Charge Studies with the Cern TestBeam of October-2003

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Outline

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- ▷ Data Runs
- ▷ Data Selection
- ▷ Velocity reconstruction
- ▷ Charge reconstruction
- ▷ Aerogel Tile homogeneity
- ▷ Conclusions

Radiators tested

Manufacturer	index	size ($\ell \times \ell \times h\ mm^3$)	Short	Comments
Novossib.	1.03	$100 \times 100 \times 31$	N.103G	tests : 2003
Novossib.	1.04	$57 \times 57 \times 26$	N.104	tests : 2003
Novossib.	1.05	$55 \times 55 \times 25$	N.105	tests : 2003
Novossib.	1.03	$50 \times 50 \times 25$	N.103	tests : 2002, 2003
Matsushita	1.03	$115 \times 115 \times 11$ (3 tiles)	MNN.103	tests : 2003
Matsushita	1.036	$42 \times 56 \times 11$ (3 tiles)	MNN.1036	tests : 2003
Matsushita	1.03	$113 \times 113 \times 11$ (2 tiles)	MN.103	tests : 2002, 2003
Matsushita	1.05	$100 \times 100 \times 11$ (2 tiles)	MN.105	tests : 2002, 2003

Data analysed

Run	A/Z	Radiator	Drift (cm)	Comments
612 538-546	2.25 2	N.103 ? N.103G	33.4 42.3	 Tile scan
525-533	2	MNN.103	42.3	Tile scan

Runs 612, 538-546 : madrid production

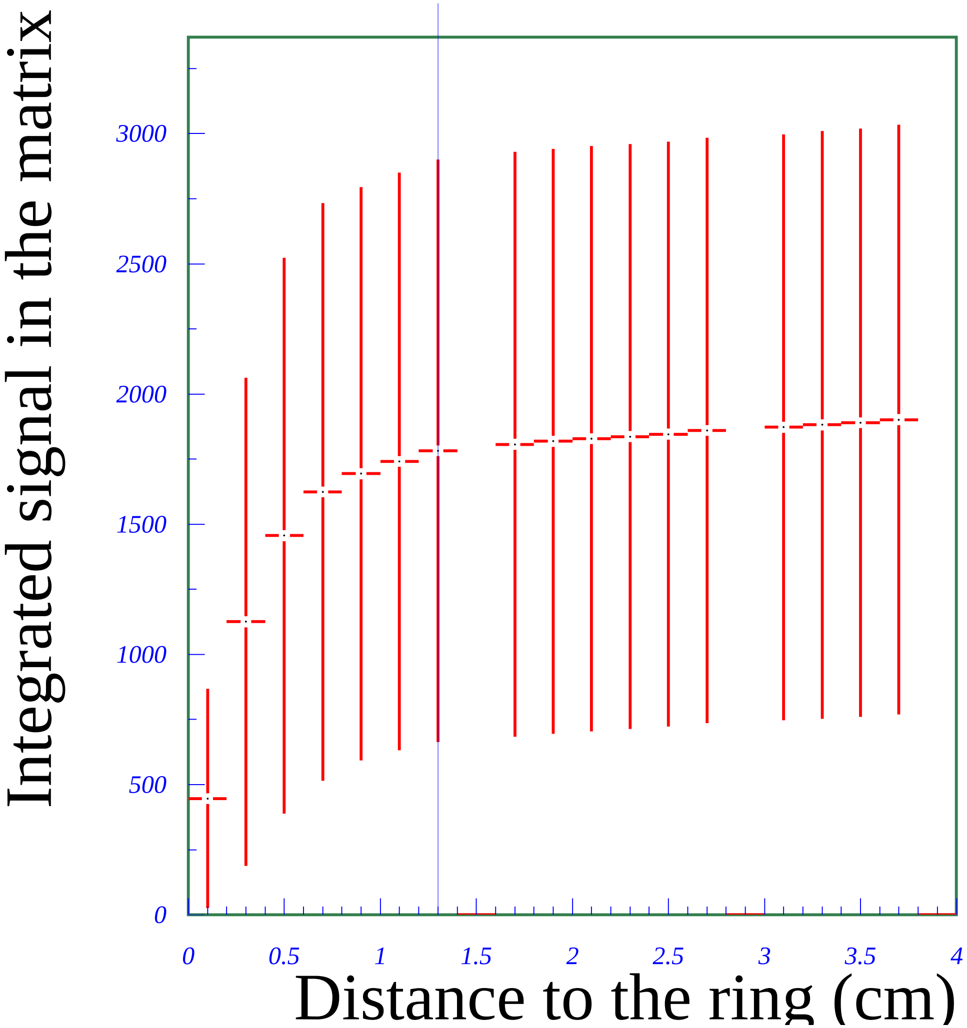
Runs 525-533 : lip production

Data Selection

- ▷ Photon vertex reconstructed from cerenkov ring information on an event to event basis
  compatibility between *running vertex* and LG max hit
- ▷ Cerenkov ring *flatness*
  hits azimuthal uniformity demanded
- ▷ Event signal (excepting particle)/ Cerenkov Ring signal < 1
  reject 2nd interactions
- ▷ $|\beta - 1| < 3 \times 10^{-3}$
  particle velocity compatible with 1

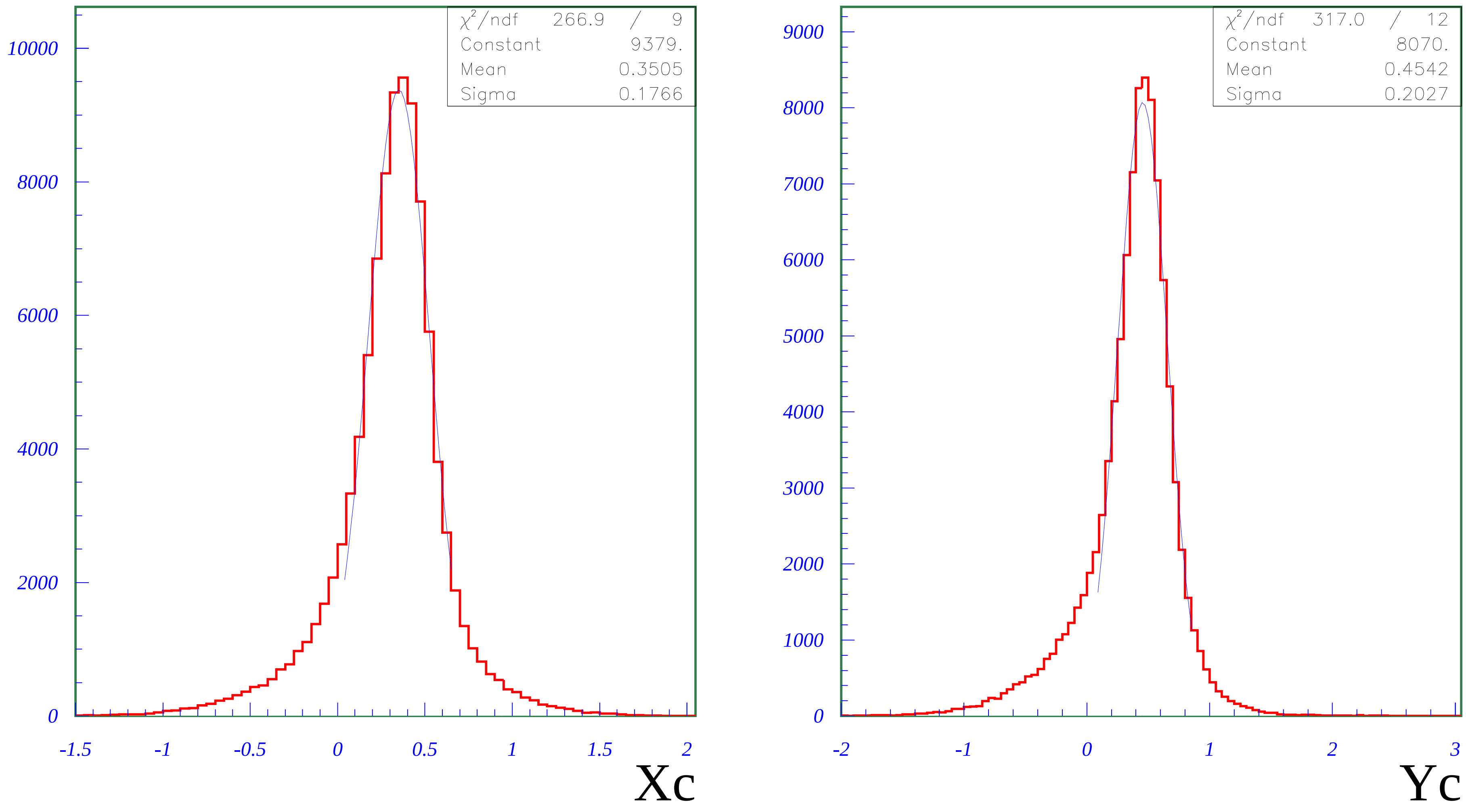
Charge Reconstruction

- Cerenkov Ring acceptance
  full ring events demanded
- Signal integration
  hits within 1.3cm of the reconstructed ring



Particle Impact Point

The particle impact point is obtained from the cerenkov ring pattern

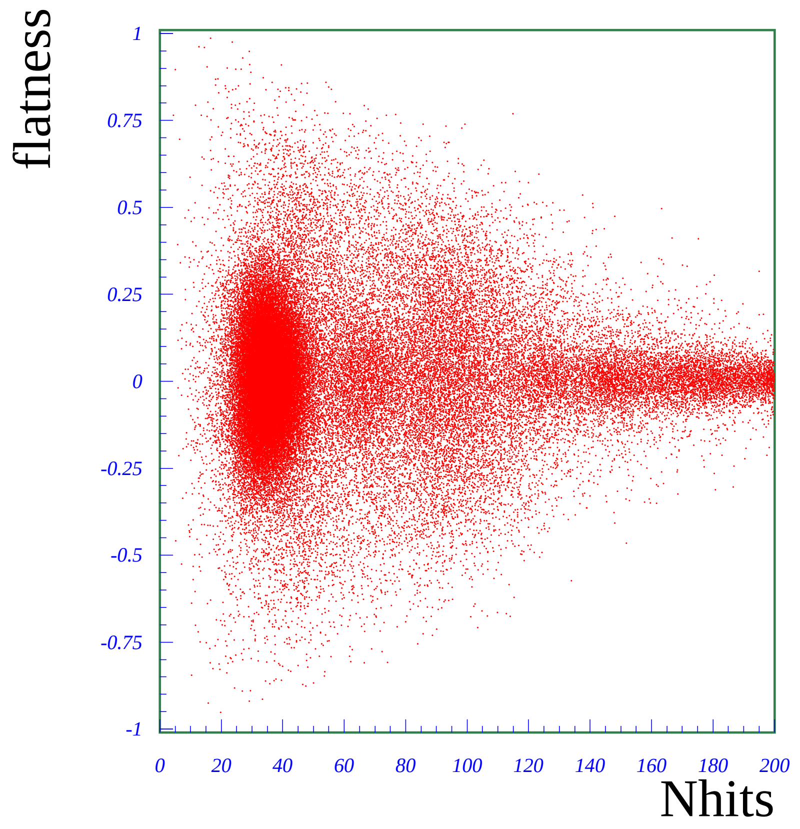


Ring flatness

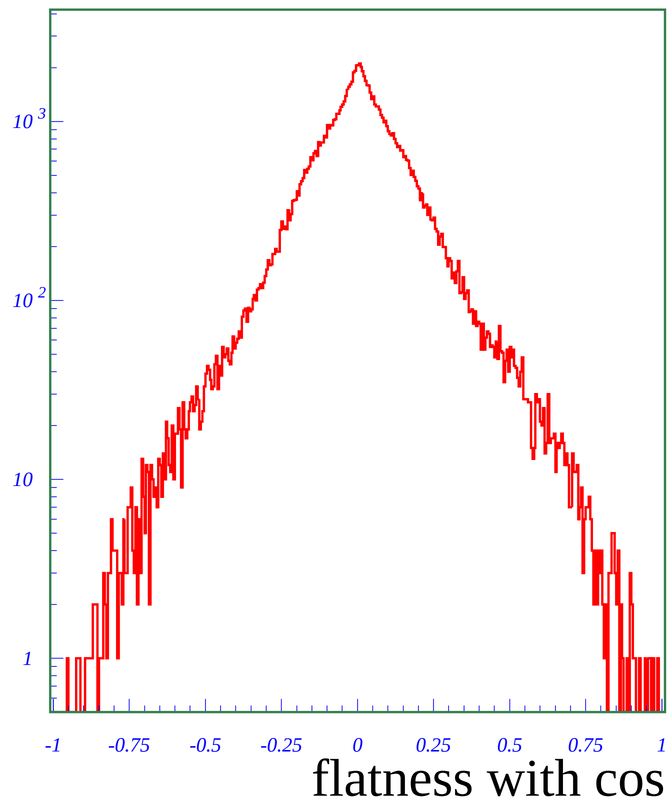
Particles inciding with $\theta = 0$ shall have cerenkov photons uniformly distributed

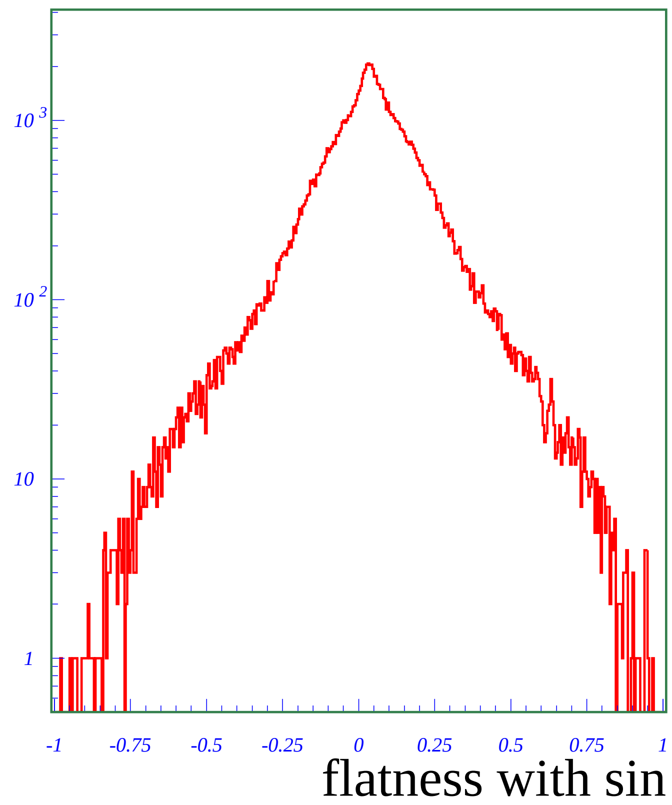
$$Flatness = \frac{\sum w_i cos\phi_i}{\sum w_i} \qquad w_i = signal$$

$$Flatness < \begin{cases} 0.7, & nhits < 20 \\ 0.4, & 20 < nhits < 120 \\ 0.2, & nhits > 200 \end{cases}$$

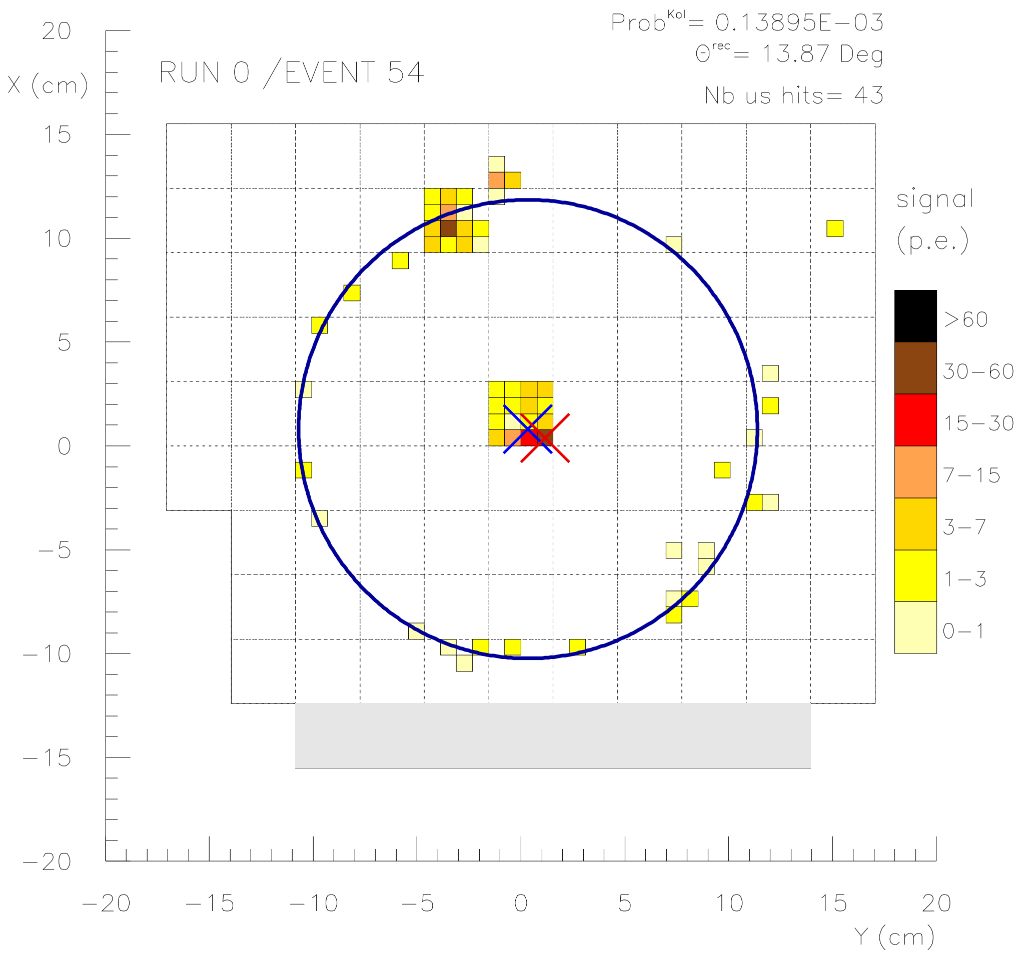


Ring flatness distributions





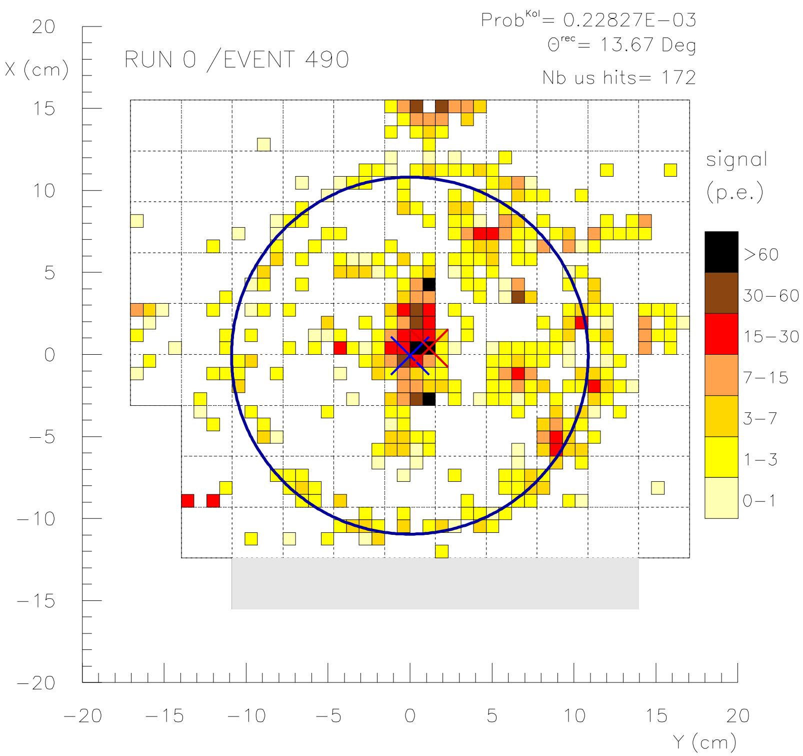
Ring flatness distributions



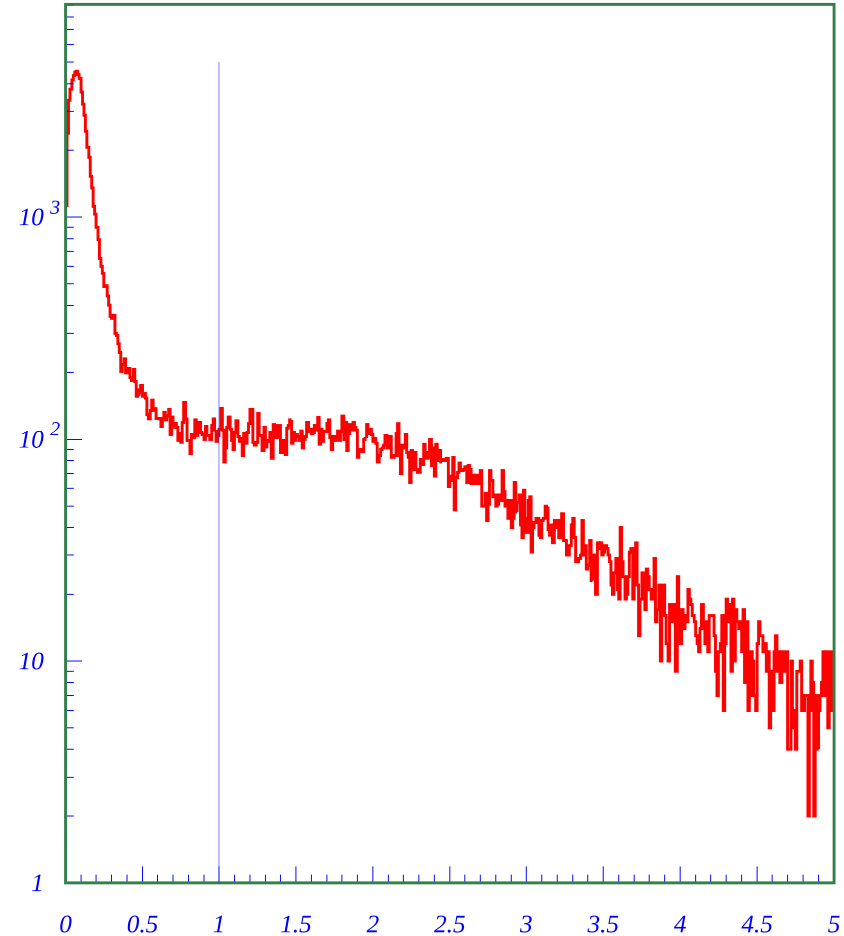
rejected event : $Flatness = 0.7$

Event signal

Noisy events were rejected by demanding a small noisy-ring signal ratio

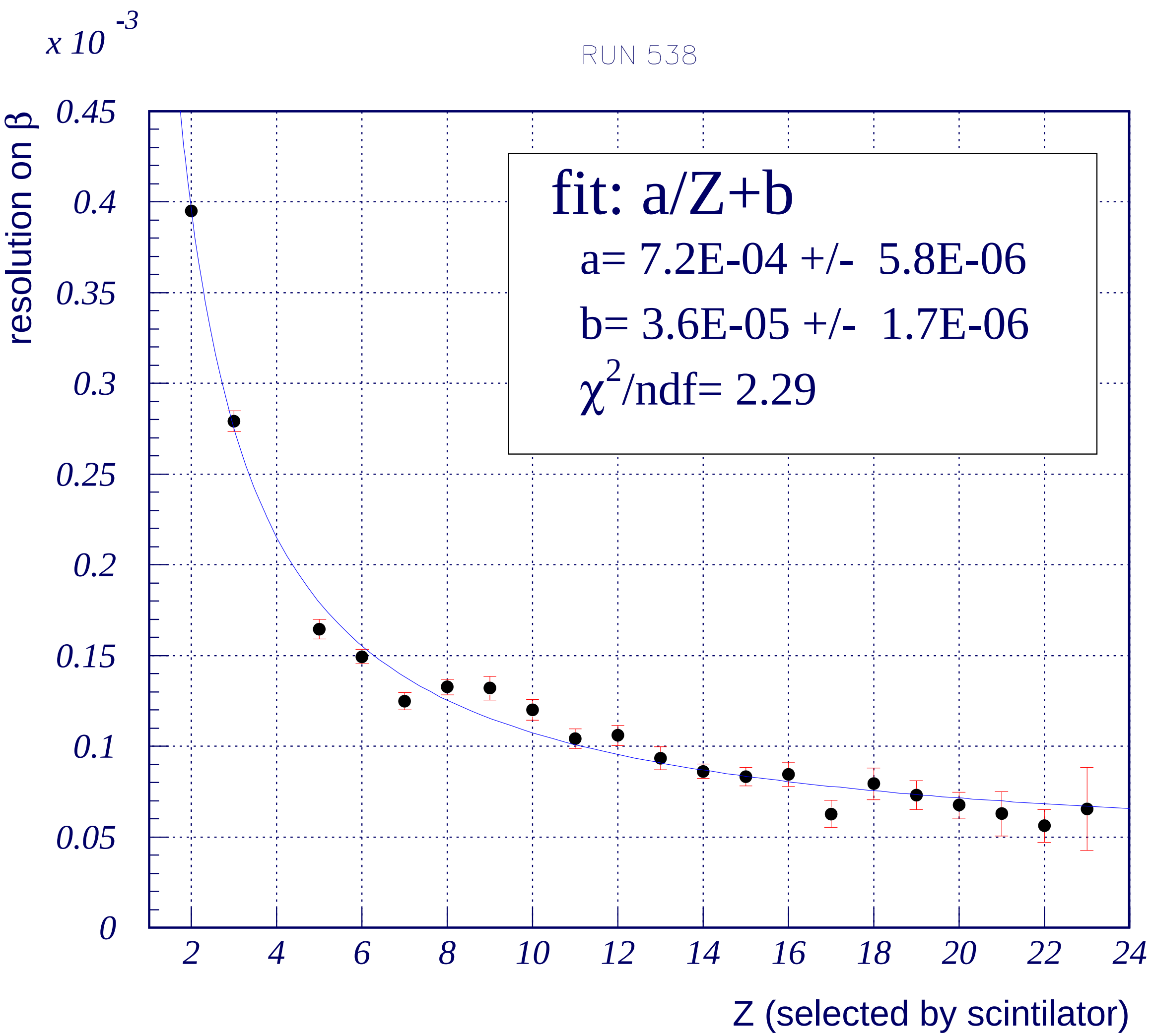


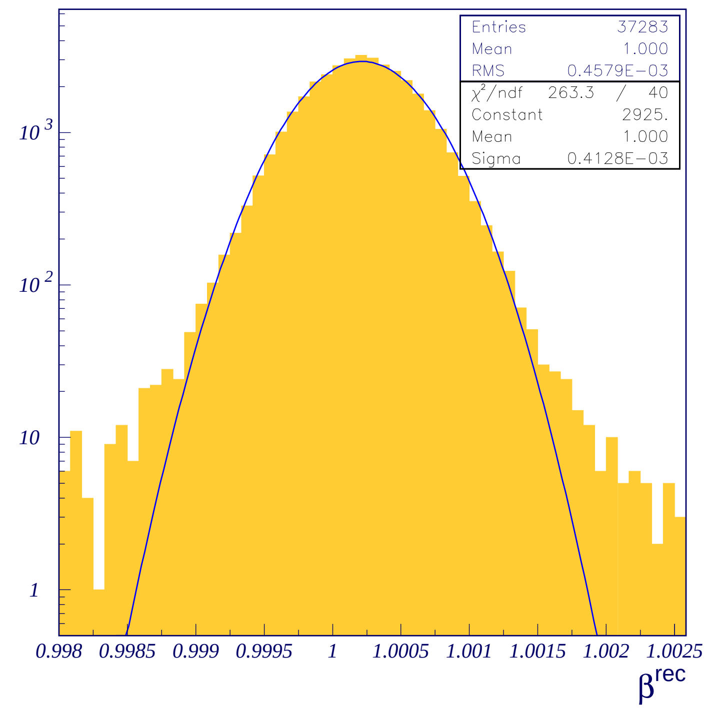
Event display with signal ratio ~ 1.6



sig out of ring(excepting particle)/sig ring

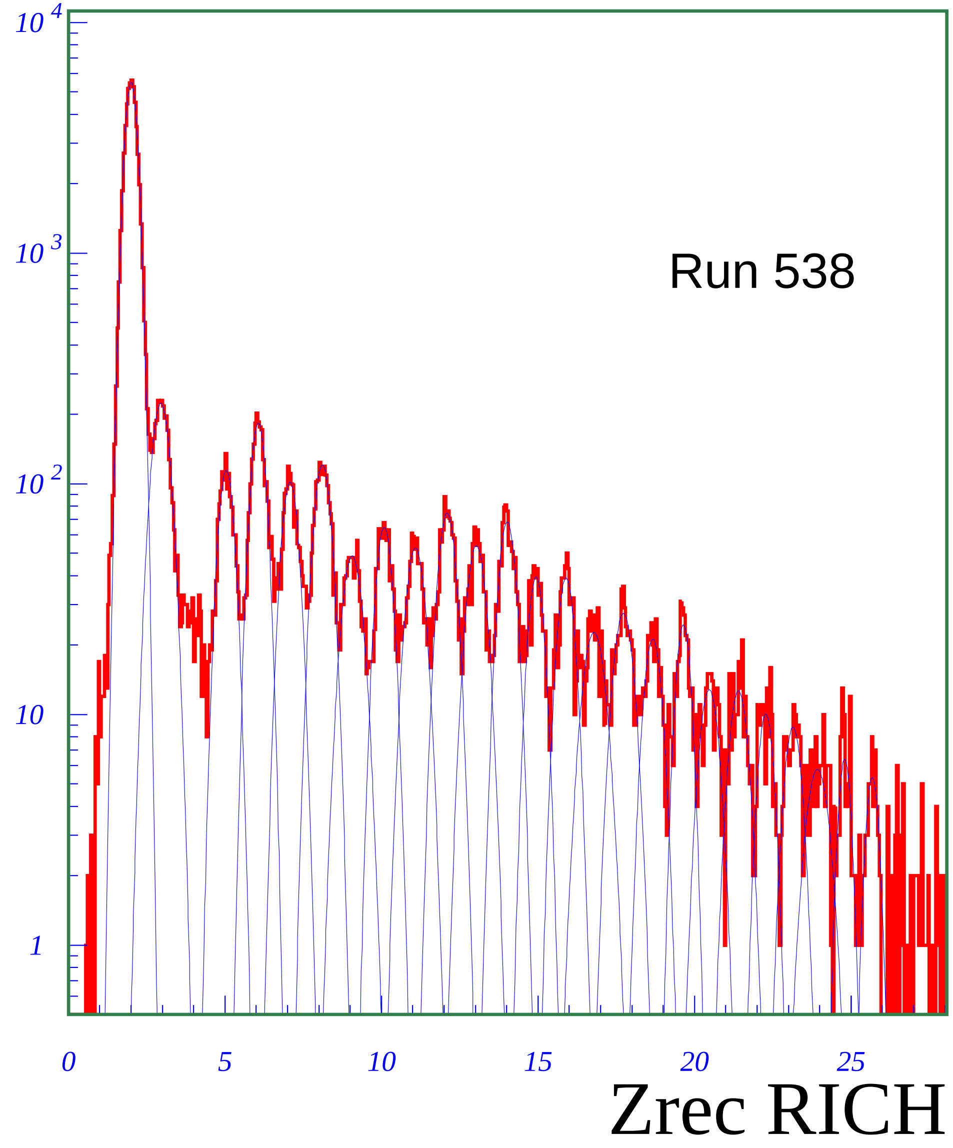
Velocity reconstruction (run 538)



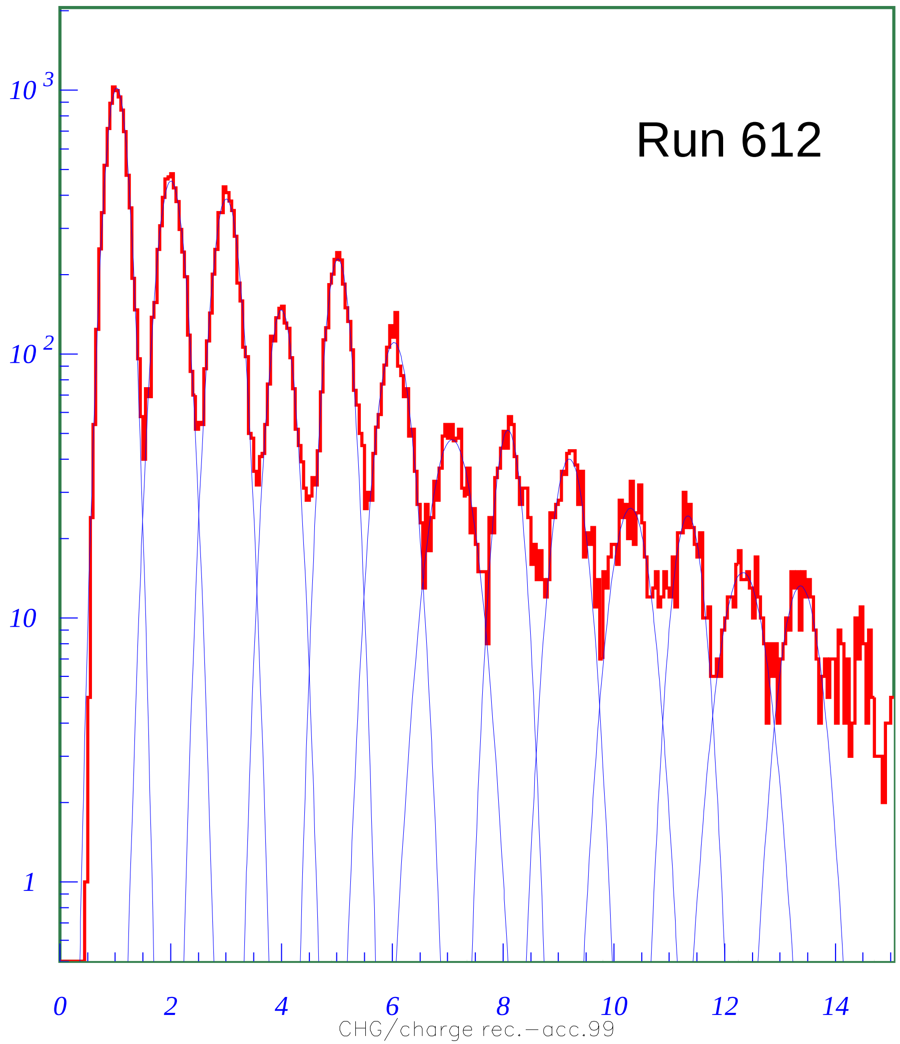


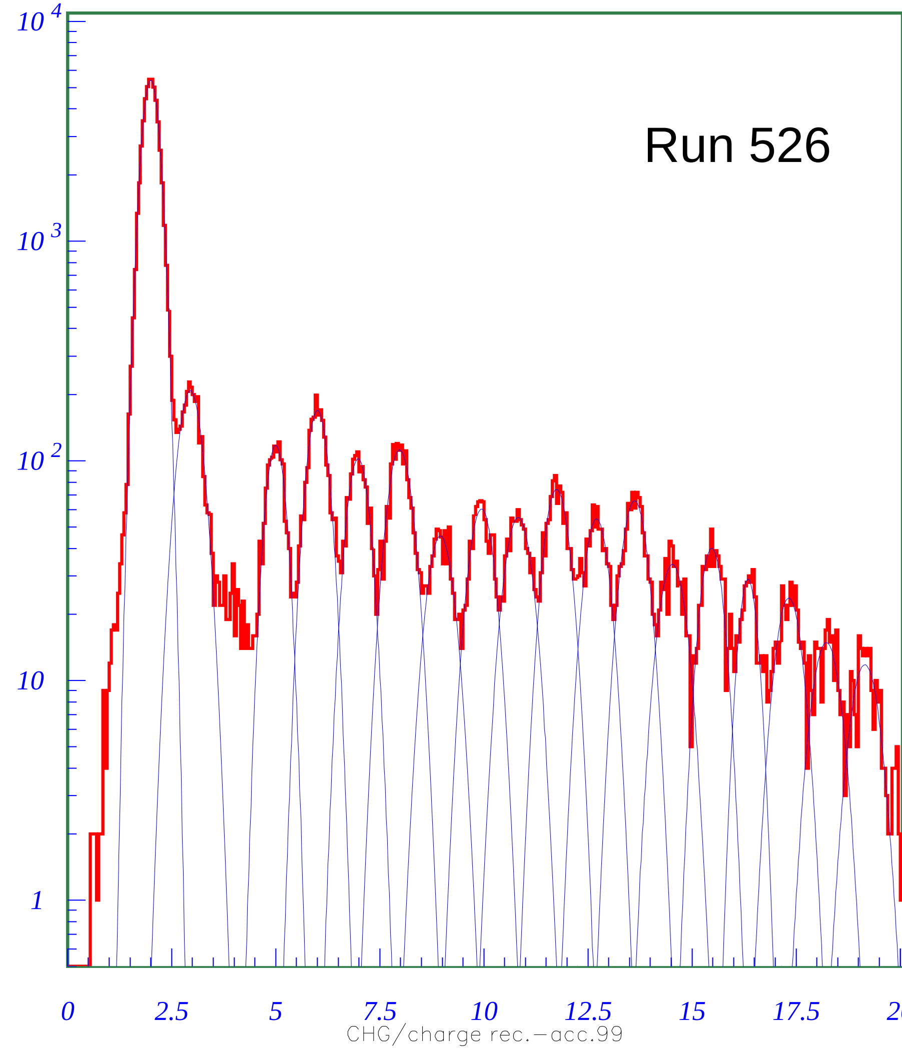
Charge reconstruction

$$N_{pe} \propto Z^2 \; \ell \; sin^2\theta_c \; \varepsilon_{rad} \; \varepsilon_{geo} \; \varepsilon_{lg} \; \varepsilon_{pmt}$$

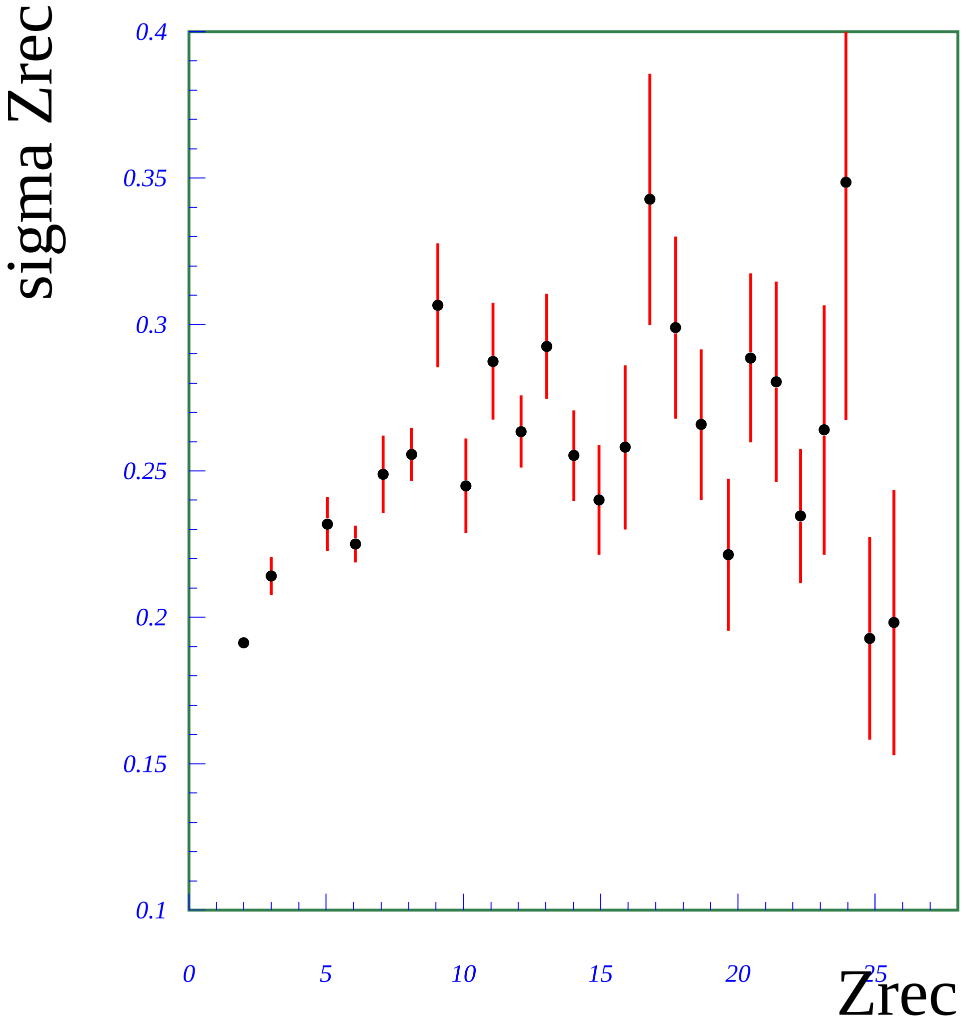


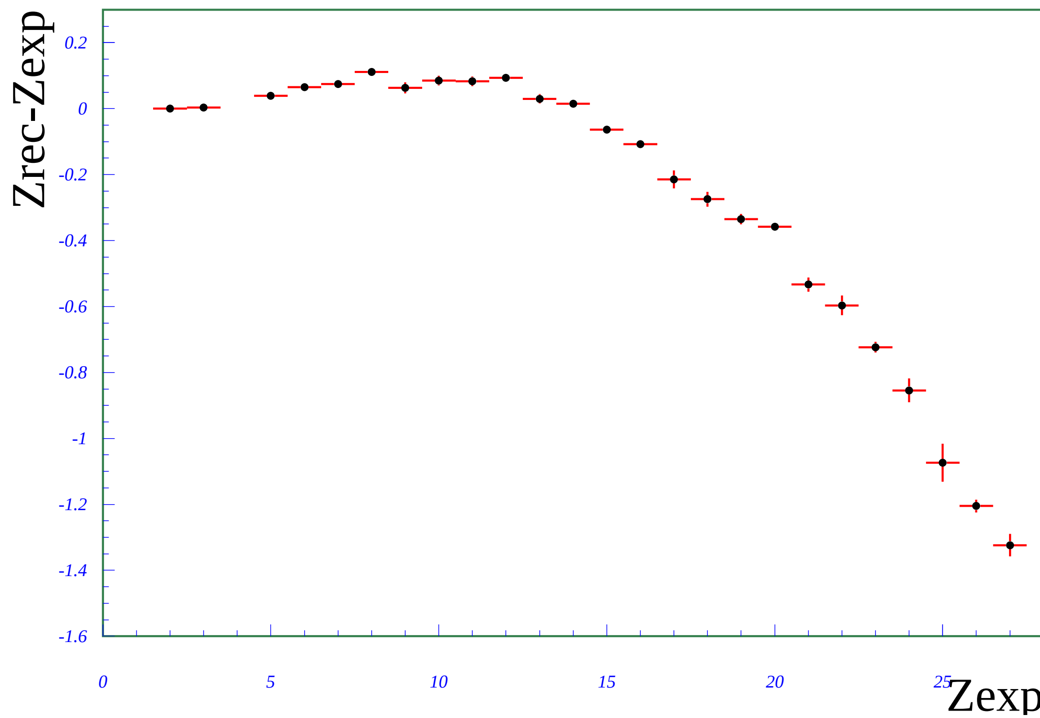
Charge reconstruction



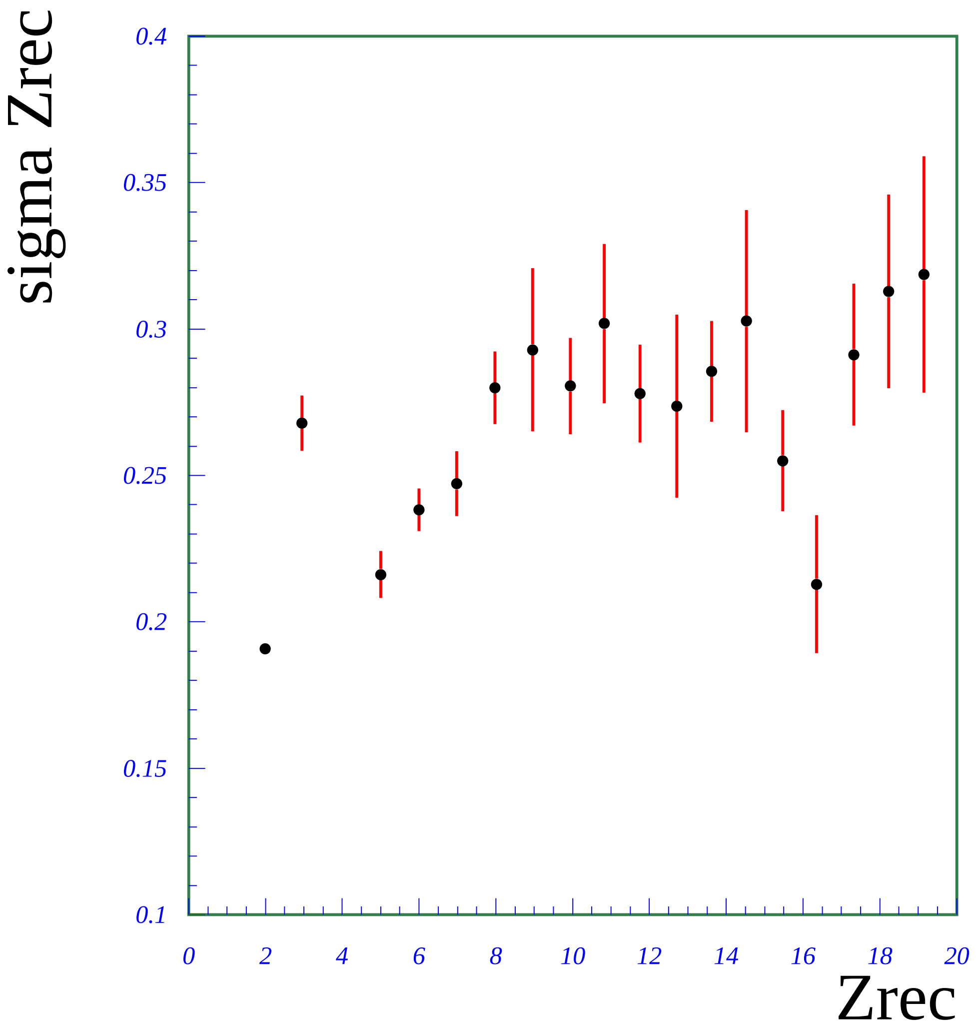


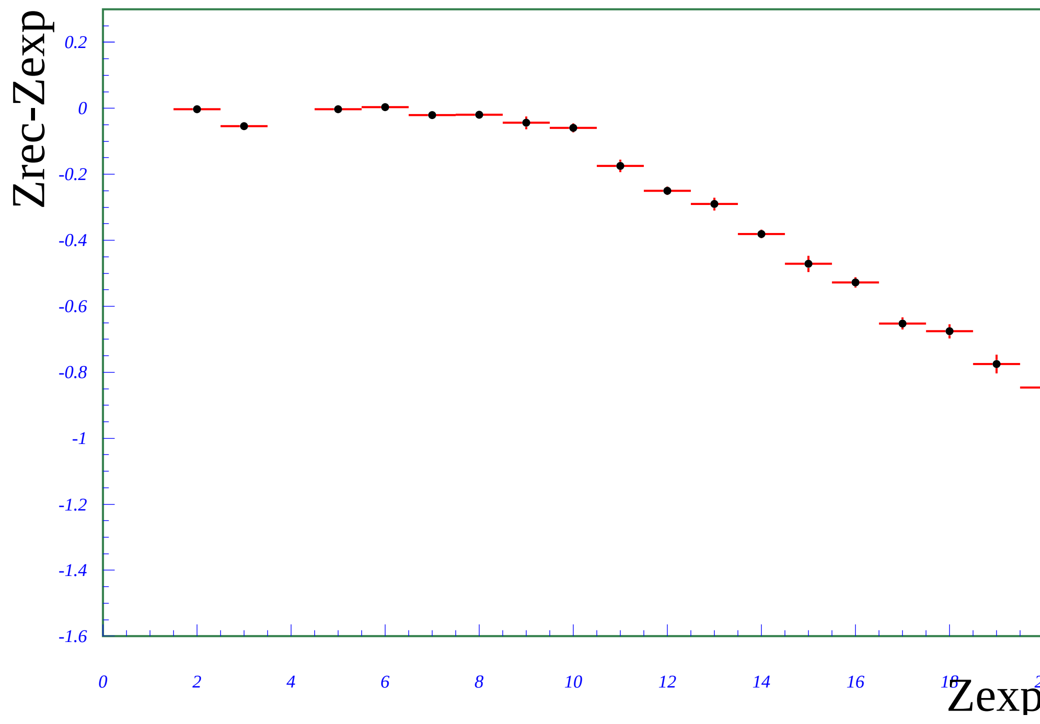
Charge error and deviation : N.103G/Run538





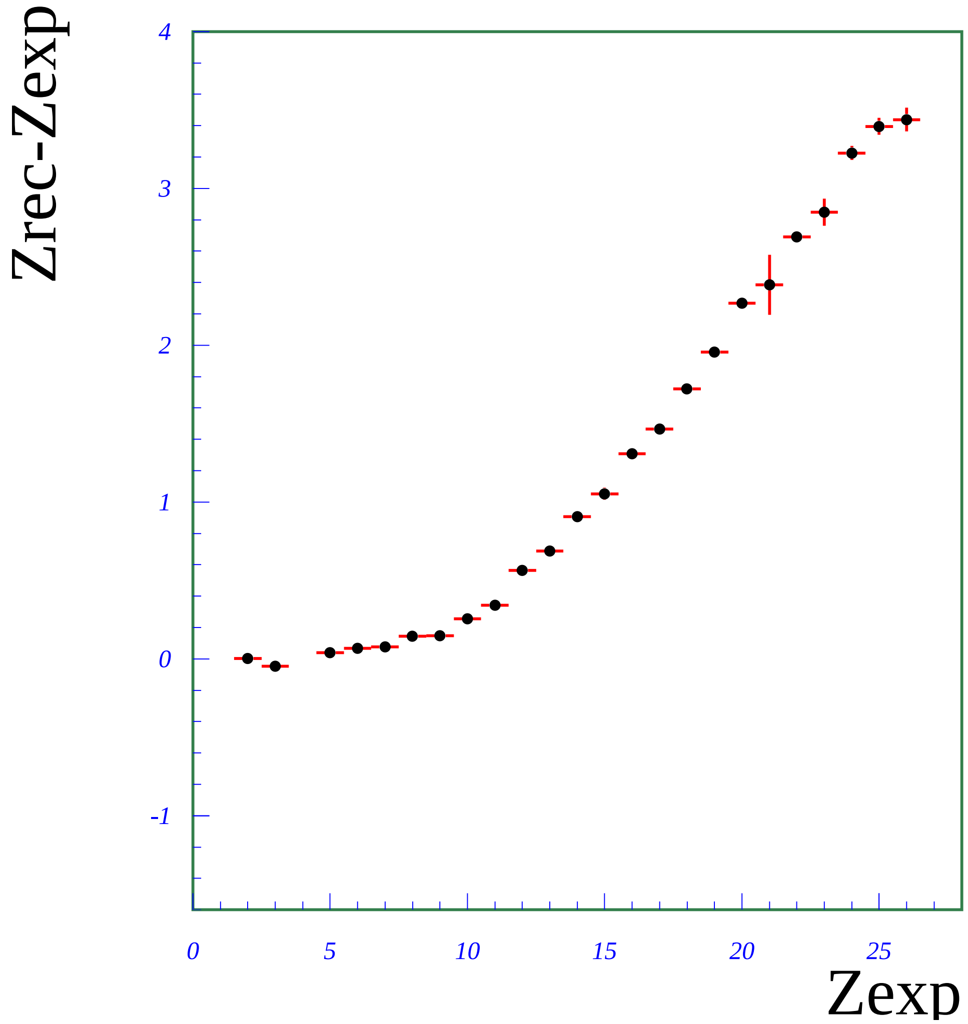
Charge error and deviation : MNN.103/Run526





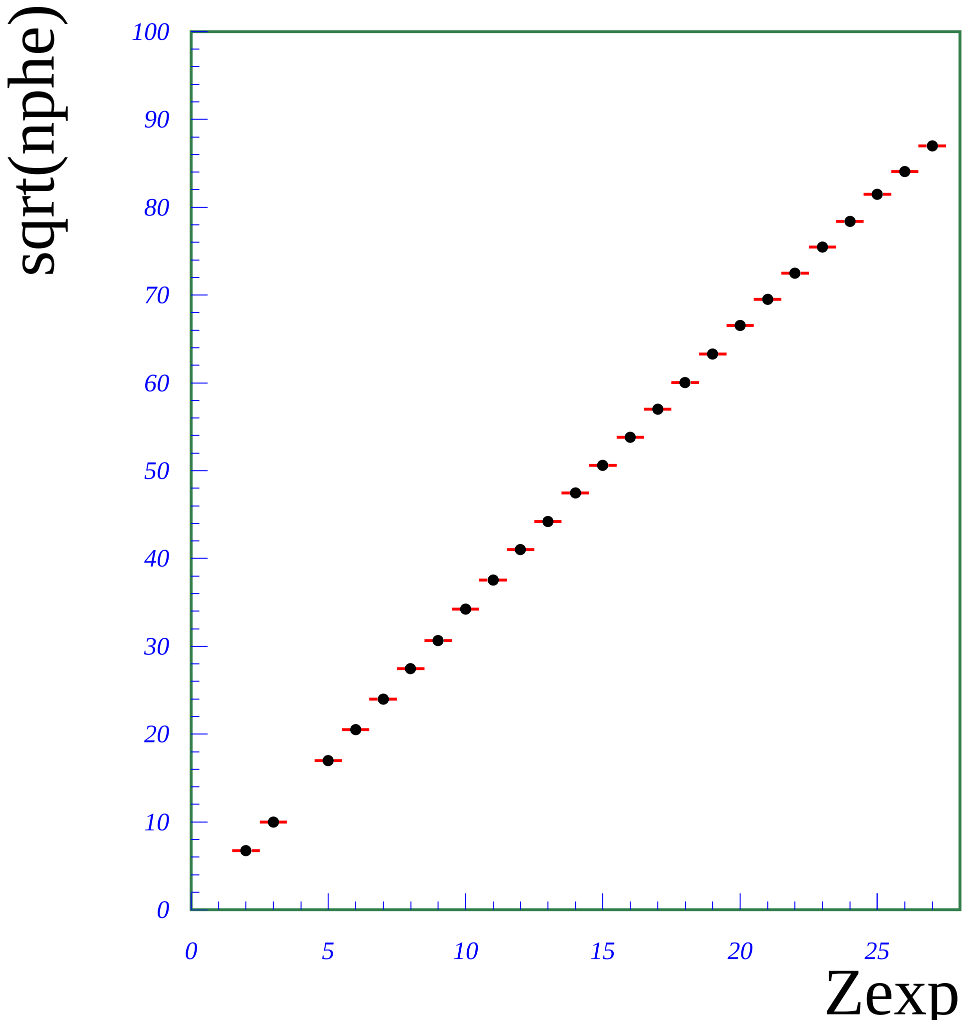
PMT saturation

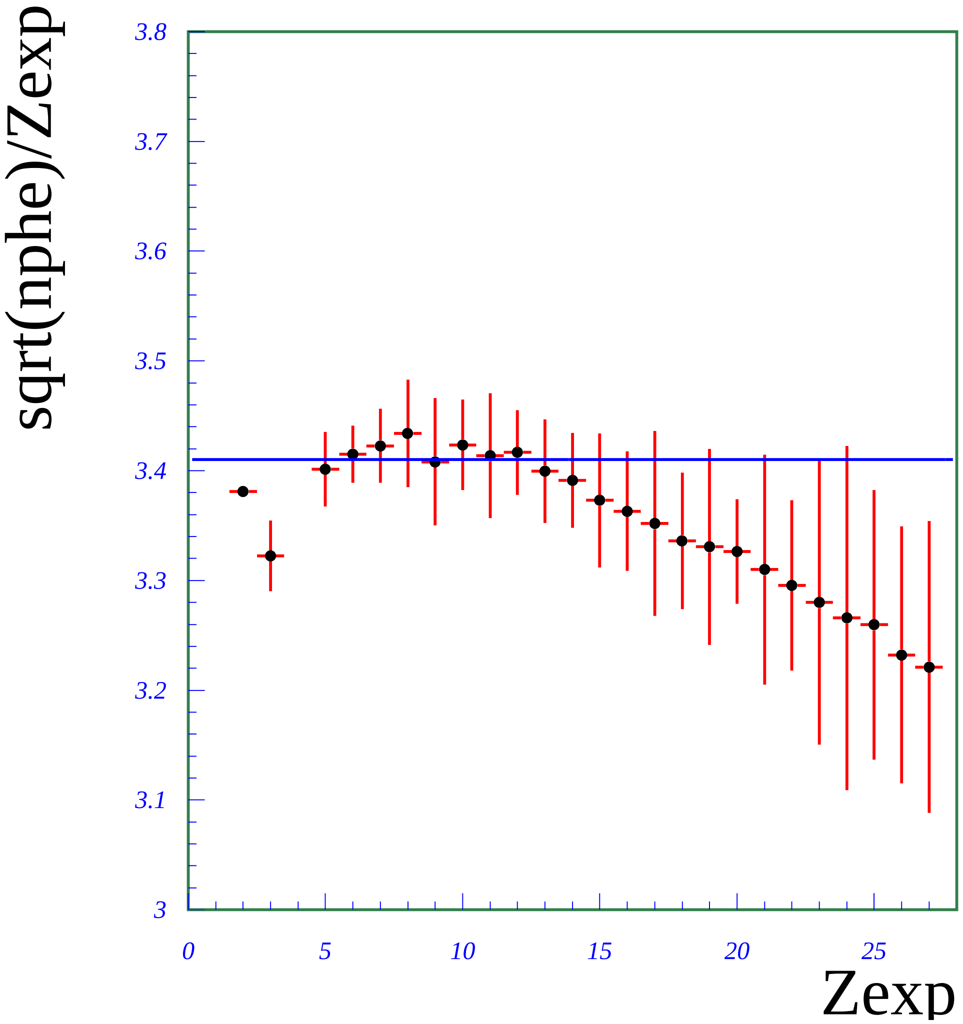
- Charge measurement starts deviating from nominal values for $Z > 12$
- Introduction of the PMT saturation law previously used on 2002 run obviously misadapted !
- The PMT saturation law can be derived from data



run 5

Integrated signal saturation



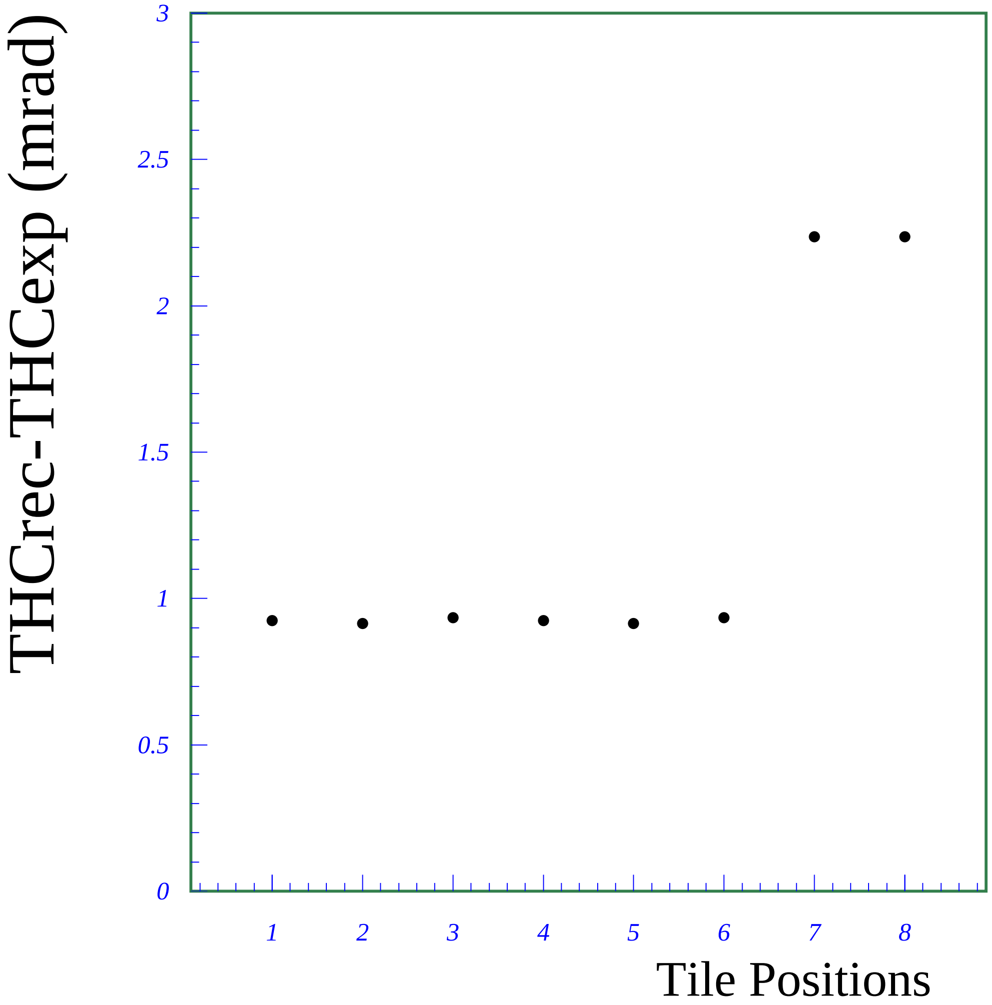


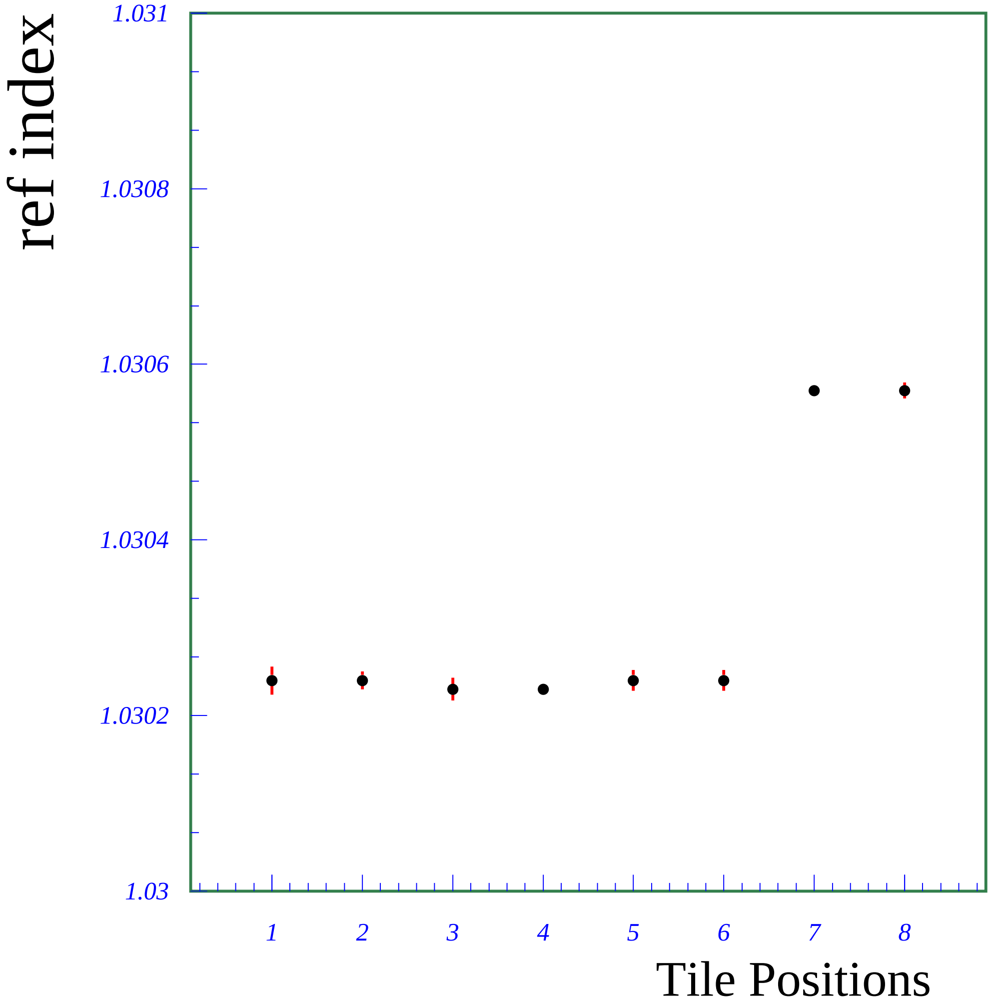
Charge confusion

- nominal beam charges selected with scintillators
  high purity demanded
- rich charge confusion evaluated

run	helium confusion
538	0.9%
612	1.3%

Tile scan : Cerenkov angle



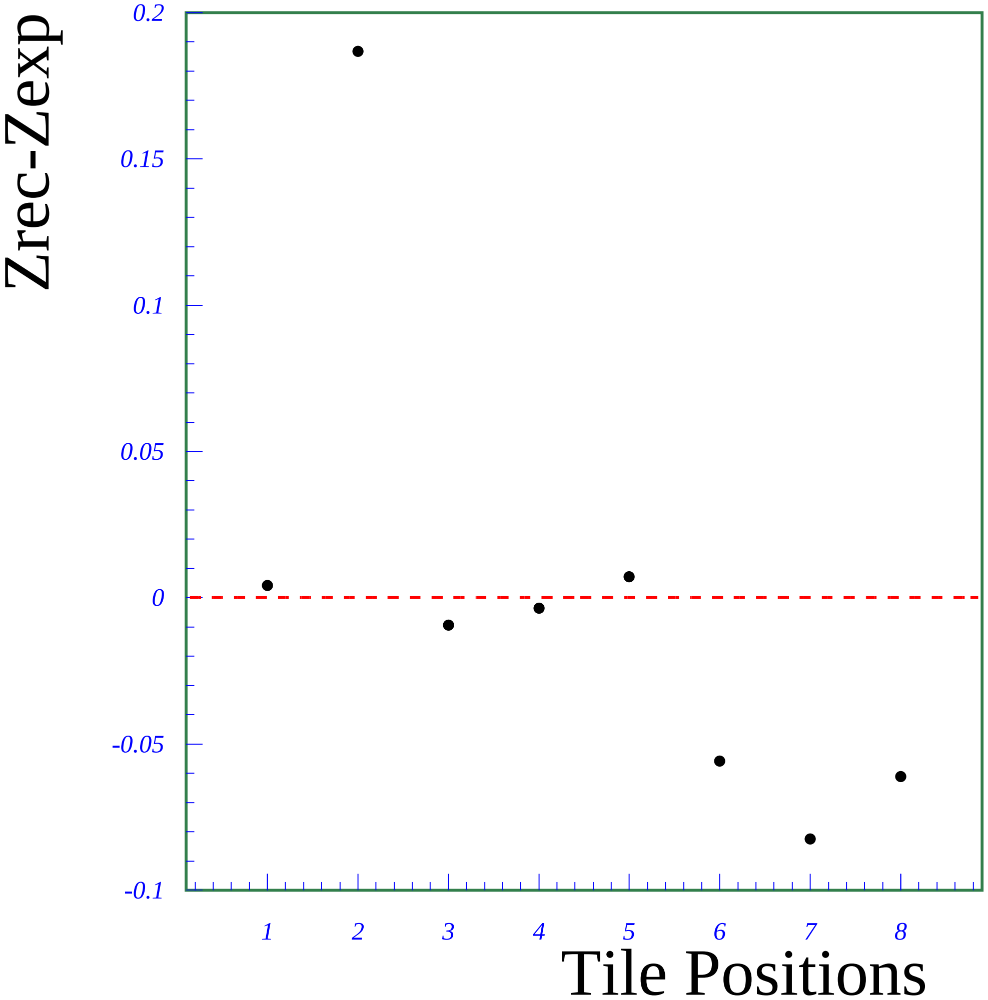


(N.103G) run 538-546

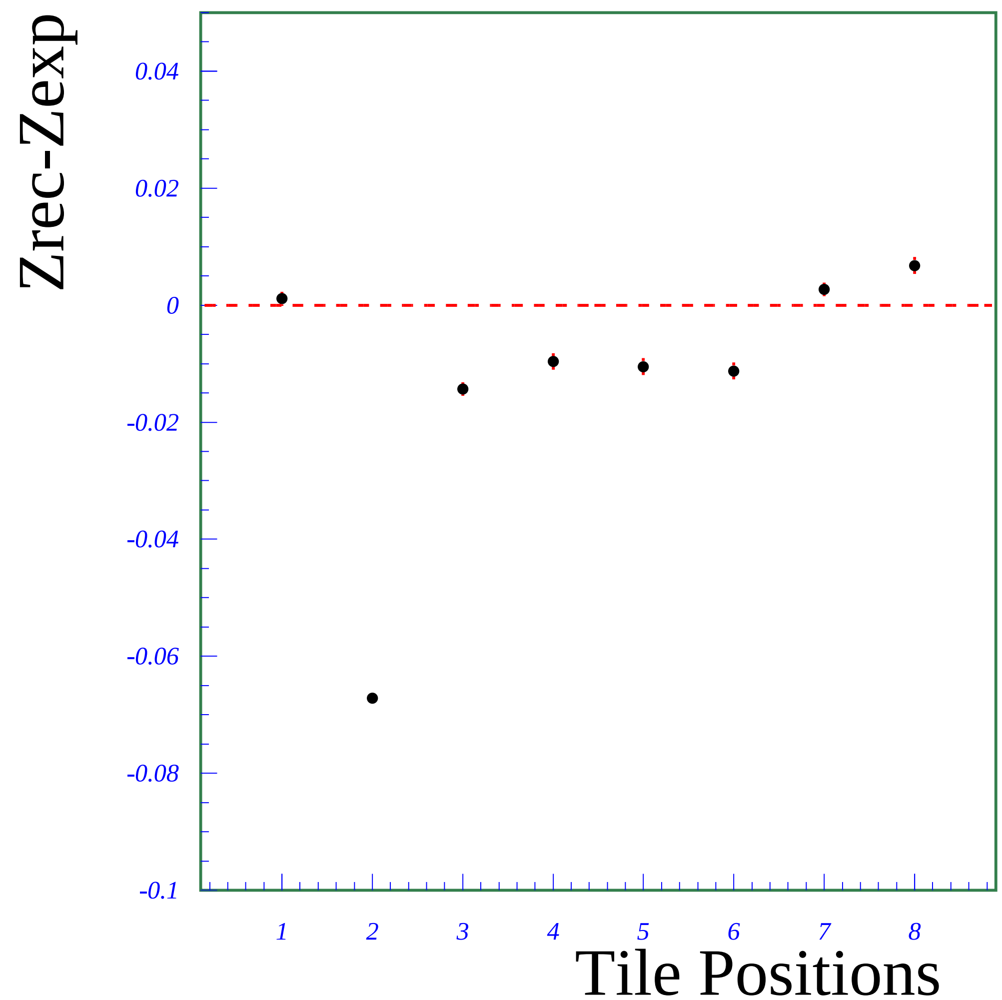
Scale : $\frac{\Delta n}{n-1} \simeq 3\% \quad \Rightarrow \frac{\Delta n}{n} \sim 0.1\%$

Very stable refractive index along the tile.

Tile scan : helium charge evaluation



(N.103G) runs 538-546



(MNN.103) runs 525-533

Conclusions

- Charge reconstruction performed for different runs
- Charge saturation observed for Z>10
- Tile uniformity studied with Cerenkov angle and light yield
  - θ_c reconstructed indicates refractive index stability
  - light yield variation can be due to radiator thickness or transmitance variations ? ? ?
- to be continued...