Test Beam 2003
On going analysis of the runs with mirror
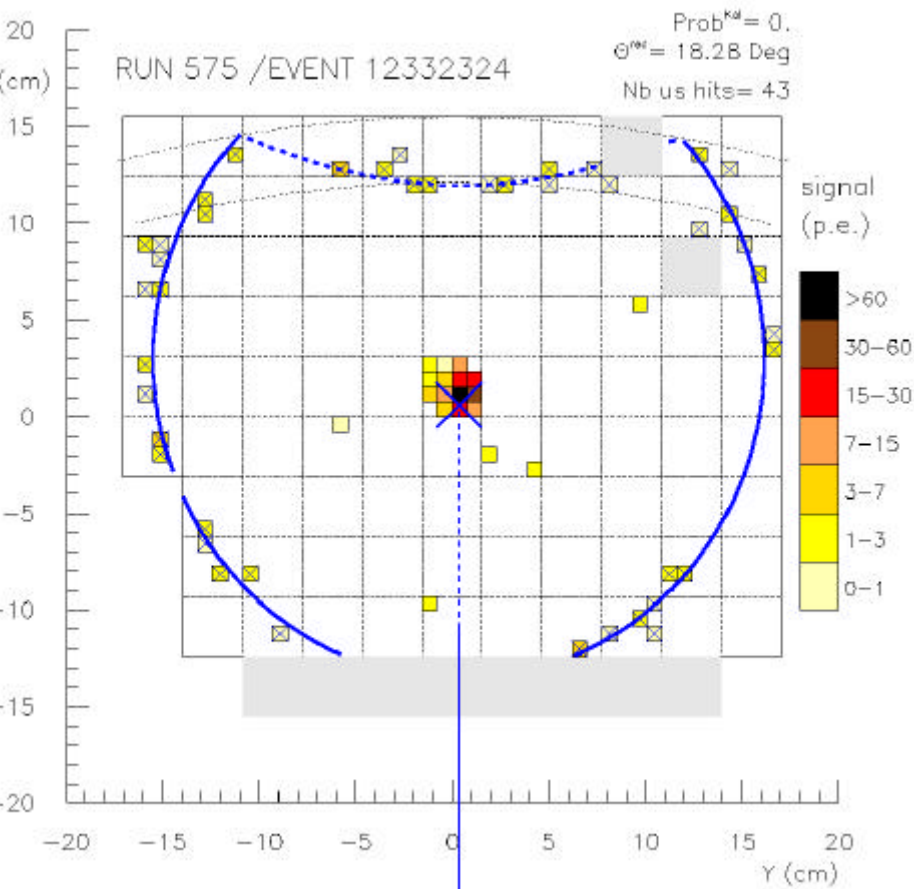
LIP (Lisbon)

MIRROR REFLECTIVITY EVALUATION
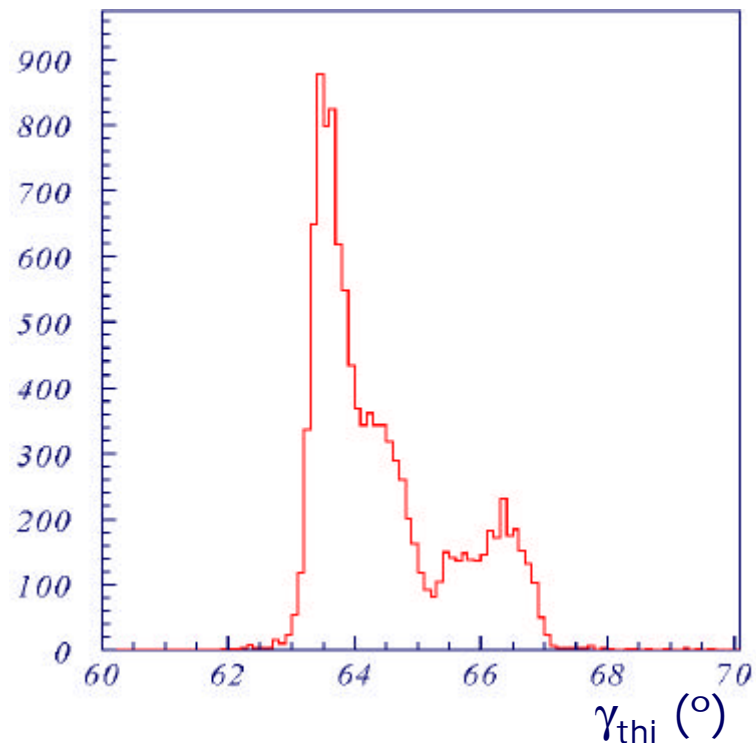
- ## RUN 575 (15^0)
  - CIN105 2.5 cm H=43.2 cm
  - PMT status corrected (2 dead PMTs)

- ## RUN 585 (0^0)
  - MNN103 3 cm H=43.2 cm

Z=2 event

Distribution of the photon incident angle on the mirror (related to the normal to the mirror surface)

RUN 575 /EVENT 12332324

Prob^{Kal}= 0.
Θ^{Kal}= 18.28 Deg
Nb us hits= 43

signal (p.e.)

>60
30–60
15–30
7–15
3–7
1–3
0–1

Y (cm)

γ_{thi} (°)

Helium events (Z=2) selected

χ^2/ndf	118.9	/ 38
Constant	1473. ±	11.75
Mean	35.38 ±	0.4791E-01
Sigma	6.958 ±	0.3738E-01

Numb direct p.e.

χ^2/ndf	163.6	/ 27
P1	9.508 ±	0.2387E-01
P2	0.7222 ±	0.9145E-02
P3	0.2641E+05 ±	162.5

Numb reflected p.e.
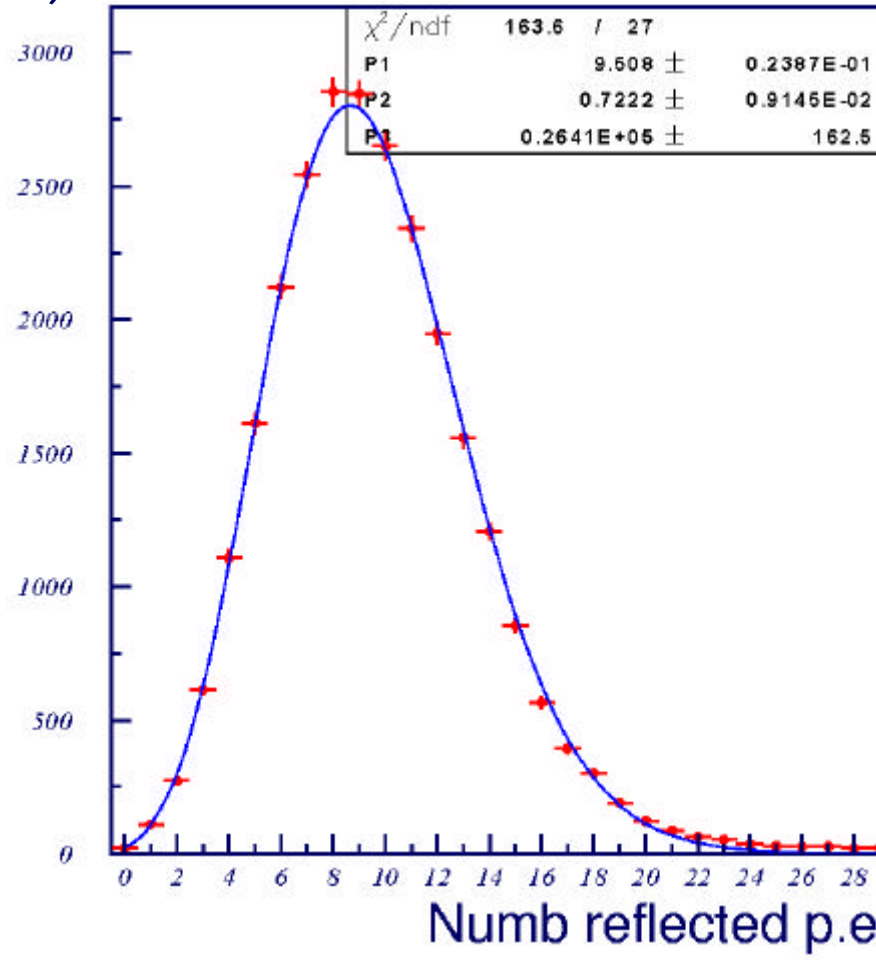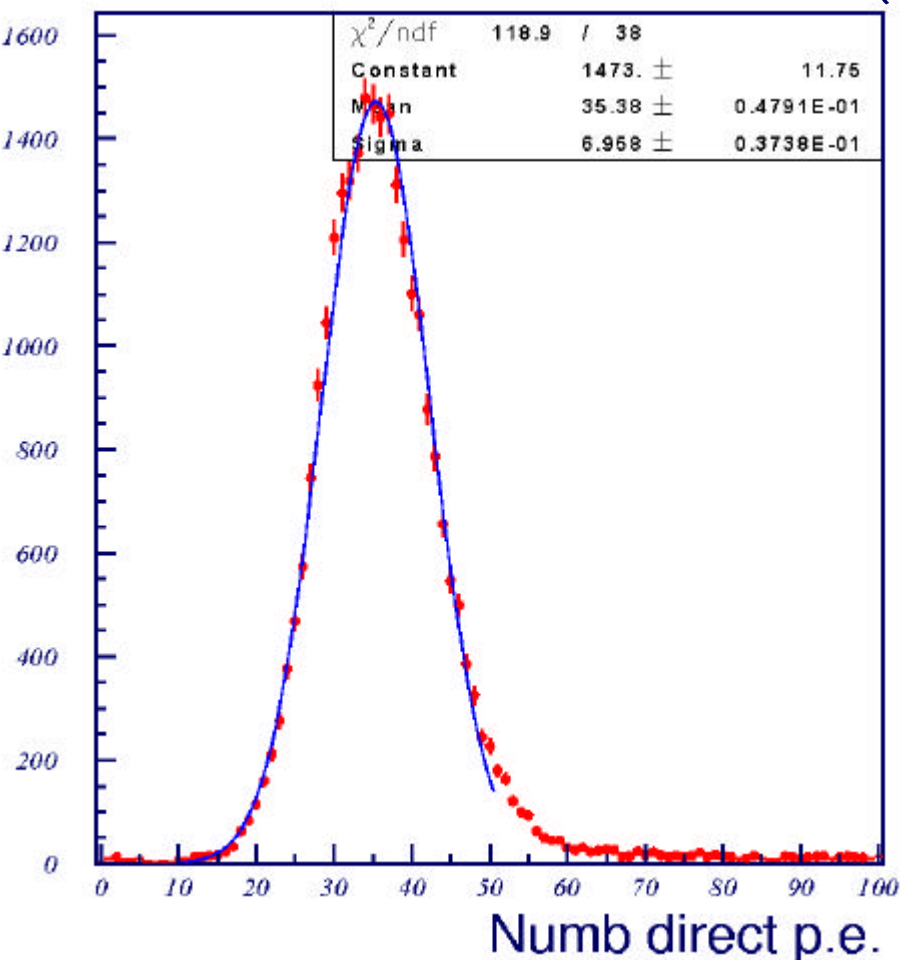
Direct photons: < Npe > = 35.38 +/- 0.05   Reflected photons: < Npe > = 9.508 +/- 0.0

$$\mathbf{e}_{mir} = \frac{N_{pe}^{ref}}{N_{pe}^{dir}} \frac{\mathbf{e}_{geo}^{dir}}{\mathbf{e}_{geo}^{ref}} \frac{\mathbf{e}_{lg}^{dir}}{\mathbf{e}_{lg}^{ref}}$$

He events:

	Direct	Reflected
N_{pe}	35.38+/-0.05	9.51+/-0.02
ε_{LG}	0.7067+/-0.2E^{-4}	0.7709+/-0.3E^{-4}
ε_{geo}	0.6254+/-0.7E^{-4}	0.205+/-0.2E^{-4}

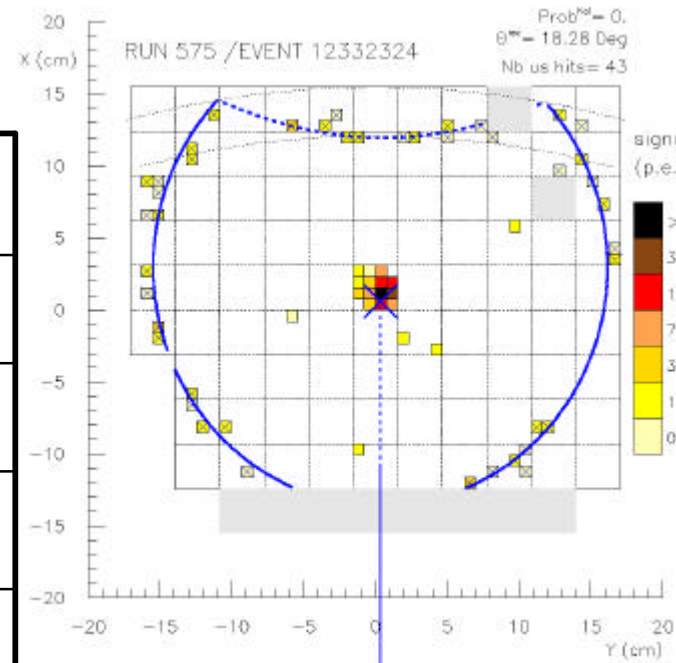Systematics

- Bad association of corner hits

- Pixelization

Few percent

Reflectivity ~ (75.1 +/- 0.2 +/-syst) %

Mirror reflectivity:dependence with the incident angle

✓ Z=2 events

✓ reflected branch divided in 5 parts

Branch	Δphi	$<npe_{ref}>$	εlg_{ref}	$<\theta>\gamma_s$ (º)	Reflectivity (%)
1	0.2569 +/-0.4E^{-4}	1.64 +/- 0.2E^{-1}	0.767 +/- 0.4E^{-5}	66.0	65.3 +/- 0.9
2	0.2569+/-0.4E^{-4}	1.472 +/- 0.3E^{-1}	0.762 +/- 0.2E^{-4}	64.3	59. +/- 1.
3	0.2569+/-0.4E^{-4}	1.936 +/- 0.2E^{-1}	0.760 +/- 0.6E^{-4}	63.5	77.6+/- 0.9
4	0.2569+/-0.4E^{-4}	1.849 +/- 0.3E^{-1}	0.761 +/- 0.5E^{-5}	63.7	74. +/- 1.
5	0.l755+/-0.2E^{-3}	1.109 +/- 0.4E^{-1}	0.763 +/- 0.4E^{-5}	64.5	65. +/- 2.

RUN 575 /EVENT 12332324
Prob^{tot}= 0.
θ^{rec} = 18.28 Deg
Nb us hits= 43

✓ **Signal variation dominated by pixalization** error of 20% for a branch Δφ~15°

Direct part

< Npe > = 35.38 +/- 0.05

<Eff LG> = 0.7067+/-0.2E^{-4}

<acc geo> = 0.6254+/-0.7E-4

Mirror reflectivity:dependence with the incident angle

✓ Z=6 events

Branch	Δphi	$<npe_{ref}>$	εlg_{ref}	$<\theta>\gamma_s$ (º)	Reflectivity (%)
1	0.2581 +/-0.1E^{-3}	18.7 +/- 0.2	0.7675 +/-0.1E^{-3}	66.3	59.2 +/- 0.7
2	0.2581 +/-0.1E^{-3}	17.1 +/- 0.3	0.7624 +/-0.9E^{-4}	64.5	54.4 +/- 0.8
3	0.2581 +/-0.1E^{-3}	22.8 +/- 0.3	0.7601 +/-0.1E^{-3}	63.7	72.7 +/- 0.9
4	0.2581 +/-0.1E^{-3}	23.6 +/- 0.3	0.7606 +/-0.1E^{-3}	63.8	75.3 +/- 0.9
5	0.1715 +/-0.3E^{-3}	14.03 +/-0.2	0.7634 +/-0.9E^{-4}	64.8	67. +/- 1.
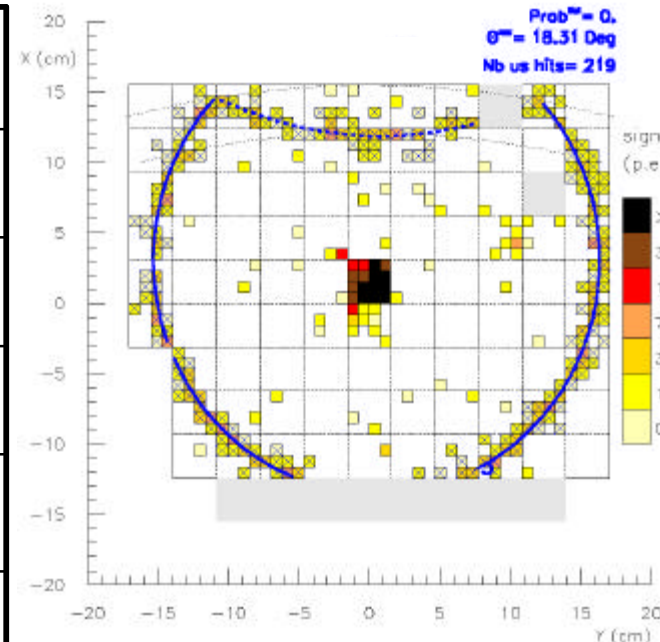
Direct part

< Npe > = 445. +/- 2.

<Eff LG> = 0.7075+/-0.8E^{-}

<acc geo> = 0.6270+/-0.2E^{-}

Uniformity of the signal with the g azimuthal angle

Run 538   (θ=0°)   CI N103
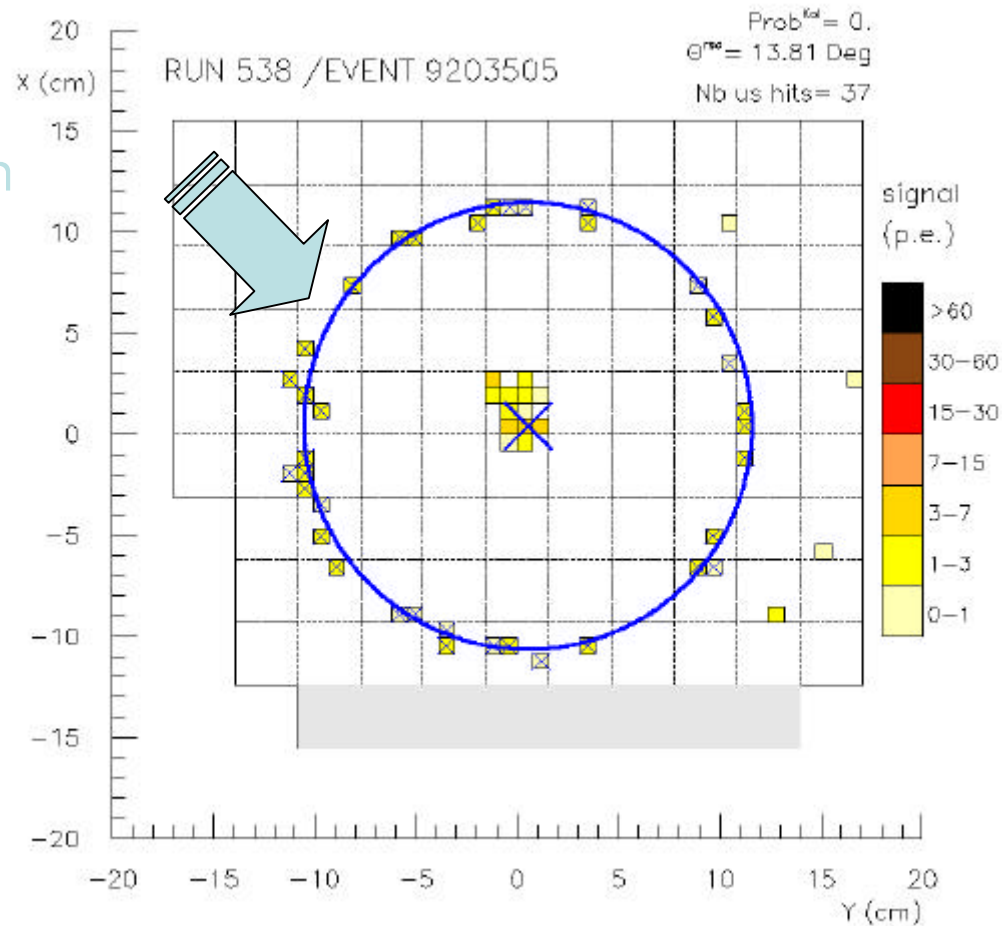
full contained direct ring

4 parts division:
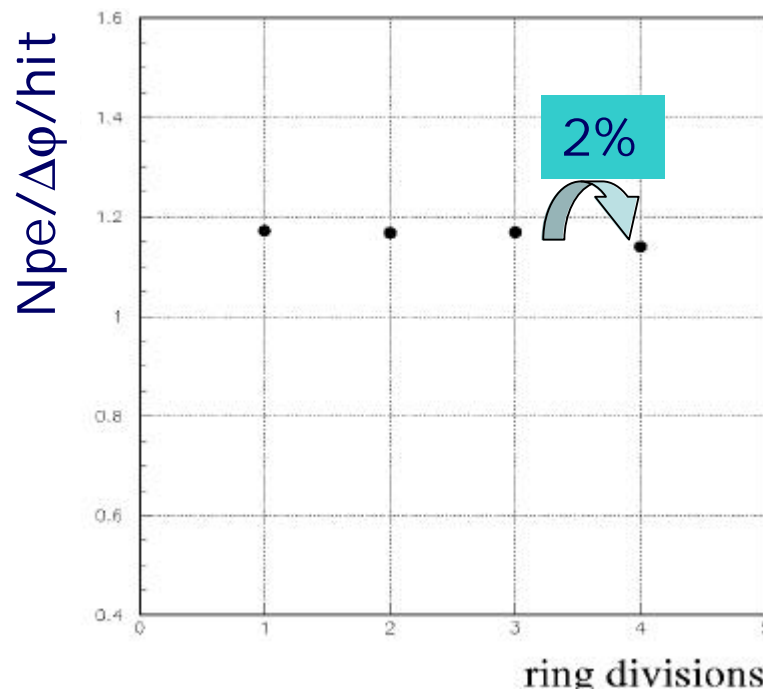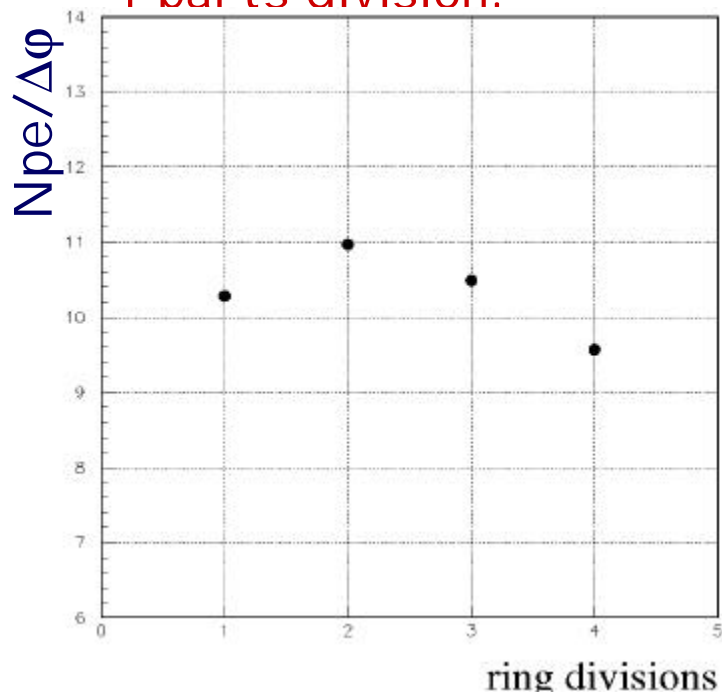
✓ Pixelization effect starting to be visible in the first 3 measures

✓ 2% decresce in the npe/pixel: Maybe a missfunction related with the Kapton ?!
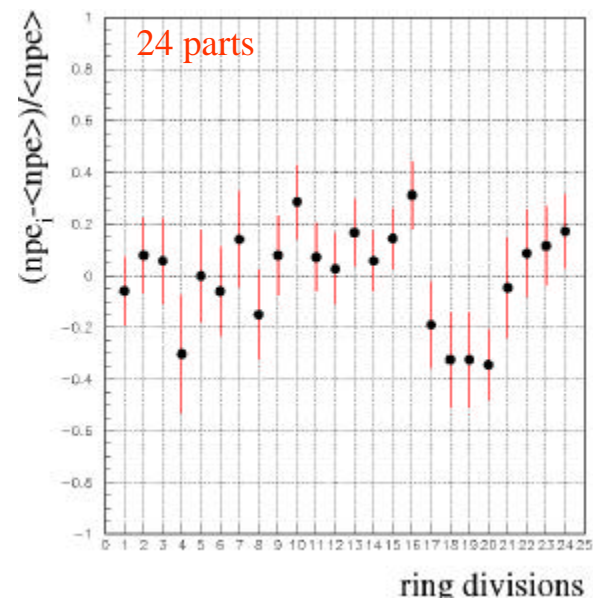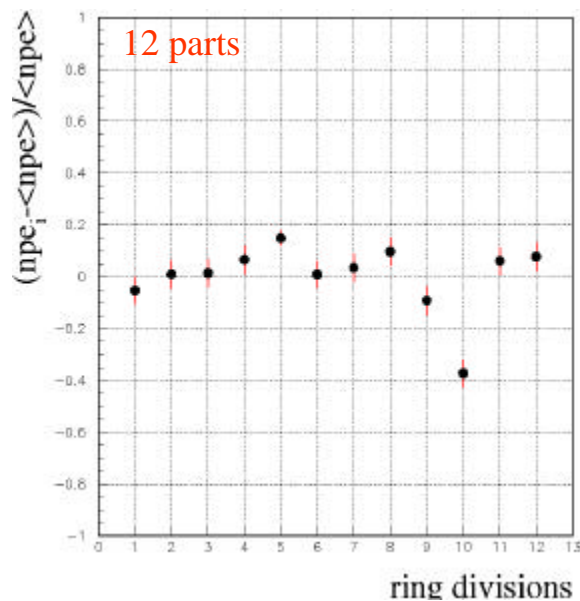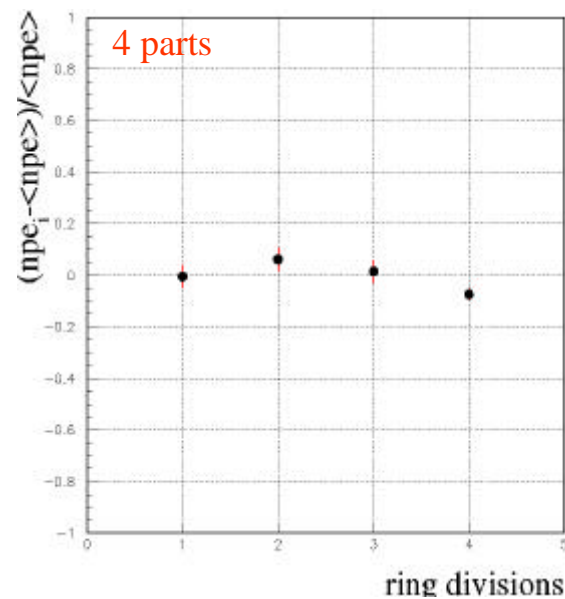
Problematic signal zone
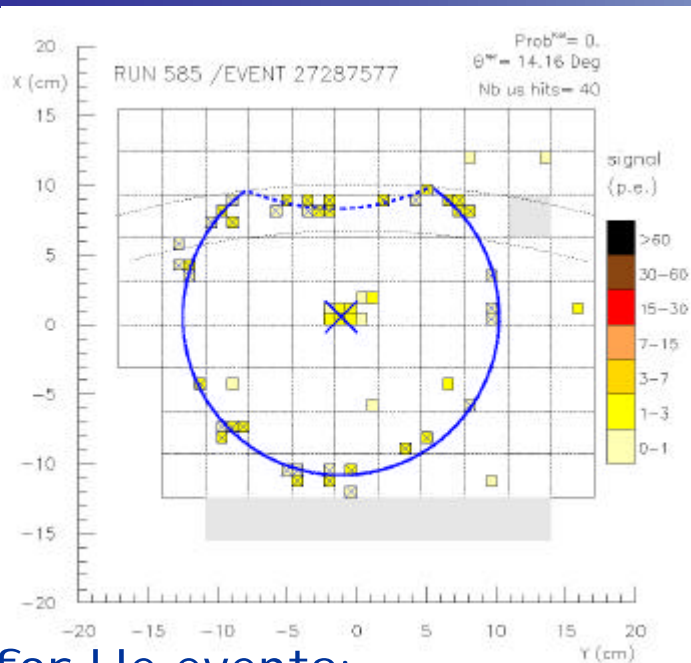
Run 538

Z=2 event

Region with
a decrease
of signal

Uniformity of the signal with the g azimuthal angle

✓ 24 divisions Δφ=15° within 20% of error in npe/Δφ

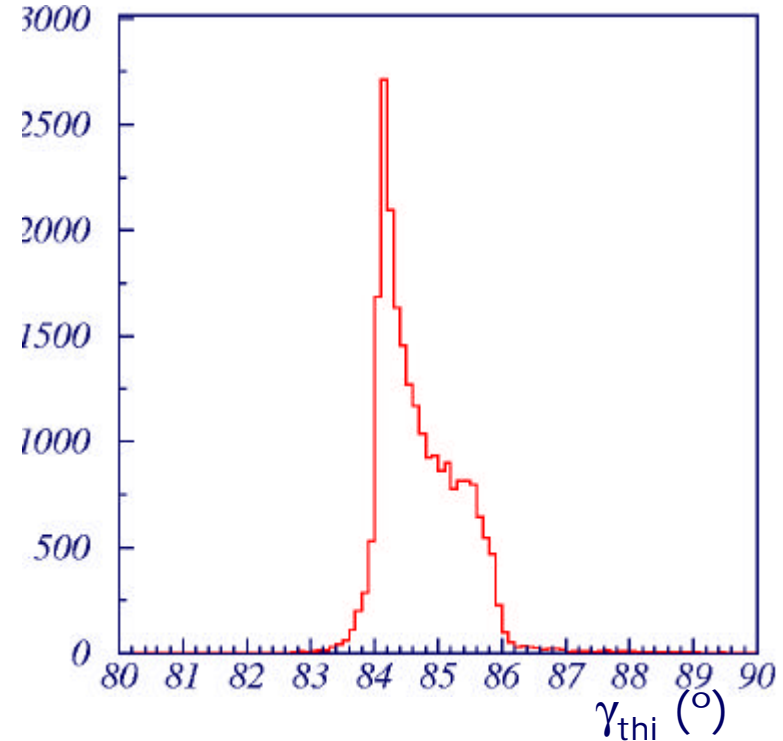Distribution of the photon incident angle on the mirror (related to the normal to the mirror surface)

for He events:

	Direct	Reflected
N_{pe}	38.30 +/- 0.3	7.426 +/- 0.1
ε_{LG}	0.7857 +/- 0.1E^{-4}	0.7859 +/- 0.6E^{-4}
ε_{geo}	0.8081 +/- 0.3E^{-3}	0.1919 +/- 02E^{-3}

γ_{thi} (°)

Reflectivity ~ (81.7 +/- 1.7 +/- syst)
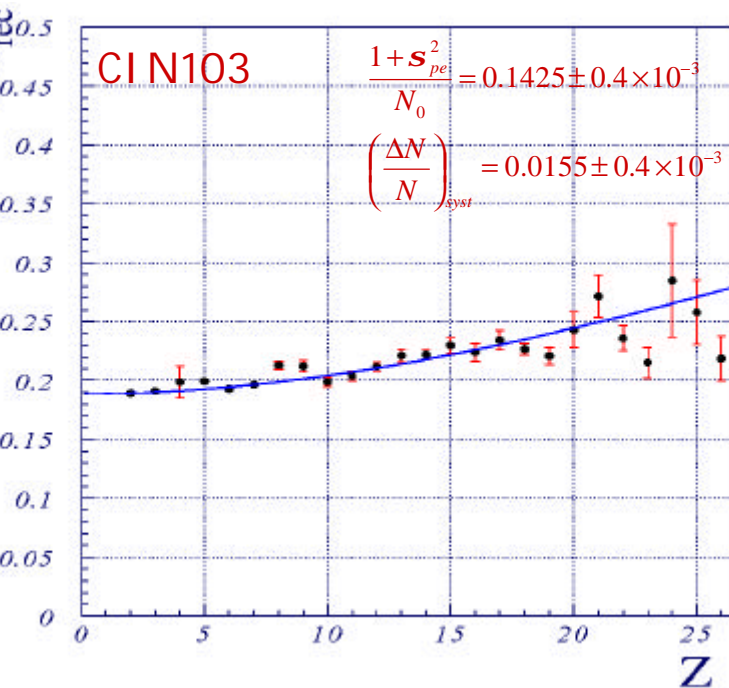
Test Beam 2003
Charge resolution

Charge resolution

Estimation of charge resolution obtained with both Tracker and scintillators charge selection

For CIN103 all the statistics of scan runs 538-546
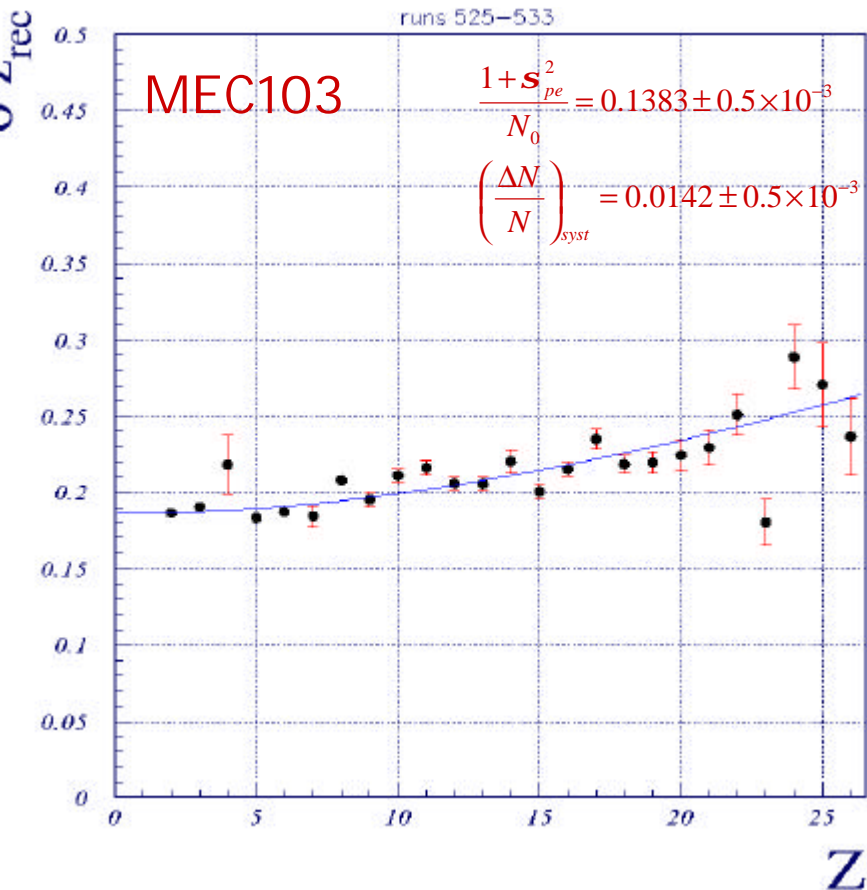
For MEC103 all the statistics of scan runs 525-533

For CIN 105 statistics of run 548 (tile too small to check its uniformity)
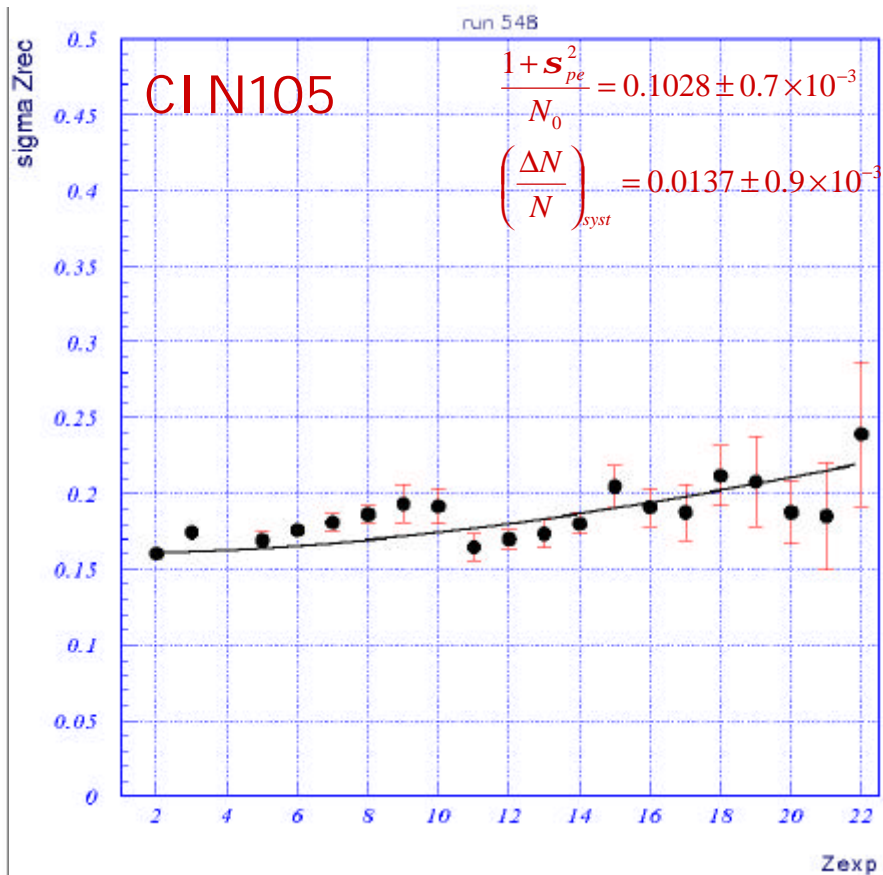

CIN103

$$\frac{1+s_{pe}^2}{N_0} = 0.1425 \pm 0.4 \times 10^{-3}$$

$$\left(\frac{\Delta N}{N}\right)_{syst} = 0.0155 \pm 0.4 \times 10^{-3}$$

$$s(Z) = \frac{1}{2}\sqrt{\frac{1+s_{pe}^2}{N_0} + \left(\frac{\Delta N}{N}\right)_{syst}^2 Z^2}$$
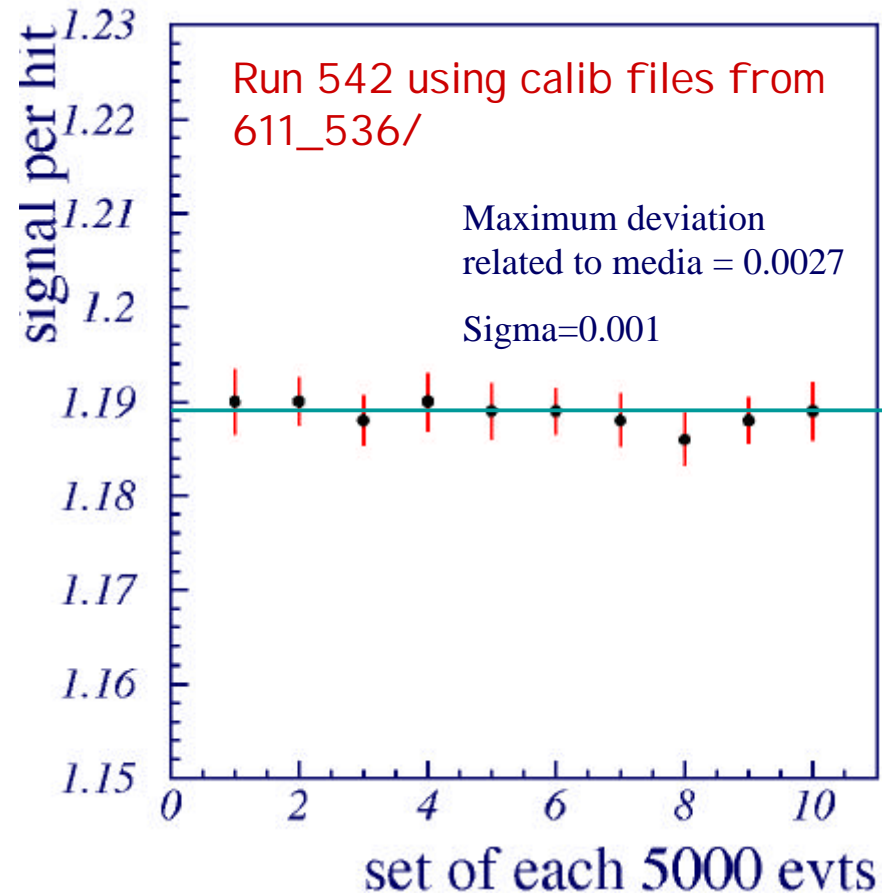
Charge resolution

Run 525-533

Run 548

MEC103

$$\frac{1+s_{pe}^2}{N_0} = 0.1383 \pm 0.5 \times 10^{-3}$$

$$\left(\frac{\Delta N}{N}\right)_{syst} = 0.0142 \pm 0.5 \times 10^{-3}$$

CIN105

$$\frac{1+s_{pe}^2}{N_0} = 0.1028 \pm 0.7 \times 10^{-3}$$

$$\left(\frac{\Delta N}{N}\right)_{syst} = 0.0137 \pm 0.9 \times 10^{-3}$$

Gain Stability within each run

Run 538 using calib files from 611_536/

Maximum deviation related to media = 0.0039

Sigma=0.002

Run 542 using calib files from 611_536/

Maximum deviation related to media = 0.0027

Sigma=0.001
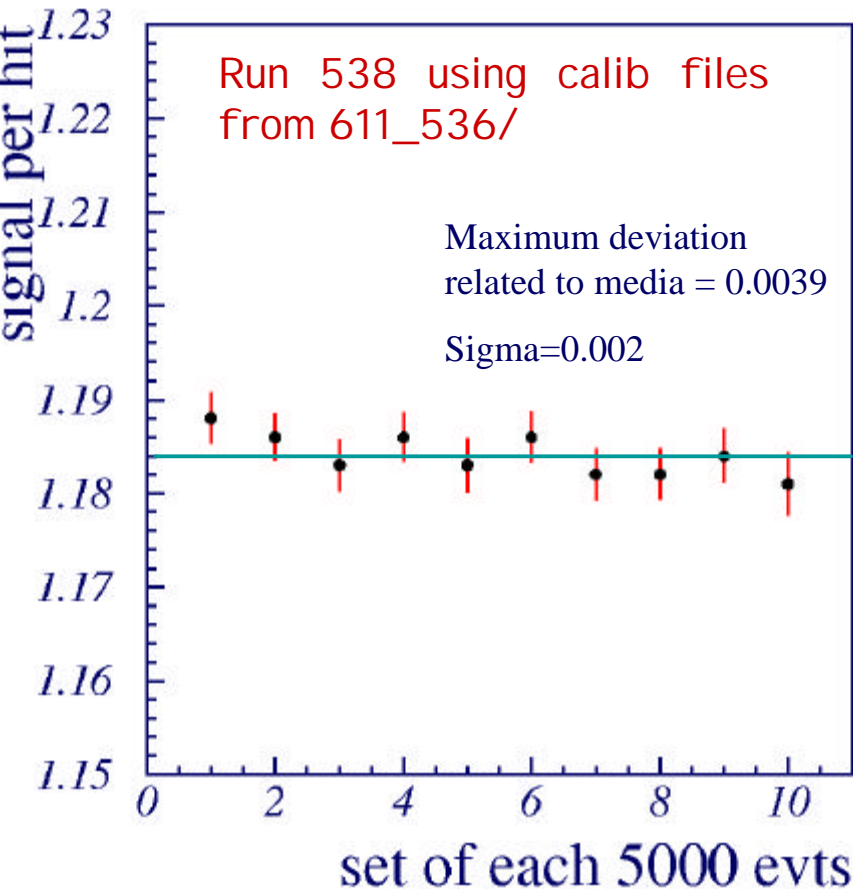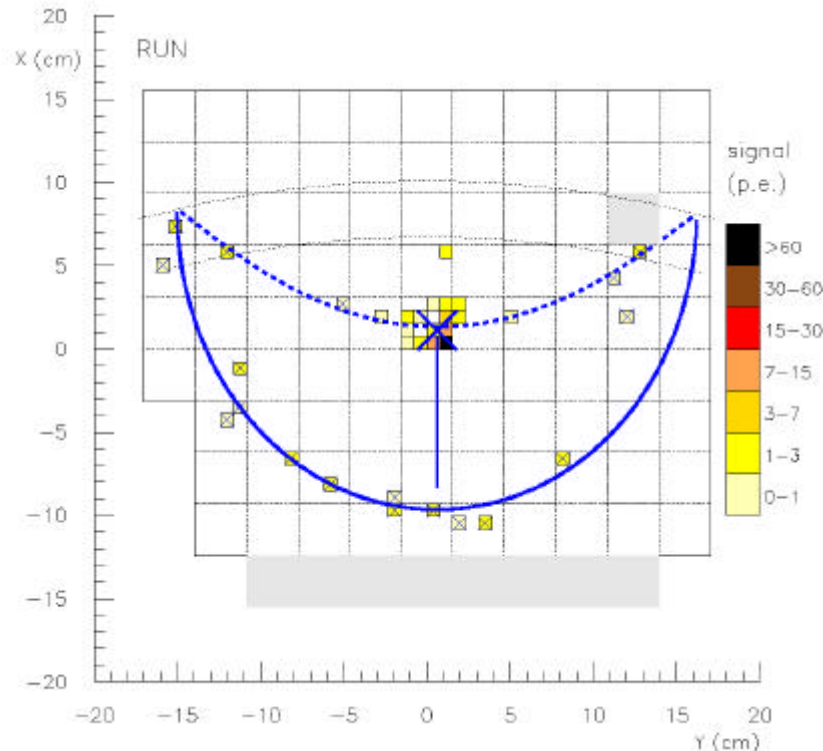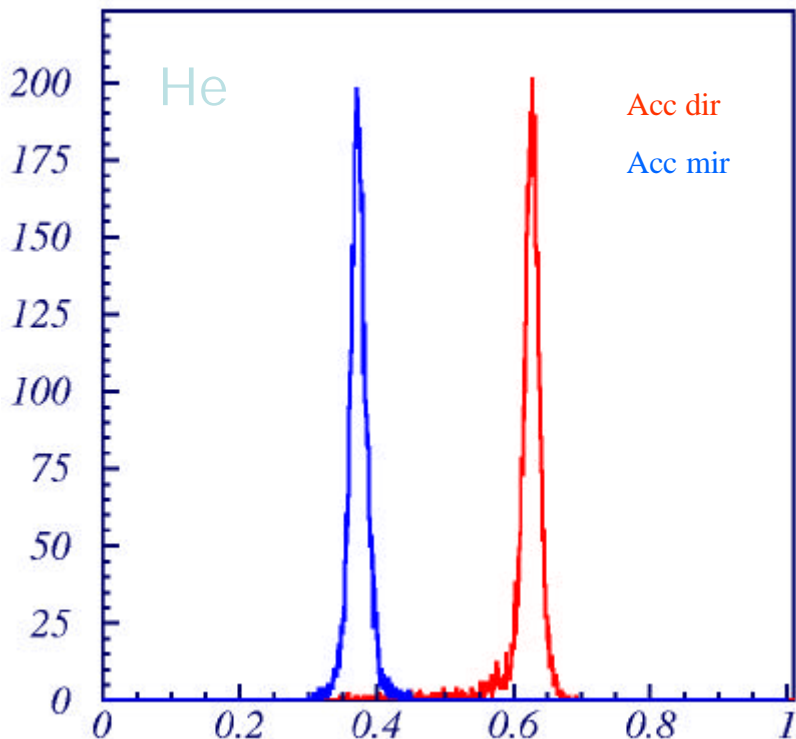
✓ Gain stability at the order of 1/1000 verified within each run

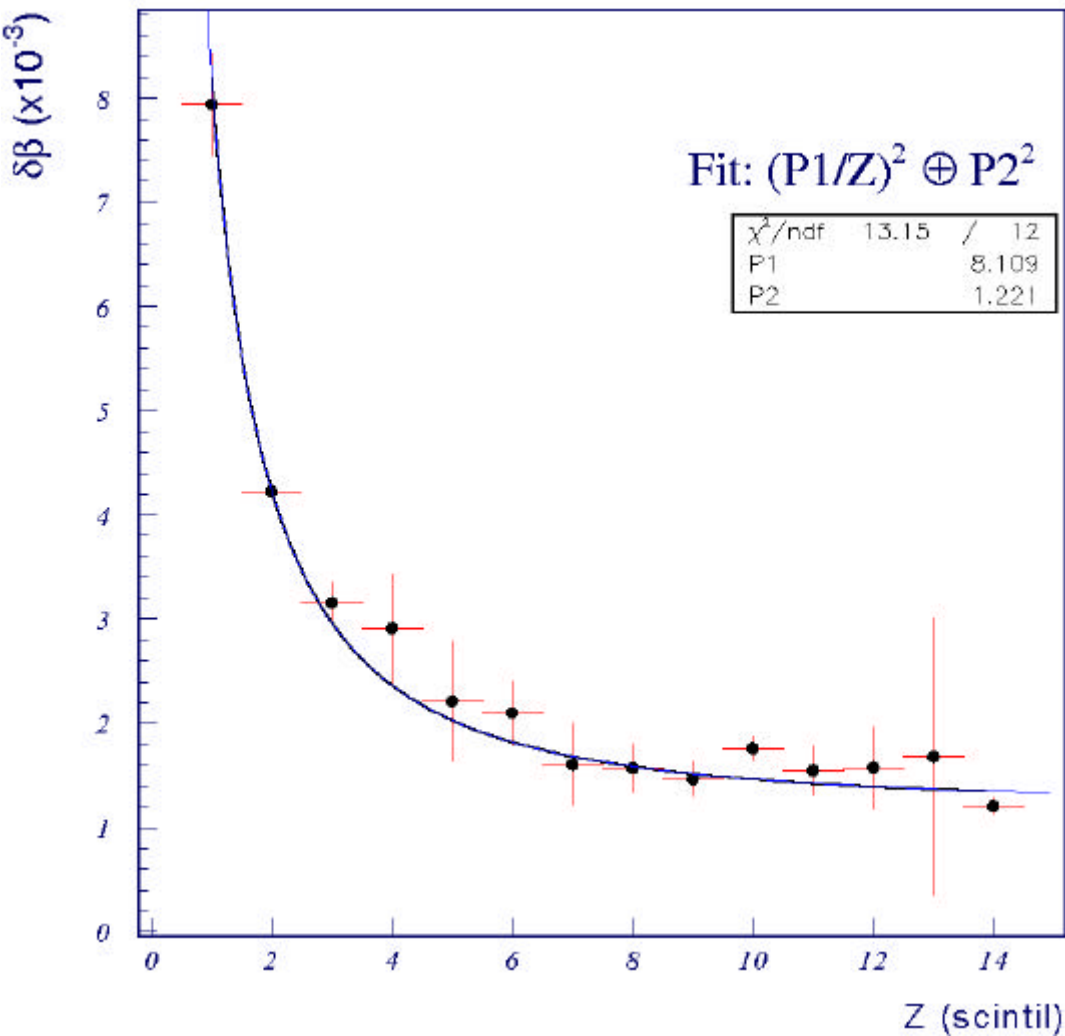✓ Between runs variation of 5/1000

Test Beam 2003
NaF runs analysis

Geometrical ring acceptance:

➢ Direct ~ 63%

➢ Reflected ~37%

Velocity resolution NAF 0.5 cm q=5° H=7.8 cm

Fit: $(P1/Z)^2 \oplus P2^2$

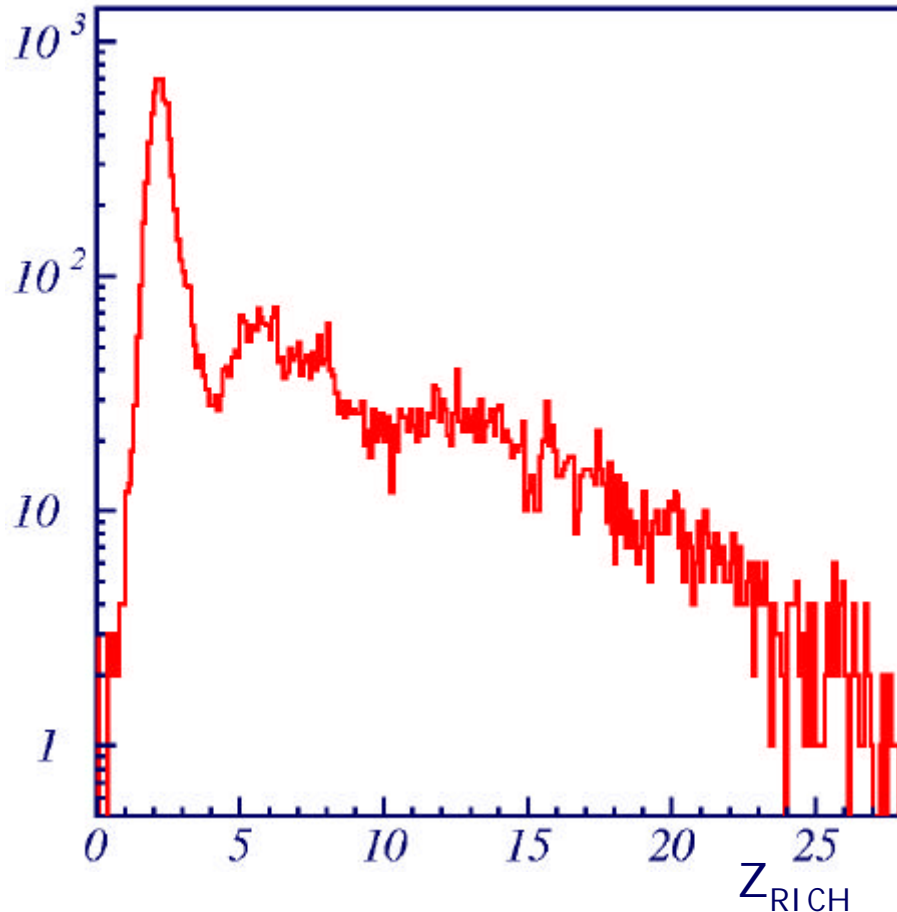| χ^2/ndf	13.15	/	12
P1			8.109
P2			1.221

Resolution:

(Z=1) ~ 8.1×10^{-3} +/- 0.1×10

(Z>>) ~ 1.2×10^{-3} +/- 0.7×10^{-4}

Charge reconstruction with NaF

✓ Charge reconstructed only with direct branch

From data:

$$\sigma Z_{(Z=2)} = 0.320 \; +/- \; 0.3E^{-2}$$

and expected:

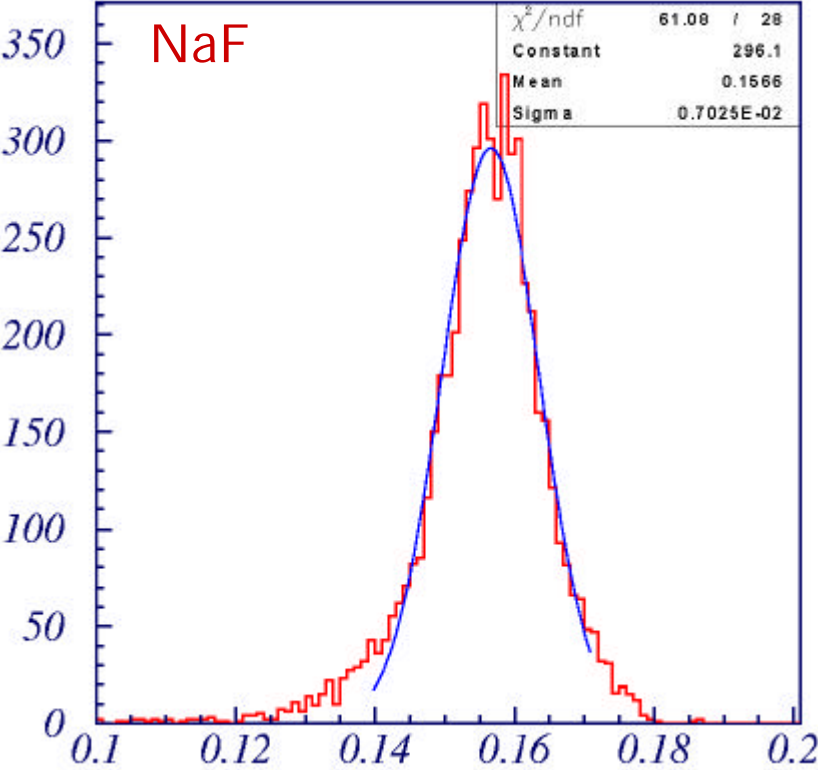$$s(Z)_{stat} = \frac{1}{2}\sqrt{\frac{1+s_{pe}^{2}}{N_0}} = 0.32$$

with $\quad s_{pe} = 0.75 \quad$ and

$N_0 \sim 3.8\,pe \quad (npe$ of the direct part for $Z =$

Charge reconstruction: errors

He events

Total efficiency

NaF

χ^2/ndf	61.08 / 28
Constant	296.1
Mean	0.1566
Sigma	0.7025E-02

✓ A large statystical error (0.32) can be improved by using almost all the ring (direct hits + some reflected hits)

✓ A large systematic error ~4%

⟹ look for runs with full contained rings

$\Delta eff_{tot} = 0.7E^{-2}$ ⟹ Systematic error 4%

Conclusions

✓ reevaluation of the mirror reflectivity with run 575 (15°) after PMT status correction and evaluation with run 585 (0°)

✓ mirror reflectivity study dividing the reflected branch to study the correlation with the incident angle in the mirror rended impossible because we are being dominated by pixalization ⟹ error of 20% for a branch $\Delta\varphi \sim 15°$

✓ Charge resolution obtained with CIN103, MEC103, CIN105

✓ NaF run analysis:

    ✓ velocity resolution for Z=1 (8.1×10^{-3} +/- 0.1×10^{-3})

    ✓ charge reconstruction with large statystical error (0.32)

       to be improved by using almost all the hits in the ring in the runs with mirror