

# ***TOF alignment status***

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# *TOF alignment:* *past, present and future*

1. Nov/09: alignment tests with cosmic-ray data

- cross-check of 2 different preliminary alignment procedures
- discovery of some problems related with TOF geometry

PROBLEM: low statistics on SM 0-17-8-9 → unreliable alignment parameters → skip to p-p data

2. Gen/10: optimization of the TOF alignment procedure and analysis of run 104892\_pass2

- first TOF alignment objects

PROBLEM: introduction of new ITS and TPC alignment objects in the OCDB → skip to pass4

3. Feb/10: TOF alignment with run 104892\_pass4

- TOF alignment objects in OCDB/TOF/Align/Data format

PROBLEM: pass4 is affected by an error on the integrated track length (see *bug #63571*) → not usefull alignment parameters → skip to pass6

4. We will study the TOF alignment on pass6 and we will check the obtained parameters with a TOF dedicated reconstruction step on a couple of runs

***TOF alignment: the past***  
*tests with cosmic-ray data*

# Alignment tests with cosmic-ray data: 1

Using 2 different/independent **preliminary** alignment procedures we got comparable TOF volumes displacements

*Alignment based on  
STEER/AliAlignmentTracks class*

*Alignment based on  
a private procedure developed by  
R. Preghenella*

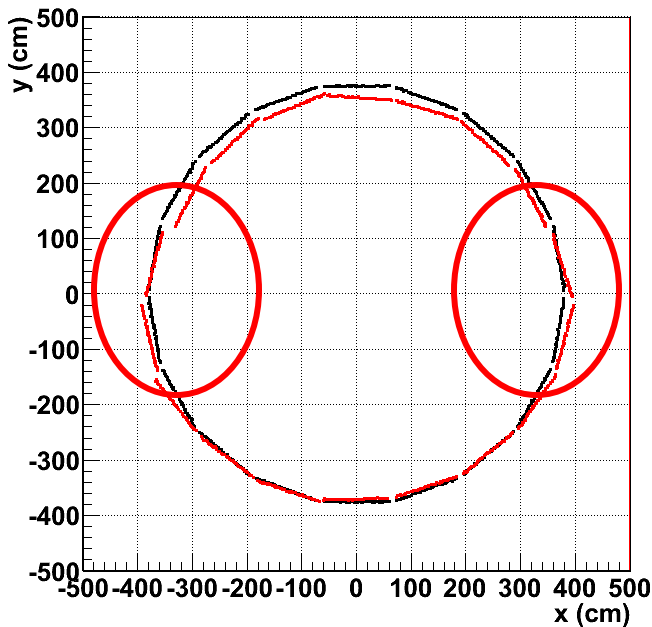
Points = pad centre positions

Points = SM centre positions

TOF section

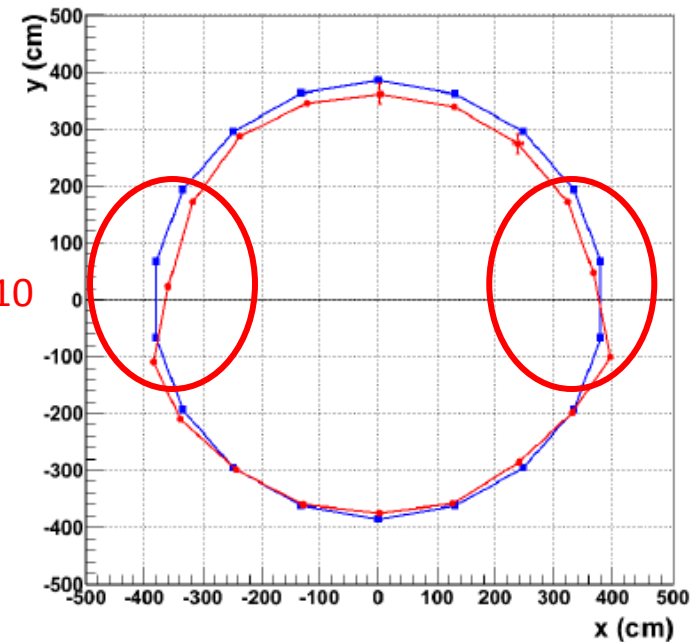
Black: ideal geometry

Blue: ideal geometry



←→  
Red: "amplified" aligned geometry defined by  
 $\text{ideal geometry} + (\text{aligned geometry} - \text{ideal geometry}) * 10$

○ SM with very low statistic: unreliable displacements

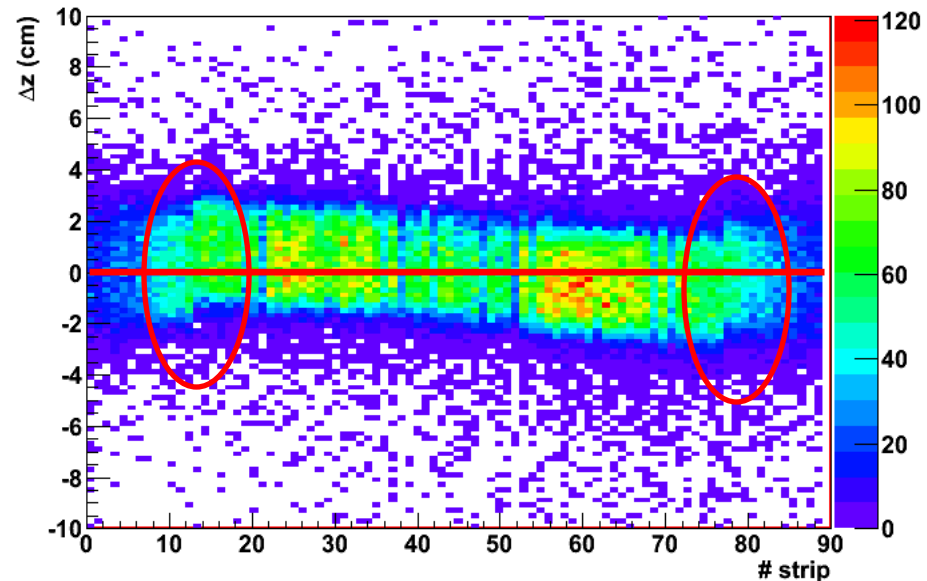
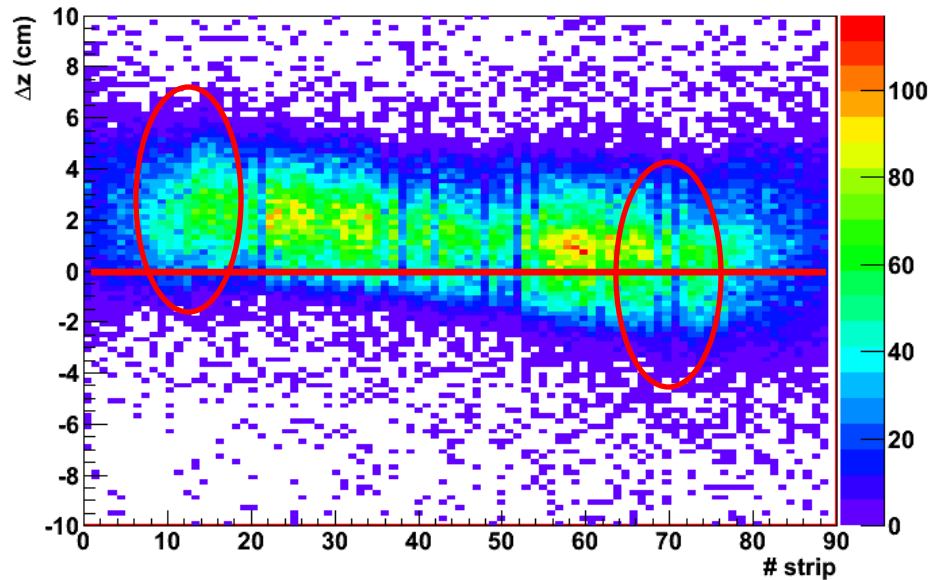


# Alignment tests with cosmic-ray data: 2

Looking at the z residuals ( $\Delta z = z.\text{track extrapolation point} - z.\text{space point}$ ) we found some errors in the strip position in TOF geometry. Errors fixed in AliRoot rev. 37616 and 37617 (A. Decaro)

Before alignment

After alignment



***TOF alignment: the present***  
*current procedure*  
*and run 104892\_pass4 analysis*

# ***Current TOF alignment procedure: 1***

1. Track selection → tree of selected AliTrackPointArray
  2. AliAlignmentTracks::AlignVolumes
    - AliTrackFitterRieman
    - AliTrackResidualsLinear
- } Best performance on simulated data on which I have introduced a known misalignment
- Alignment respect to TPC (LayerMin=kTPC1; LayerMax=kTPC2)
  - Procedure repeated 10 times (after 10 iterations the residual alignment parameters are  $\sim 0$ )

# ***Current TOF alignment procedure: 2***

- With AliAlignmentTracks we can align only the TOF sensitive alignable volumes → 1593 strips (we can produce 1593 alignment matrices) and not mother volumes like the whole SM
- BUT, as first step, we want to align SM by SM and not strip by strip so we assume each SM as a rigid object: we define 1593 matrices but all the strips belonging to the same SM have the same alignment matrix
- Once we know the displacements of the mother volumes (SM) we will search for the residual misalignments strip by strip

With this procedure we have analysed run 104892\_pass4 (~ 6000 selected tracks per SuperModule) and we have:

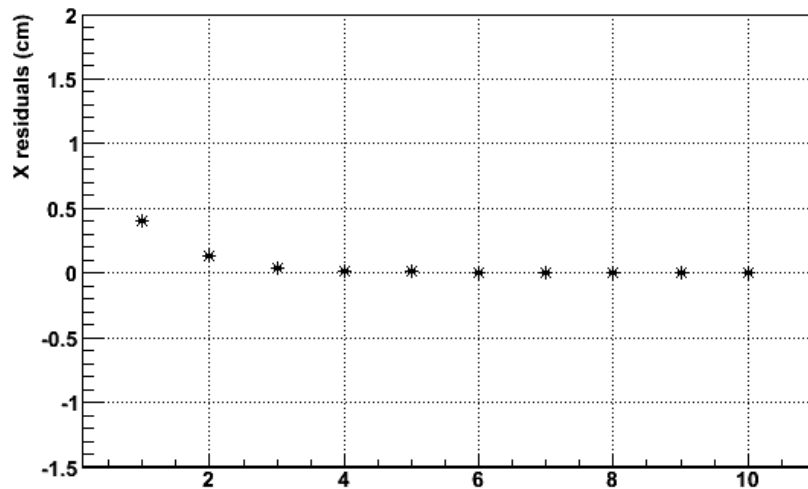
- aligned SM by SM producing 1593 matrices
- produced a list of the TOF alignment parameters in the OCDB/TOF/Align/Data format



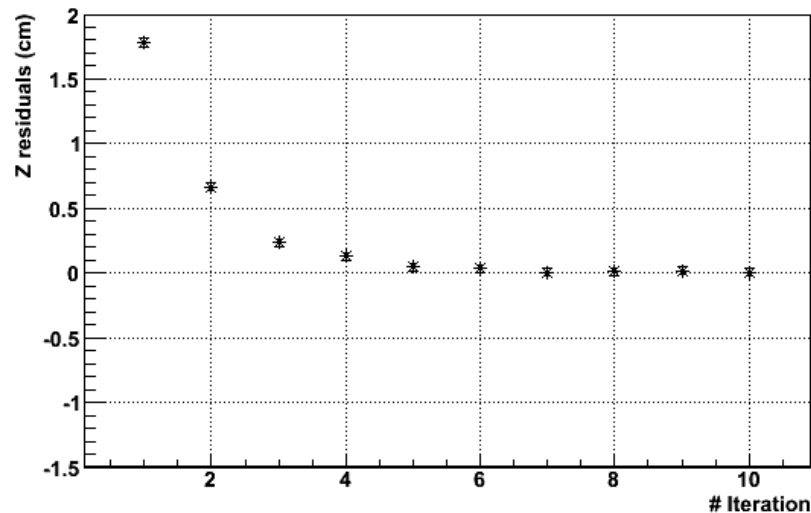
# TOF residuals

The track residuals (track space points – track extrapolated points) within TOF after the alignment procedure are small

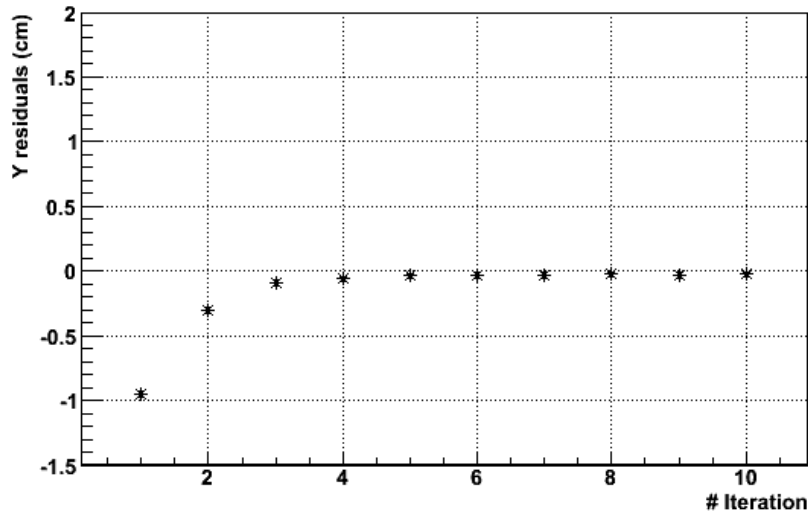
X residuals vs Iteration Number



Z residuals vs Iteration Number



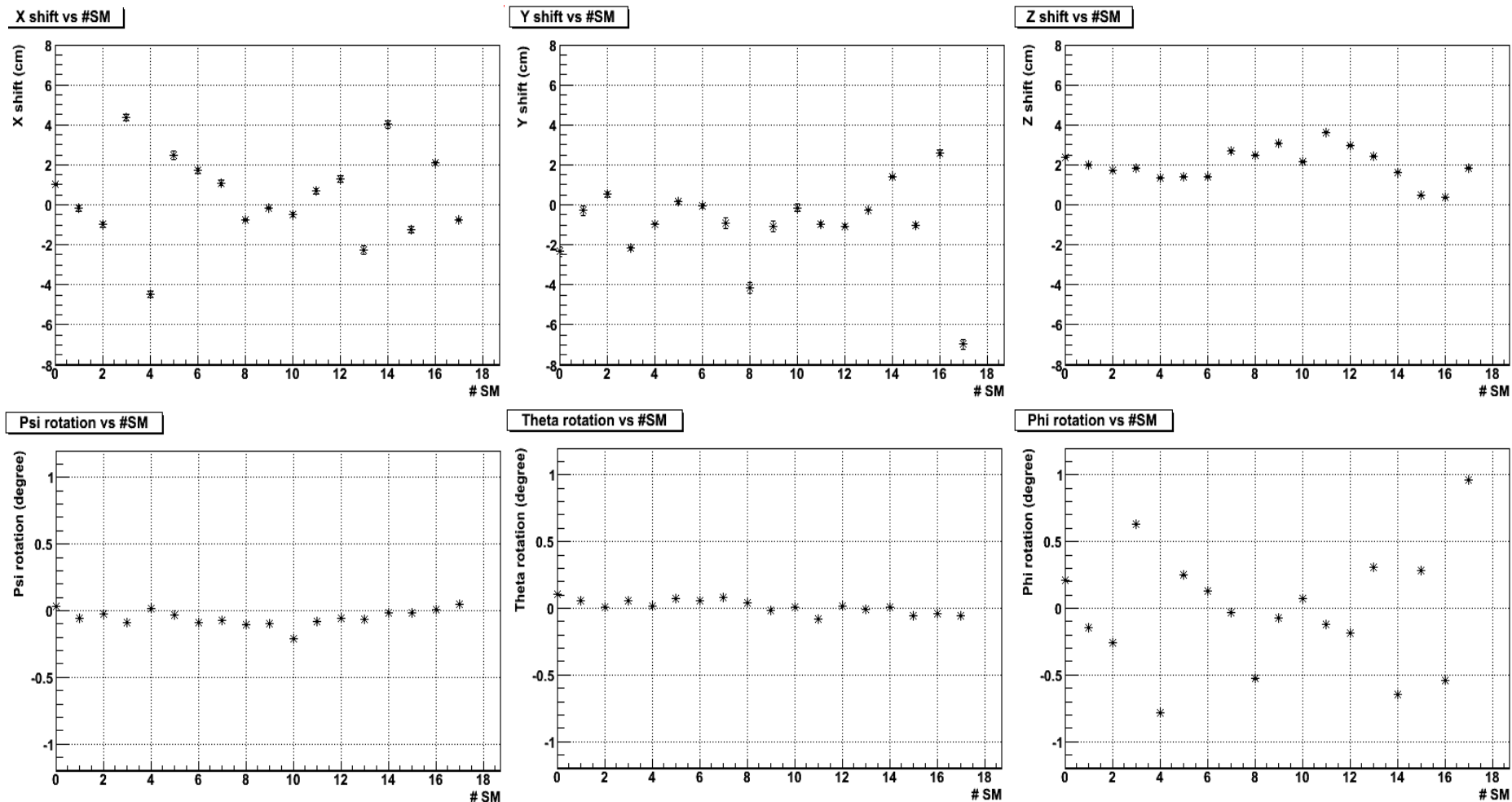
Y residuals vs Iteration Number



Residuals for SM0:  
it is the same for  
all SM

# Alignment parameters for each SM

global coordinates, ALICE reference frame

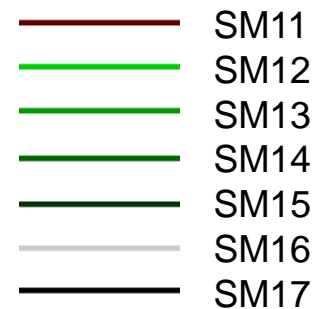
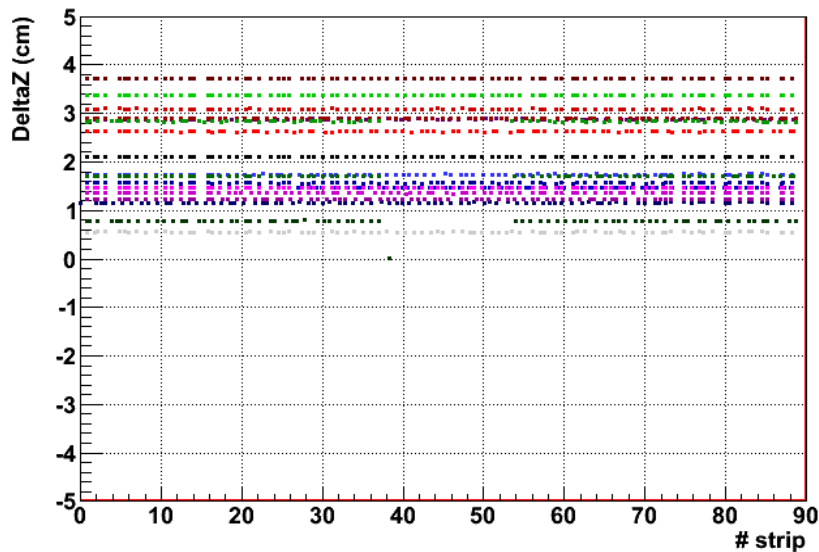
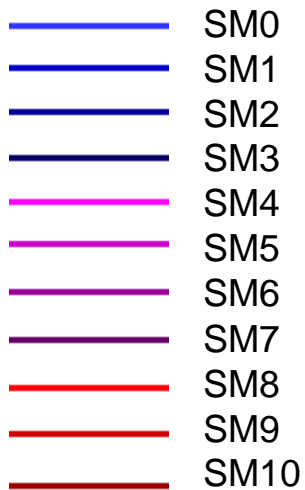
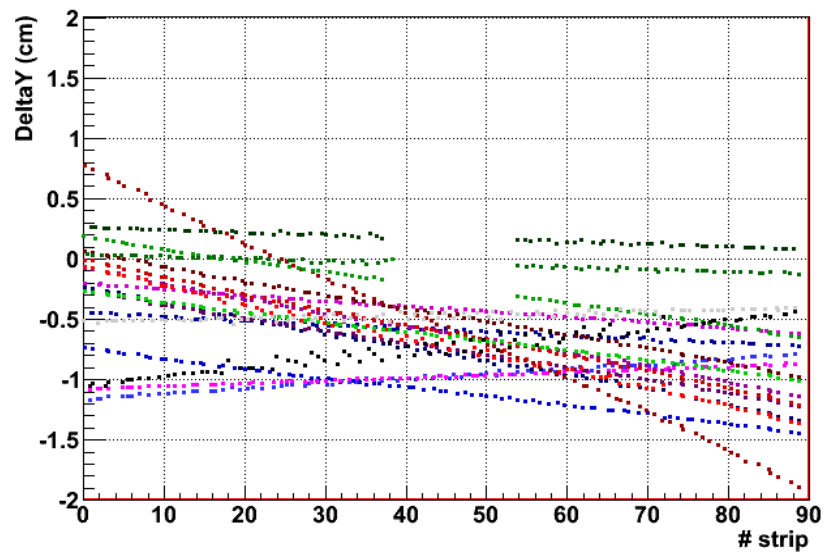
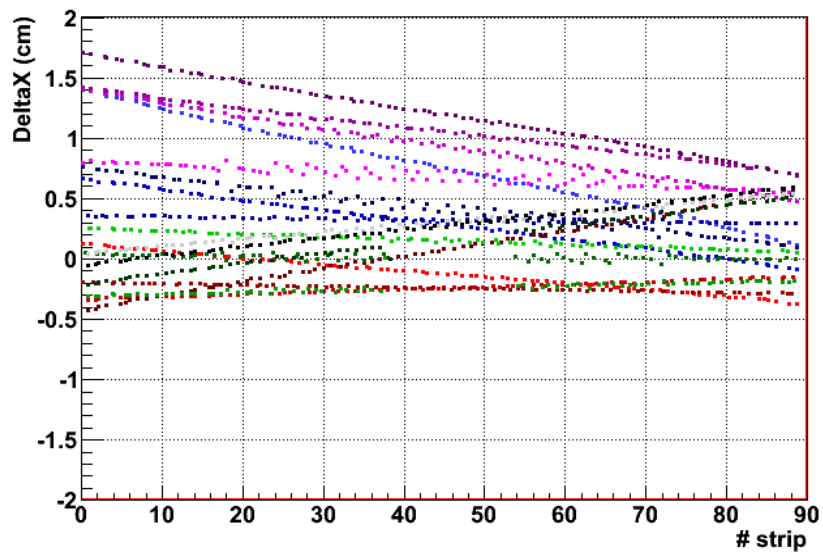


# TOF strip displacements

DeltaX=Xaligned-Xideal

DeltaY=Yaligned-Yideal

DeltaZ=Zaligned-Zideal

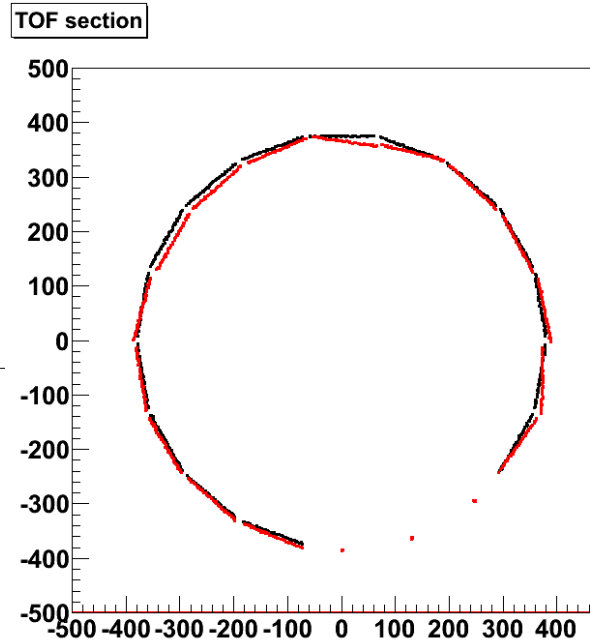


# TOF section deformation in aligned geometry

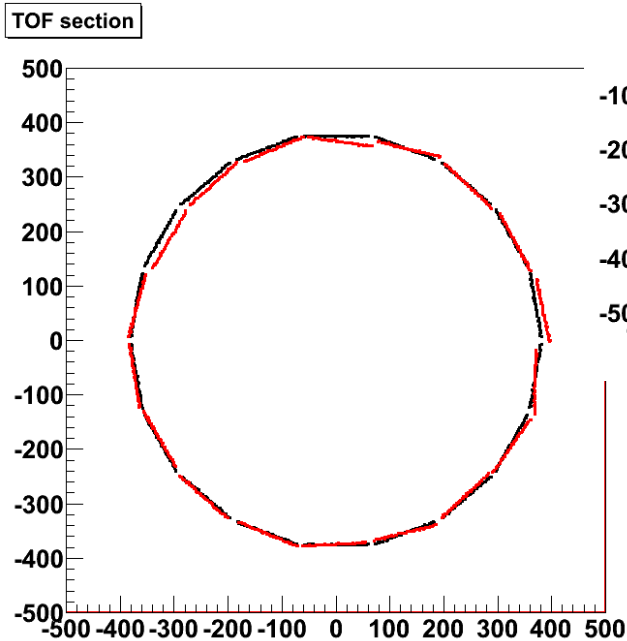
Black: ideal geometry

Red: "amplified" aligned geometry; each point is defined by  
ideal geometry + (aligned geometry-ideal geometry)\*10

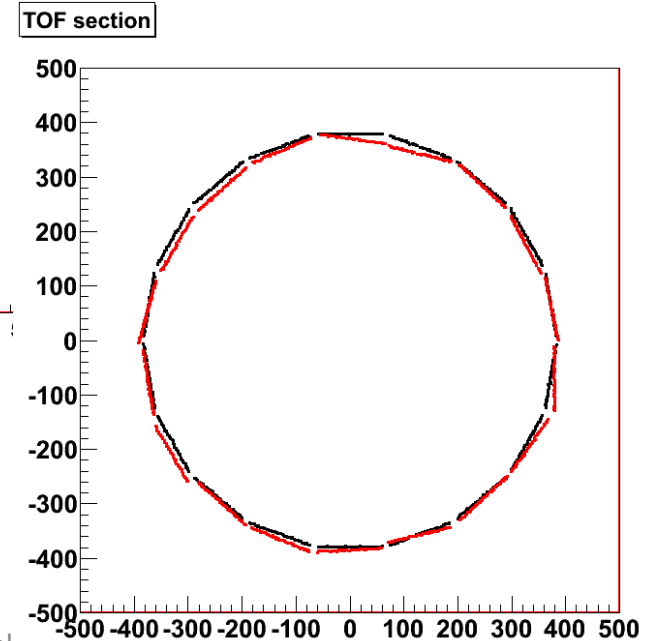
Z ~ 0 cm



Z ~ +360 cm



Z ~ -360 cm



# ***TOF overlap/extrusion: 1***

If we apply the 1593 alignment matrices to each strip we find that the new aligned geometry has  $\sim 60$  overlap/extrusion for each SM due to the fact that we are moving the single strip.

To avoid this problem we have to move the whole SM so we have defined 18 more alignment matrices associated to the mother volumes, each SM:

1593 matrices associated to each strip (alignable sensitive volumes) = identity

18 matrices associated to each SM (alignable non sensitive volumes) = displacement found before

In this way, moving the whole SM, we have the same strip displacements but we reduce the overlap/extrusion number to 14

Probably, these left overlaps could be reduced by aligning the space-frame volumes (i.e. BSEGMOx), in case of TOF and TRD SM alignment parameters are in agreement

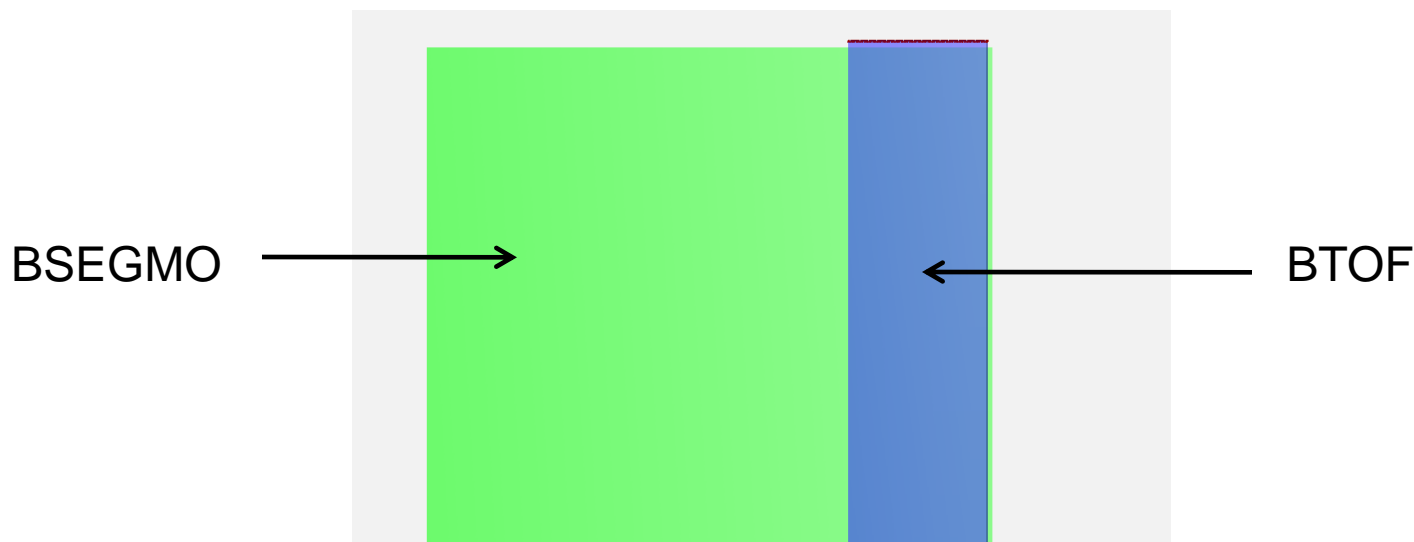
# TOF overlap/extrusion: 2

Info in <TGeoNodeMatrix::CheckOverlaps>: Checking overlaps for B077 and daughters within 0.1

Check overlaps: [=====] 517252 [100.00 %] TIME 00:00:08

Info in <TGeoNodeMatrix::CheckOverlaps>: Number of illegal overlaps/extrusions : 14

- = Overlap ov00000: BSEGMO11 extruded by: BSEGMO11/BTOF11\_1 ovlp=1.45312
- = Overlap ov00001: BSEGMO12 extruded by: BSEGMO12/BTOF12\_1 ovlp=1.00325
- = Overlap ov00002: BSEGMO9 extruded by: BSEGMO9/BTOF9\_1 ovlp=0.809024
- = Overlap ov00003: BSEGMO10 extruded by: BSEGMO10/BTOF10\_1 ovlp=0.745489
- = Overlap ov00004: BSEGMO7 extruded by: BSEGMO7/BTOF7\_1 ovlp=0.613336
- = Overlap ov00005: BSEGMO13 extruded by: BSEGMO13/BTOF13\_1 ovlp=0.476416
- = Overlap ov00006: BSEGMO8 extruded by: BSEGMO8/BTOF8\_1 ovlp=0.3598



# *TOF overlap/extrusion: 3*

= Overlap ov00007: BSEGMO17 extruded by: BSEGMO17/BTOF17\_1 ovlp=0.260749

= Overlap ov00008: BSEGMO0 extruded by: BSEGMO0/BTOF0\_1 ovlp=0.172669

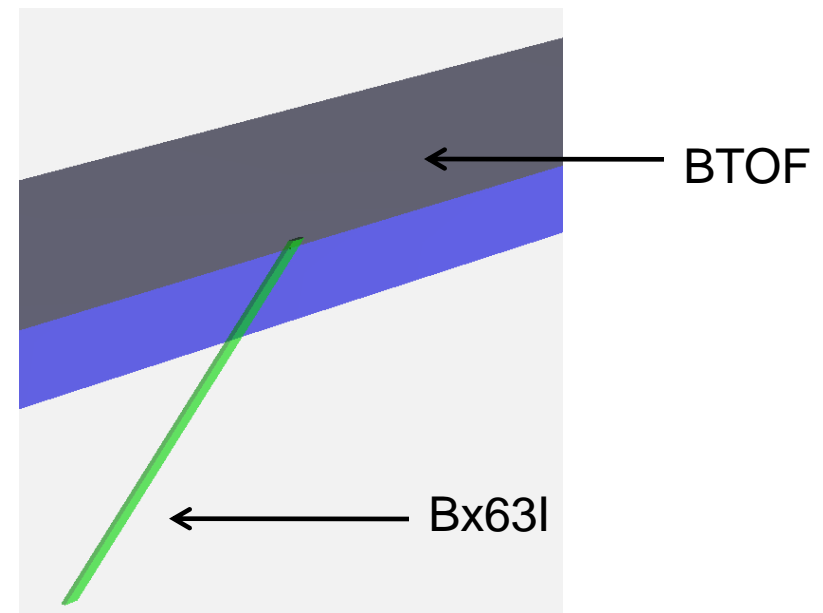
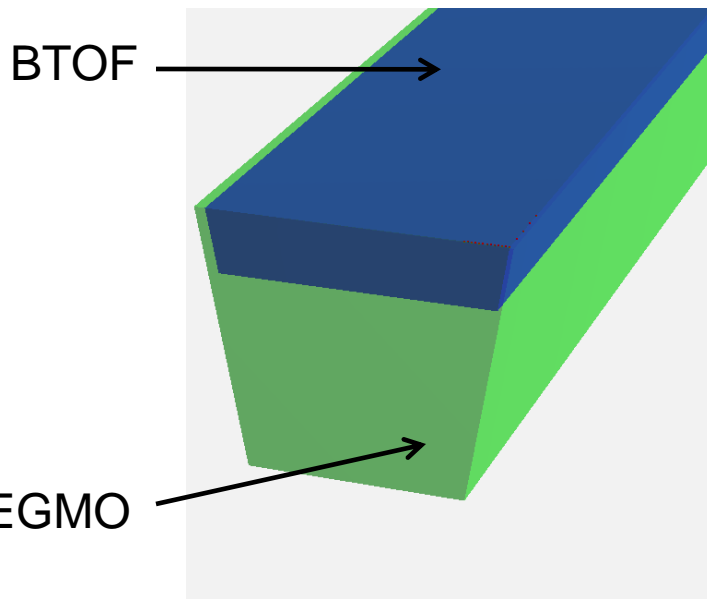
= Overlap ov00009: BSEGMO4/B463I\_40 overlapping BSEGMO4/BTOF4\_1 ovlp=0.326141

= Overlap ov00010: BSEGMO4/B263I\_40 overlapping BSEGMO4/BTOF4\_1 ovlp=0.283899

= Overlap ov00011: BSEGMO4/B163I\_40 overlapping BSEGMO4/BTOF4\_1 ovlp=0.231905

= Overlap ov00012: BSEGMO4/B063I\_40 overlapping BSEGMO4/BTOF4\_1 ovlp=0.228656

= Overlap ov00013: BSEGMO5/B463I\_44 overlapping BSEGMO5/BTOF5\_1 ovlp=0.205256



# ***TOF alignment: the future***

## *pass6 analysis*

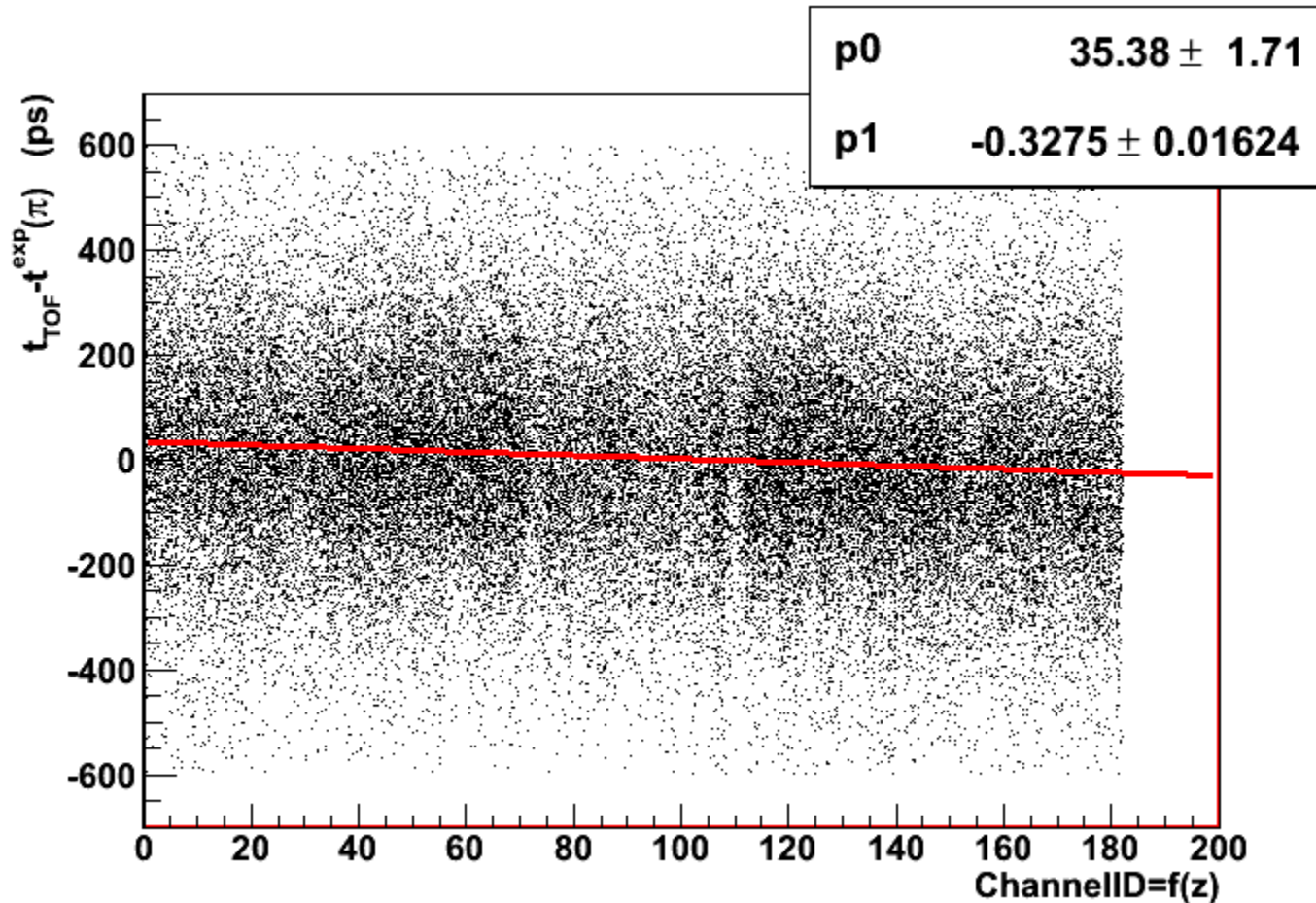


# *Pass6 analysis*

- Because of pass4 is affected by an error on the integrated track length (see *bug #63571*) the previous parameters are not useful
- We will re-run the TOF alignment procedure on pass6
- Before introducing our alignment parameters in the “raw” OCDB we will check the TOF performance with the new geometry with a TOF dedicated reconstruction step of a couple of runs. With the aligned geometry we expect:
  - small track residuals left
  - improvement in the TOF matching
  - small dependence of the difference between TOF time and integrated time on the channel position left → improvement in the TOF time resolution

# ***Backup***

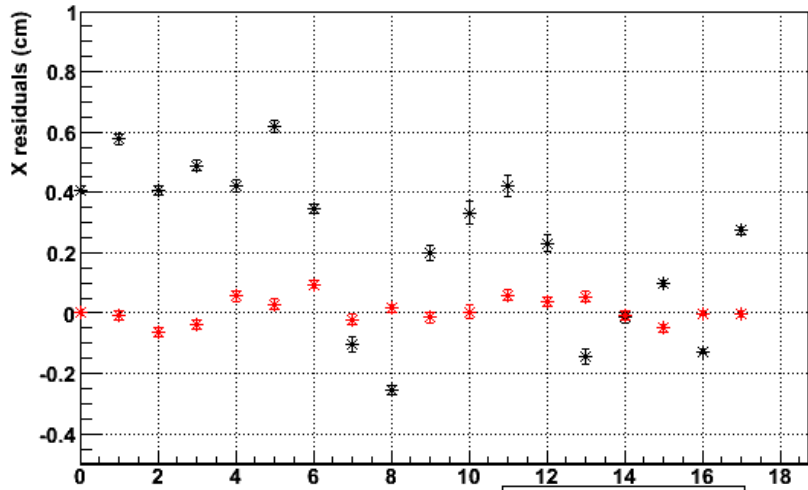
# Dependence of the difference between TOF time and integrated time on the channel position (before alignment)



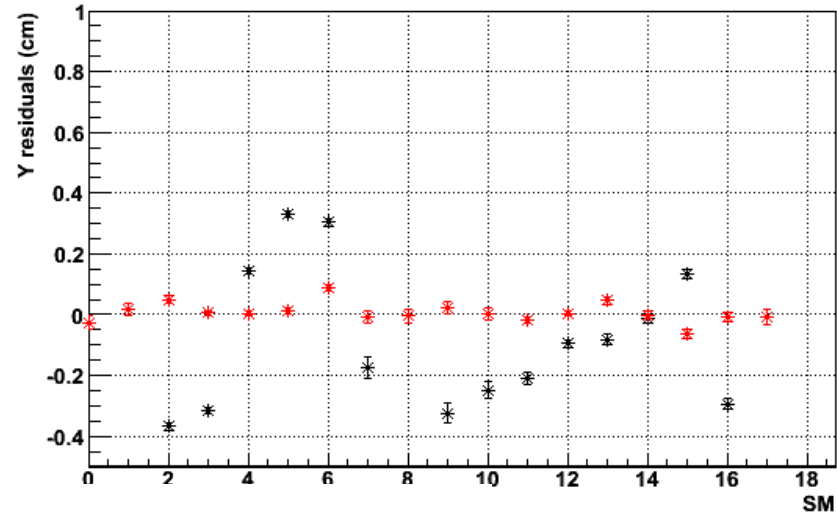
# *X,Y,Z residuals for each SM:*

black = before alignment  
red = after 10 alignment iterations

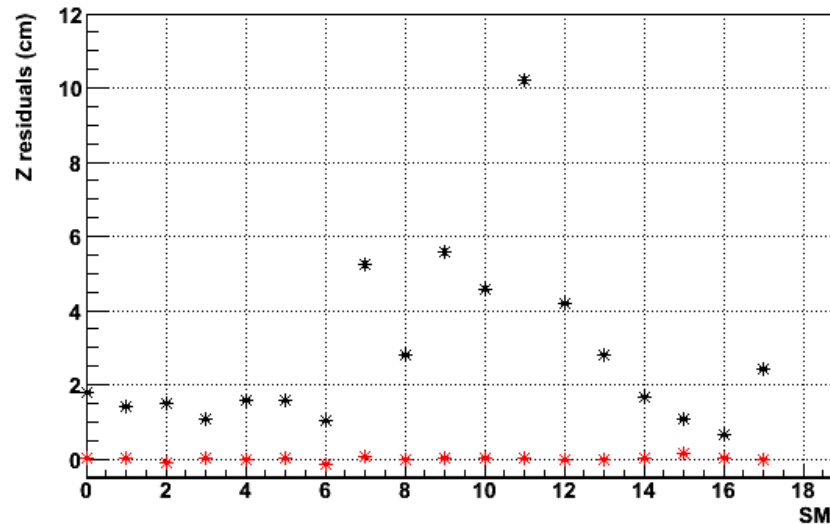
X residuals vs SM



Y residuals vs SM



Z residuals vs SM



# Residuals alignment parameters given by the procedure after each iterations for SM00

