IT reconstruction

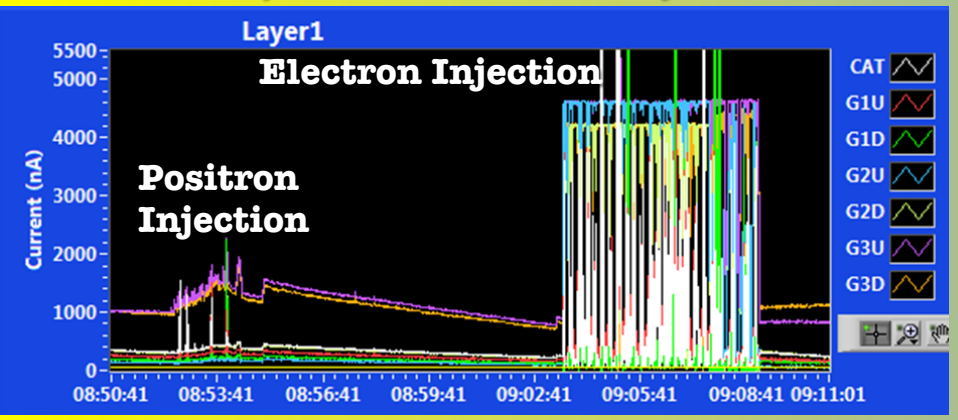
G. Morello on behalf of the KLOE-2 IT group

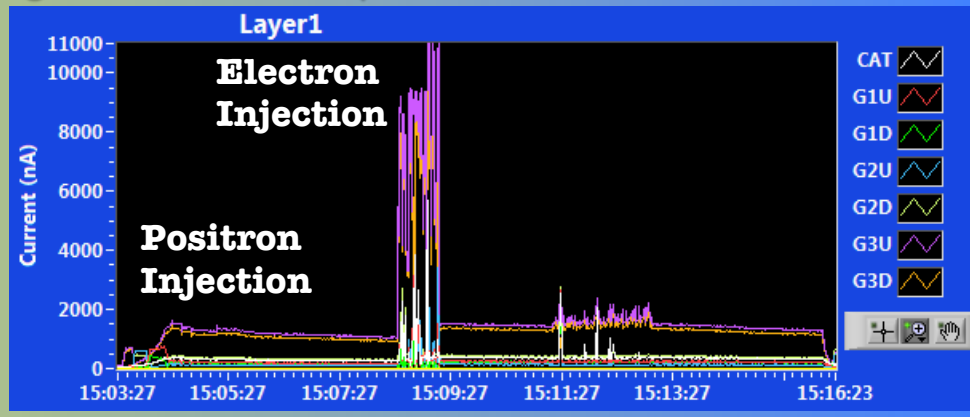
July 13th, 2015

IT Operation with Collisions

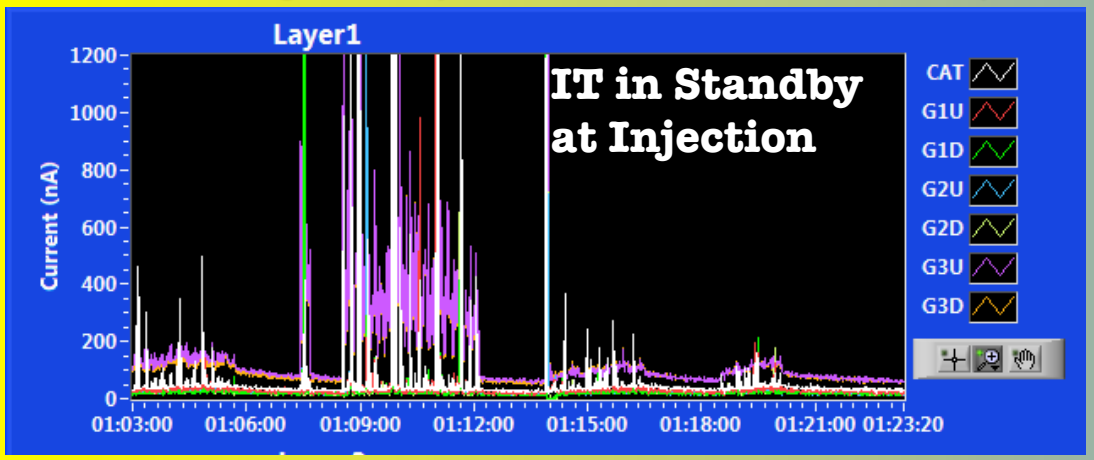
- *May 12th 2014 IT On for the very first time with Collisions*

1. **IT Layer #1 Currents at Injection**: discharges with values up to tens of microA



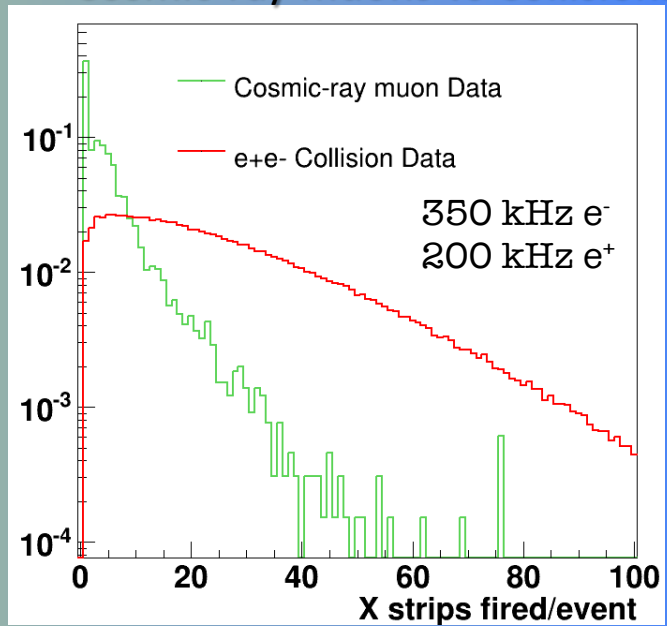


2. **IT in Stand-by mode: Layer #1 Currents**
   discharges at injection also when in Standby



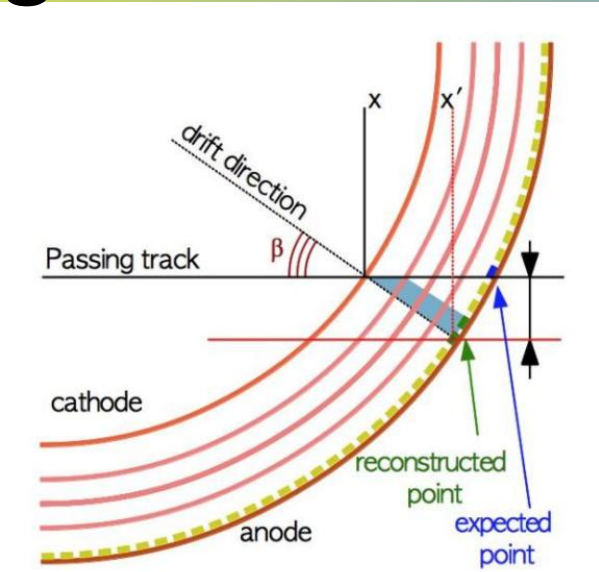
e- injection & beam losses can be very dangerous increasing the discharge occurrence → passive divider

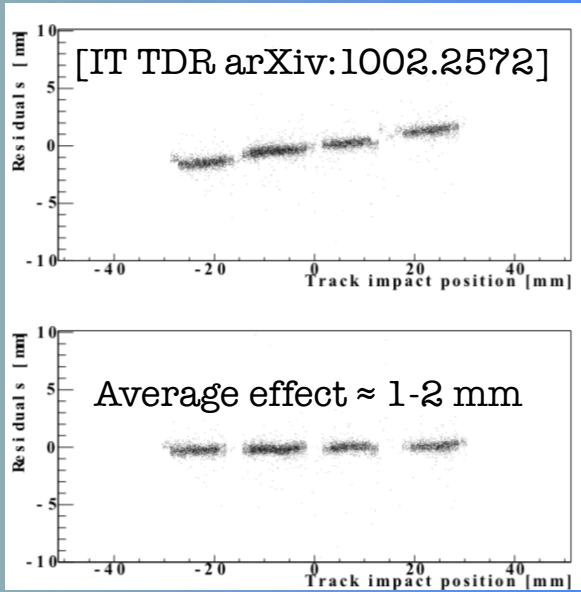
3. **IT Layer #1 Strip Multiplicity:**
   Cosmic-ray muons vs Collisions



IT Alignment & Calibration

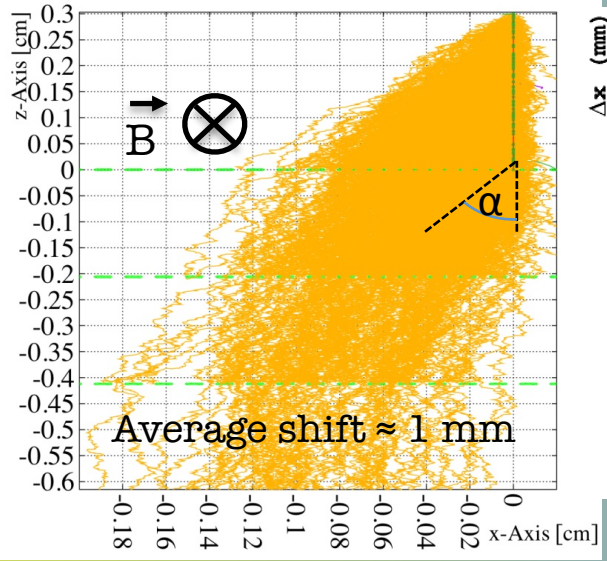
1. NON-RADIAL TRACKS
The angle formed by a track and the orthogonal to the cathode influences the reconstruction at two levels: **shift & spread**

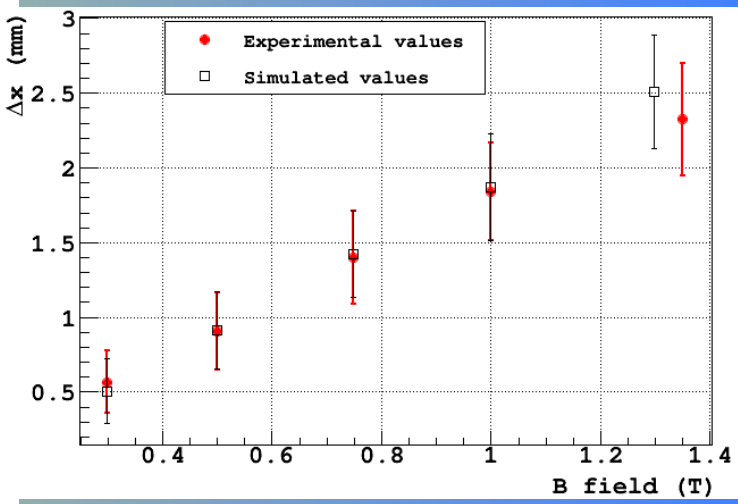




2. MAGNETIC FIELD
KLOE-2 0.52 T magnetic field is orthogonal to the electric fields of the triple-GEMs, introducing two effects: a **shift** $\Delta x(\alpha_L)$ and consequently a **larger spread of the electron cloud.**

Gas: iC_4H_{10} 10%, Ar 90%, T=290 K, p=1 atm



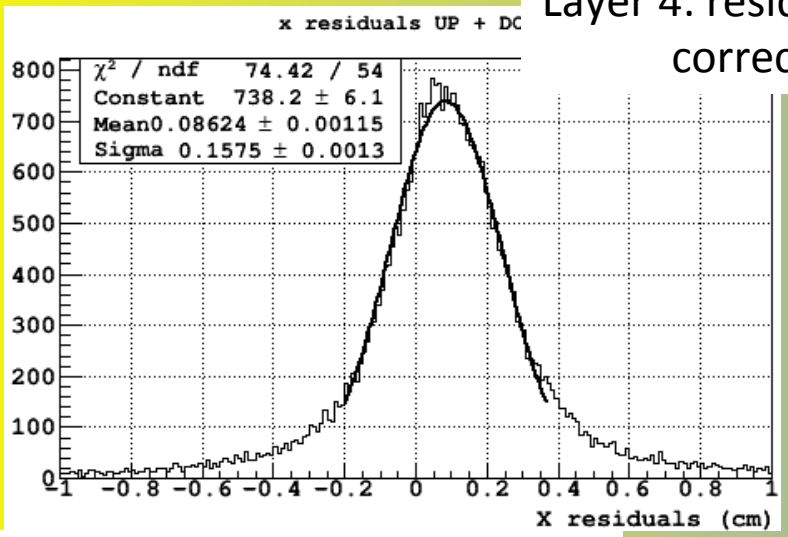


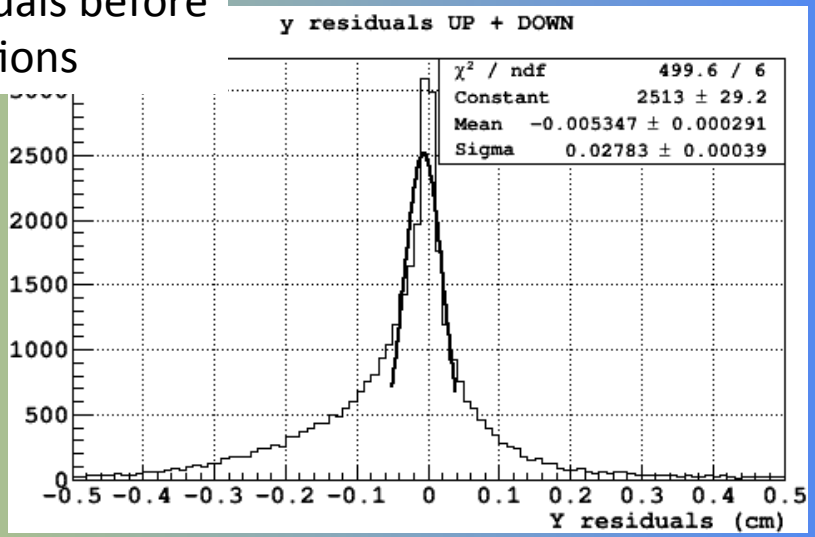
- Cosmic-ray muons, w/wout B-field & Bhabha scattering to evaluate two effects
- Reconstruction Software integration within official framework (ongoing)

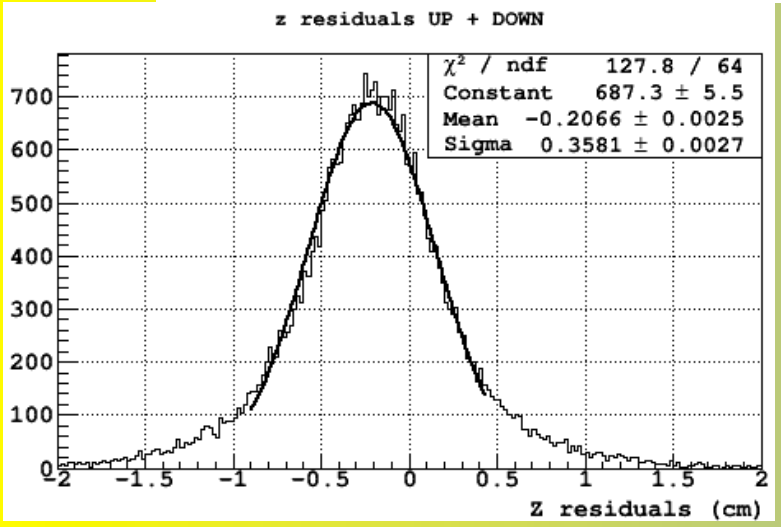
Cosmic-ray muon data without magnetic field(I)

- Alignment based on residuals distribution.
- Residuals are defined as the difference between the expected DC tracks position on IT and the reconstructed position.

Layer 4: residuals before corrections







Selection cuts for DC tracks:

- $R_{pca} < 5$ cm
- $abs(z_{pca}) < 35$ cm

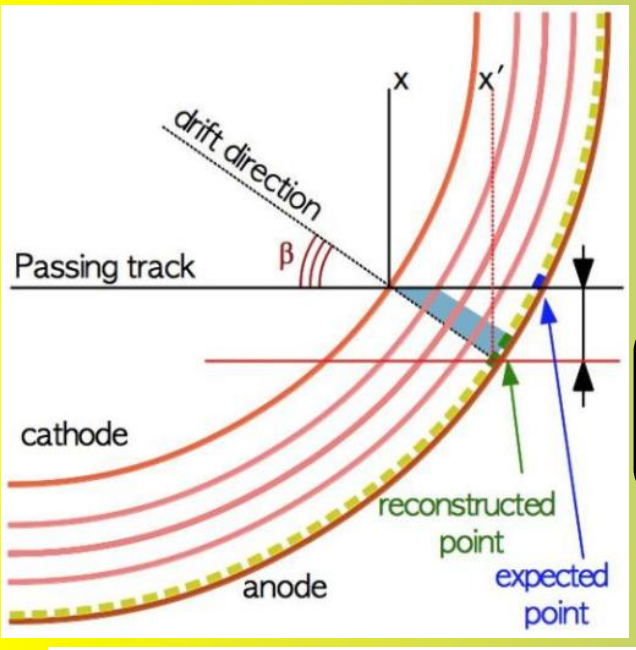
PCA: Point of Closest Approach to the beam line

Δx: 0.086 ± 0.001 cm
Δy: -0.005 ± 0.004 cm
Δz: -0.207 ± 0.003 cm

RES_x: 0.157 ± 0.001 cm
RES_y: 0.028 ± 0.004 cm
RES_Z: 0.358 ± 0.003 cm

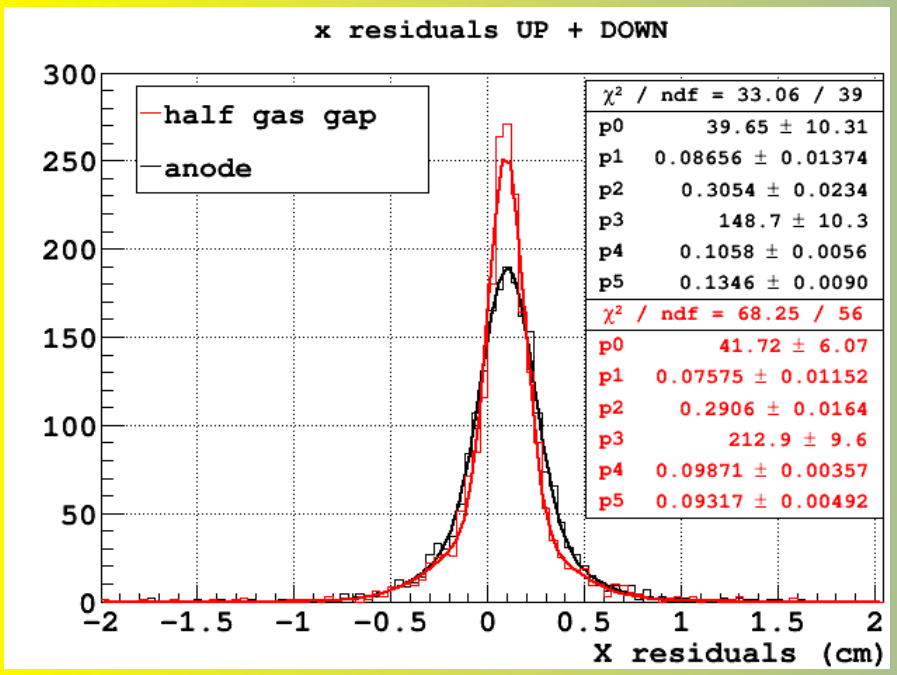
Convolution of DC and IT resolutions

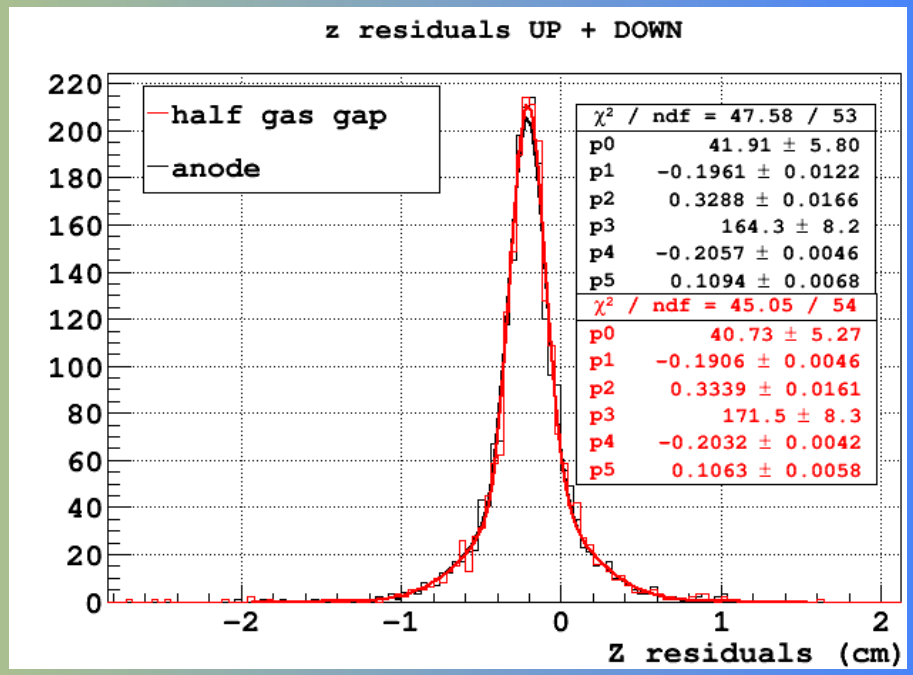
Cosmic-ray muon data without magnetic field (II)



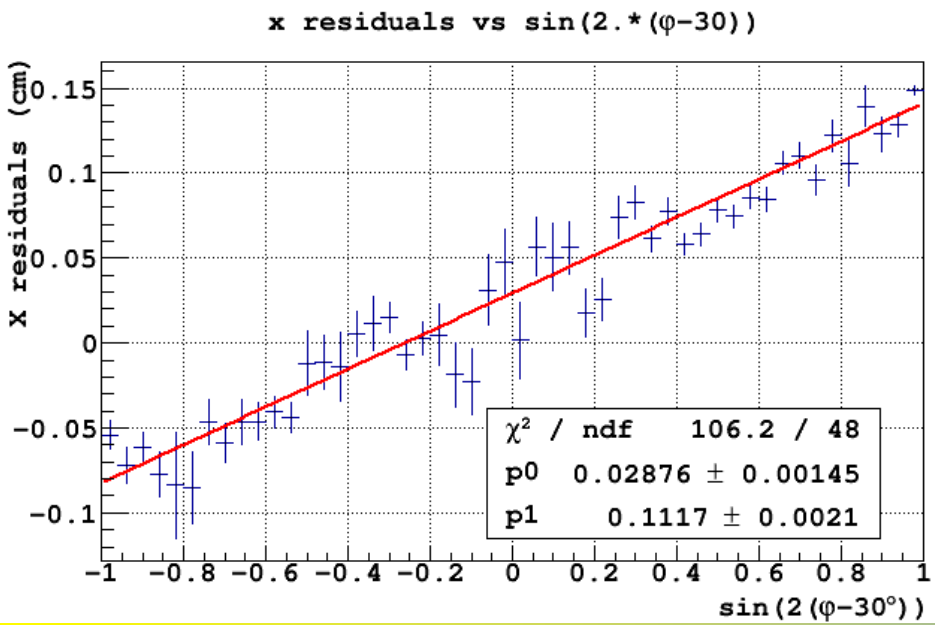
Primary charge center of gravity at **half drift gap** in good approximation, for this reason the measured point on the anode readout is projected on half drift gap.

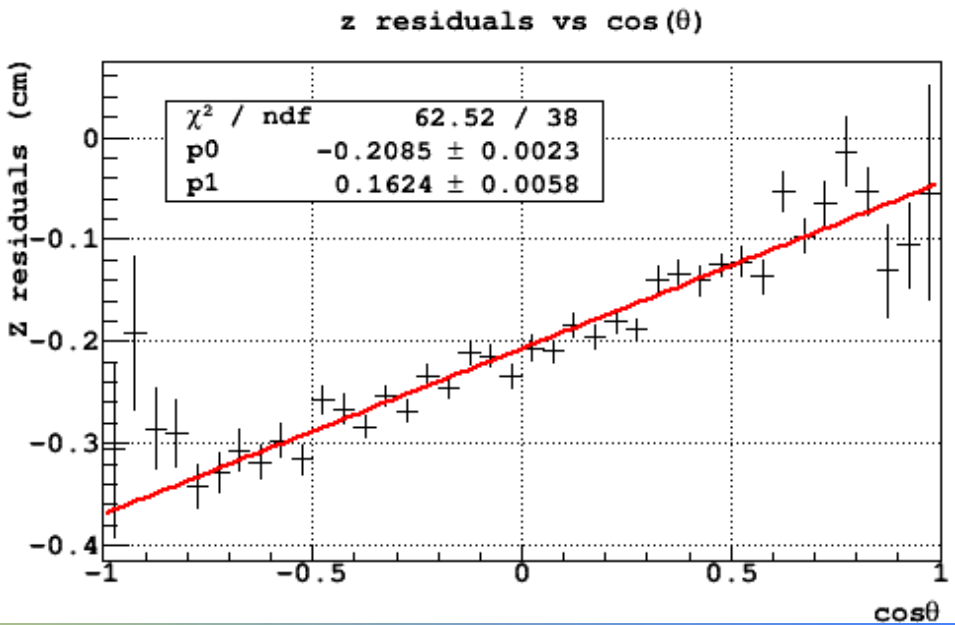
Δx: 0.098 ± 0.003 cm	**RES$_x$**: 0.157 → 0.093 ± 0.005 cm
Δy: -0.002 ± 0.001 cm	**RES$_y$**: 0.028 → 0.017 ± 0.001 cm
Δz: -0.203 ± 0.004 cm	**RES$_z$**: 0.358 → 0.106 ± 0.006 cm





First IT calibration with θ and ϕ angles from DC tracks

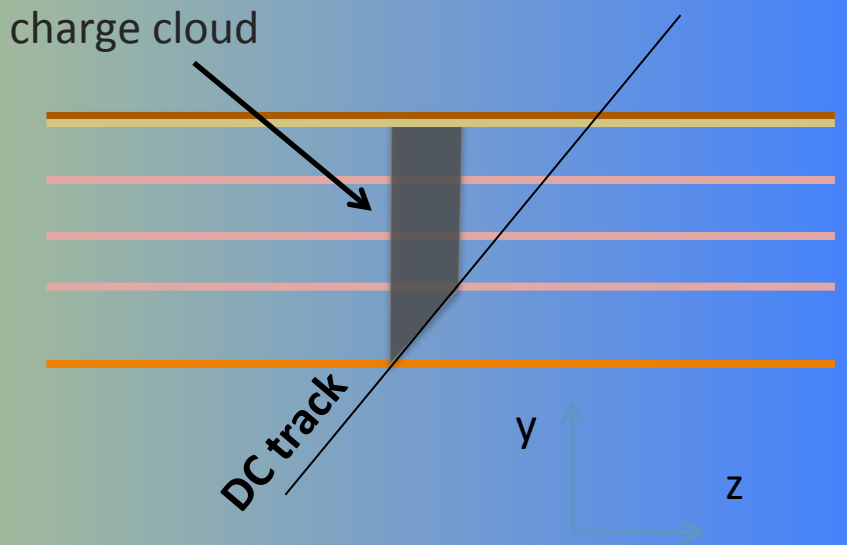




A clear dependence of the residuals on the angles of the DC crossing track is evident. From these correlations we could obtain some preliminary calibration functions:

$x' = x_{halfgap} + 0.029 + 0.115*\sin(2*(\phi-30°))$

$y' = y_{halfgap} - 0.048 + 0.07*\cos(2*(\phi-30°))$

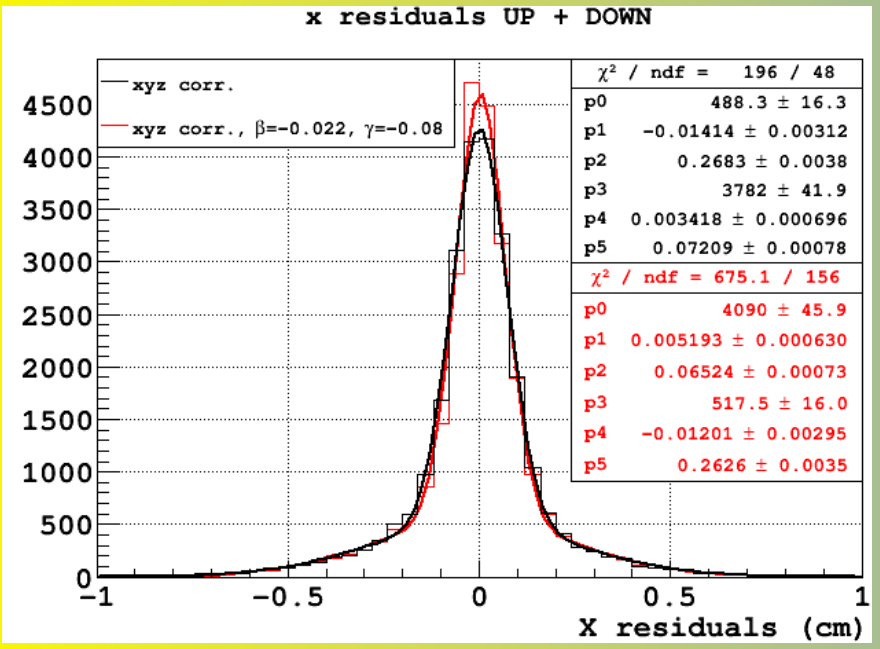


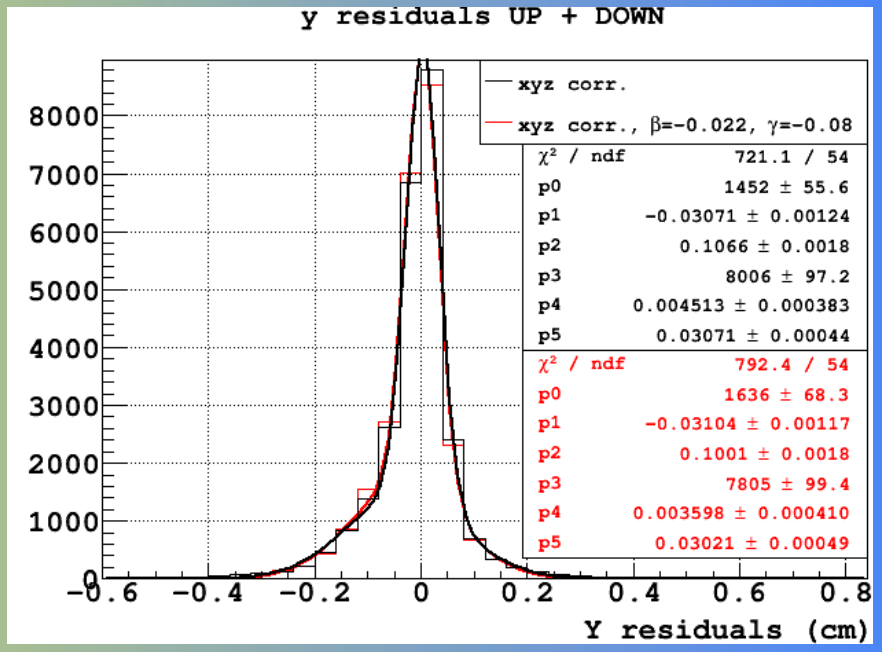
$z' = z_{halfgap} - 0.208 + 0.162*\cos(\theta)$

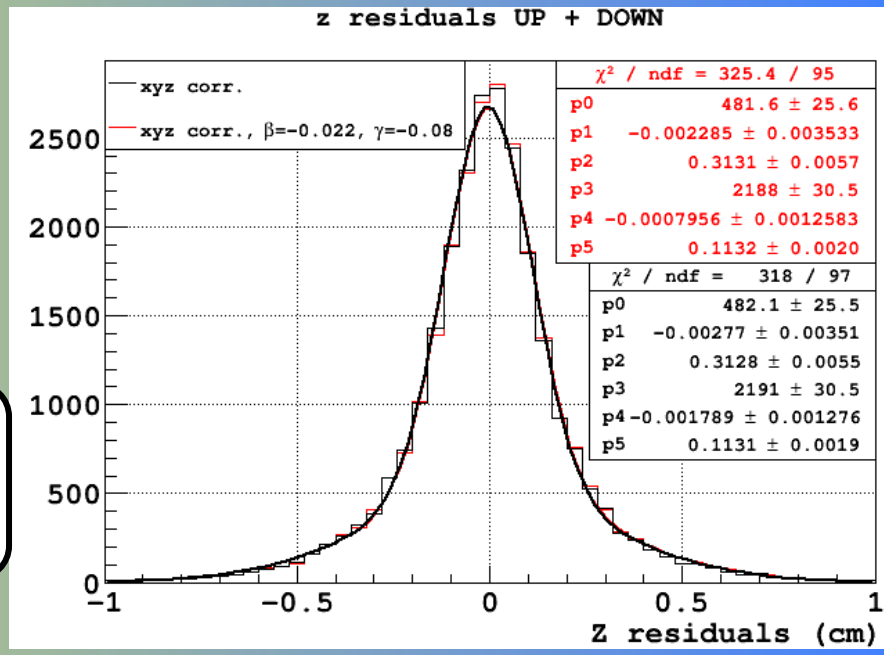
Present status

Two rotations applied:

- 0.022° around y axis (vertical dir.)
- -0.08° around z axis (beam line)







Δx: 0.005 ± 0.001 cm
Δy: 0.0036 ± 0.0004 cm
Δz: -0.0008 ± 0.0012 cm

RES$_x$: 0.065 ± 0.001 cm
RES$_y$: 0.0302 ± 0.0005 cm
RES$_z$: 0.113 ± 0.002 cm

Summary

FIRST IT ALIGNMENT AND CALIBRATION WITHOUT MAGNETIC FIELD DONE

Using the following correction:

1) move readout position to half drift gap (from validation tests @ Cosmic-ray stand)
2) DC track θ angle for z coordinate
3) DC track ϕ angle for x-y coordinate
4) rotation around z and y axis

we reached

Δx: 0.086 ± 0.001 cm → 0.005 ± 0.001 cm	**RES$_x$**: 0.157 ± 0.001 cm → 0.065 ± 0.001 cm
Δy: -0.005 ± 0.004 cm → 0.0036 ± 0.0004 cm	**RES$_y$**: 0.028 ± 0.004 cm → 0.0302 ± 0.0005 cm
Δz: -0.207 ± 0.003 cm → -0.0008 ± 0.0012 cm	**RES$_z$**: 0.358 ± 0.003 cm → 0.113 ± 0.002 cm

Convolution of DC and IT resolutions

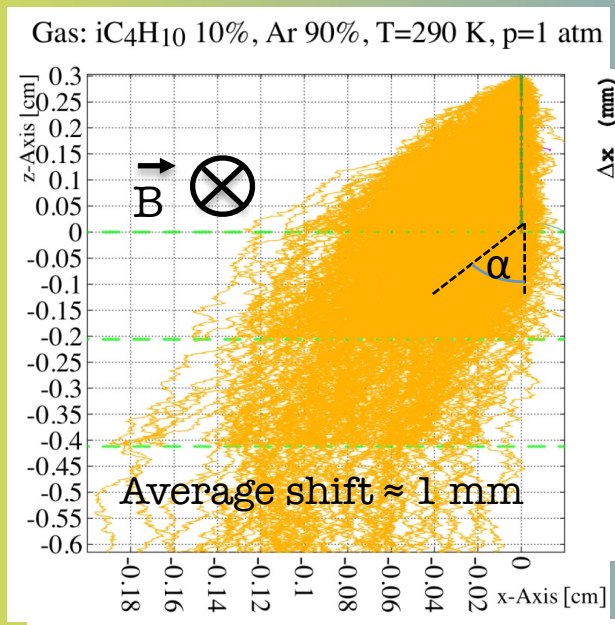
Next steps:

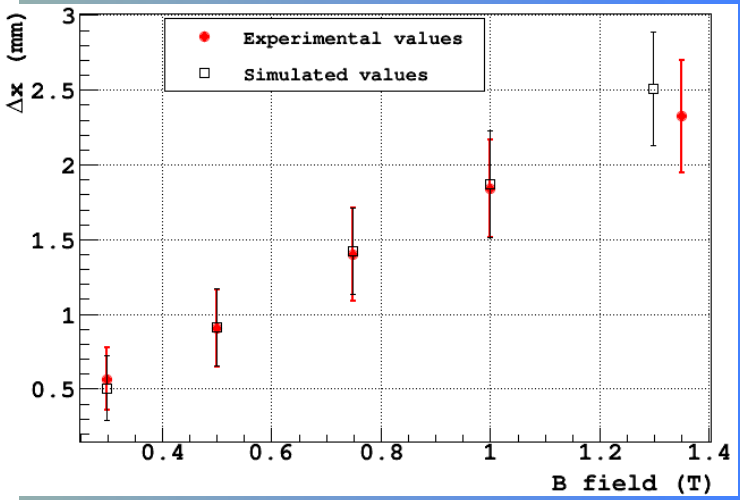
- Expected position on IT: optimization of the DC tracking residuals and computation of errors (AC module already modified)
- Alignment and calibration for all the layers
- Calibration with B-field using cosmic-ray muons and Bhabha scattering *ongoing*
- Insert final alignment and calibration in IT tracking module (ITKALM Reconstruction Software in official KLOE-2 framework ongoing)

Spare

IT Alignment & Calibration (B field on)

KLOE-2 0.52 T magnetic field is orthogonal to the electric fields of the triple-GEMs, introducing two effects: a **shift** $\Delta x(\alpha_L)$ and consequently a **larger spread of the electron cloud.**

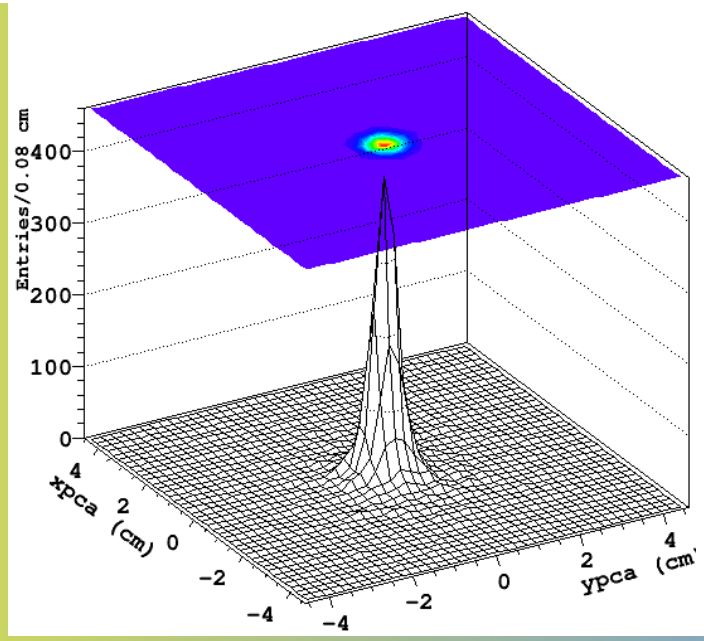


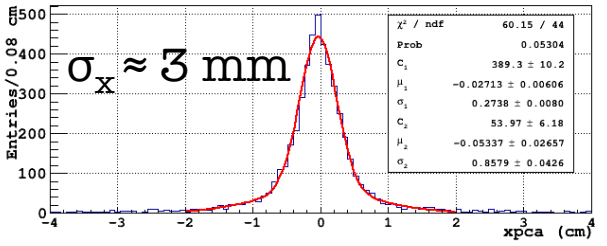


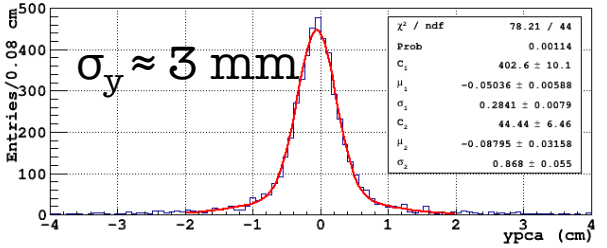
BHABHA SCATTERING

Preliminary Point of Closest Approach (PCA) of the track to beam-line

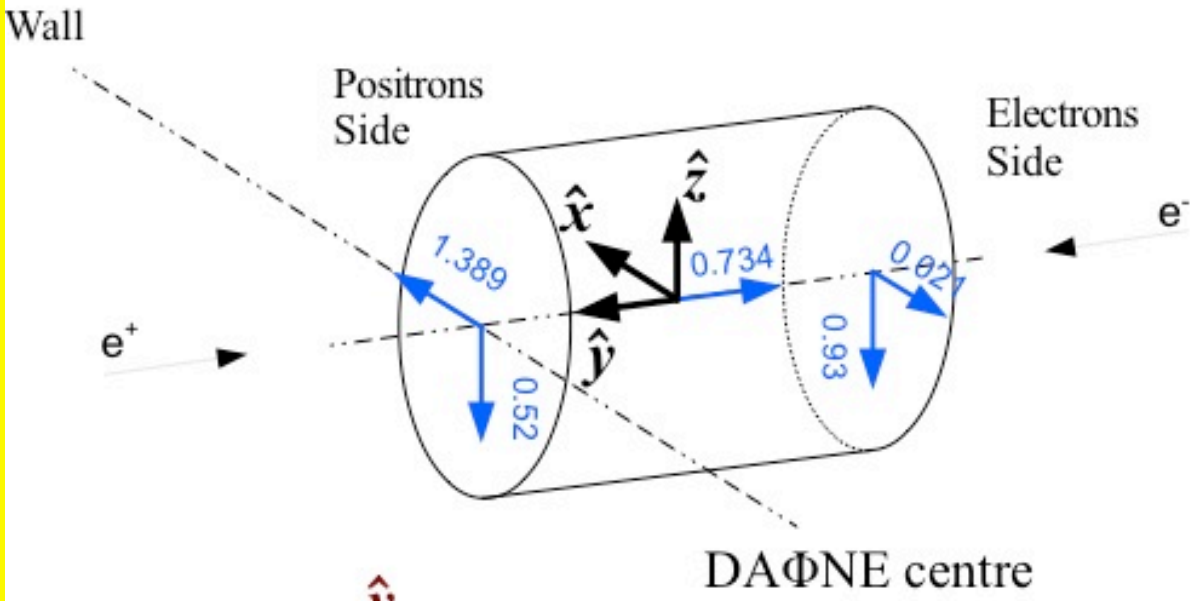
without alignment correction and calibration for B-field & non-radial tracks

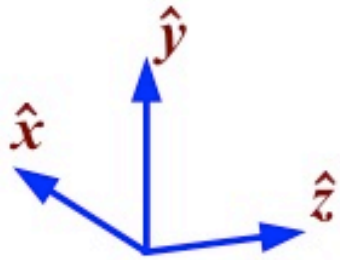




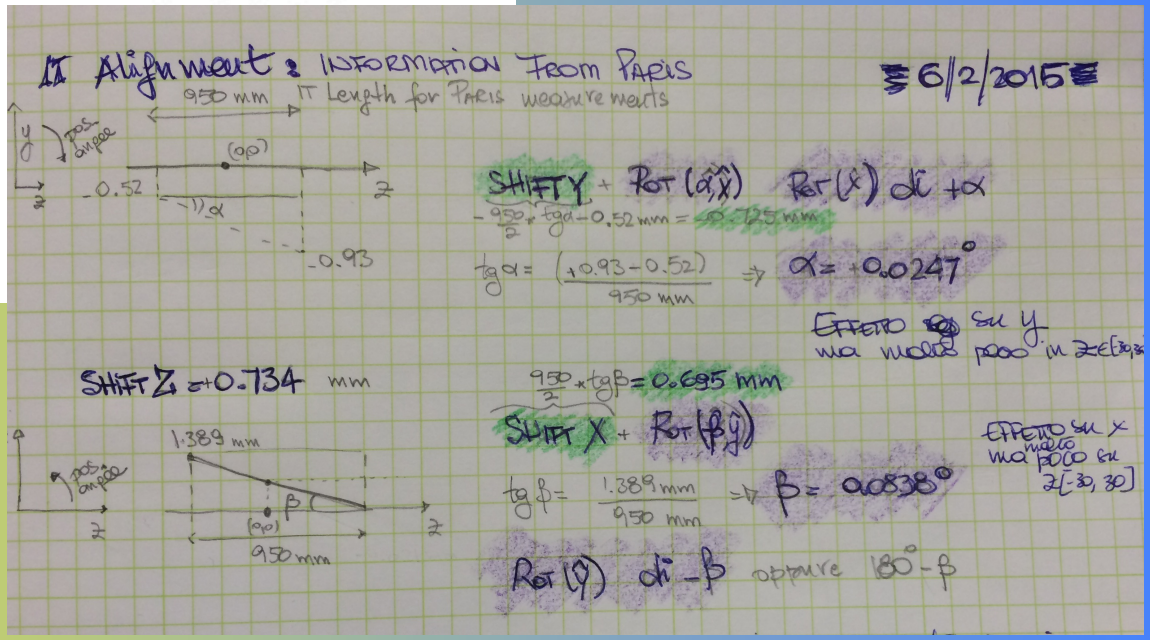


Measurements from Laser Tracker team (in mm)

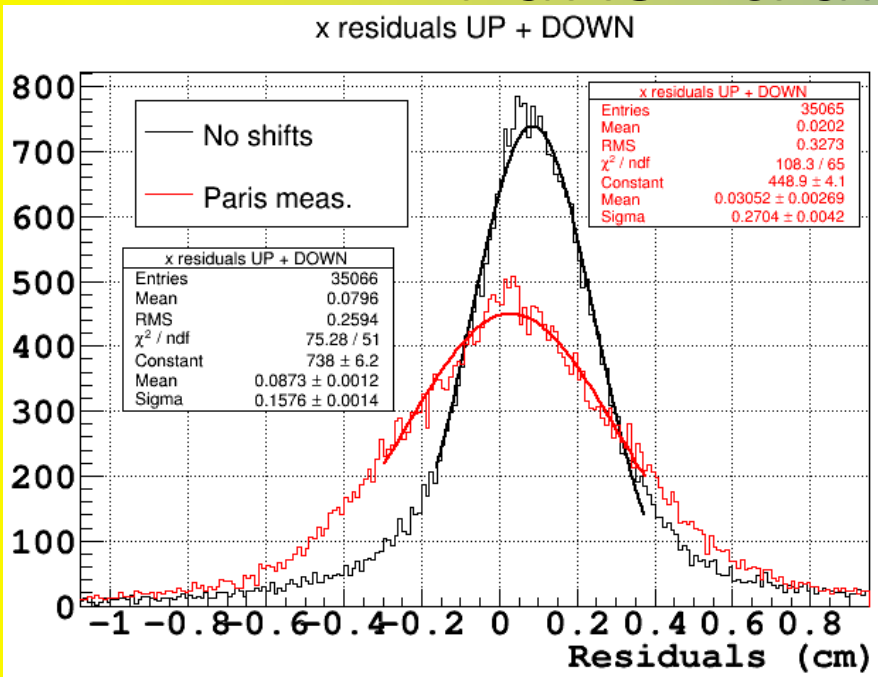


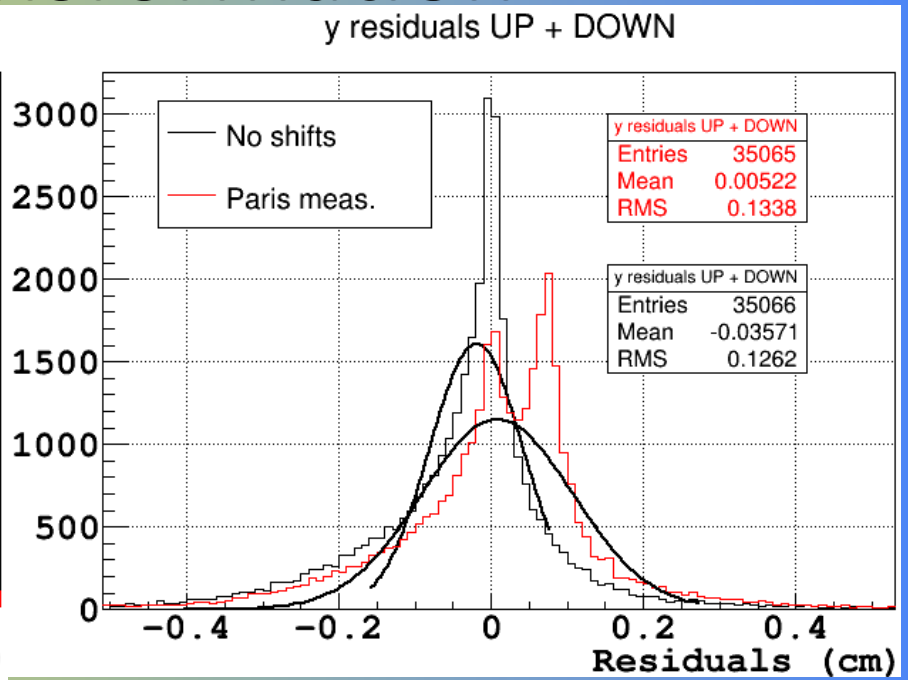


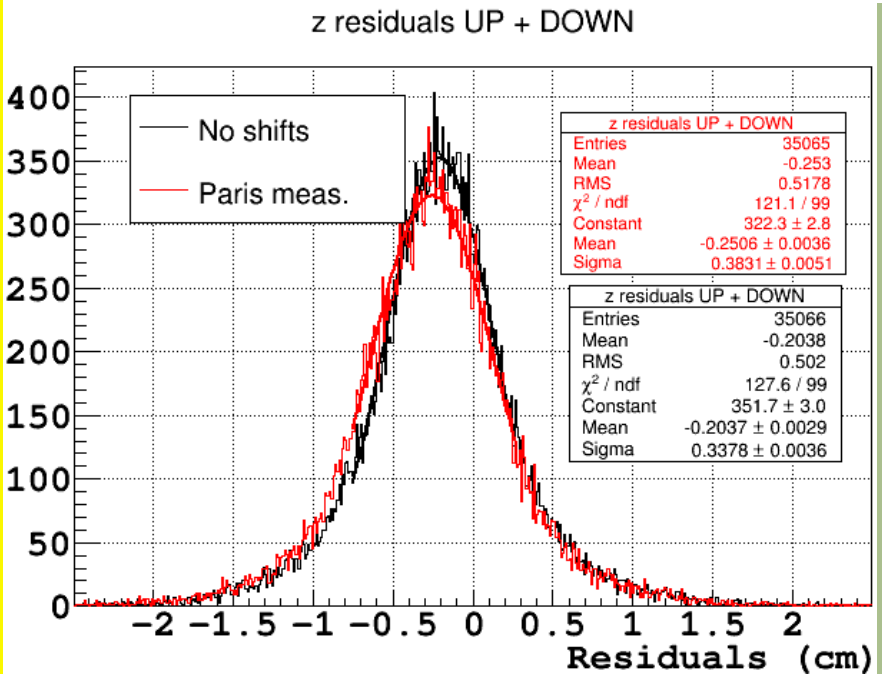
KLOE-2 coordinate system



“Paris” transformation



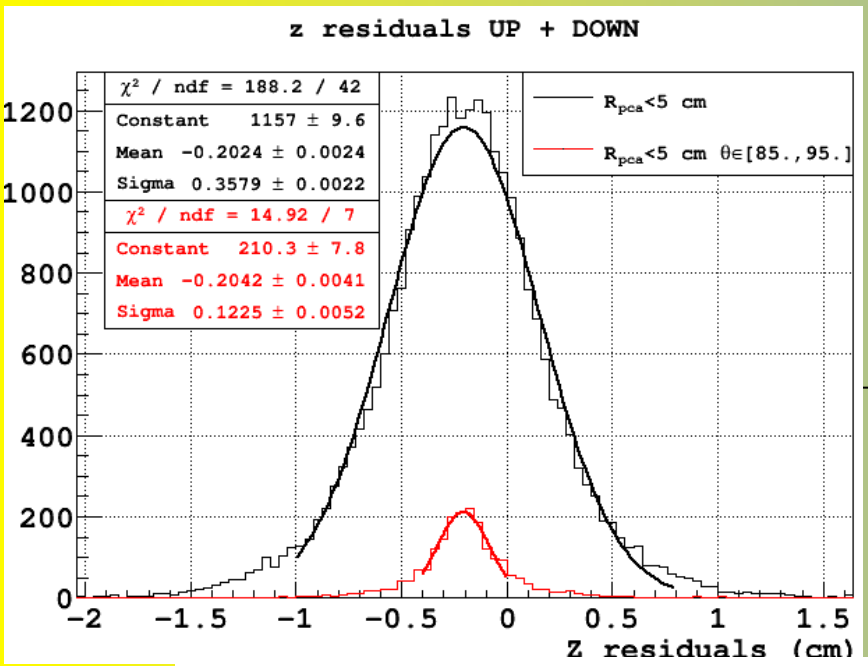




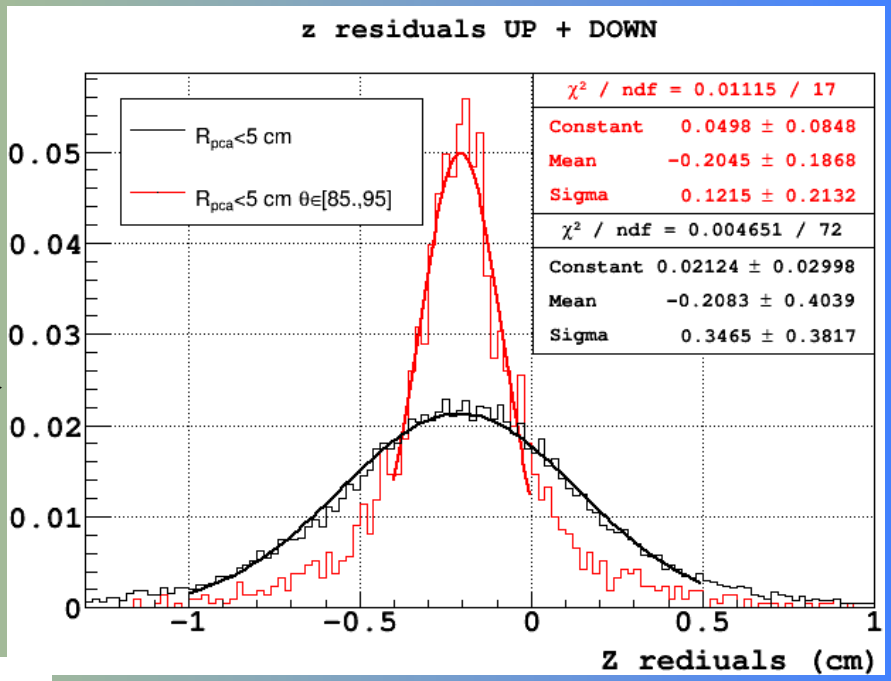
Measurements by laser tracker team were performed on the edges of the **Layer 4** and, obviously, before the insertion of the Interaction Region inside KLOE.

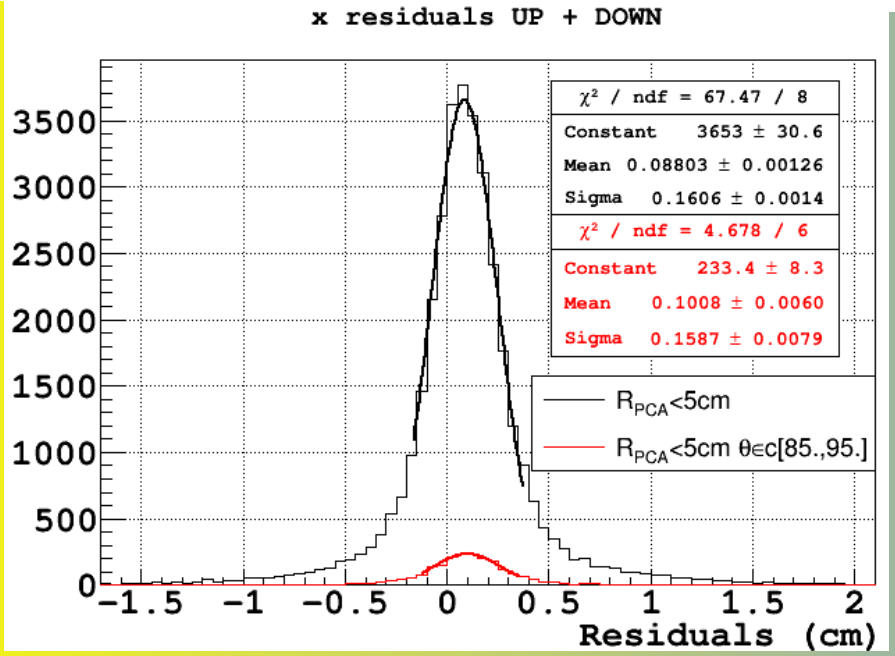
RES$_x$: 0.158 → 0.270 cm
RES$_z$: 0.338 → 0.383 cm

R_{PCA} < 5 cm and θ selection

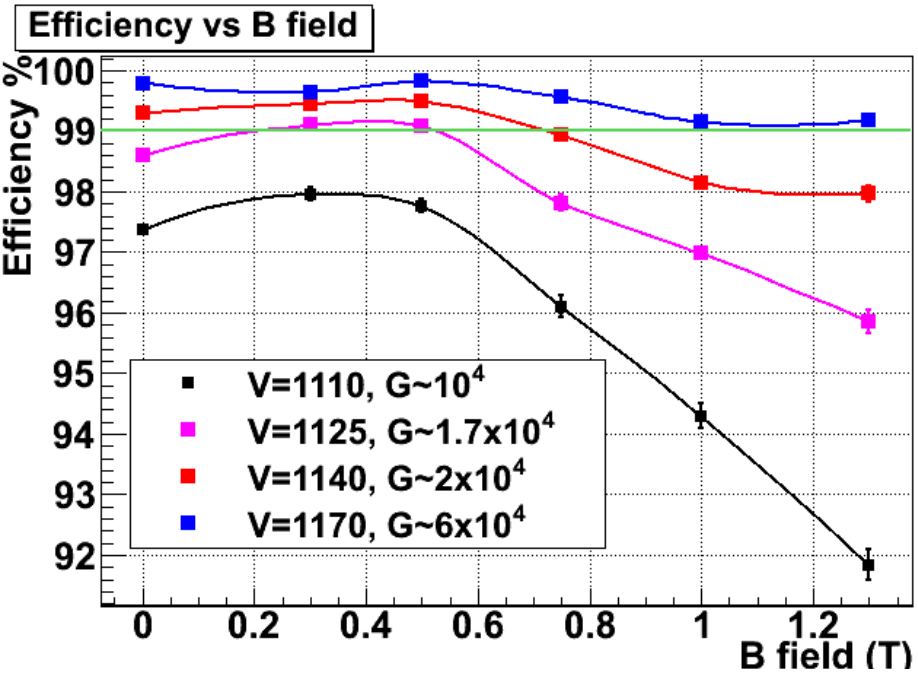


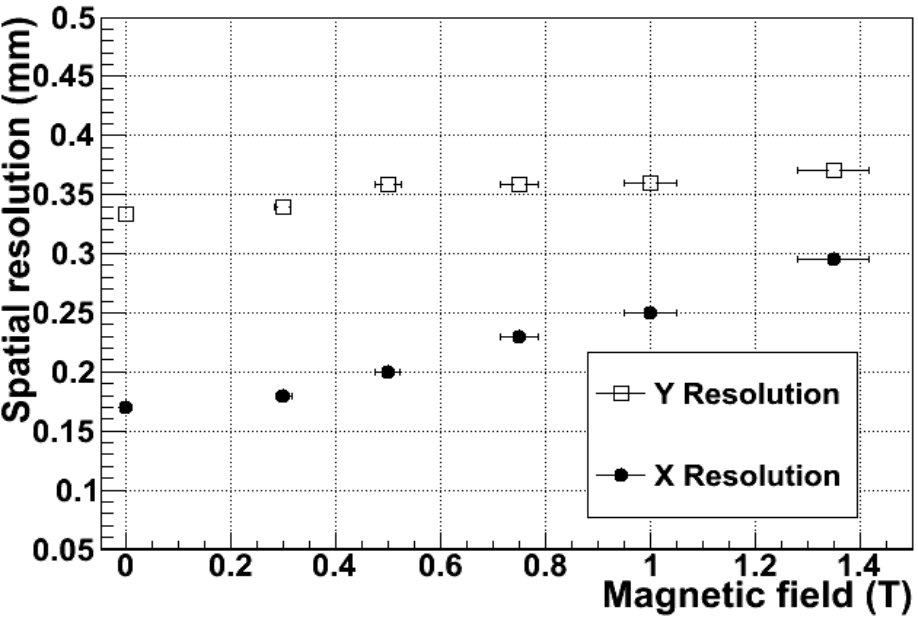
norm.





We also tried to select tracks with the angle **θ** included in the range [85°, 95°].
Here the effect on the width of the z residuals is very sensitive (**~3 times lower**) while the effect on the other coordinates is negligible (as expected).





Construction of **100 x 100 mm2** planar chambers equipped with new concept for X-V readout and study of their behaviour in magnetic field.