Test beam 2003: Preliminary results on charge measurement

Charge uniformity and resolution in runs of scan and runs with angle (CIN 1.03)

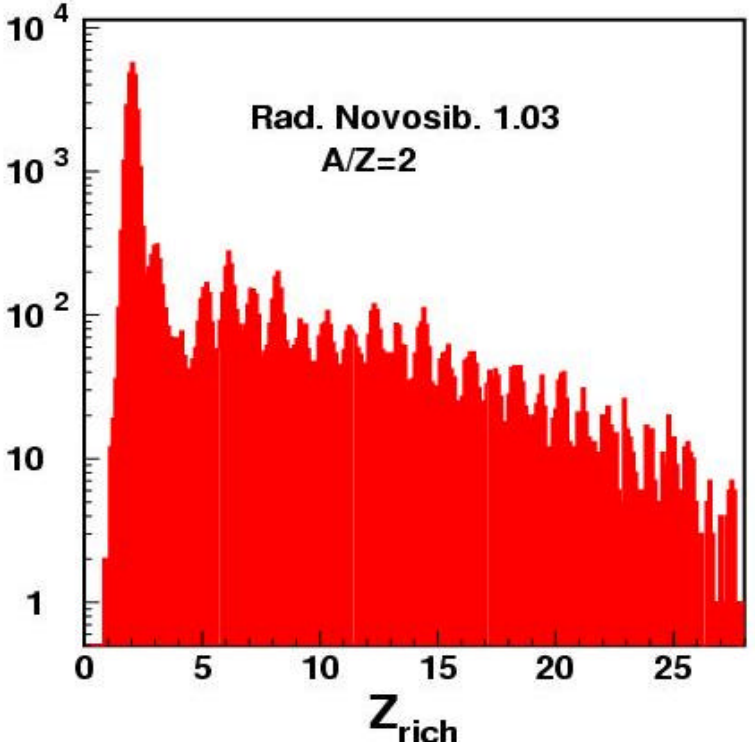
Contents

- Charge uniformity in runs of scan
- Charge measurement in runs with angle: peaks position and resolution
- Comparison of s(Z) with tb2002 data
- Runs of protons: ß and Z distribution

Charge measurement runs of scan 510-546

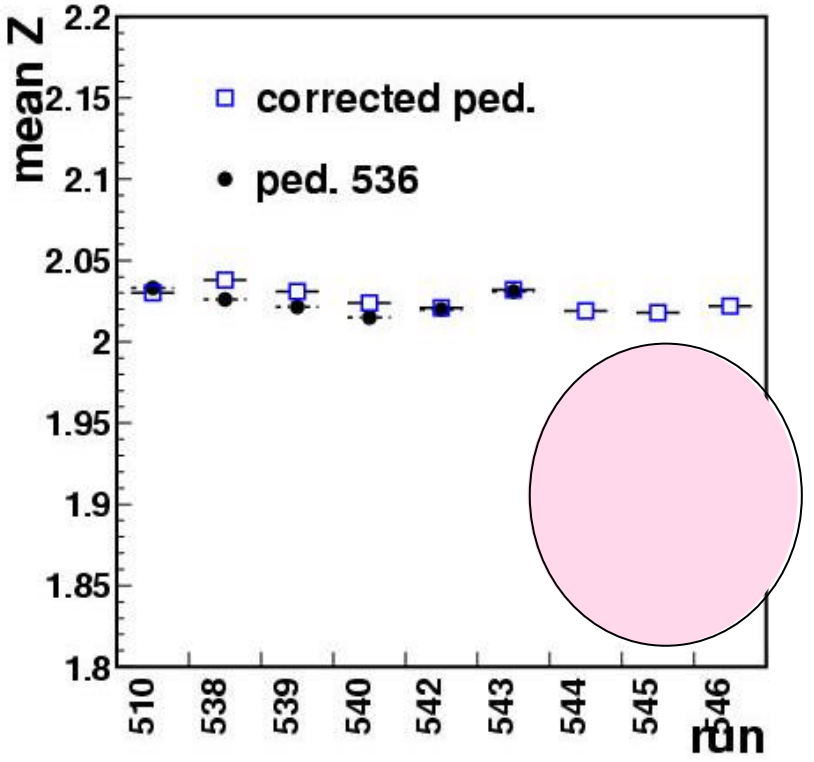
- We started with the analysis of He. Reconstruction with run vertex.
- Sample selection:

  - Kolmorogov probability associated to the ring >10%
  - only one pmt hit by a particle
  - Nexp>9 (only few events)



Charge mean value for He

The precision of the reconstruction algorithm is 2% in photon yield. Any measurement error within 1% does not compromise the final precision



- The mean charge varies in 0.8% for runs 510-543 and 3% including runs 544-546

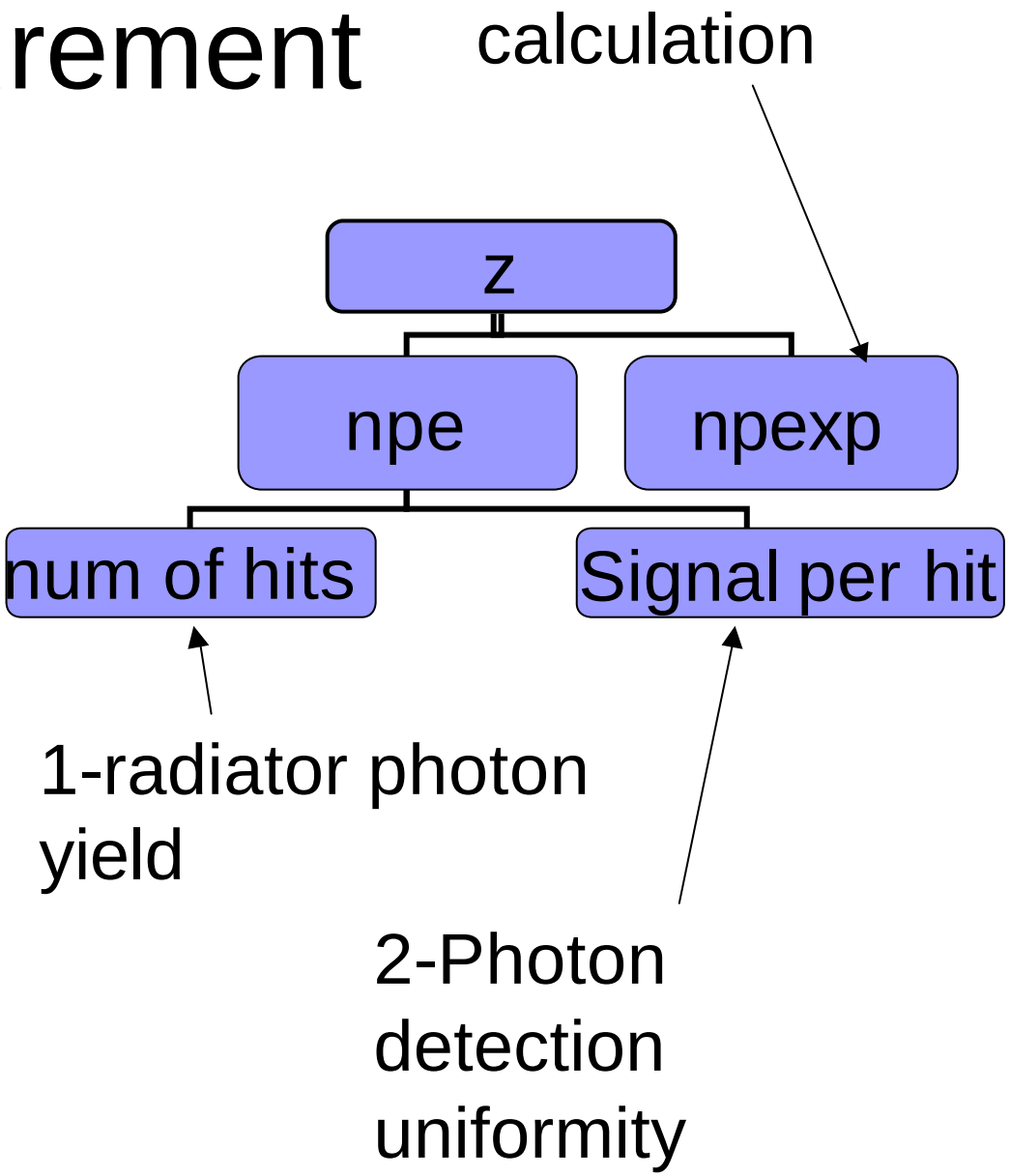
1.5% in terms of photon yield

Charge measurement

$$Z = \sqrt{Npe / N\exp}$$

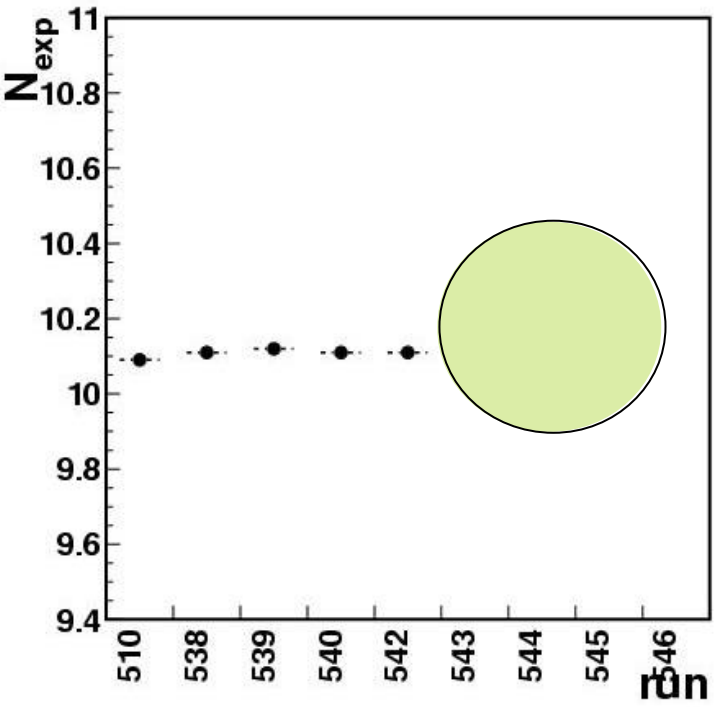
$$Npe = \sum_{1}^{nhits} signal$$

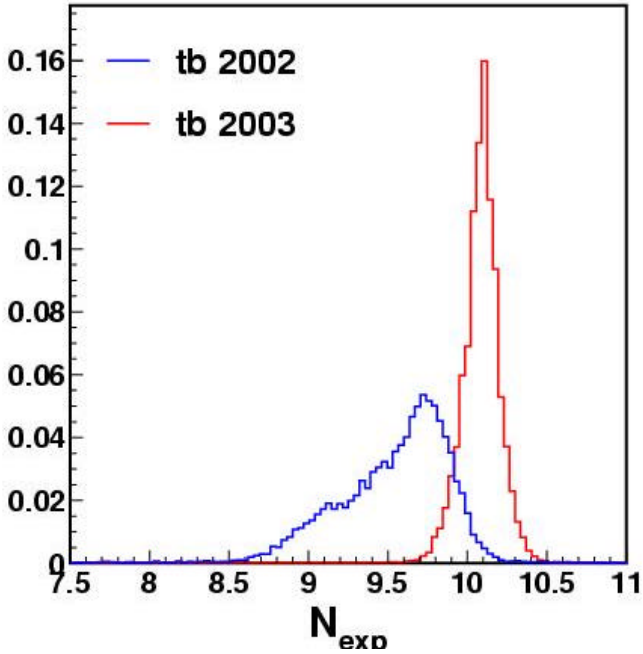
Sum over the hits reconstructed in the ring



The number of expected p.e.

The distribution peaks at 10.1 pe. In last year tb Nexp was lower (due to lower ß) and wider (dead channels)





? nexp 0.1%

Only can cause a ? Z<=0.1%

The total number of p.e.

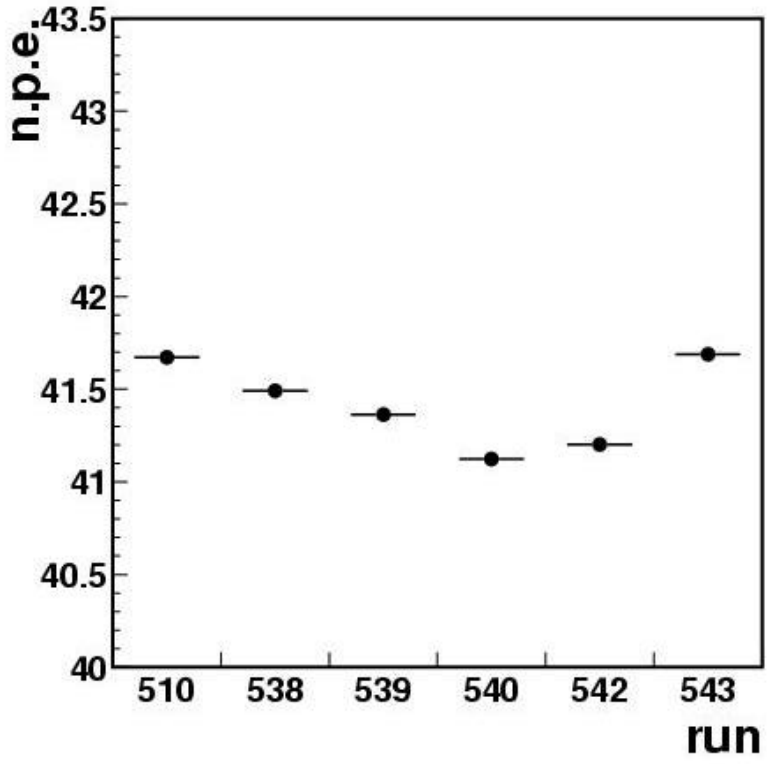
? Npe ~ 0.6 p.e. (1.5%)

It is the responsible for the charge variations of order of 1% that we observe.

? Npe depends both on

•the number of hits in the ring

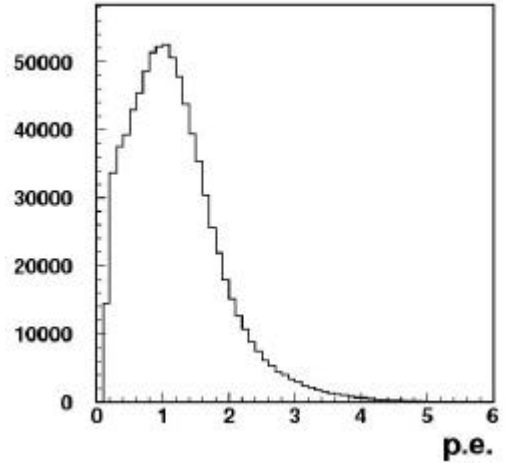
• on the variations of the signal per hit



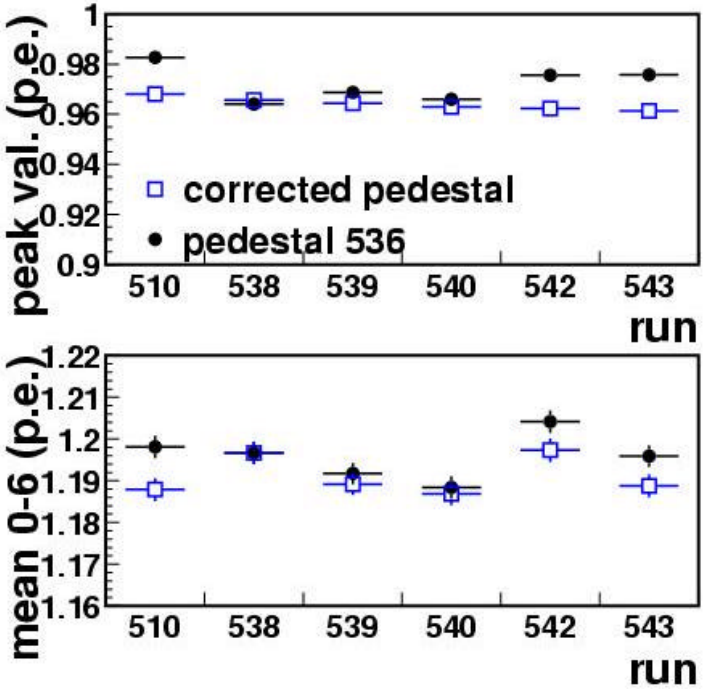
? npe = ? nhits ⊕ ? signal

Uniformity of the signal per hit

The uniformity of the signal per hit depends on the photon detection system

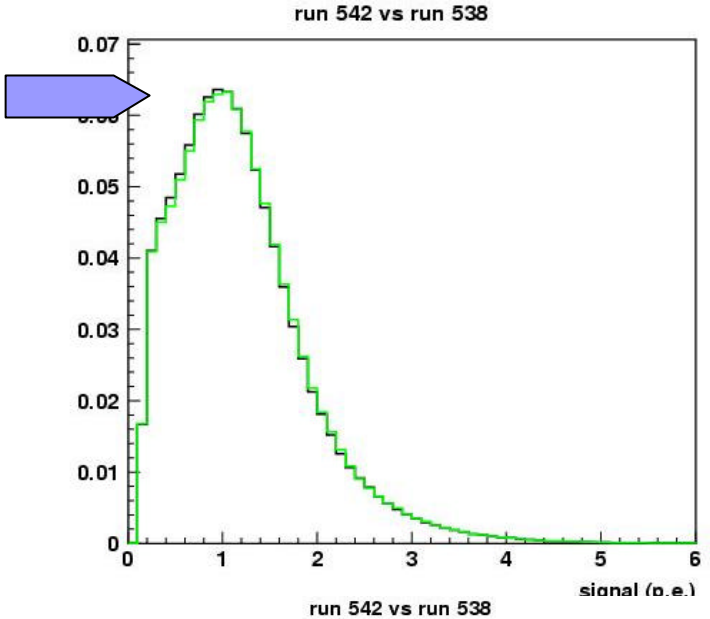


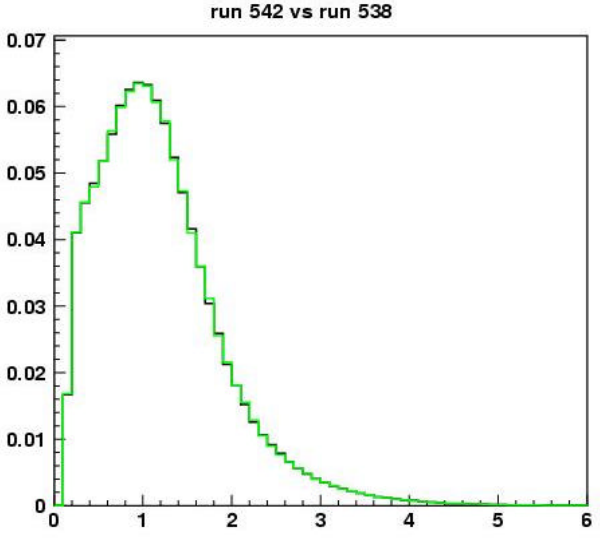
- To monitor the stability:
  - Peak value of the signal
  - Mean value of the distribution truncated at 2,3 and 6 p.e.



Corrected signal spectra

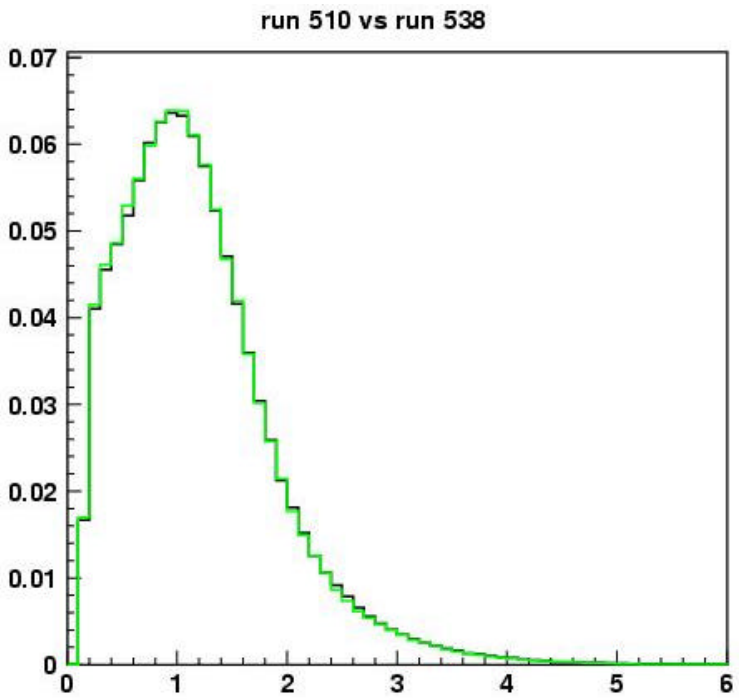
- Pedestal shift (?ped) applied to overlap the signal peak wrt run 538 i.e. 0.966 (first after pedestal run)
- The shift ?ped is the same for all the channels
- ?ped from 0.3 to 2 ADC counts
- Runs 510,539,540,543 ok
- Runs 538,542: fluctuations at high n.p.e.

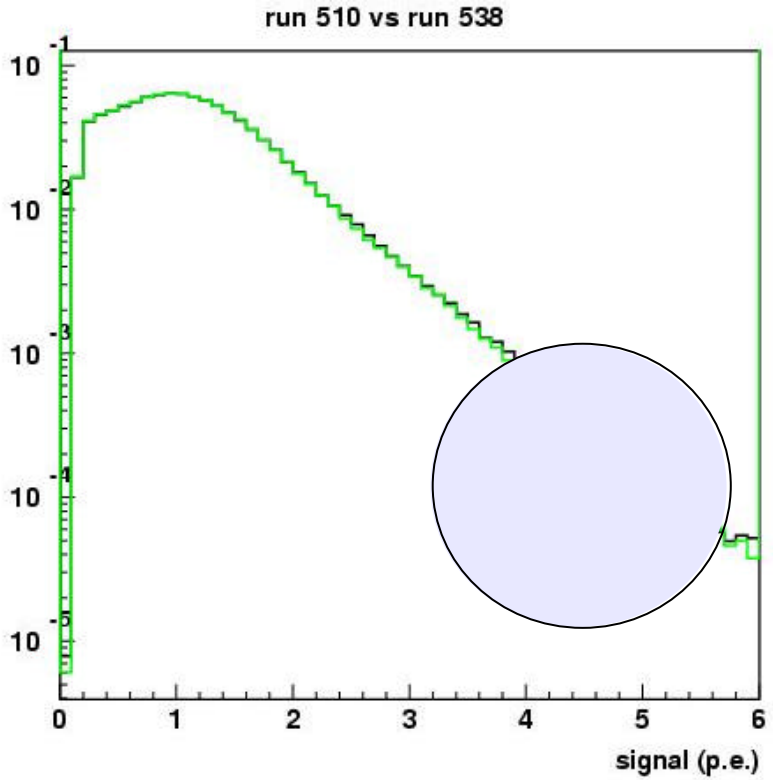




Signal fluctuation

- Applying a pedestal shift we can correct the peak value, but for run 538 and 542 the spectra differ in the part of high signal





Number of hits in the ring

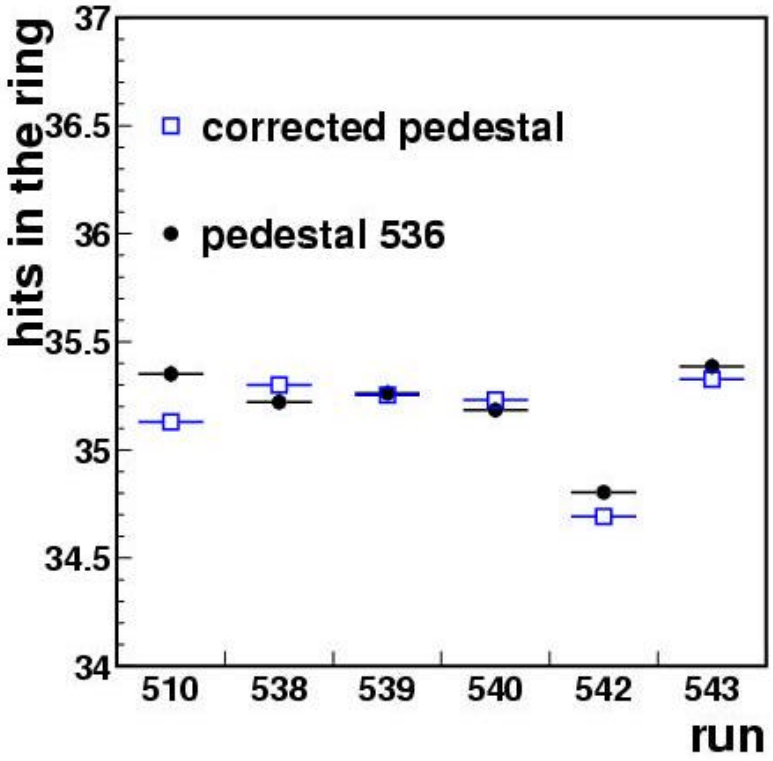
- This quantity depends on the photon yield of the radiator
- Uniformity in photon yield is within:

1-excluding run 542

0.6%

2-Including run 542

1.8%

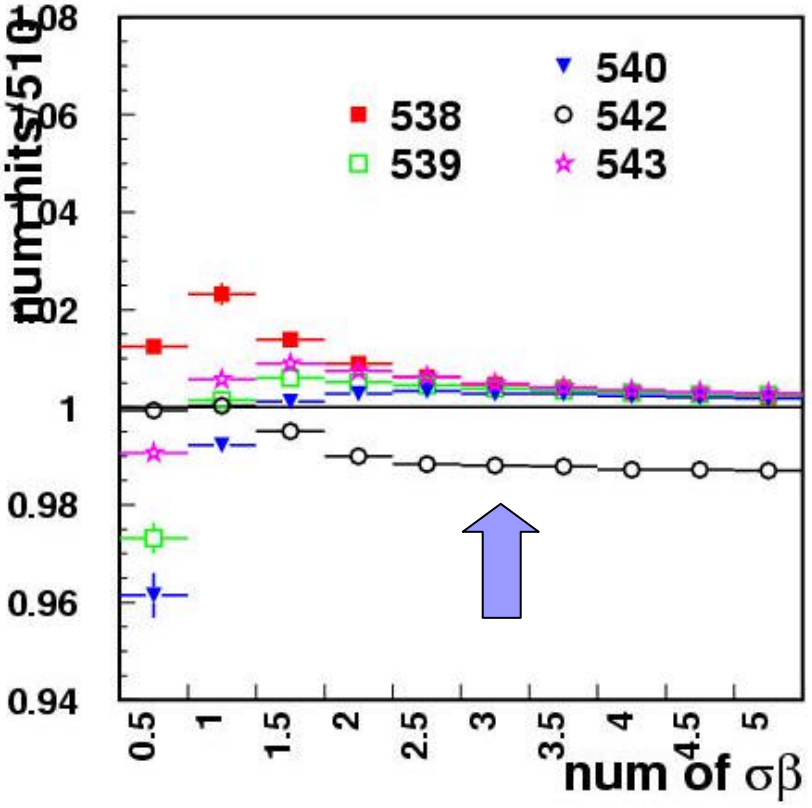


near the limit of precision given by the algorithm

Selection of good hits

We tried to recover those hits changing some parameters of the reconstruction of the ring

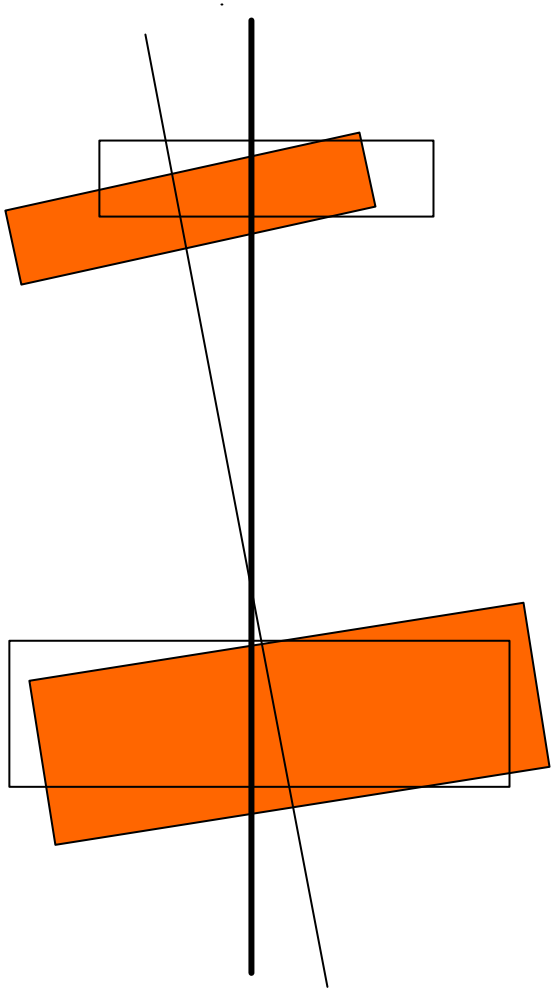
Changing the ring amplitude the relative number of hits is not changed



Conclusion

- charge uniformity within 1%. Variations are due to:
- 1-Photon yield uniformity in the radiator within 1.8% including all runs of scan
- 2-Signal uniformity within 1% considering the mean value of the distribution truncated at 6 p.e.
- Effect 1 and 2 in some runs add in the same direction (run 538) and in other compansate (run 542)
- The overall error is at the same level of precision than the reconstruction algorithm

Runs with angle 516-519

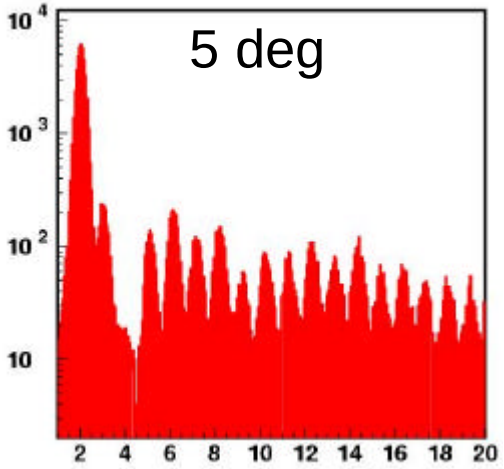


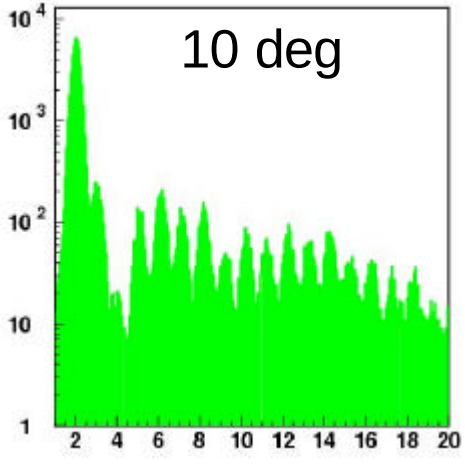
- Rotation+shift wrt the beam line of:

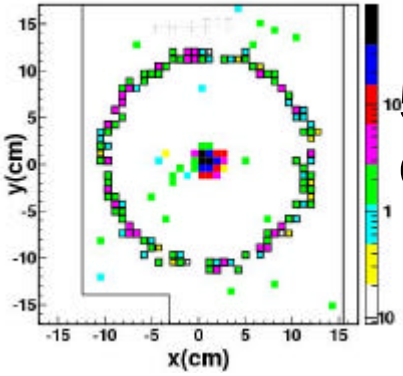
0-5-10-15-20 degrees

- peak position for elements from He up to z=20
- Estimation of charge resolution vs angle

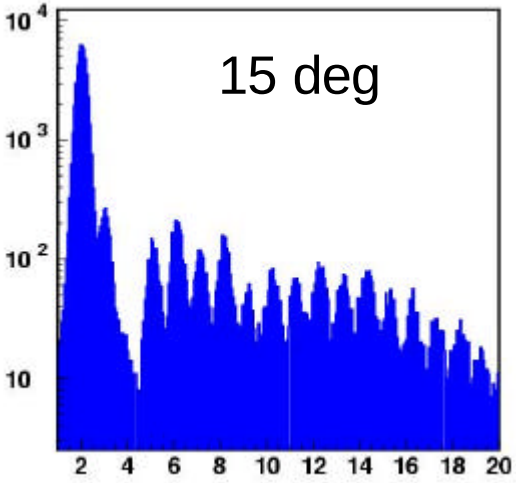
Charge spectrum for run 516-519

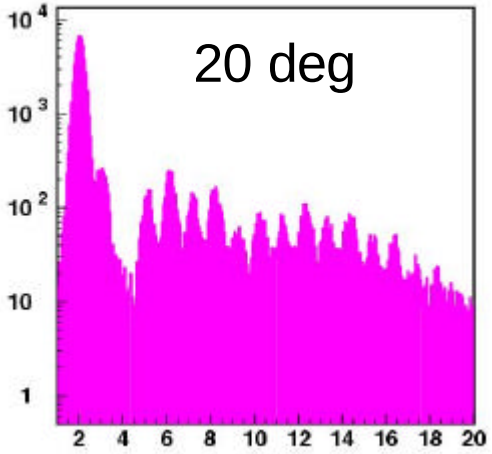


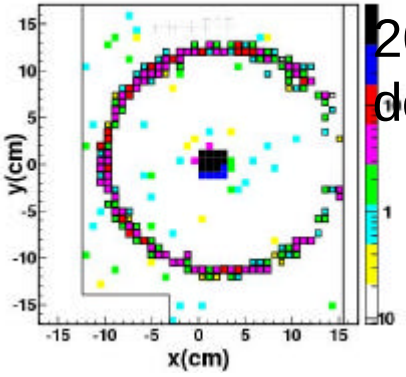




5 degrees





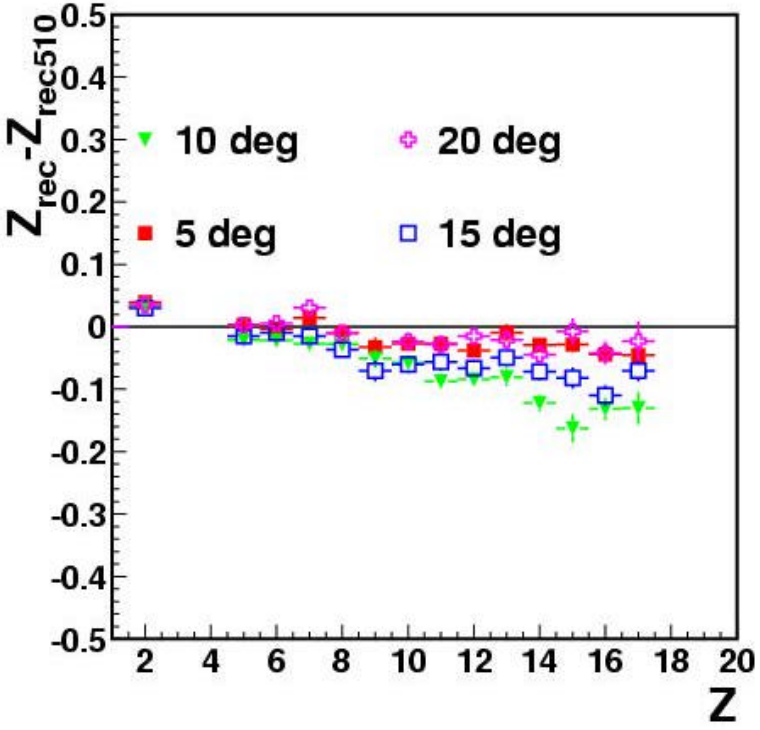


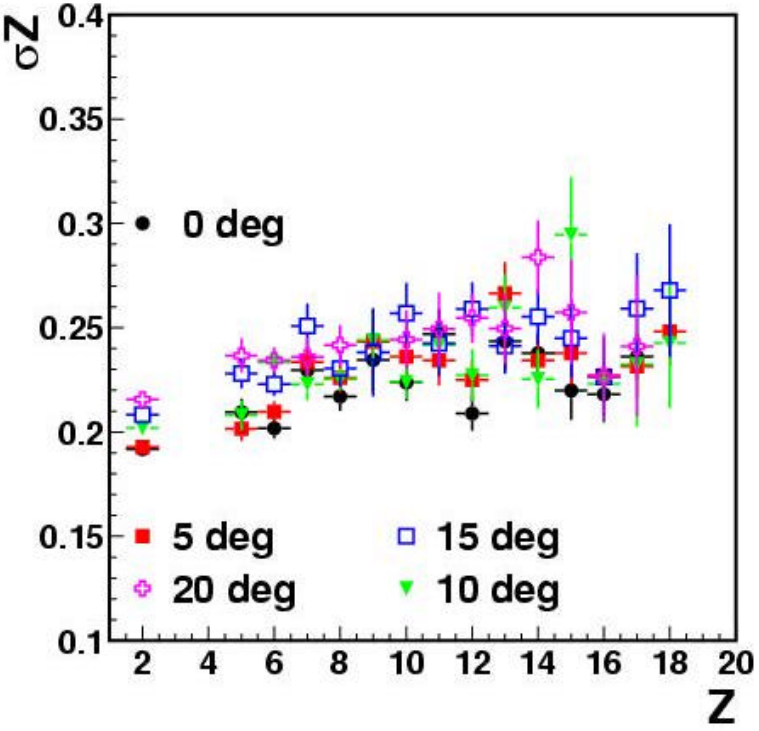
20 degrees

A preliminary estimation of peak position and resolution

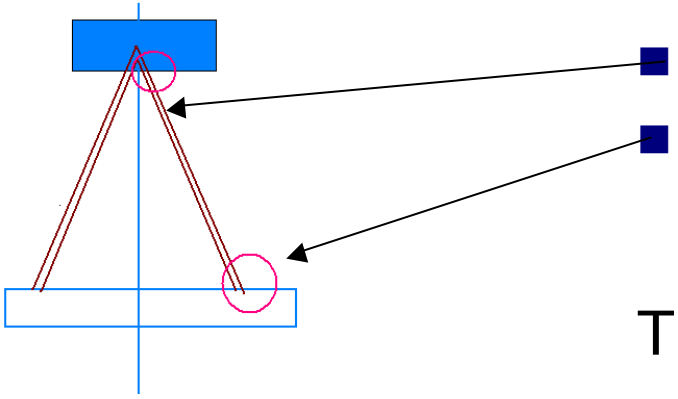
The peak position wrt run 510: there are variations up to 1.5e

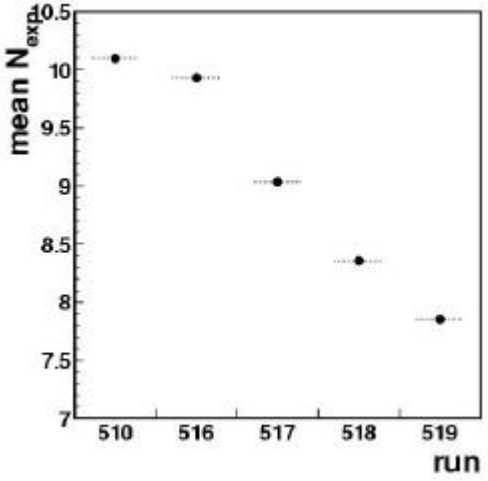
The Z resolution degradates with Z, as expected. It also decreases with the angle: approx. . 10% from 0 to 20 deg.





Peaks position





Charge fluctuations can be the consequence of 2 effects:

- A-photon yield vs angle
- B-incorrect estimation of light guide efficiency vs photon angle

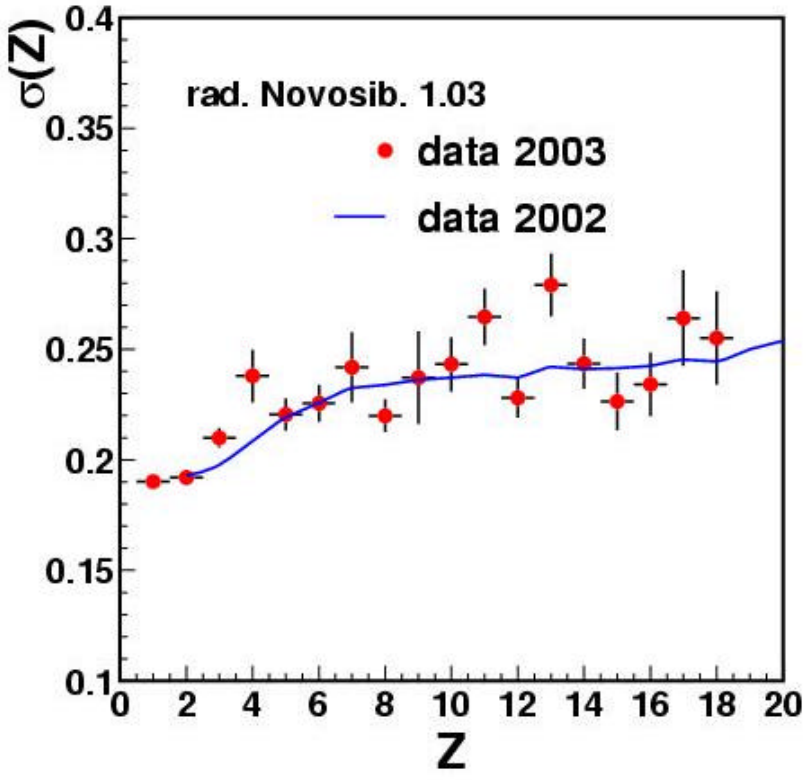
The analysis of the run with only radiator rotated is necessary to disentangle the 2 effects

Reconstructed Nexp vs angle

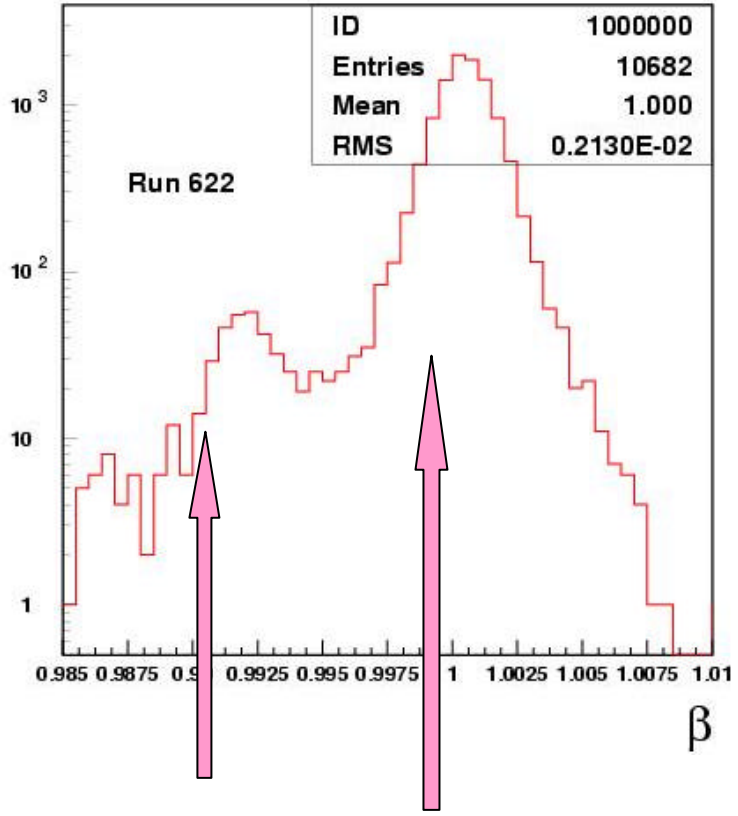
And Systematic comparison with MC simulation

Comparison of charge resolution with tb2002 data

For radiatior CIN 1.03 the charge resolution is compatible with last year tb

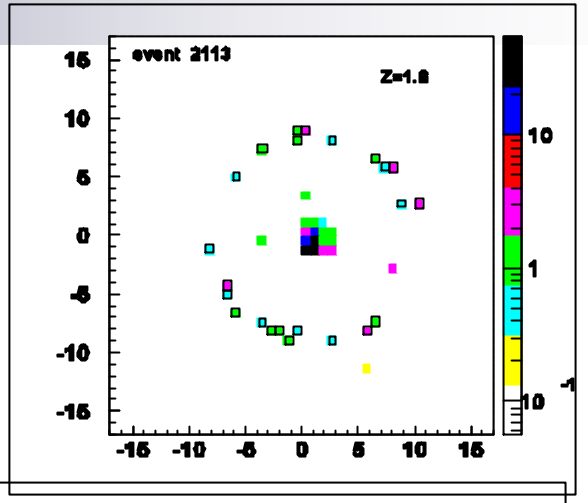


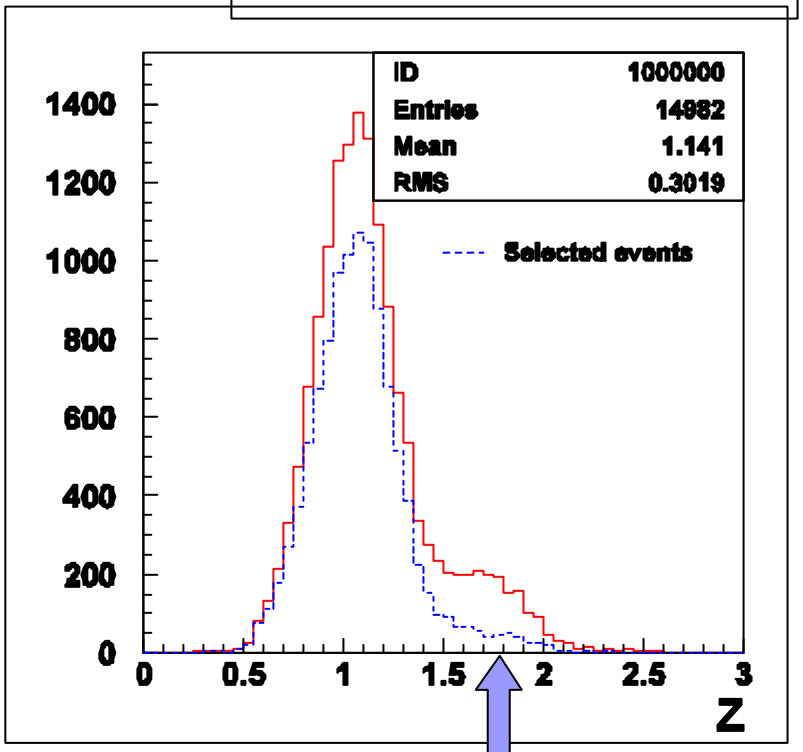
Protons: runs 618-622



protons

μ





2-particle ring