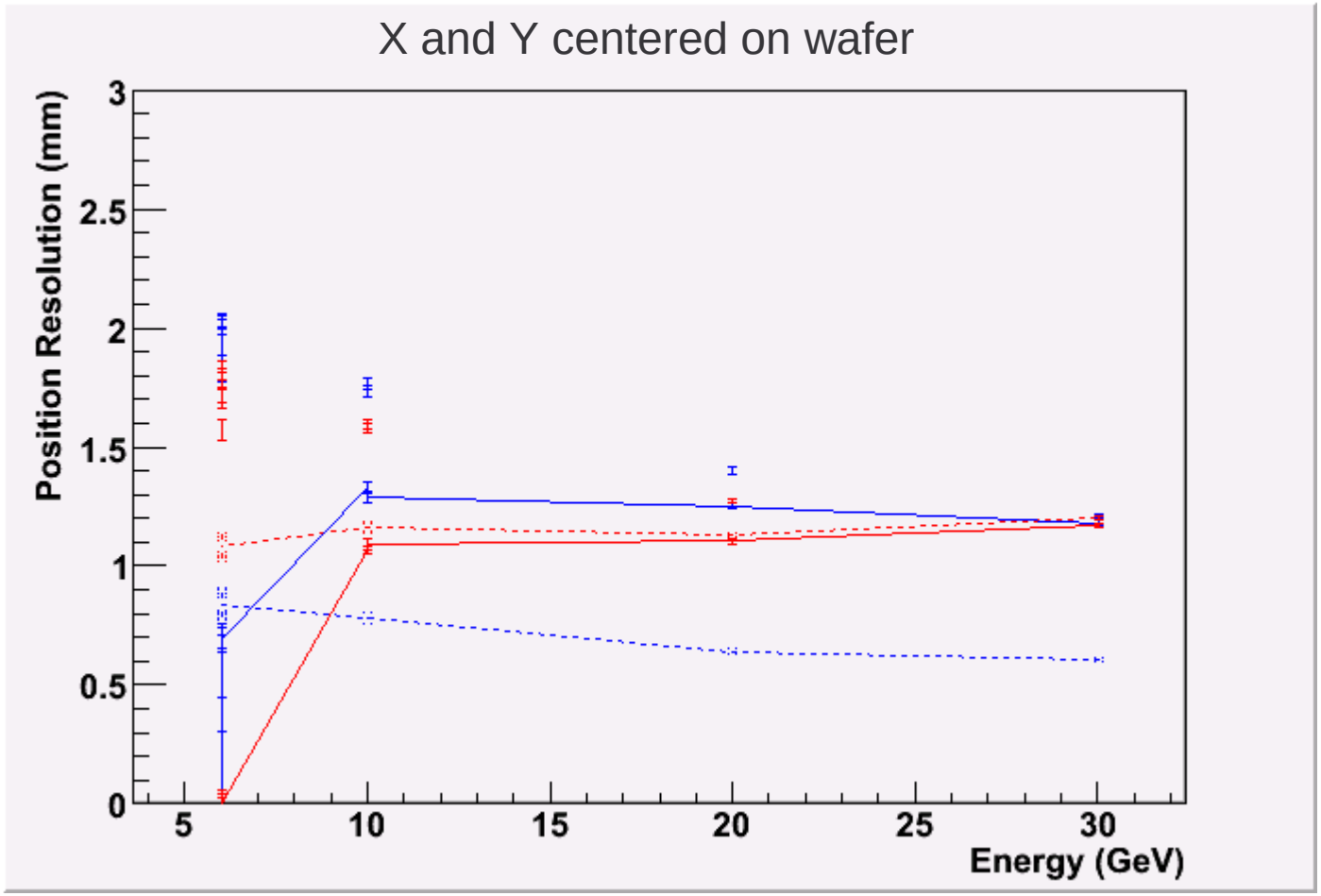


Y was wrong
X was in the minimum of resolution



Y is compatible with MC
X is 1 mm worse than MC

Position resolution 07



X_ECAL – X_Track

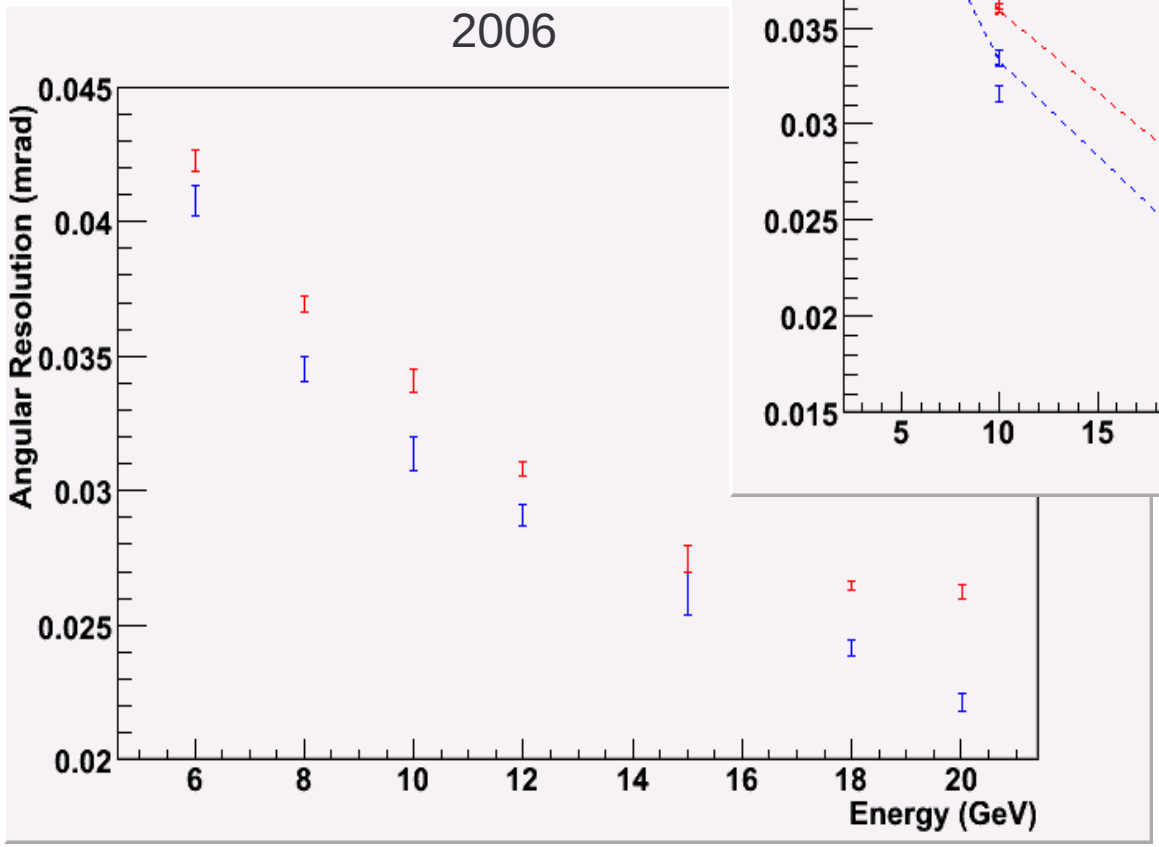
X_ECAL

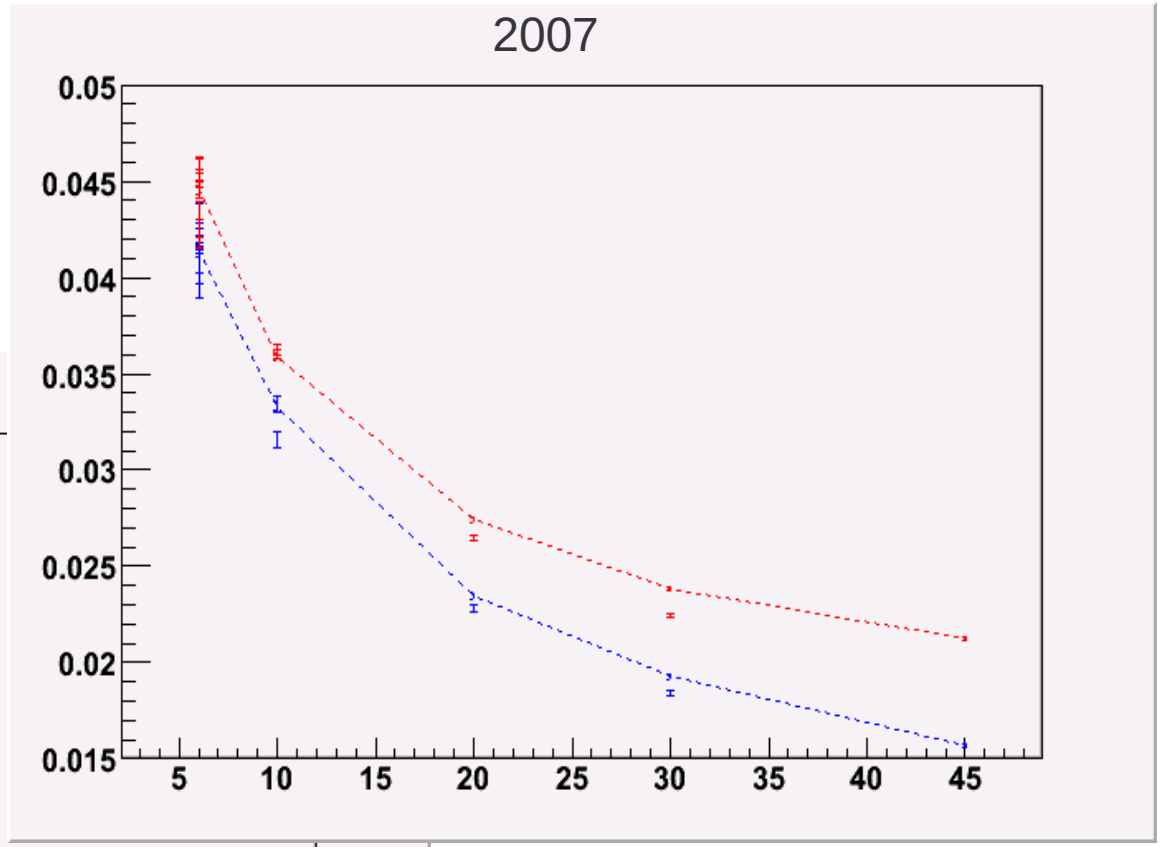
MC_ECAL

Y is even better than MC, and fail only at 6 GeV where MS has to be considered
X is better than 06 data but still 0.5 mm worse than MC

Angular resolution

Angle on Y-Z
Angle on X-Z





MC_ECAL

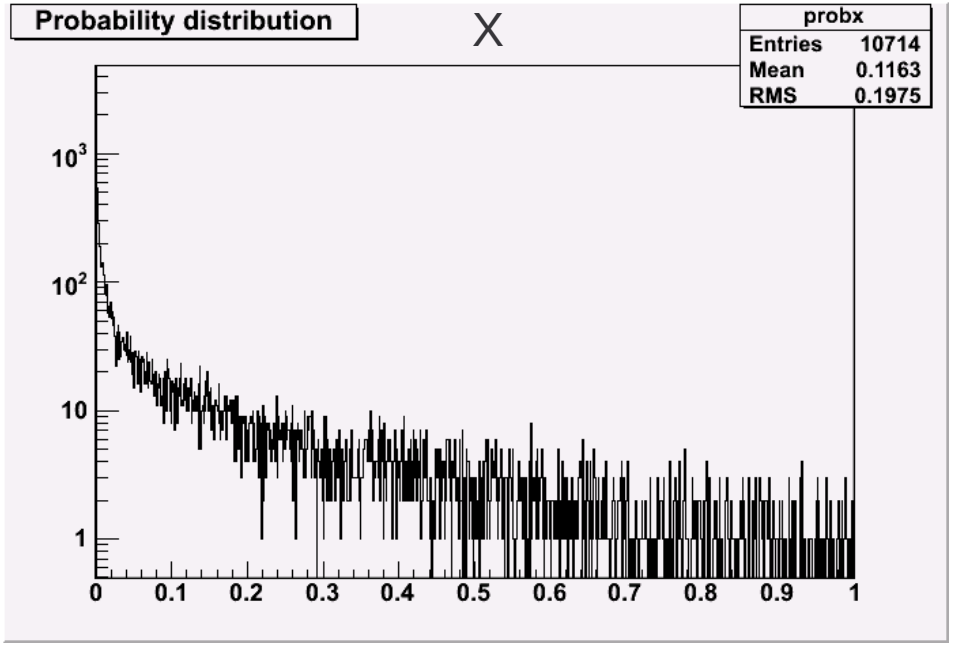
ECAL

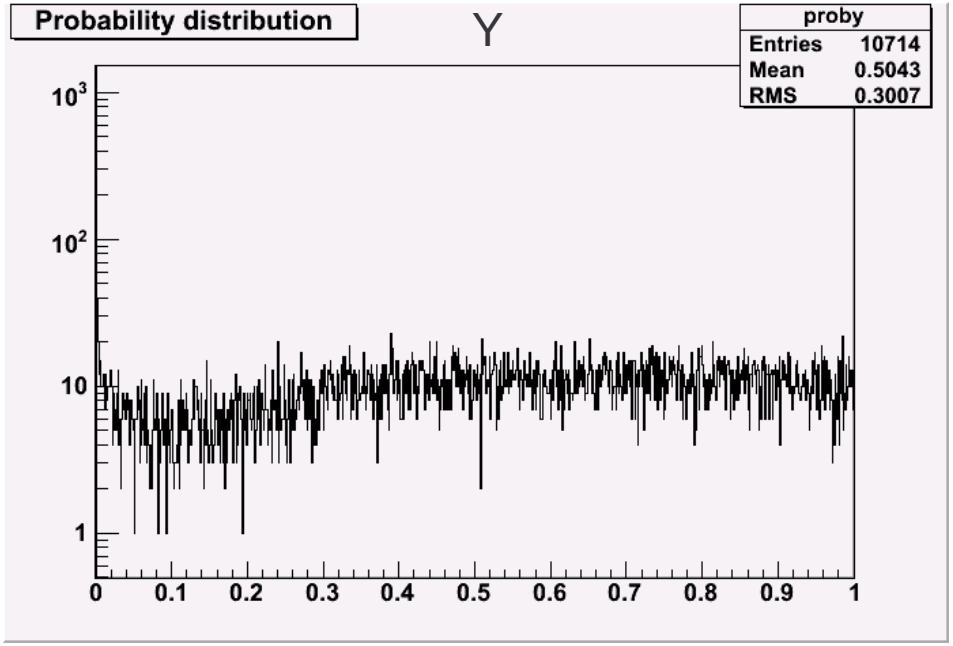
Conclusion

- Simple, steer dependent, tracking processor is already available for 2006 data
  - Now it is complete with the given offset values
- A new version with 2007 setup will be release soon after this meeting
  - Two problems to fix:
    - X propagation velocity for 2007 is to be optimized
    - Y in 2006 probably suffers from a switch of cables
- Analysis:
  - Resolution @ edge and corner
  - Evaluate systematic

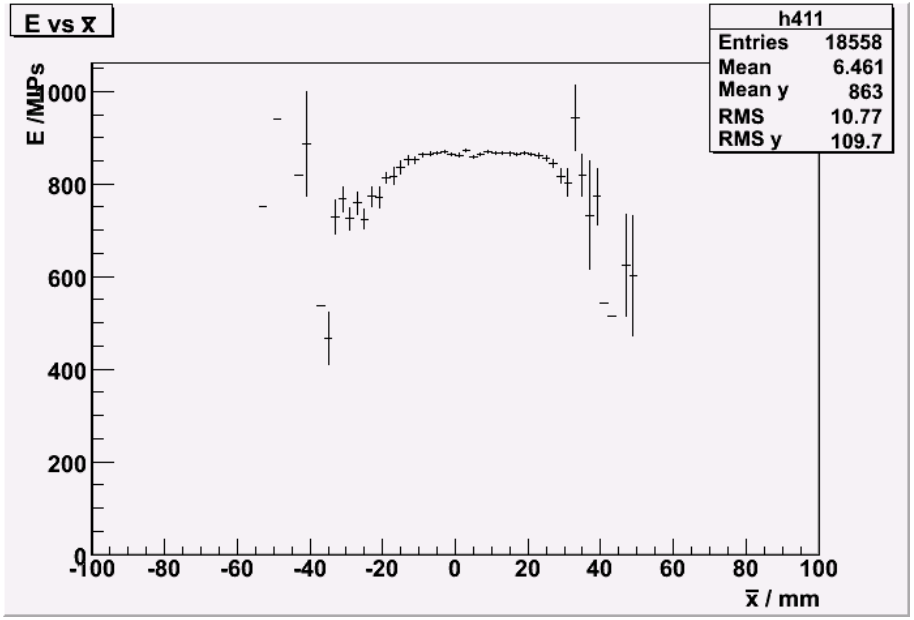
Backup slides

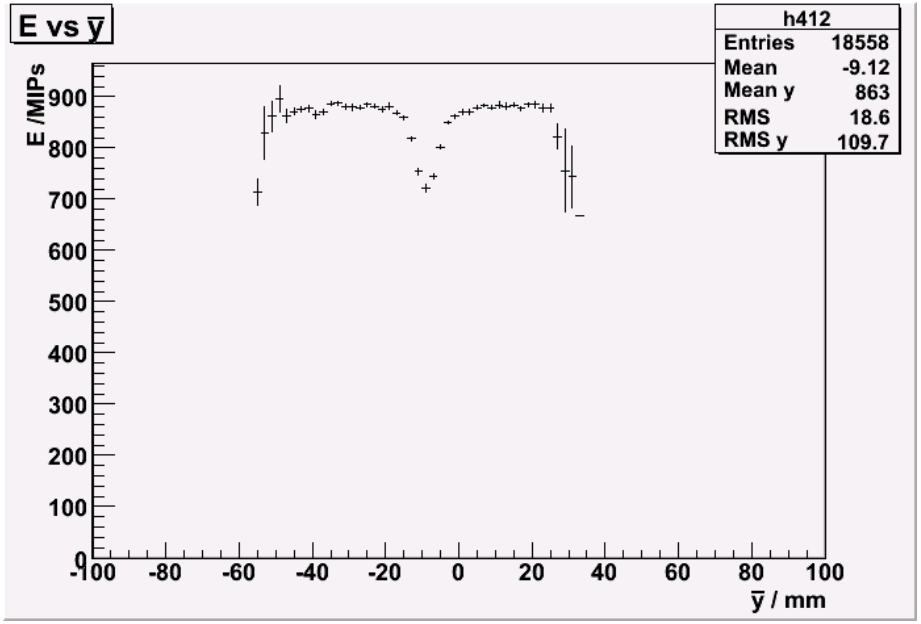
Chi2 probability





Beam position 06





Track reconstruction

- Marlin processor called DriftChambertoTrack
- Reconstruct the track using linear fit.
- Processor parameters:
  - TDC input collection,
  - Prototype name (TBDesy0506,…),
  - Drift velocity (or propagation time for CERN),
  - Off-set (x and y, implemented only for CERN),