Alignment Status

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- RealData (no field)
- Simulation: field on status
- Simuation: muid alignment with misalignments

Simulation

<table>
<tr><th>No Field</th><th>With Field</th></tr>
<tr><td>
With misalignments

- Mutr and Muid

Problem with the muid finding the misalignments. *Look at the update of the geometry when introducing MuID misalignments.*

Work on the MuID alignment

Turn a third reconstruction because it seems to converge. May be the first misalignments were a little bit big.

Look at the residuals in each detector to see how they were improved by the alignment.
</td><td>
With misalignments

- Mutr

The program converges towards a wrong walue.

Try less misalignments to help the algorithm to converge. Try to iterate. Try without the z alignment.

- Mutr and Muid

First we need to make the alignment work without field.
</td></tr>
</table>

Real data

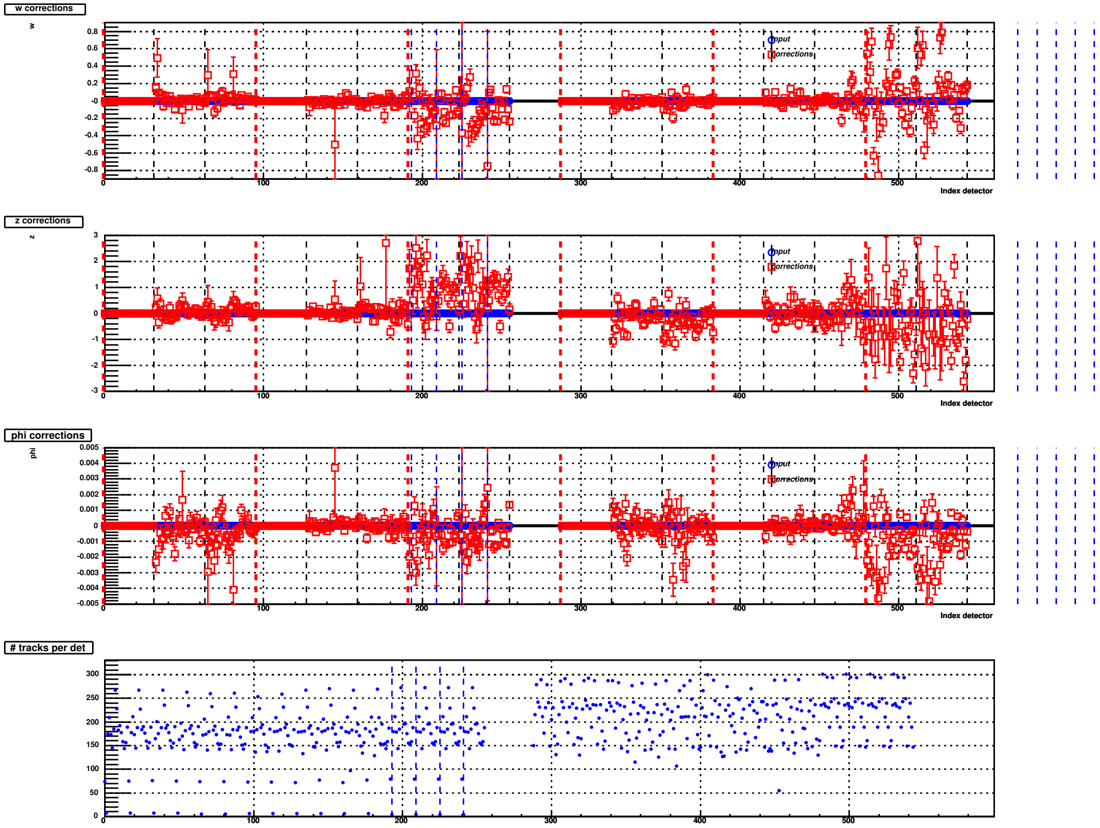
- The program seems to align. However the tracks quality DOES NOT IMPROVES.
- *Try each parameter alone (especially without z). Try with more statistics...*

RealData Alignement

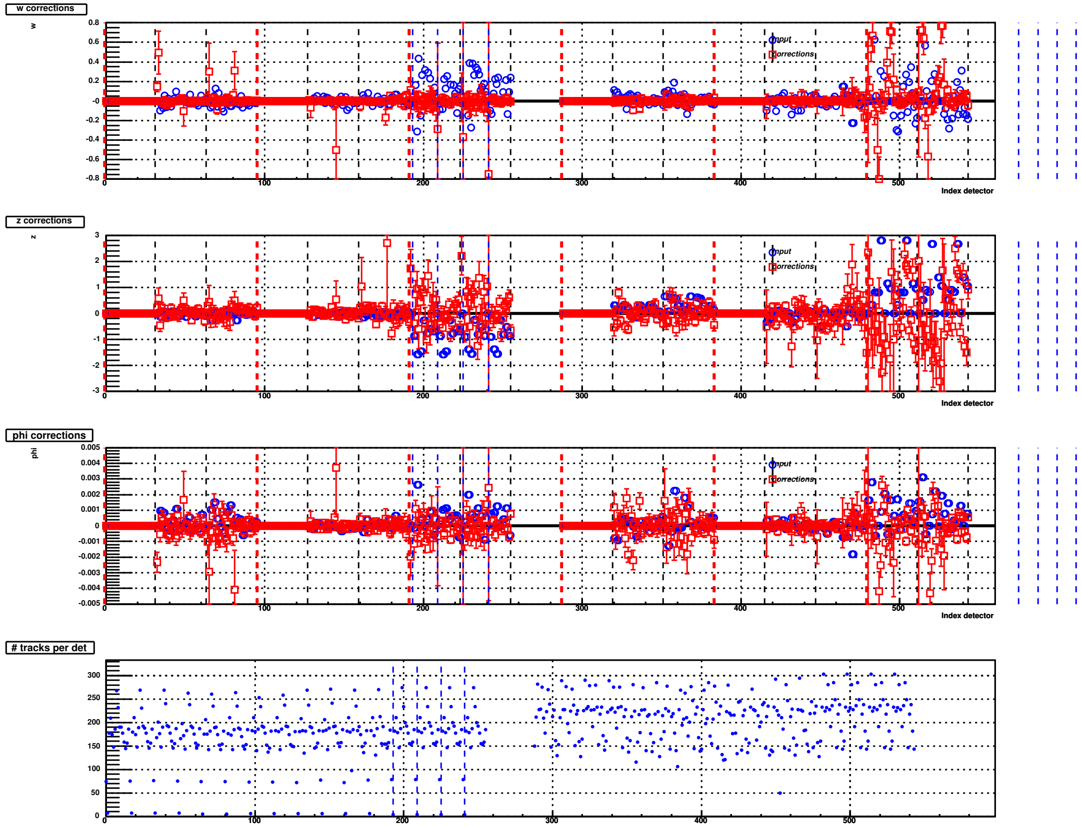
Offsets [1/4]

Results (same as last week) of the alignment with real data. Here, the 2 reconstruction in order to validate the algorithme convergence. The statistics used is twice as the one presented at a previous PR meeting.

First reconstruction



Second reconstruction



SCALE

number of hits (range for both plots): [0; 300]

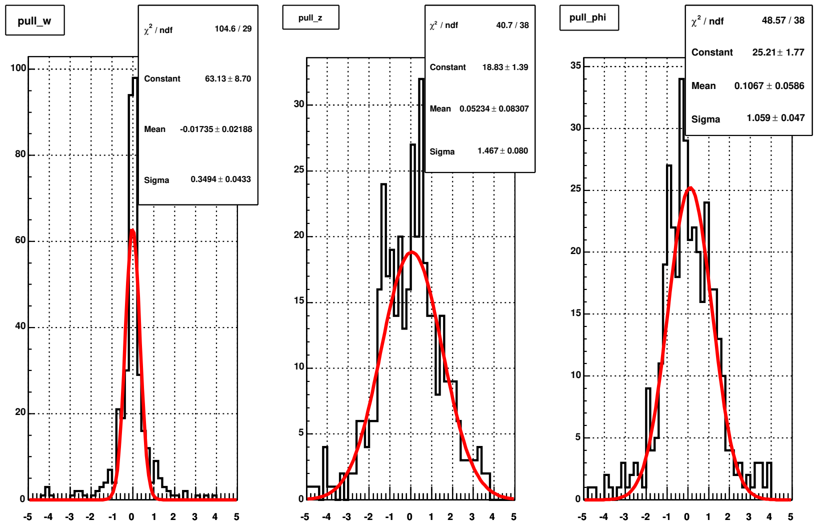
w: [-0.8; 0.8]; z: [-3; 3]; phi: [-0.005; 0.005]

w: [-0.8; 0.8]; z: [-3; 3]; phi: [-0.005; 0.005]

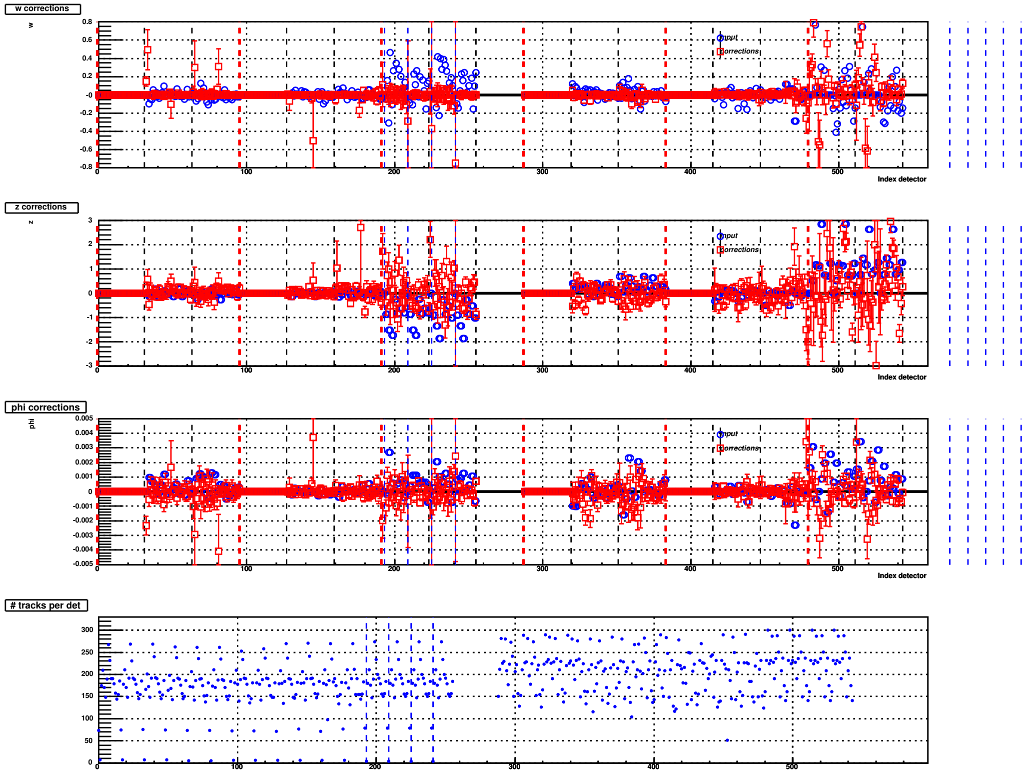
- Last stations seem to have systematics offsets, especially in z.
- The second reconstruction seem to align more homogenously around 0 the detectors. However, a carfull look at the residuals in each half octant do not agree with an improvement of the tracks quality (not shown here).

The quality of the alignment on real data should be confirmed with the pulls. Since the residuals in each half octant do not agree with an improvement of the tracks quality, we turned a third reconstruction with the hope that it will converge in the end to a best set o alignment parameters.

Pulls after the second reconstruction



offsets after the third reconstruction



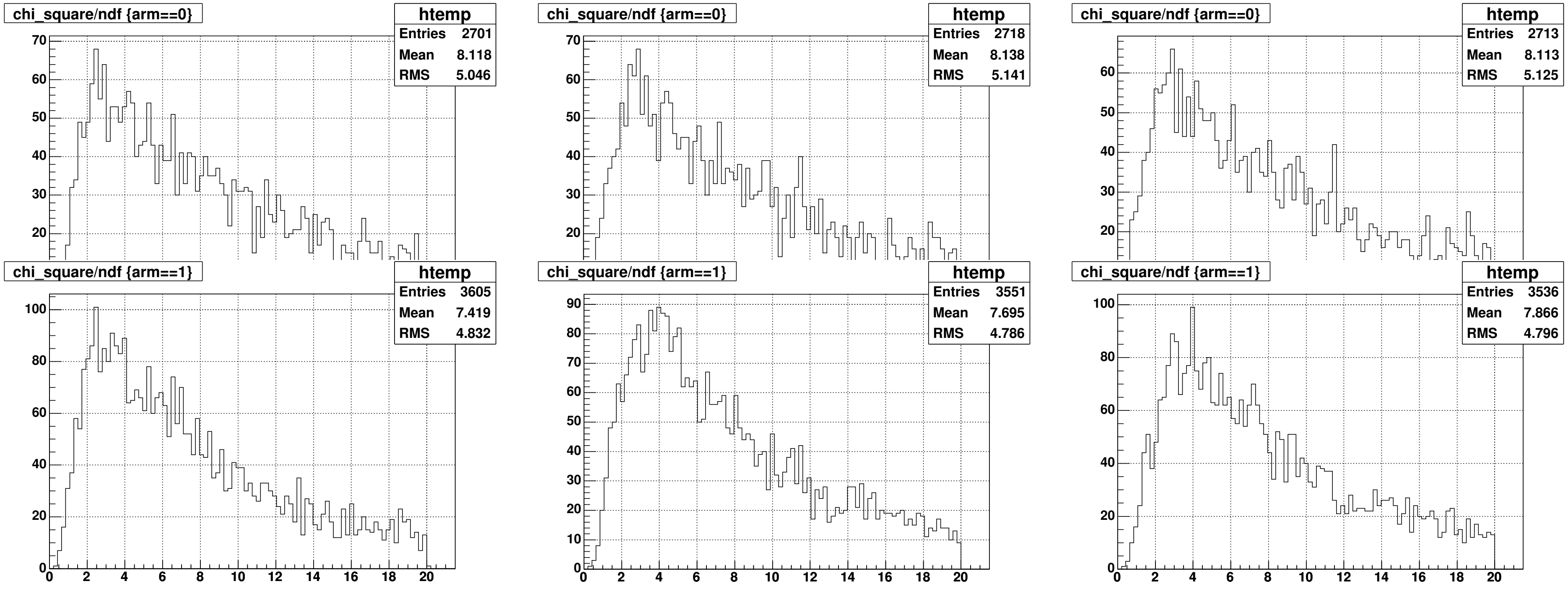
- These pulls confirm the well behaviour of the algorithm.
- The third reconstruction looks like the second one.

Track Chi Square [3/4]

If the aligment of the MuTr was working well, we should see an improvement in the track chi-square from the 1rst reconstruction to the second one.

South Arm

North Arm



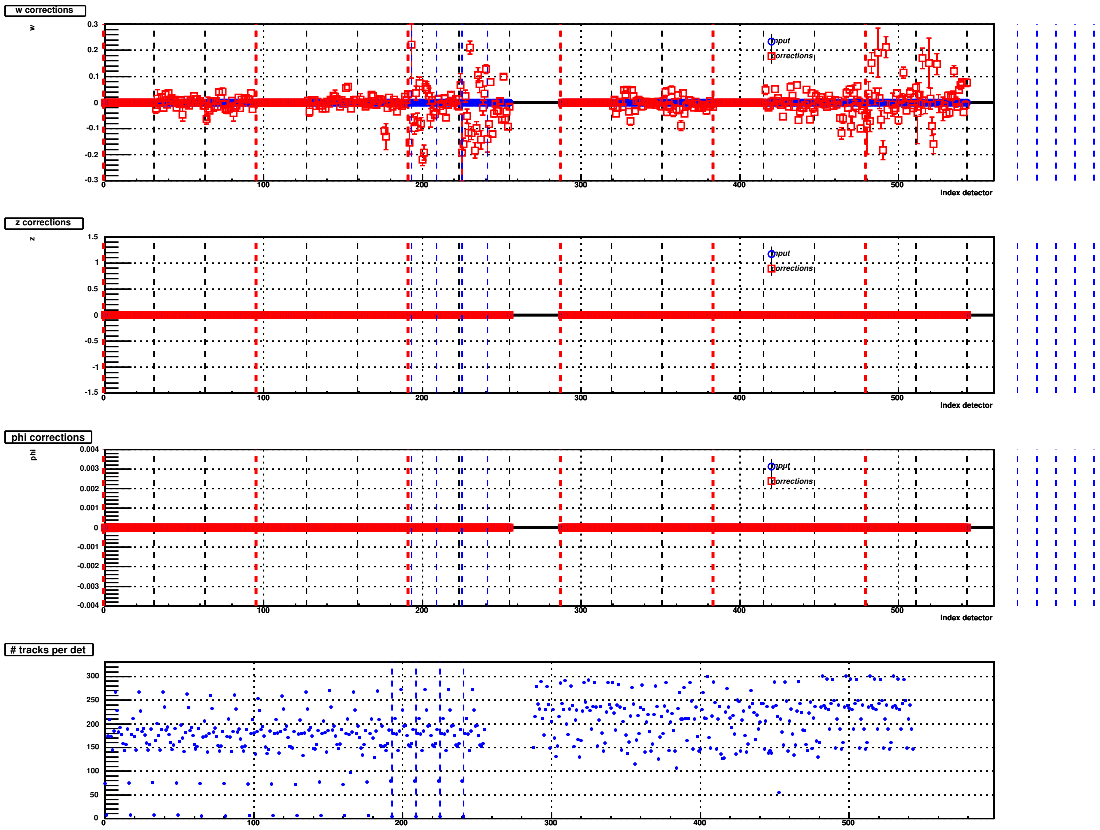
First reconstruction | Second reconstruction | Third reconstruction

- After the second reconstruction, the track chi square shows an increasement of the number of tracks for the south arm (positive result). Howerver we loose 50 tracks in the north arm (the alignment did not improve the quality of the tracks).
- We turned a third reconstruction to see if it would converge towards a better track chi square for both arm. Unfortunatly, the third reconstruciton shows worse results, for both arm.
- Something is going wrong with the real data alignment... *May be we need more statistics?* But condor crashes with more stat. *May be we need to try one parameter after the other ?* This is detailed on the following slides.

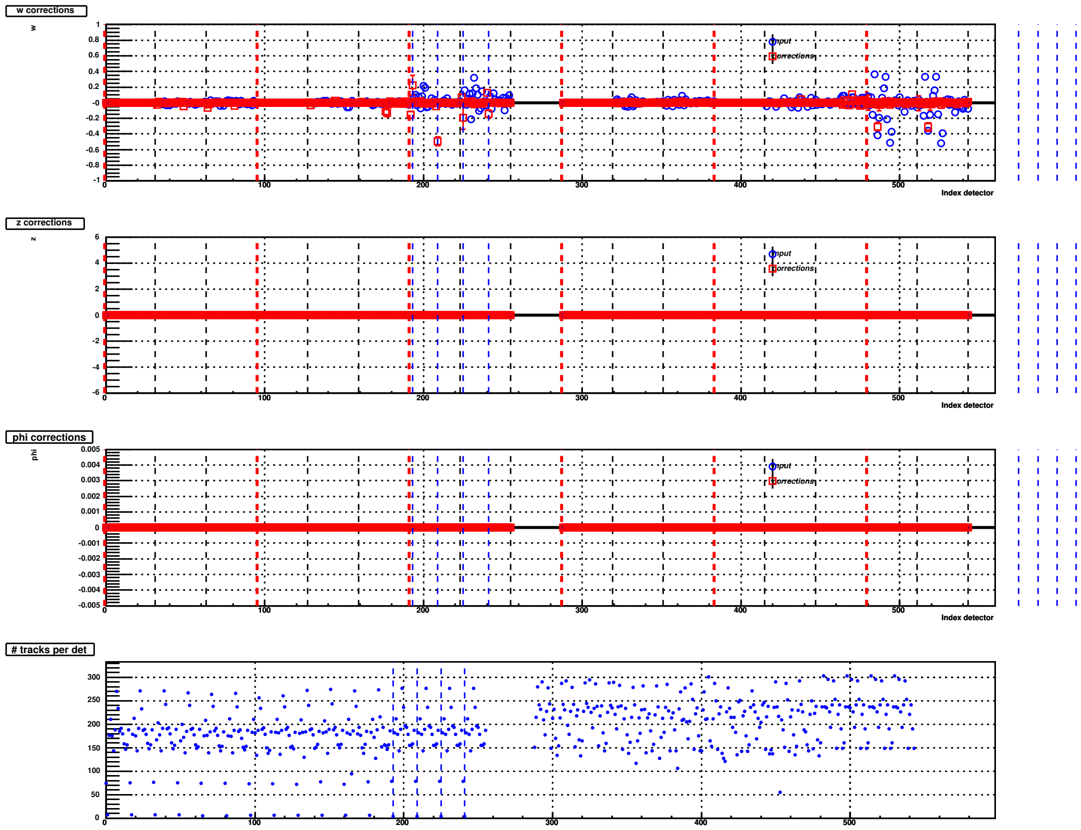
Alignment only along W [Offsets]

First we aligned only along W.

First reconstruction



Second reconstruction



SCALE

number of hits (range for both plots): [0; 300]

w: [-0.3; 0.3]; z: [-1.5; 1.5]; phi: [-0.004; 0.004]

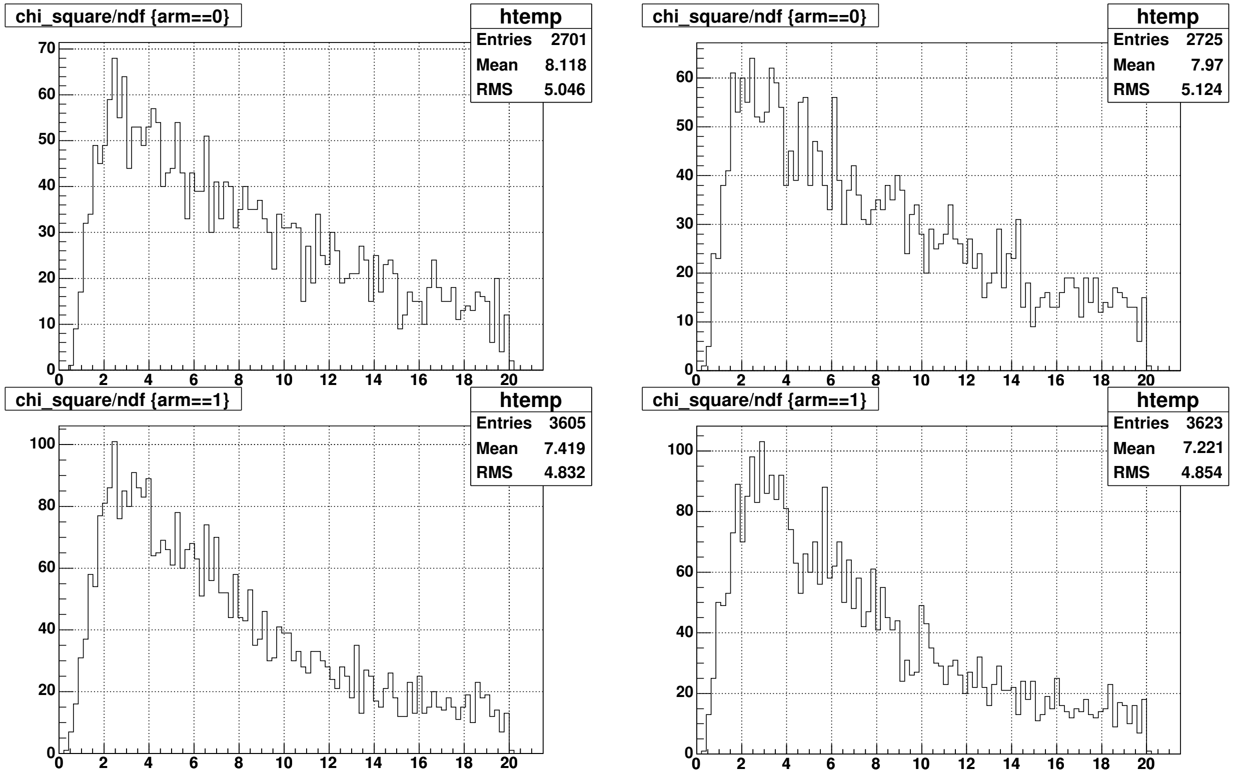
w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

- The alignment clearly converges to 0 after the second reconstruction. The misalignments were corrected by the program.

Alignment only along W [Track Chi Square]

South Arm

North Arm

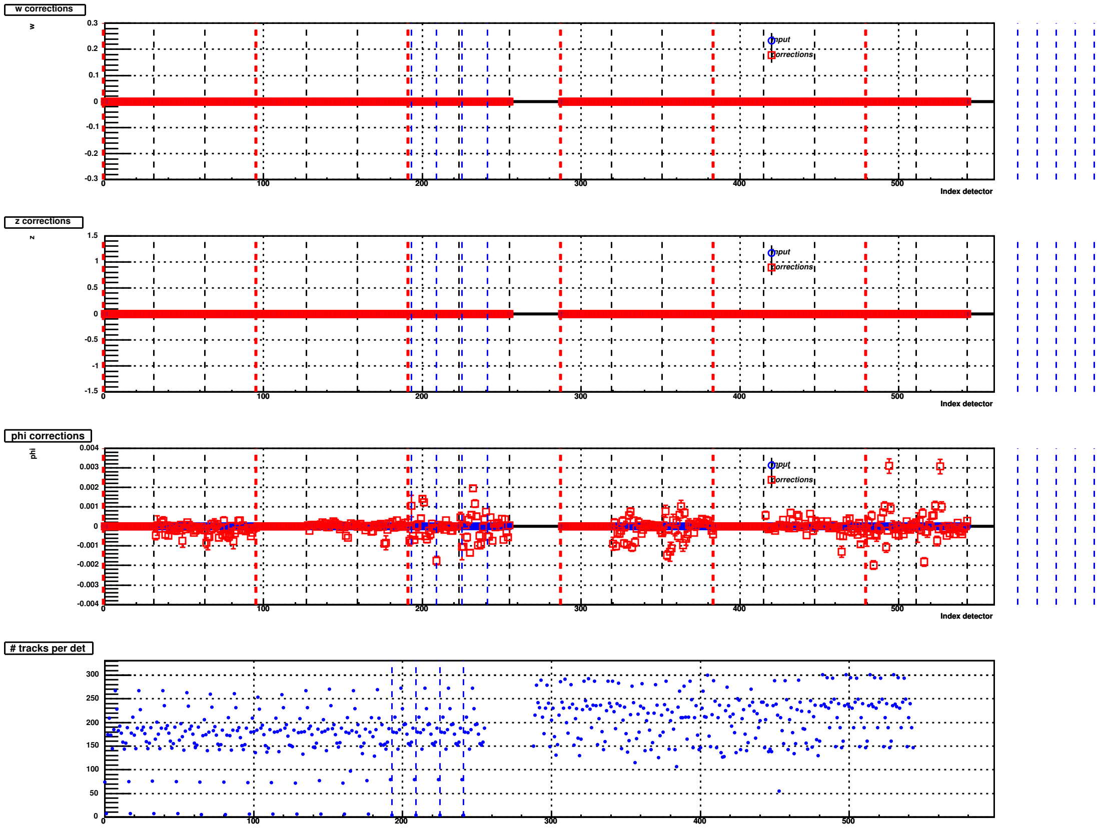


First reconstruction

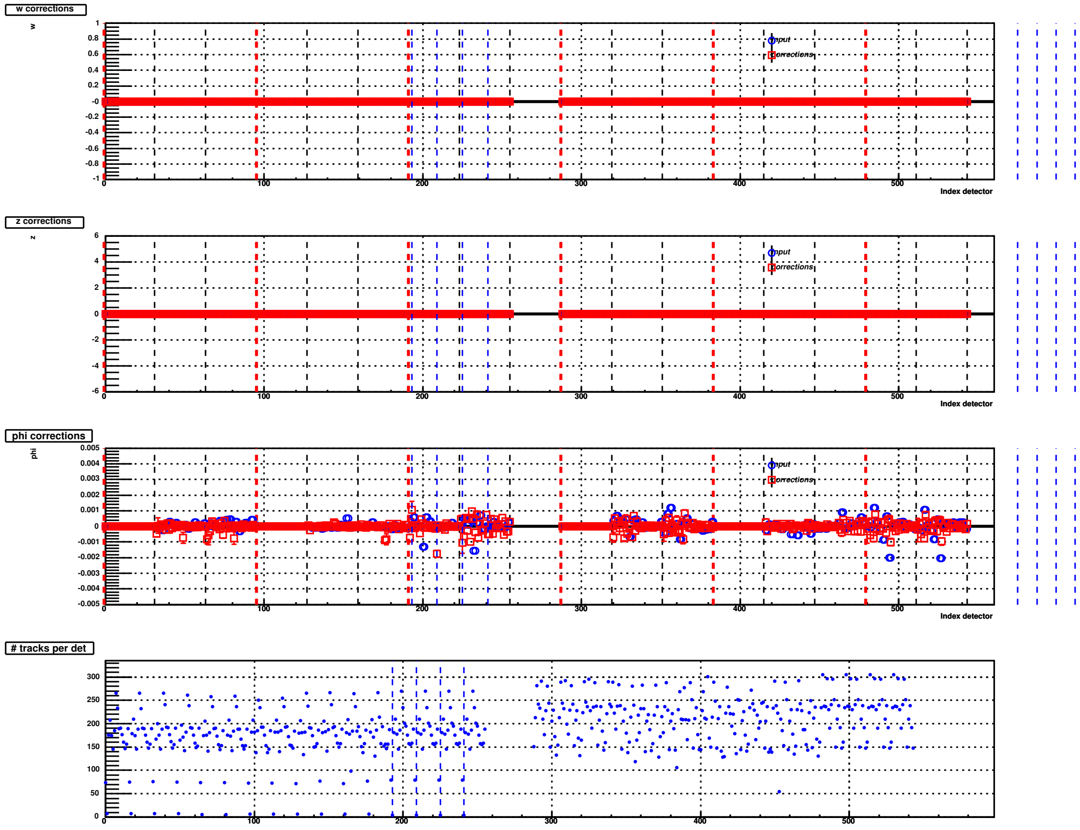
Second reconstruction

- In the south arm the number of tracks increases of 0.9% after the second reconstruction. The mean of the chi square distribution are also better after alginment.
- In the north arm, the number of tracks increases of 0.5%, and the mean is also better.
- With this little stat, the alignment improves the tracks' quality when aligning only w.

First reconstruction



Second reconstruction



SCALE

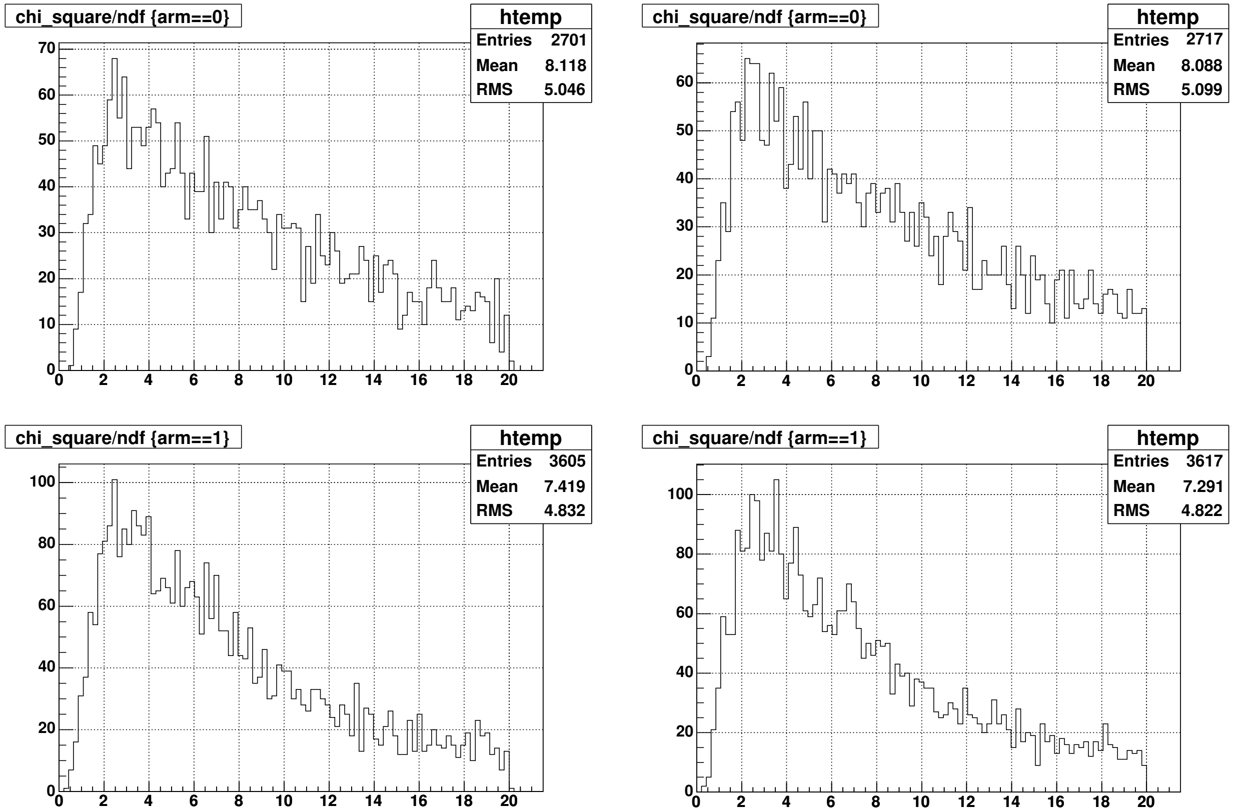
w: [-0.3; 0.3]; z: [-1.5; 1.5]; phi: [-0.004; 0.004]

number of hits (range for both plots): [0; 300]

w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

- The alignment looks a little bit better. A closer look at the chi square should help decide of the improvement.

We looked at the alignment along Phi alone.



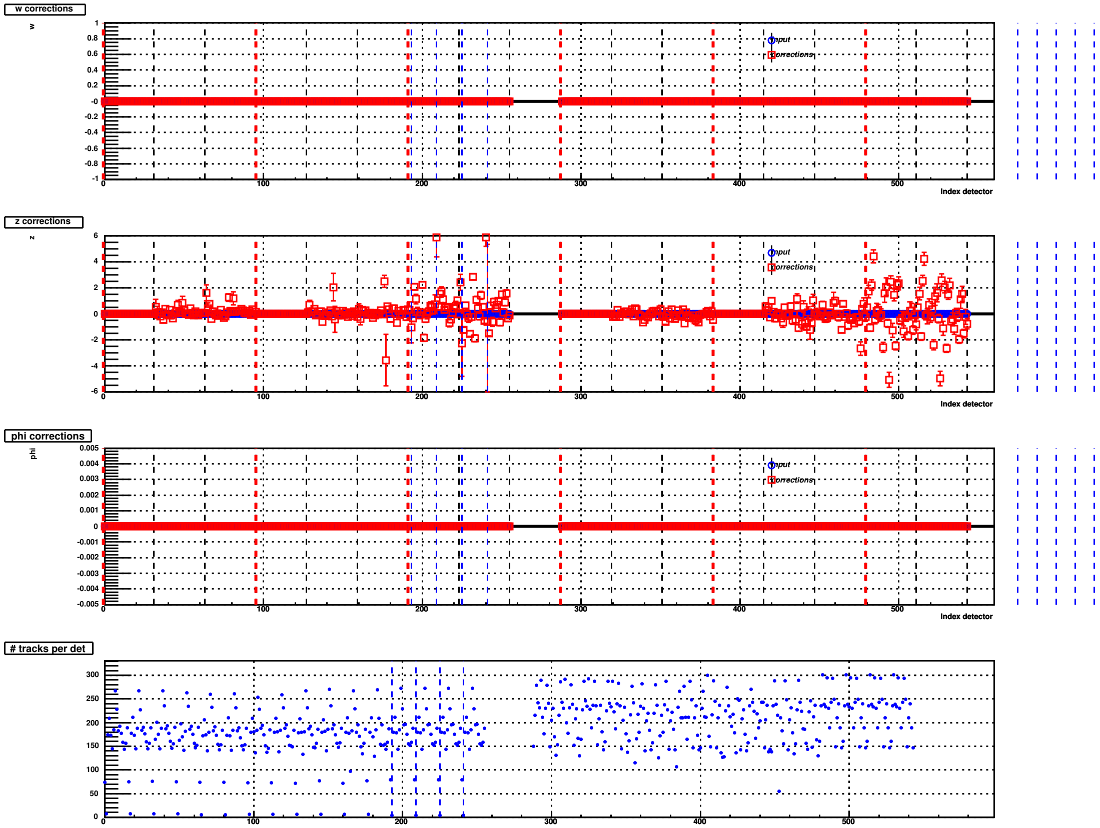
South Arm

North Arm

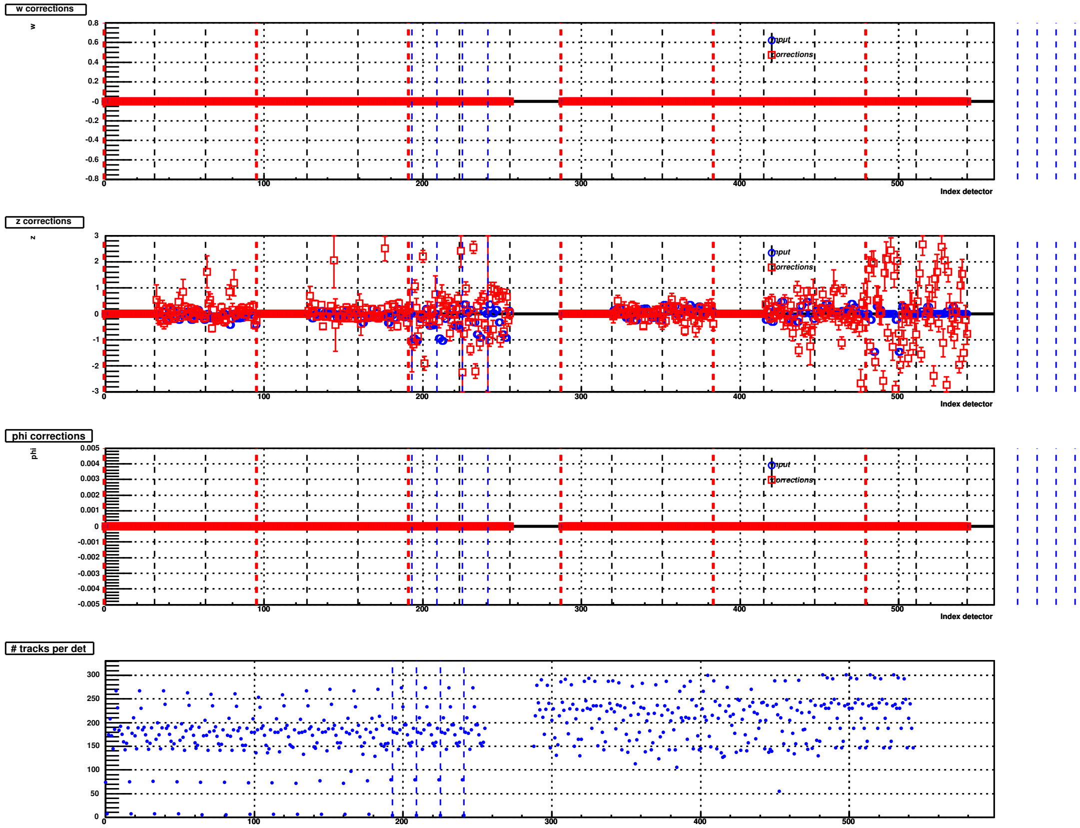
First reconstruction   Second reconstruction

- The number of tracks improves of 0.6% for the south arm and 0.33% in the north arm. The means for both arms improves also.

First reconstruction



Second reconstruction



SCALE

w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

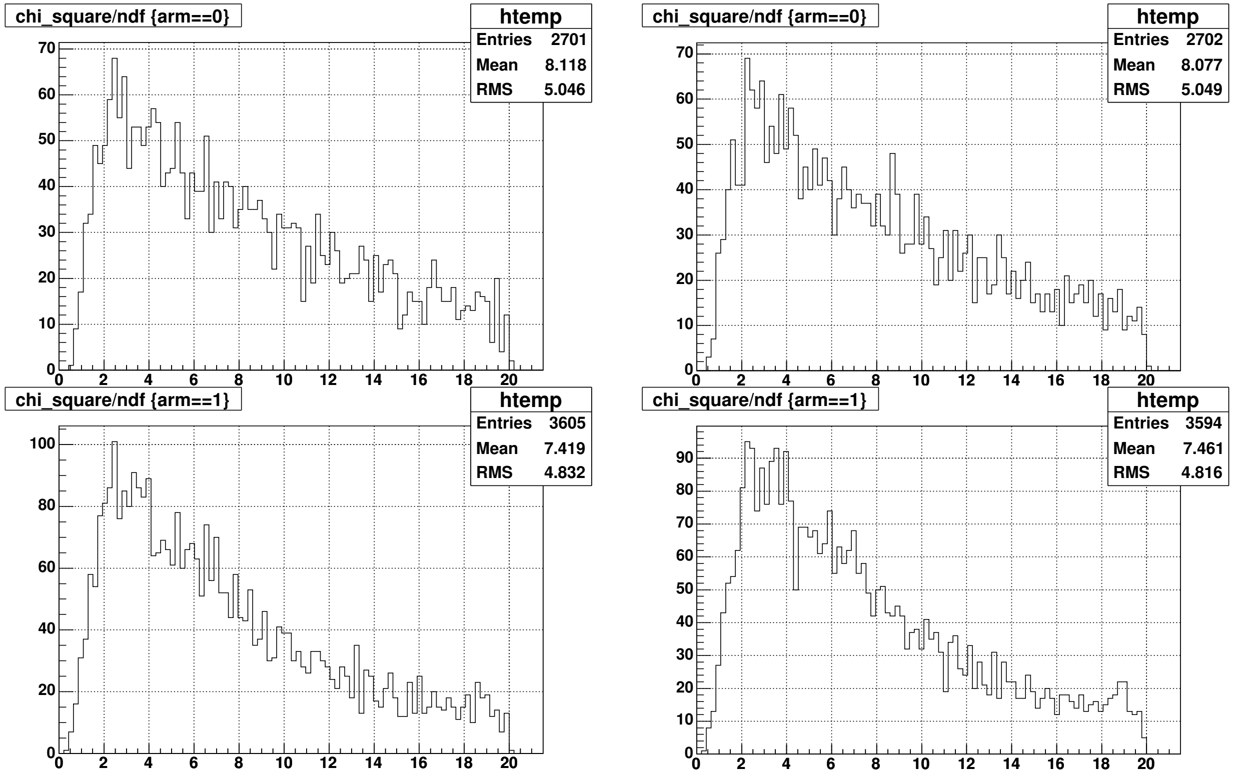
number of hits (range for both plots): [0; 300]

w: [-0.8; 0.8]; z: [-3; 3]; phi: [-0.005; 0.005]

- The program do not seem to be aligning so well_carefull because of the changes of scale. *May be it needs to be iterated ?*

Alignment only along Z [Track Chi Square]

South Arm



North Arm

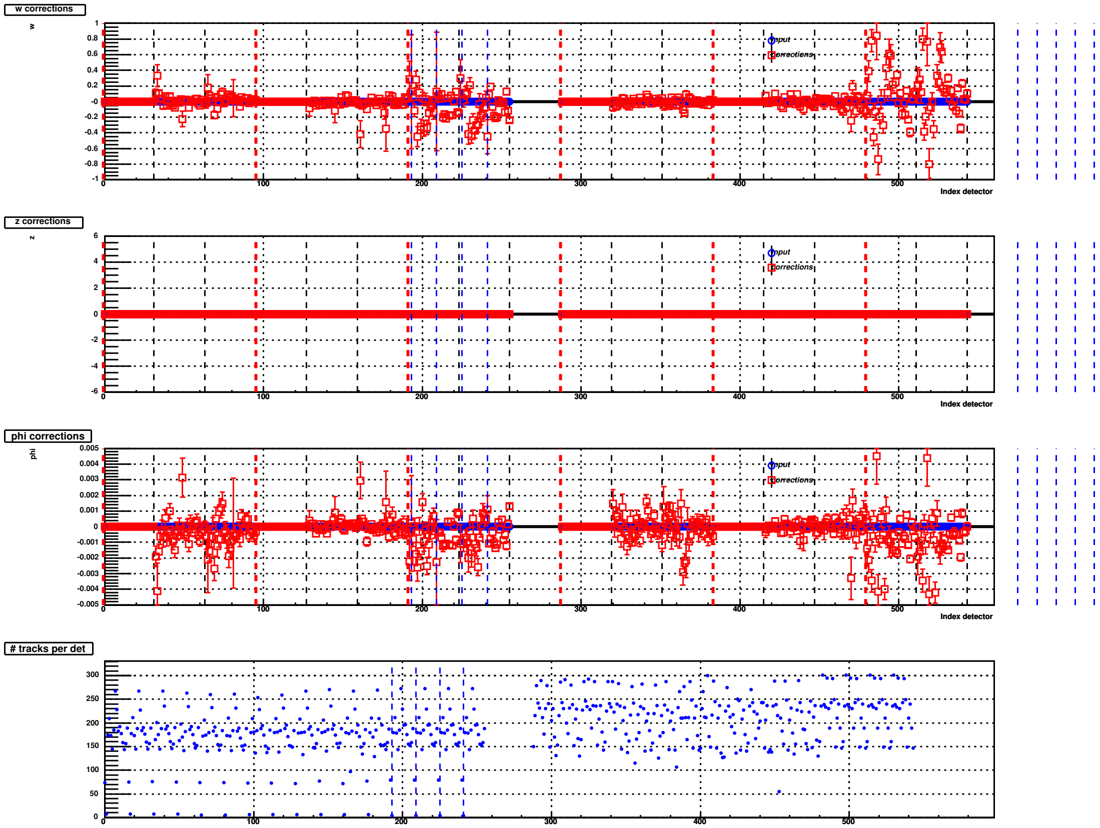
First reconstruction

Second reconstruction

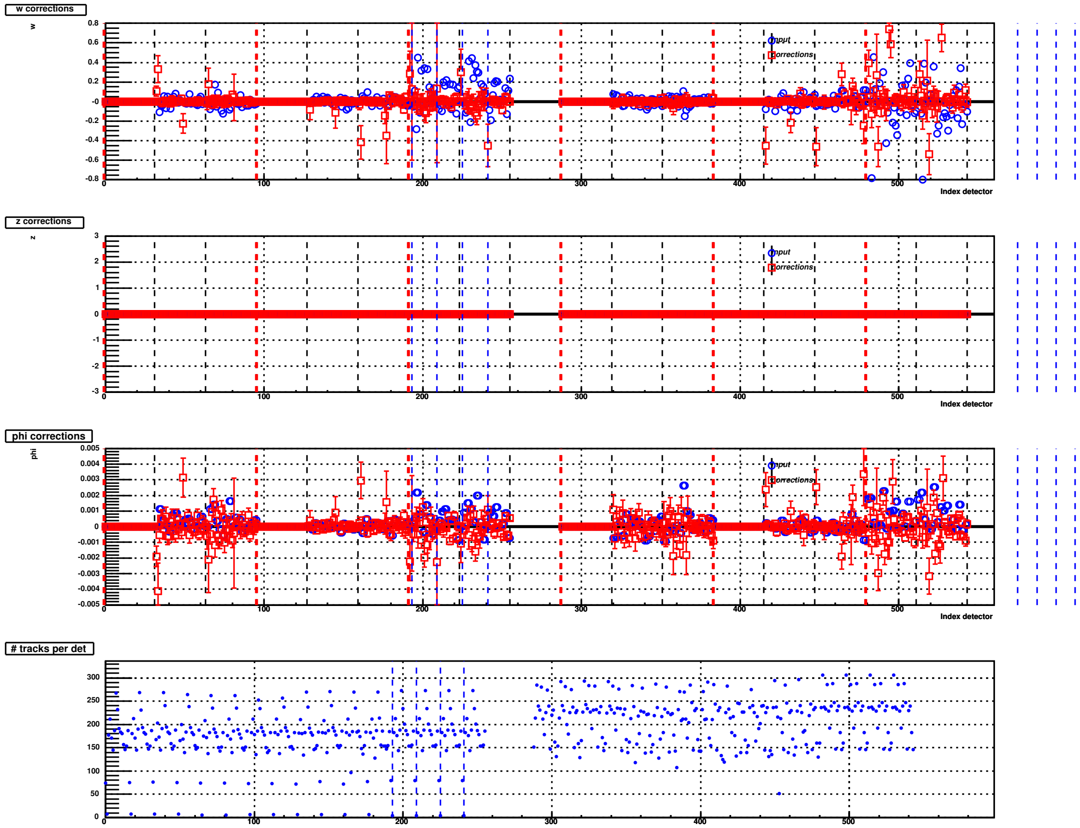
- The track quality confirms that the alignment was not efficient. Indeed there is only 1 more entry in the south arm after the second reconstruction and we loose 9 tracks in the north arm. *Better not use the alignment along Z with that statistics.*

Alignment only along W and Phi [Offsets]

First reconstruction



Second reconstruction



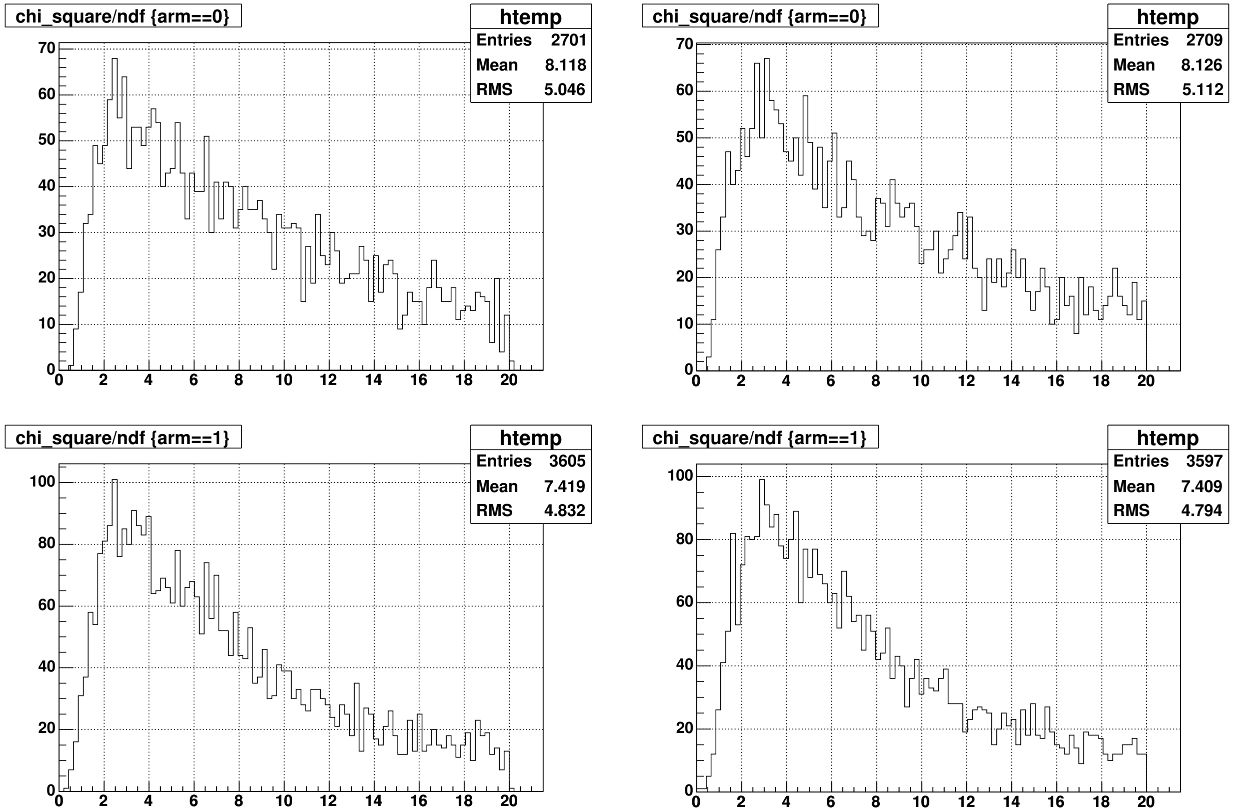
SCALE

w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

number of hits (range for both plots): [0; 300]

w: [-0.8; 0.8]; z: [-3; 3]; phi: [-0.005; 0.005]

- It seems that after the second reconstruction, the offsets are more centered around 0.

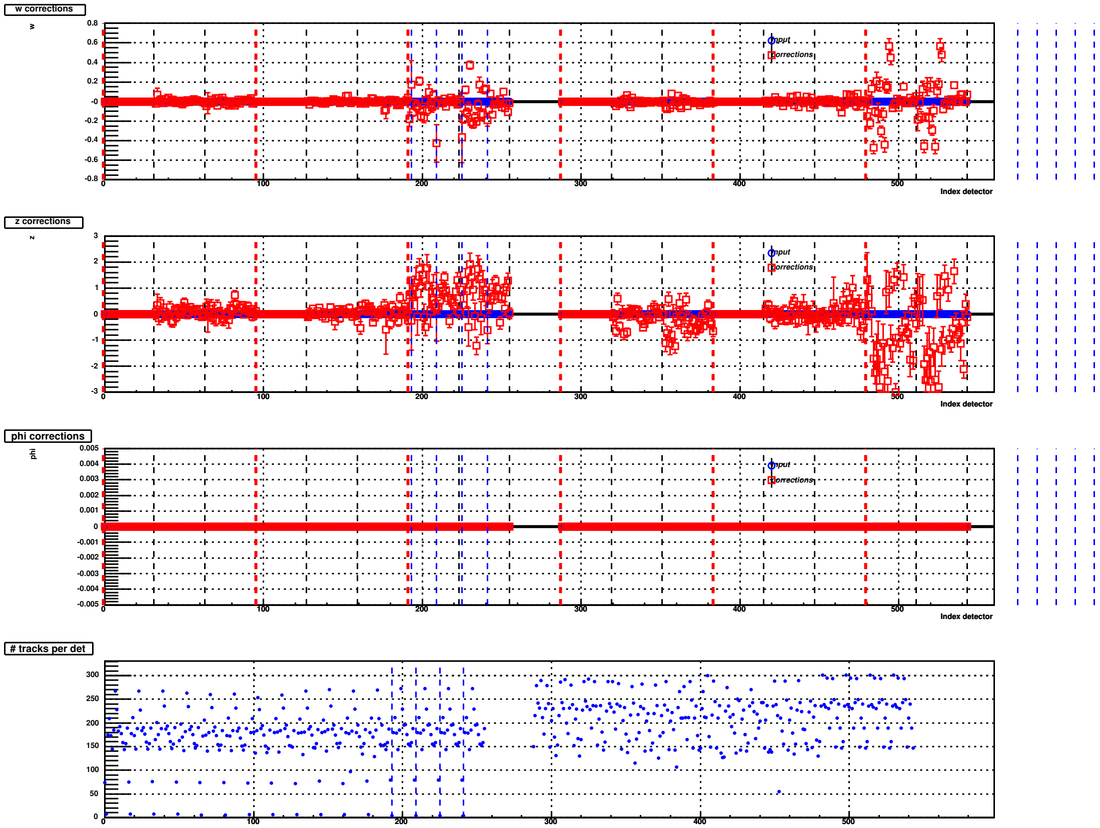


South Arm

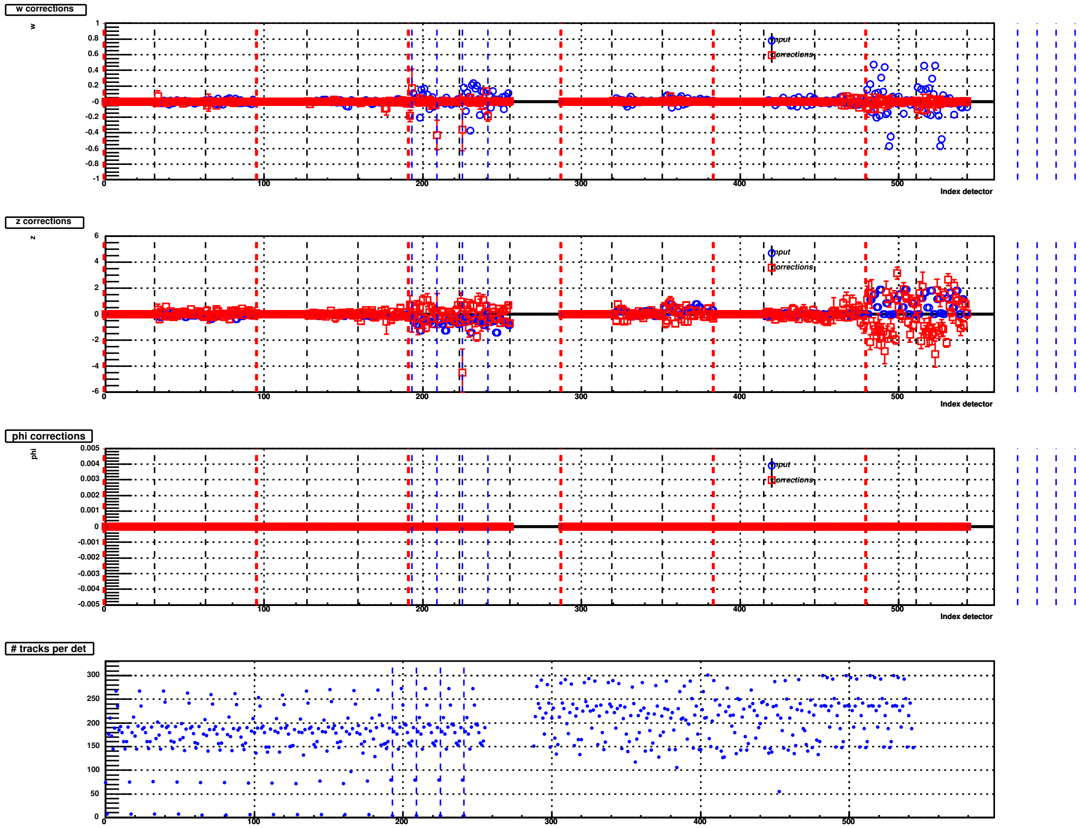
North Arm

- The alignment stills affects the tracks negatively in the north arm since we loose 8 tracks (-O.22%). In the south arm we only gain 8 tracks, 0.3%.
- So aligning both W and Phi do not show improvement in the tracks quality...

First reconstruction



Second reconstruction



SCALE

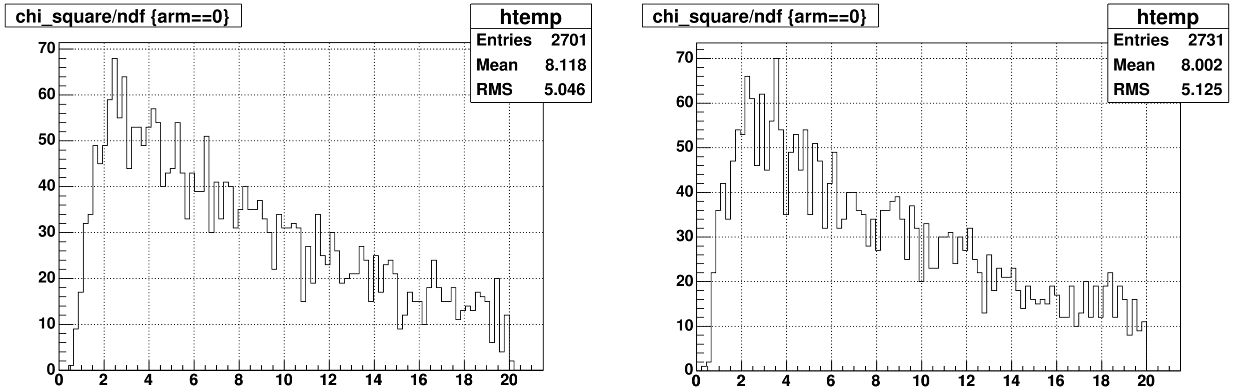
number of hits (range for both plots): [0; 300]

w: [-0.8; 0.8]; z: [-3; 3]; phi: [-0.005; 0.005]

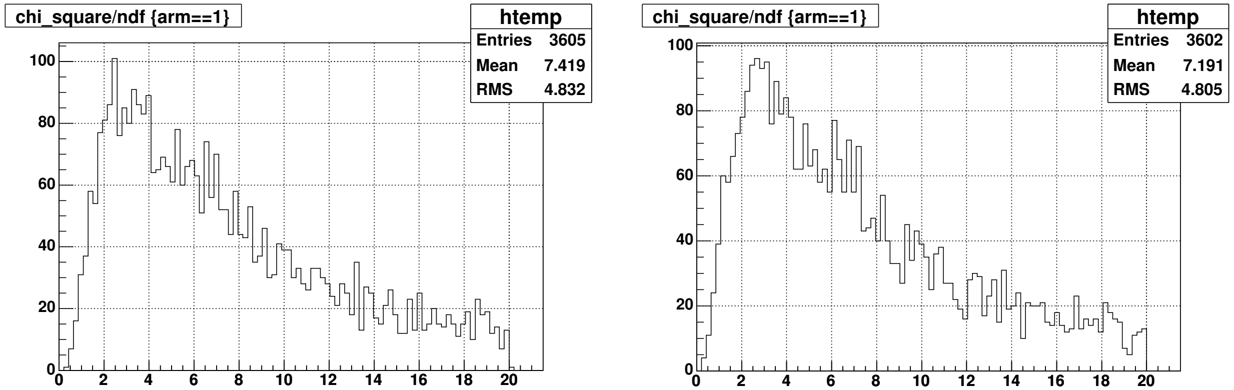
w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

- Even if we included Z in the alignment with W, is seems that the tracks were recentered around 0 after the second alignment.

Alignment only along W and Z [Track Chi Square]



South Arm



North Arm

- Even if the Z alignment seemed to be bad, the number of tracks after the second reconstruction in the south arm is better aligning W and Z than W and Phi. *Why is it not better with Phi than with Z?* Indeed, now we gain 1.11% of tracks in the south arm.

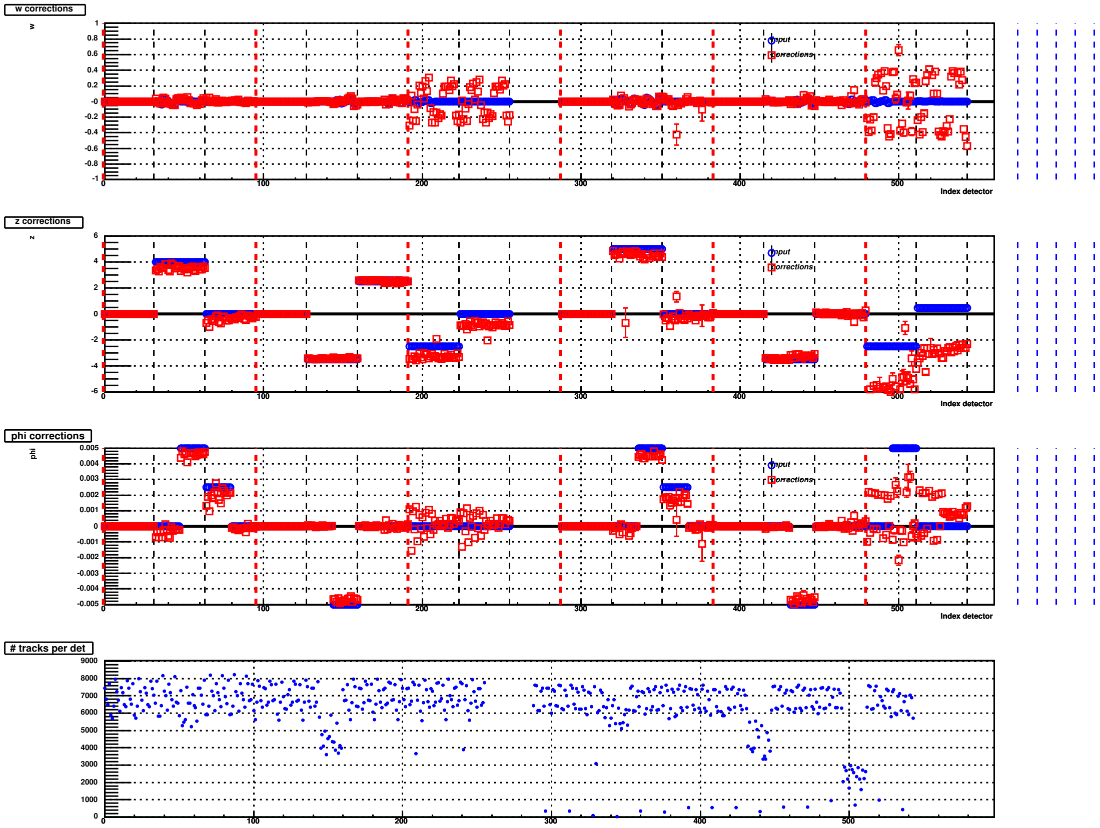
- For the north arm, the results is not soo good since we loose 3 tracks (0.08%).

- In both case the mean improves.

- *Should we not consider the lack in the north arm given the big improvment in the south arm ?* Anyway, is is not so convicing neither because the improvement is relativly small. *Is it because we don't have enough stastics?*

Field ON, with misalignments, simulation

First reconstruction



SCALE

w: [-1; 1]; z: [-8; 8]; phi: [-0.005; 0.005]

colorblack number of hits : [0; 300]

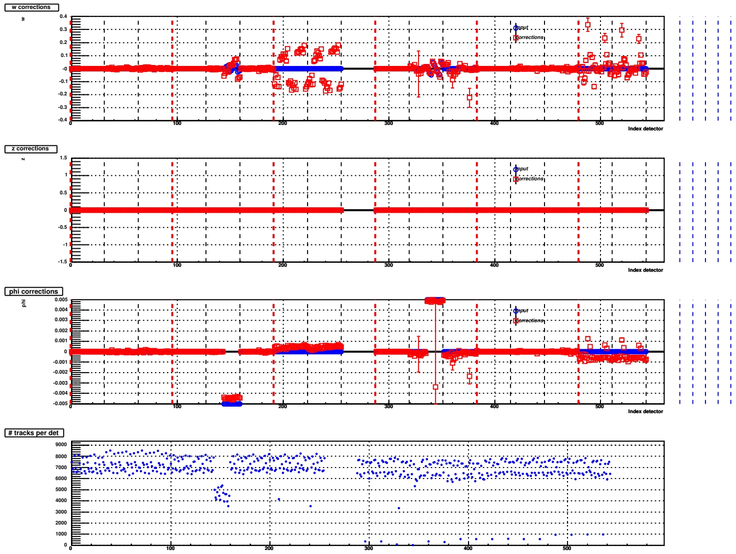
Since aligning with magnetic field ON is more difficult for the program, the alignment might need to be iterated in order to approximate the best set of solution. Another option could be to put small misalignments compared to the no field case.
The following analysis was done with half less misalignment than last week.

- The alignment does not found the input misalignments but wrong ones for some cathodes. There seemes to be a problem with the alignment of the last station.

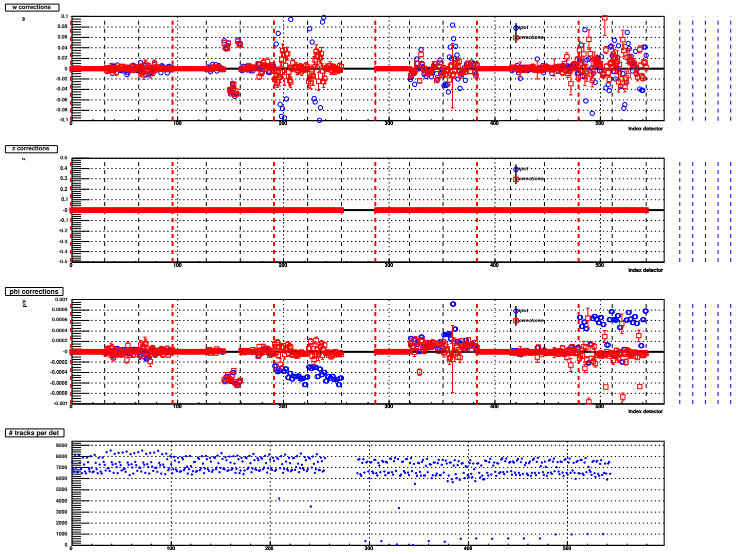
- The understand what is really happening (if the program has a bug or if the problem conmes from somewhere else) we will look at the alignment for each parameter seperatly.

First we looked at the alignment of W and Phi (without Z), with in input misalignments.

First reconstruction



Second reconstruction

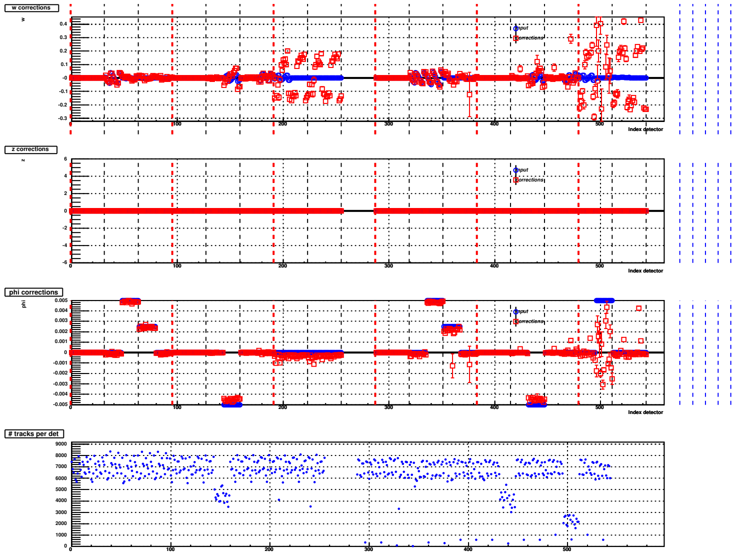


SCALE

w: [-0.4; 0.4]; z: [-8; 8]; phi: [-0.005; 0.005]

number of hits : [0; 300]

w: [-0.1; 0.1]; z: [-0.5; 0.5]; phi: [-0.001; 0.001]

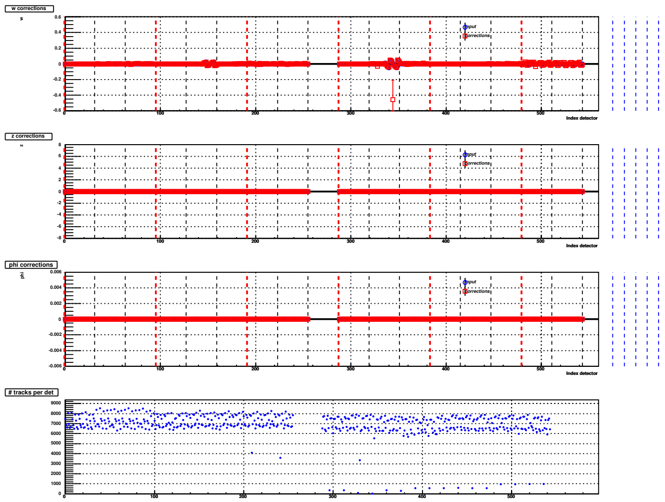


- In the first reconstruction, the same wrong misalignments are seen in the last station as when aligning with Z (top case: only 2 cathodes misaligned; bottom case: lots of misalignments).

- The second reconstruction recenters the offsets around 0, even the wrong ones. It is as if the wrong misalignments found previously were real misalignments. *We should look at the way the last station is align. May be an offset has been wrongly introduced in the coding ? But then, why don't we see the same offsets in the "No Misalignments" case ?*

Field on Random misalignments W [Offsets]

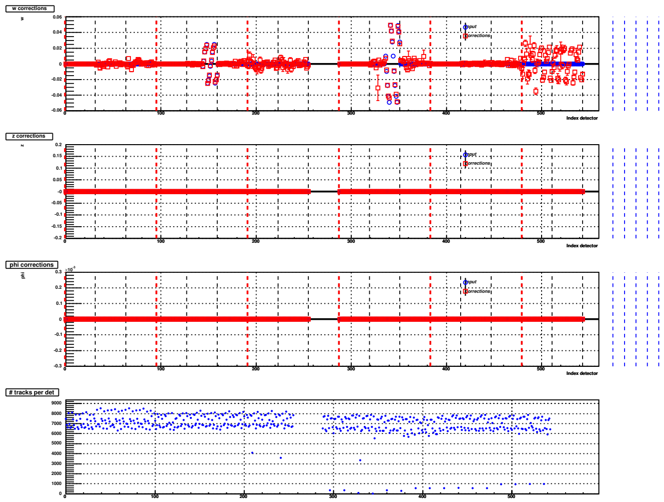
First reconstruction



SCALE

w: [-0.8; 0.8]; z: [-8; 8]; phi: [-0.006; 0.006]

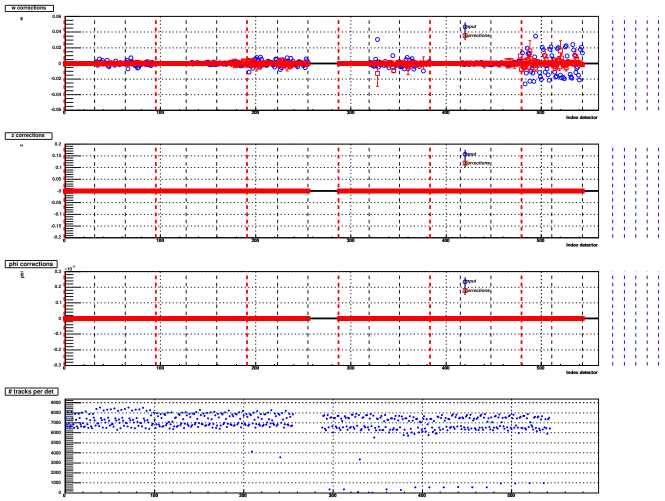
Zoomed



number of hits : [0; 300]

w: [-0.8; 0.8]; z: [-0.2; 0.2]; phi: [-0.0003; 0.0003]

Second reconstruction



w: [-0.6; 0.6]; z: [-0.2; 0.2]; phi: [-0.0003; 0.0003]

Misaligning only 2 cathodes (not ones of the last station), we run the alignment only for W.

- In the zoom of the first reconstruction we mainly see a problem in the found offsets of the north arm last station (also in the south but less). The other misalignments seems to have been well found.

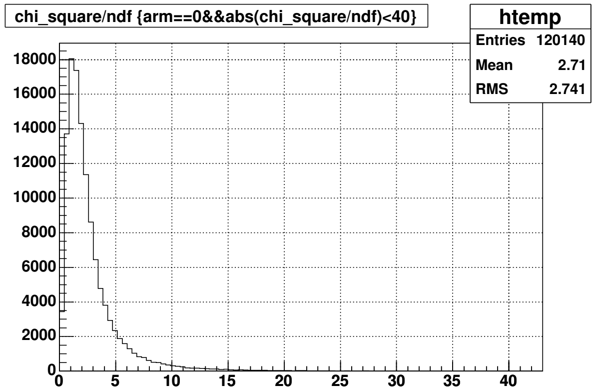
- The second reconstruction shows that the strange offsets of the last stations have disapeared. So the problem of the last station still exists and can be seen when aligning only W.

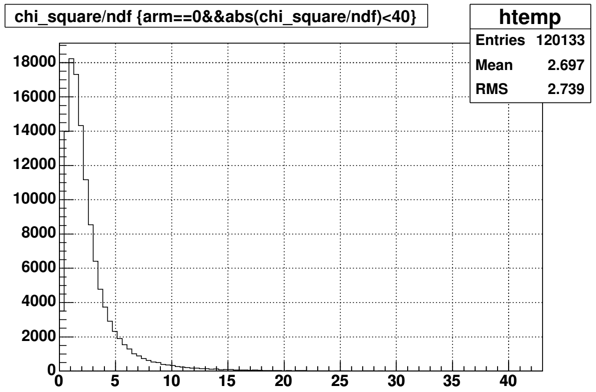
Chi Square [Aligning only W]

First reconstruction

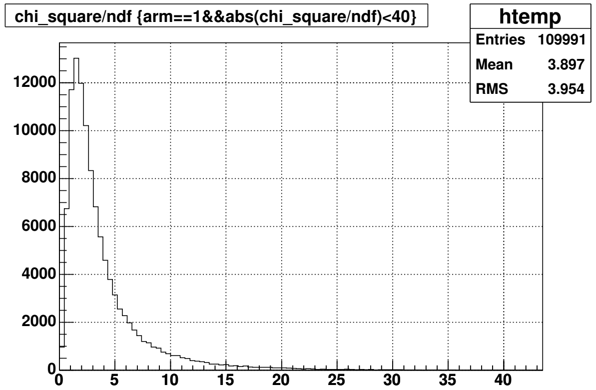
Second reconstruction

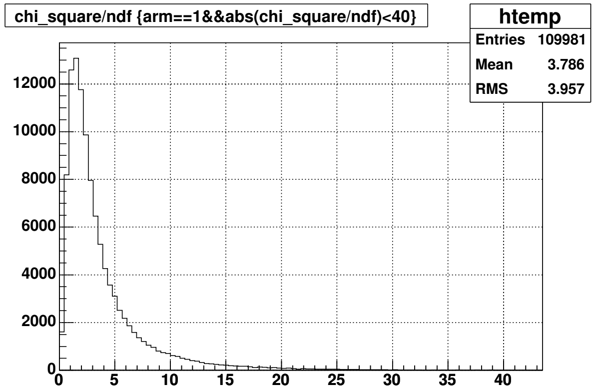
South Arm





North Arm



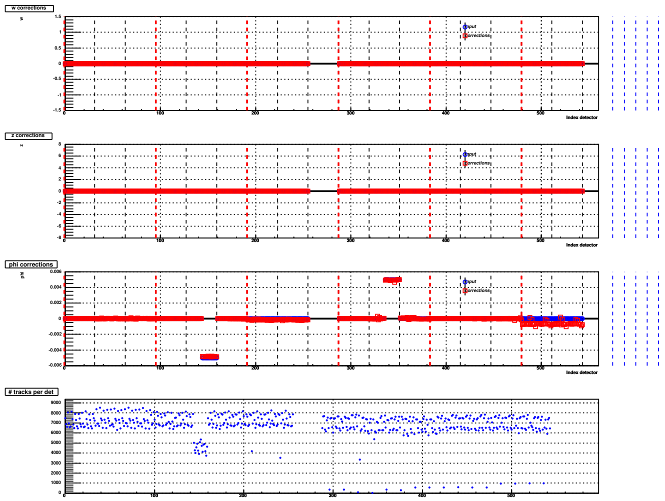


- Prob: we loose tracks for both arms... Ok, given the amount of statistics, the number of tracks lost is not a lot. Eventhough, a good alignment should help gain tracks. So the alignment removed some misterious offsets that were helping getting better tracks quality.

Field on Random misalignments Phi [Offsets]

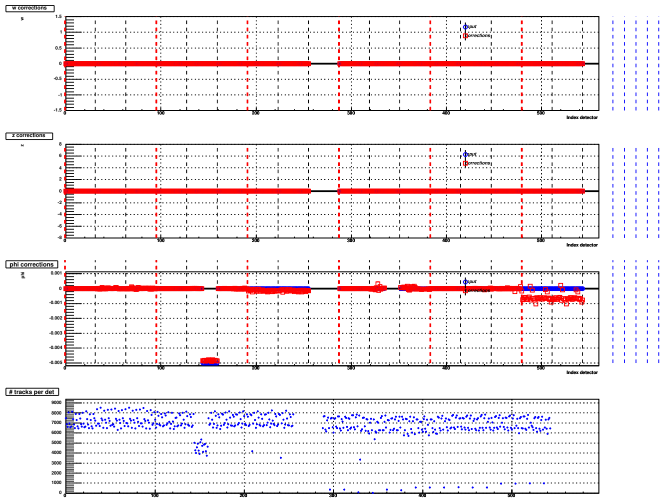
Misaligning only 2 cathodes (not in the last station) we run the alignment only for Phi.

First reconstruction



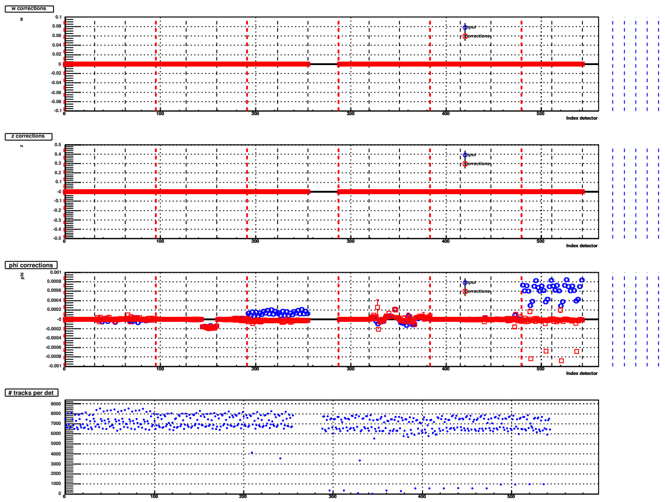
w: [-1.5; 1.5]; z: [-8; 8]; phi: [-0.006; 0.006]

Zoomed



w: [-1.5; 1.5]; z: [-8; 8]; phi: [-0.005; 0.001]

Second reconstruction



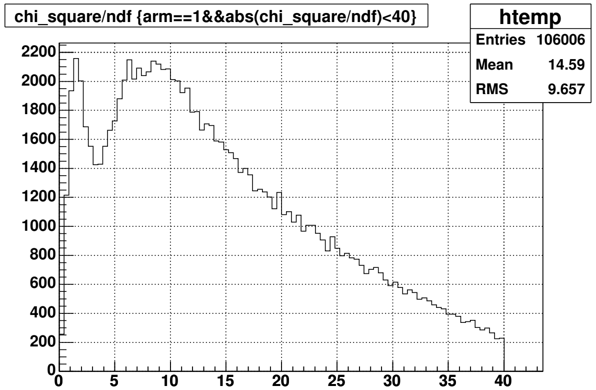
w: [-0.1; 0.1]; z: [-0.5; 0.5]; phi: [-0.001; 0.001]

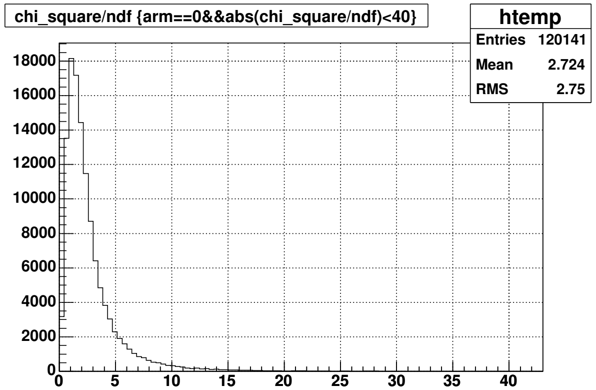
- The first reconstruction still shows the problem in the last station alignment.
- The second reconstruciton erase the wrong offsets. *So the problem for the last station is also here when only aligning Phi.*

Chi Square [Aligning only Phi]

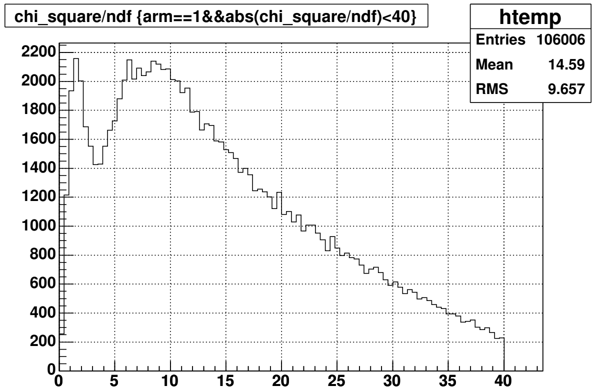
First reconstruction

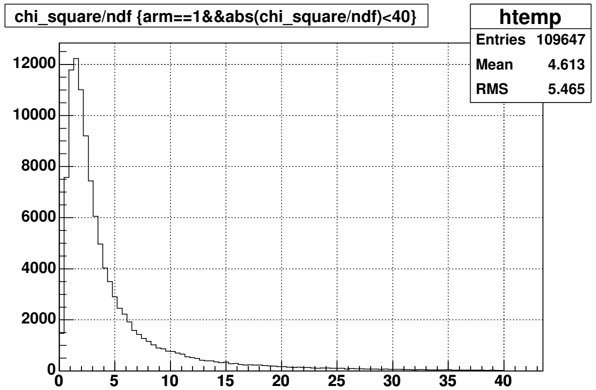
Second reconstruction





South Arm





North Arm

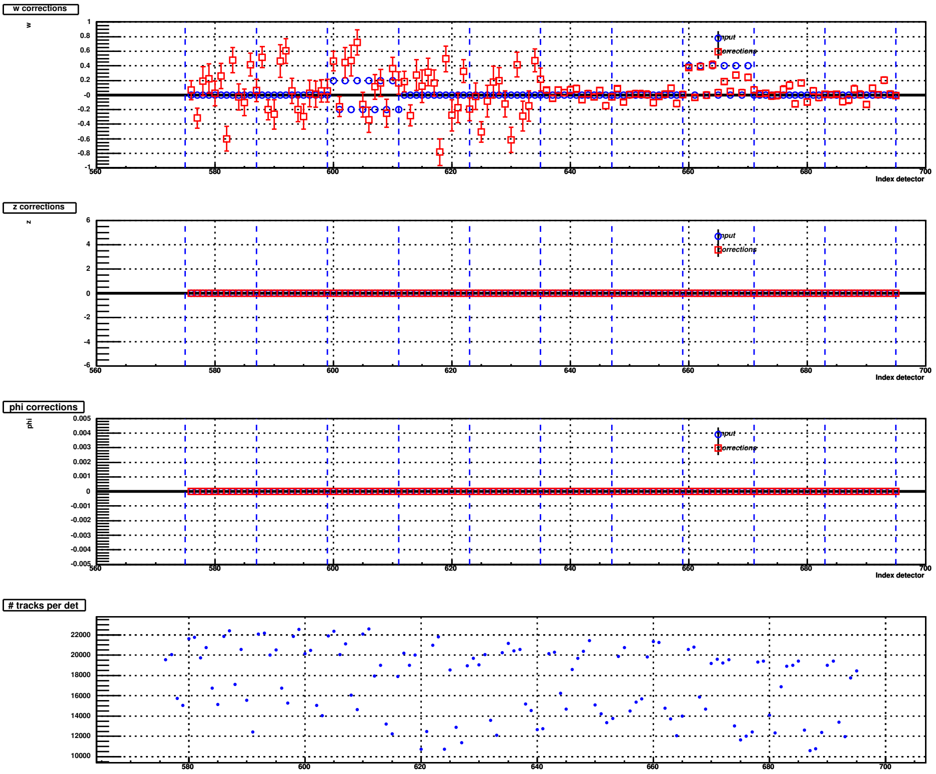
- Obviously the alignment worked well.
- For south arm, the number of tracks was improved of 13.33% and for the north arm of 3.43%, not talking about the mean and RMS that are far better.
- *May be we shoould have put bigger misalignments on the previous analisis wis W to see such an improvement.*
- So the last station wrong offsets are either created withing the alignment program. But we do not treat each station dseperatly: all should be affected in that case. Or the offsets vcould be linked to something done when introducing misalignments since without input misalignments, no such big offsets in the last stations have been seen. Or the problem might come from the PR. But this is not relevant since all analisis have shown pertinant results with this PR.

Muid alignment, no field, with misalignments, simulation

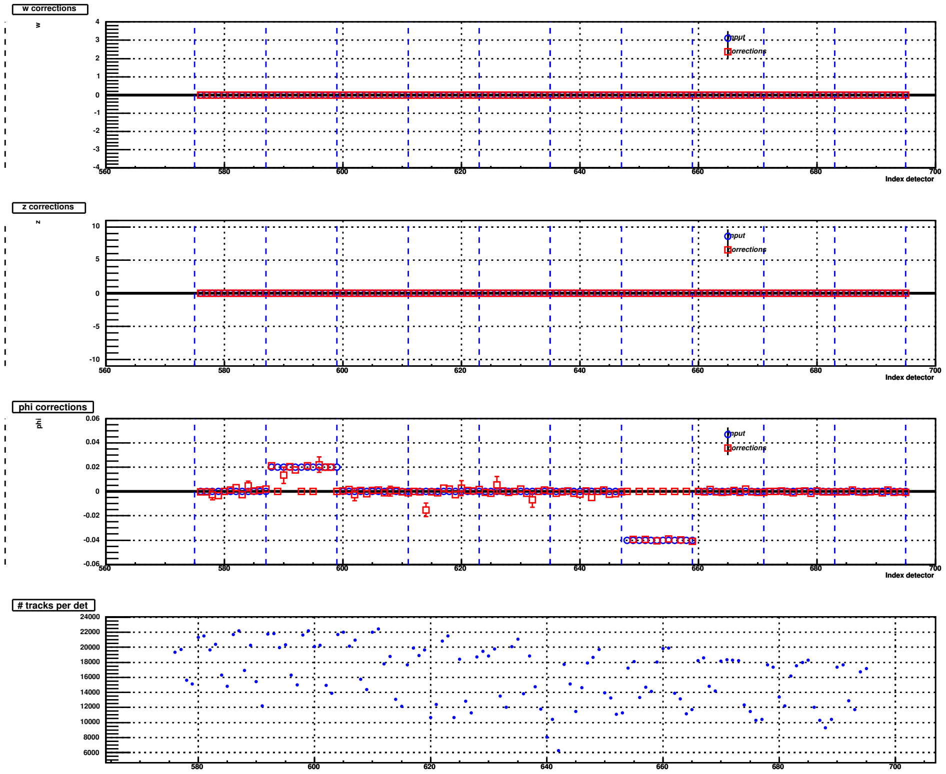
Offsets [Without Z] 1/4

When introducing misalignments to the muid and trying to align, we note a strange behavior for one orientation of the two. To understand the correlations to this problem we tryed to align without Z, each parameter seperatly.

First reconstruction W alone



First reconstruction Phi alone



SCALE

w: [-1; 1]; z: [8; 8]; phi: [-0.005; 0.005]

number of hits : [0; 300]

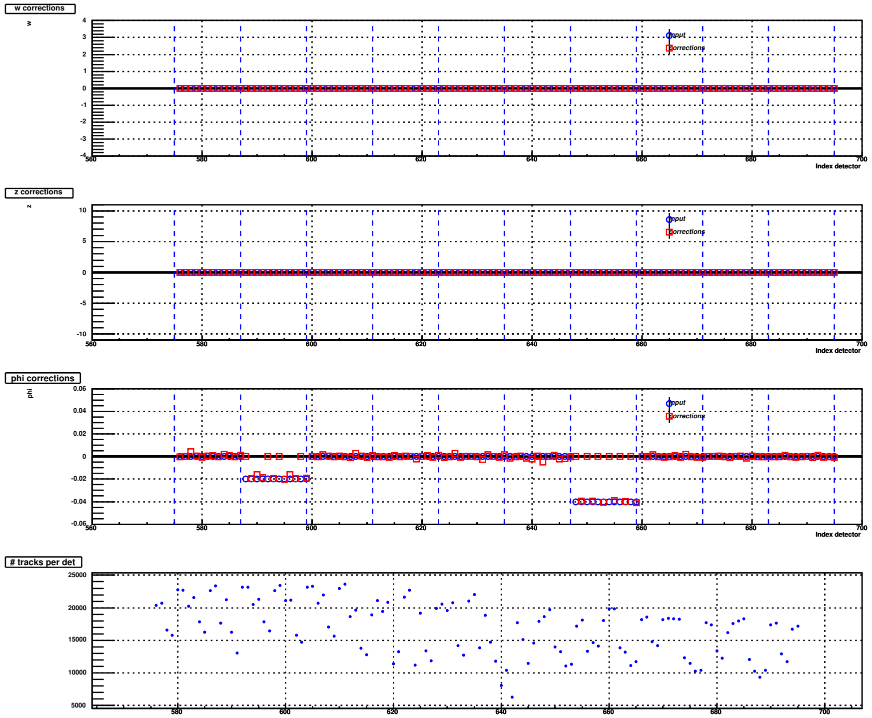
w: [-4; 4]; z: [-11; 11]; phi: [-0.006; 0.006]

- For W, the misalignments seem to have been found more or less.
- For the alignment of Phi, we note the above cited phenomenon: some orientations seems to have been fixed to 0: no tracks, no misalignments output. *So the problem is linked to the Phi alignment: no correlation with the w alignment.*

Offsets [Phi alone] 2/4

We looked at the influence of the sign of the input misalignments for the Phi alignment.

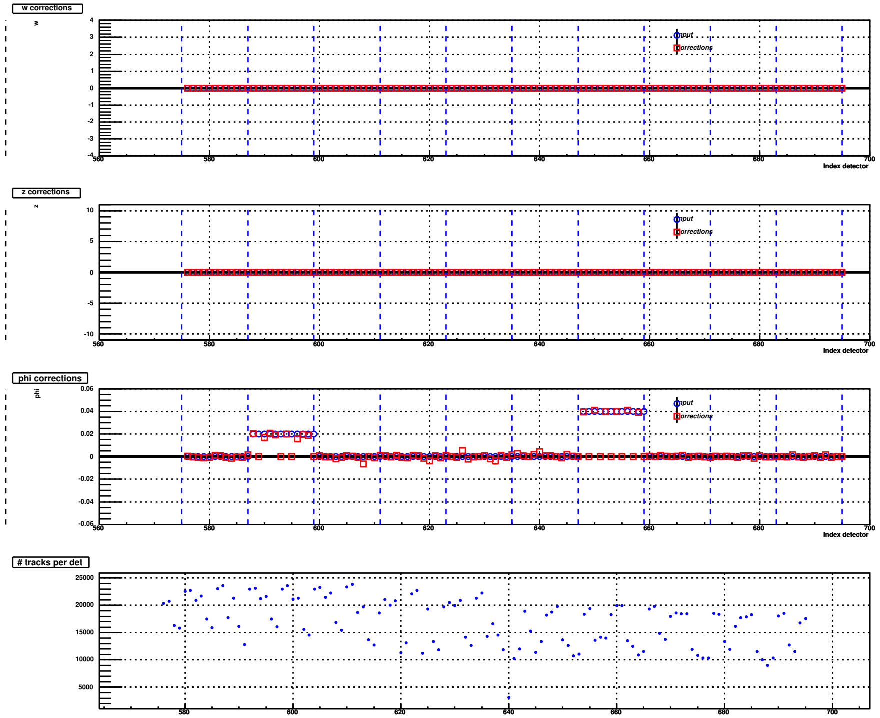
Negative Misalignments



number of hits : [0; 300]

w: [-4; 4]; z: [-10; 10]; phi: [-0.006; 0.006]

Positive Misalignments



w: [-4; 4]; z: [-10; 10]; phi: [-0.006; 0.006]

- The problem appears in both case. It does not depends on the misalignments sign. *I looked at the source files that disalign the panels when we introduce misalignments by hand. It seems that moving a panel always includes its too orientations. Therefore I don't understand...*

Simulation

No Field

With misalignments

- Muid

  Problem with the muid finding the misalignments especially when aligning Phi. *Should be linked to the update of the geometry or the founding of the misalignments parameters for orientations of the muid (prob with the index?)* Look at the update of the geometry when introducing MuID misalignments: done. Nothing apparent. Need to print out, but don't see what to print out yet...

  Turn a third reconstruction because it seems to converge.. May be the first misalignments were a little bit big: no because does the same when dividing by 2 the input misalignments.

  Look at the residuals in each detector to see how they were improved by the alignment: they did not improve.

With Field

With misalignments

- Mutr

  The program converges towards a wrong walue.

  Try less misalignments to help the algorithm found them better: it is the same.Try to iterate: it does converge to 0 after the second reconstruction. So the misalignments wrongly found look like systematic generated or by the PR or by the alignment program. But the systematics are only visible on the last station, with field on and with misalignments. Try without the z alignment: it is the same.

Real data

- The alignment is improving the track quality when aligning W seperatly, Phi speratly, and W and Z.
- The best alignments seemss when alignment W. Adding Z improves a lot the quality of the tracks in the south arm, but not in the north arm.
- Any ideas will be usefull !!