μ+ tracking update

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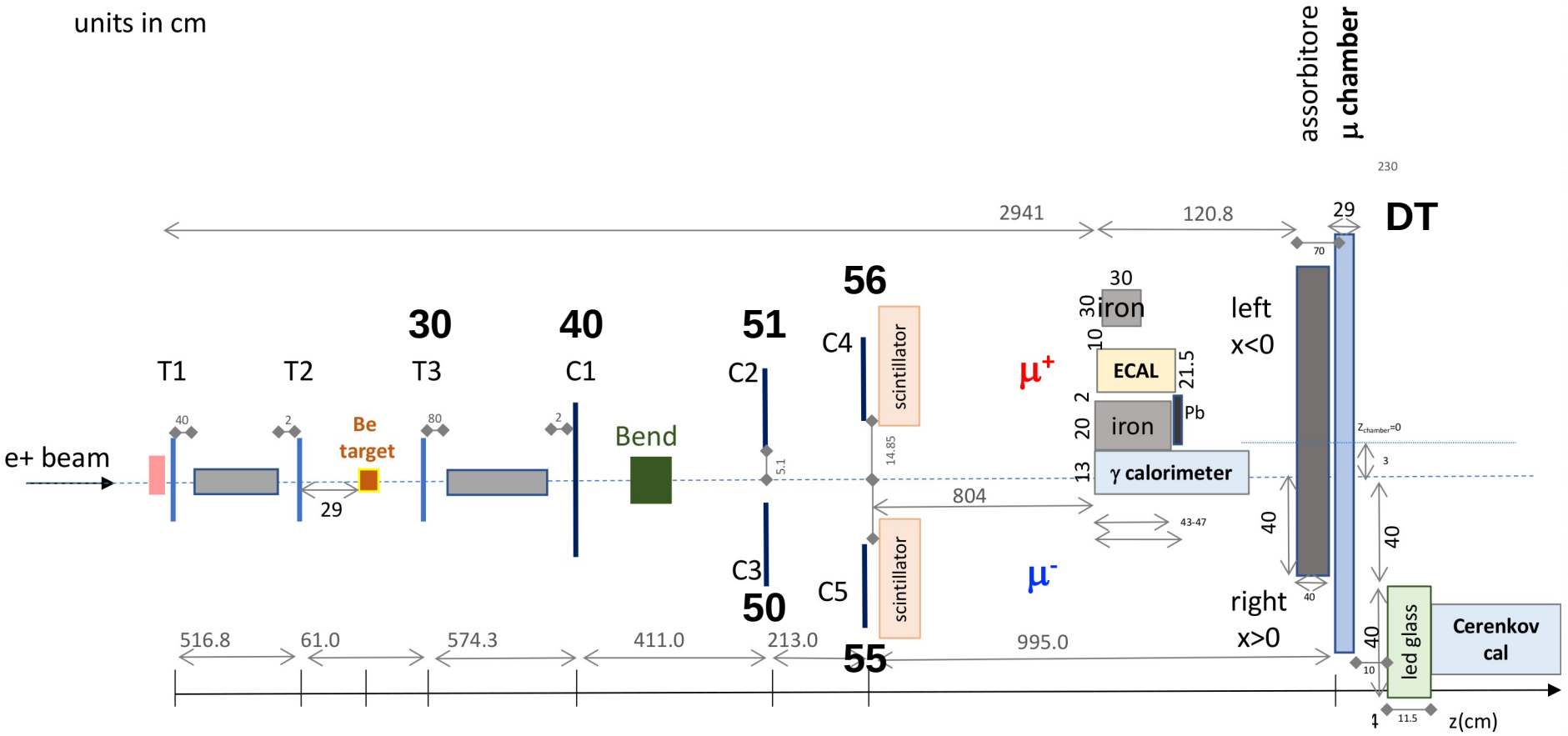
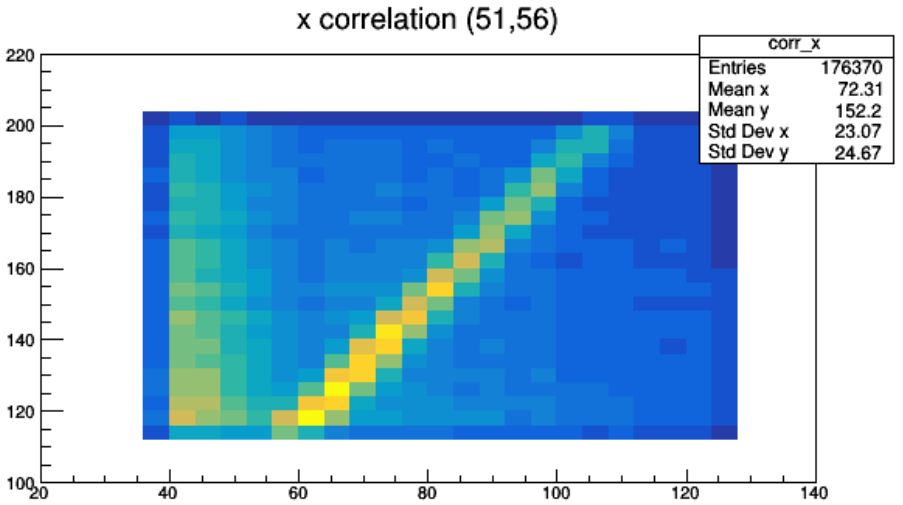
Testbeam setup 2017

units in cm



μ+ tracking

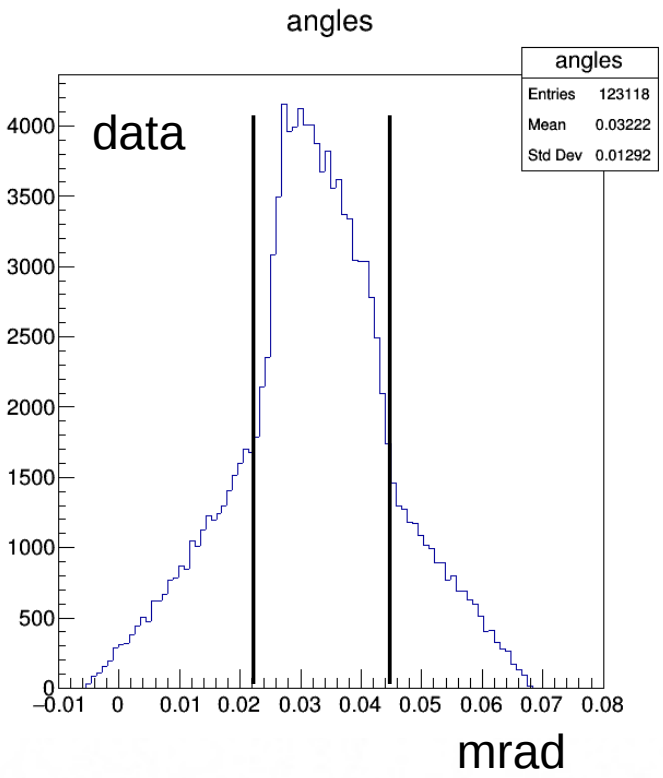
- Until now: we used DT tracks and hits in detector 51 and 56 (after magnet) to tag μ+ events.
- We found several inconsistencies in the properties of these tracks.
- The μ+ line shows different problems with respect to the μ- line:
  - μ+ line: un-identified backgrounds, iron shield, not suitable calibration run
  - μ- line: inefficiency of detector 51

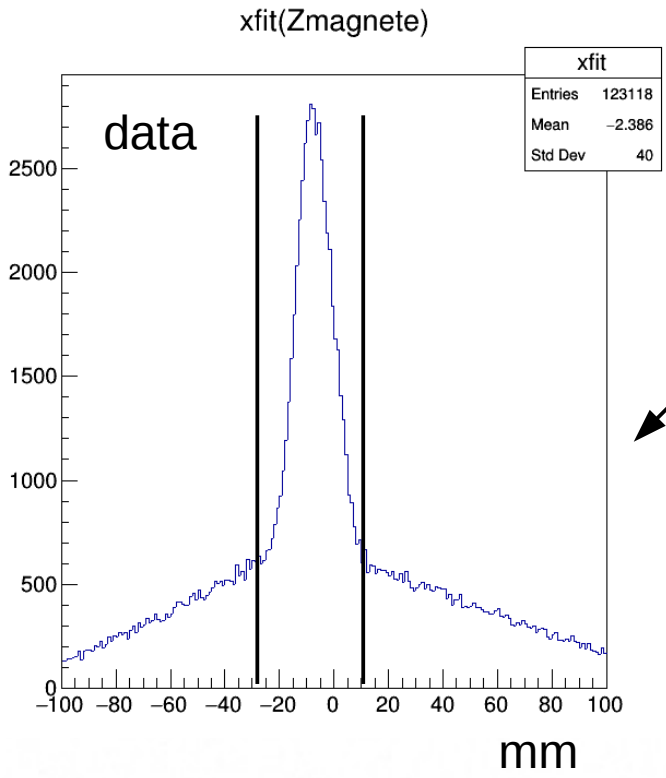


- The μ- tracking algorithm has been developed to overcome the problems in the μ- line: it cannot be used exactly as it is in the μ+ line.
- Today I will show a complete dedicated algorithm to track μ+ (from the DT to the first detector after target.
- **In all the plots in this talk a μ- tracks is pre-selected.**

Silicon tracks (after magnet)

- We have good hints that the efficiency of detectors 51 and 56 is high.
- We build all the possible Si tracks with two hits, one in 51 and one in 56.



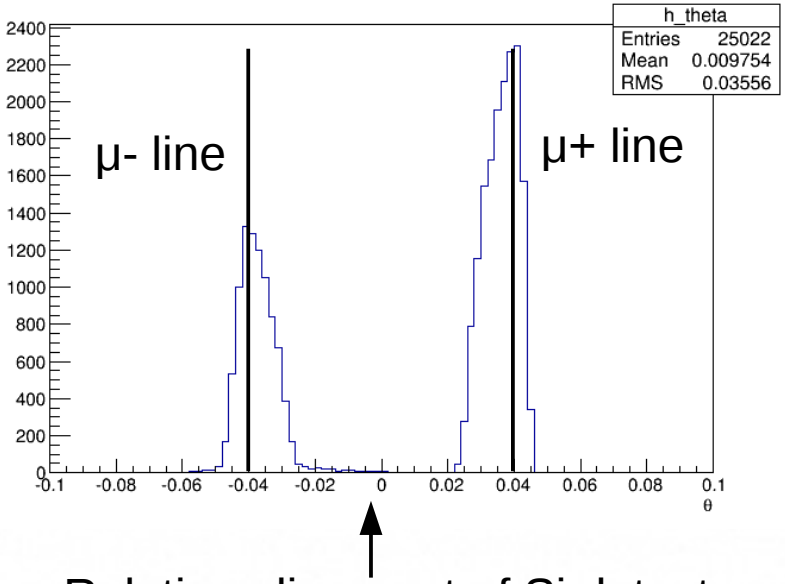


X position extrapolated at the magnet center

- The combinatorial background can be removed by cutting on θ and $x(z_M)$

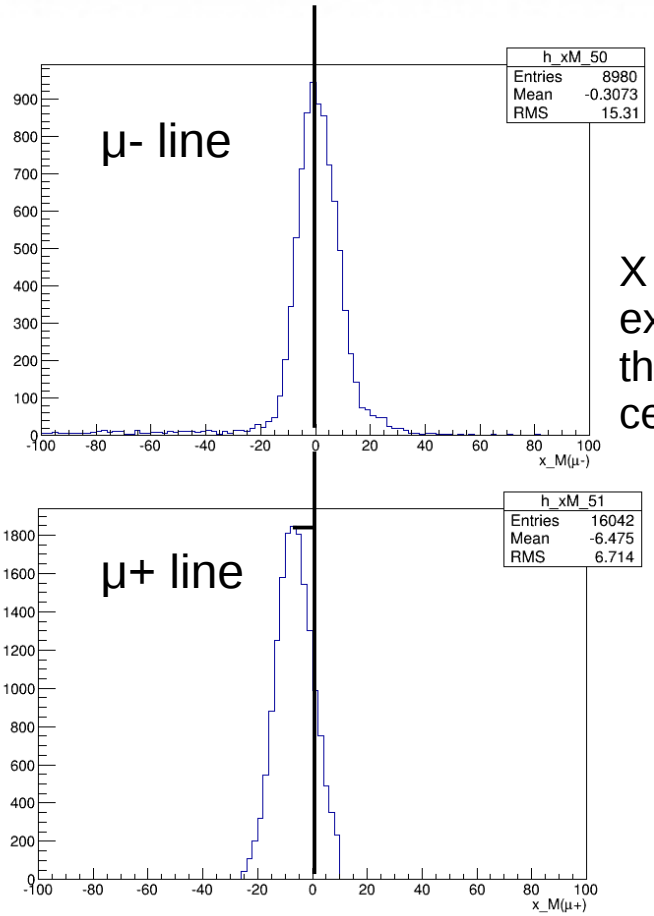
Residual Si alignment (after magnet)

- The μ- line has been aligned with the calibration runs.
- The μ+ line alignment has been obtained by “reflecting” the μ- alignment.



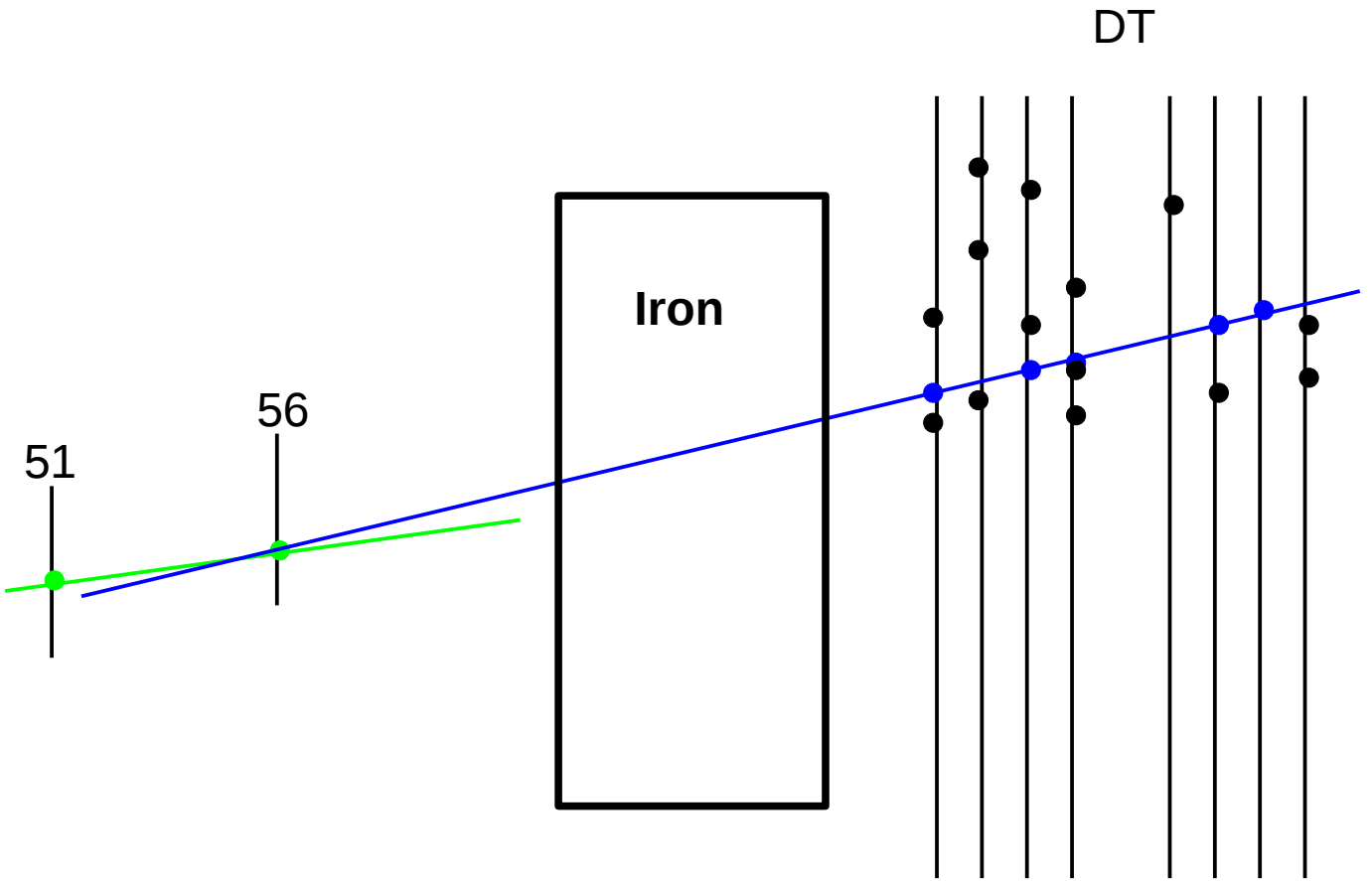
Relative alignment of Si detector after magnet is ok.

Residual mis-alignment of 7 mm for both Si detectors



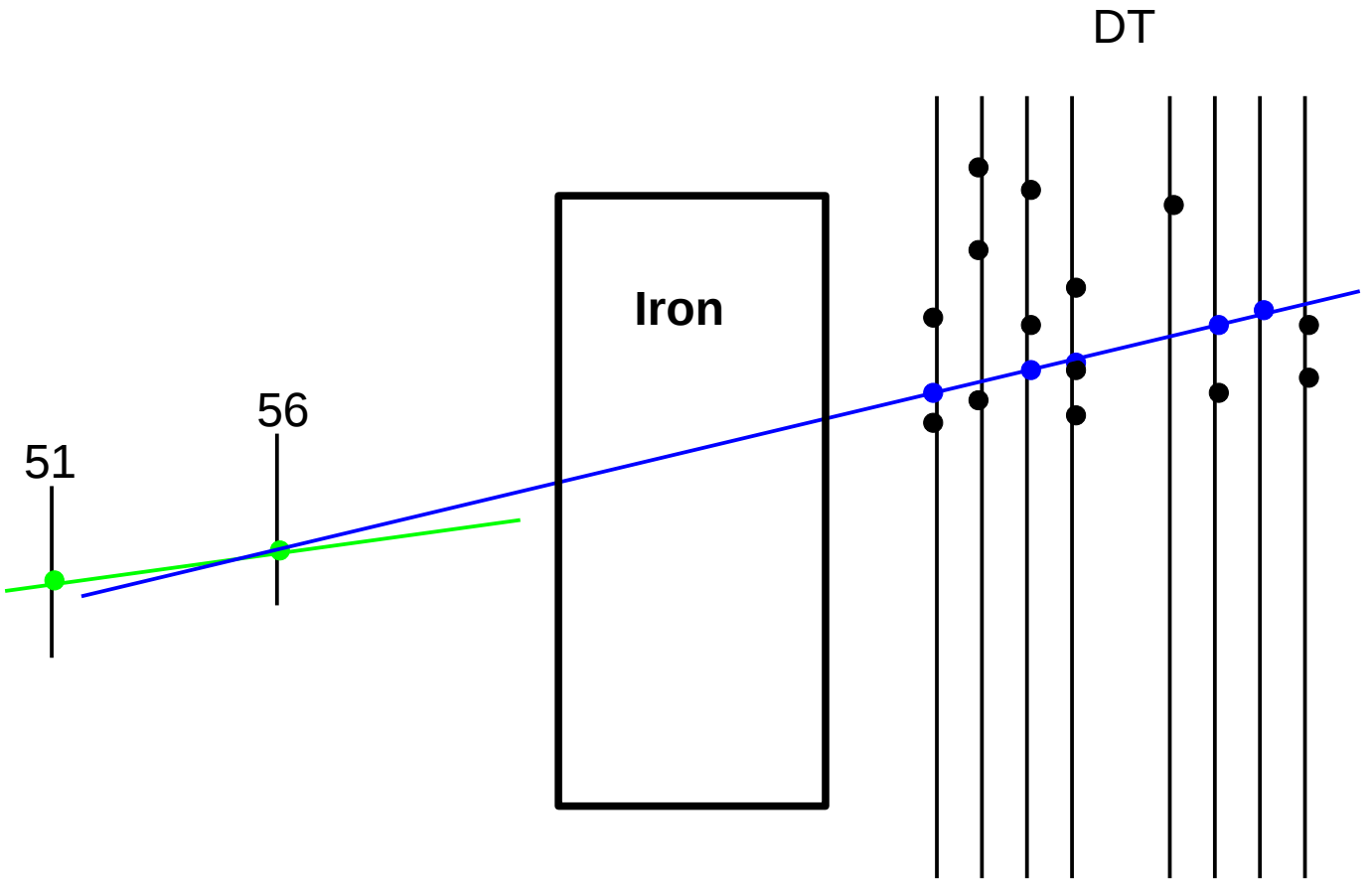
X position extrapolated at the magnet center

DT and multiple scattering



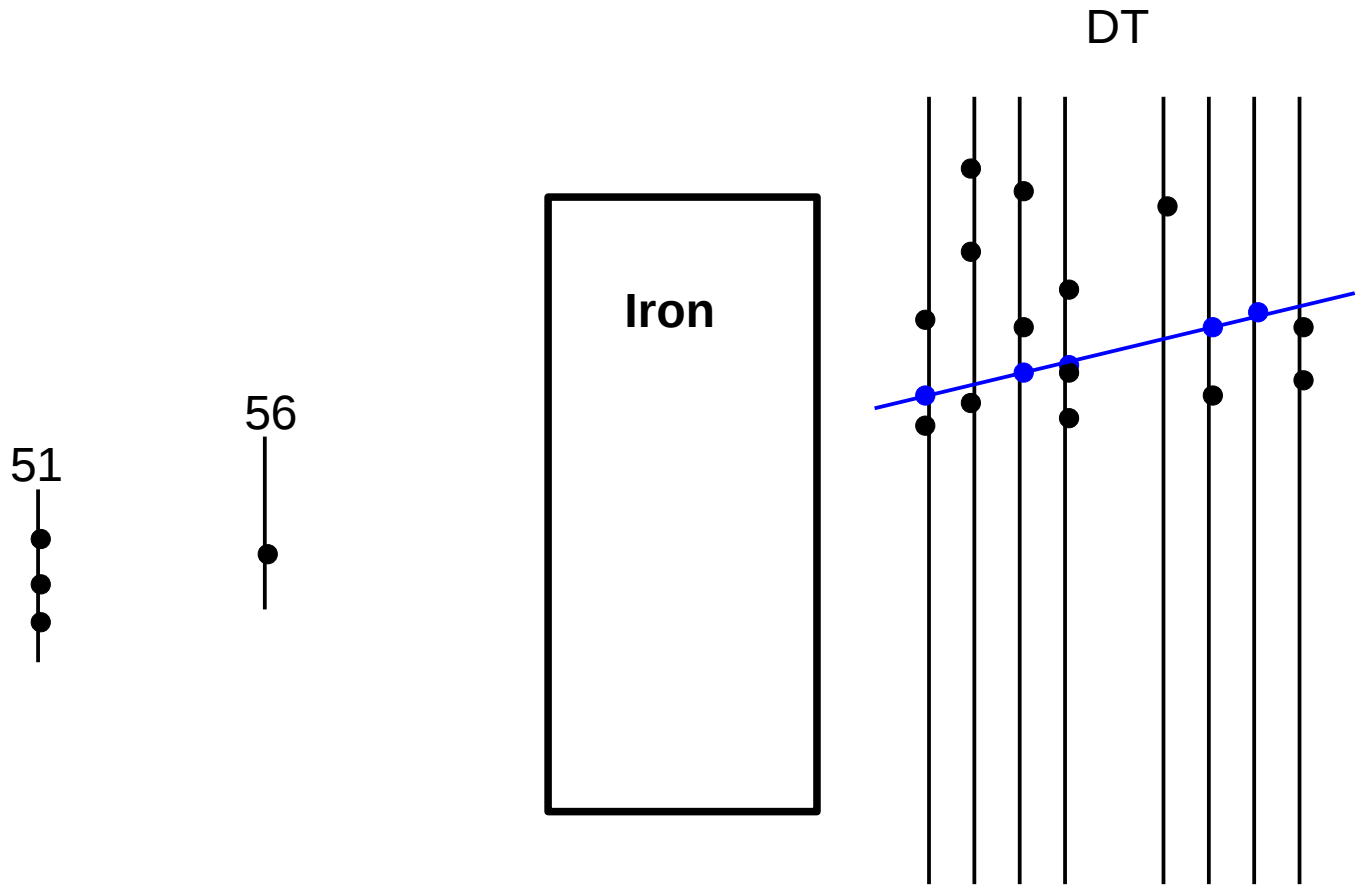
- The μ+ track in the DT may have a different angle with respect to the track in the Si detectors: this is due to the multiple scattering in iron.
- We verified in simulation that the multiple scattering uncertainty is not negligible with respect to the track uncertainty.
- There is also another uncertainty: the DT has been aligned with the μ- line calibration beam.

DT and multiple scattering



- For this reasons the pointing resolution (to detector 40) of the μ+ tracks built using 51+56 only is better than the pointing resolution of DT+51+56

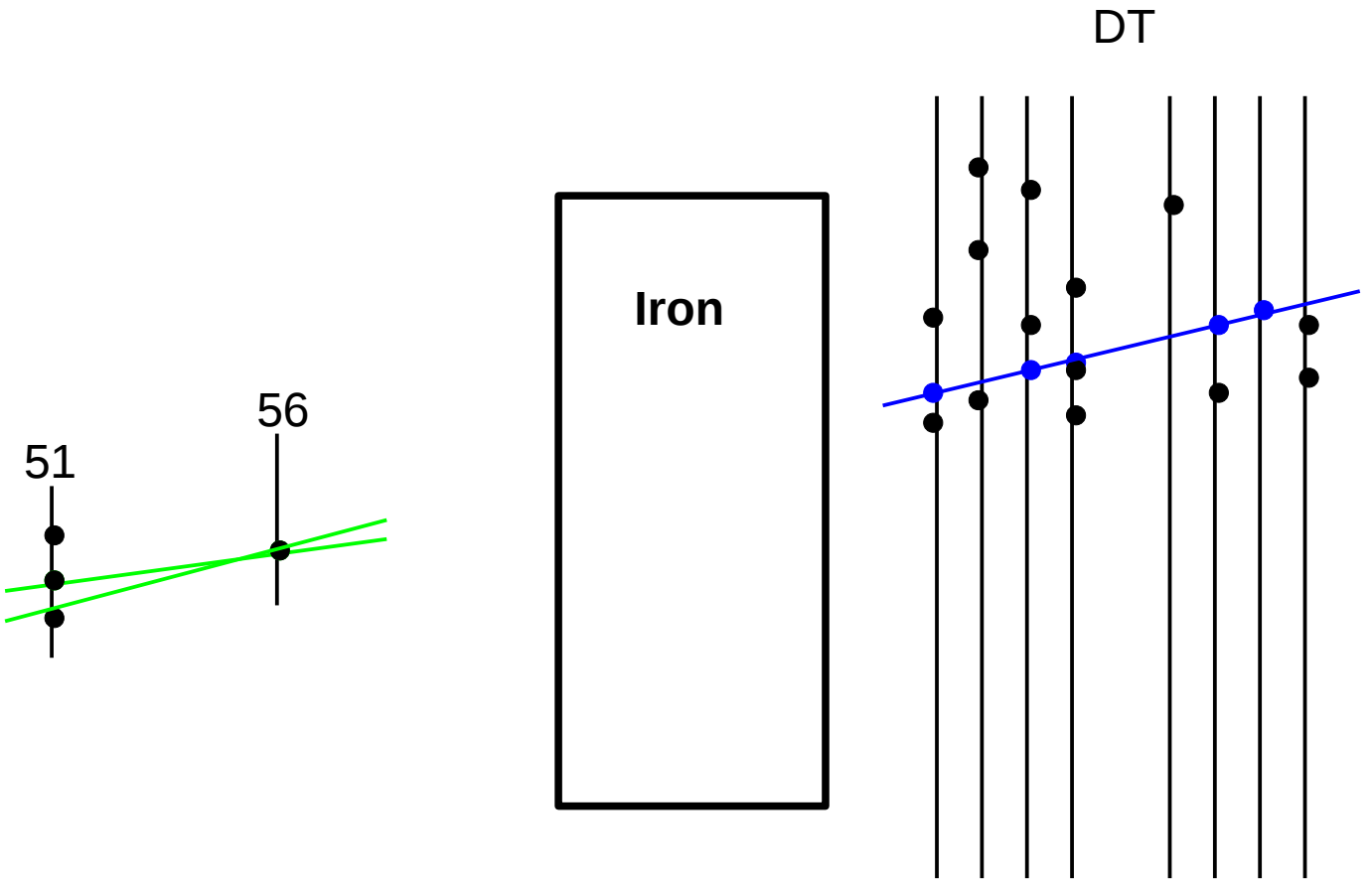
μ+ line tracking algorithm



The μ+ line tracking algorithm goes as follow:

- Events with a good DT track in μ+ side are selected and tagged as μ+ candidates.

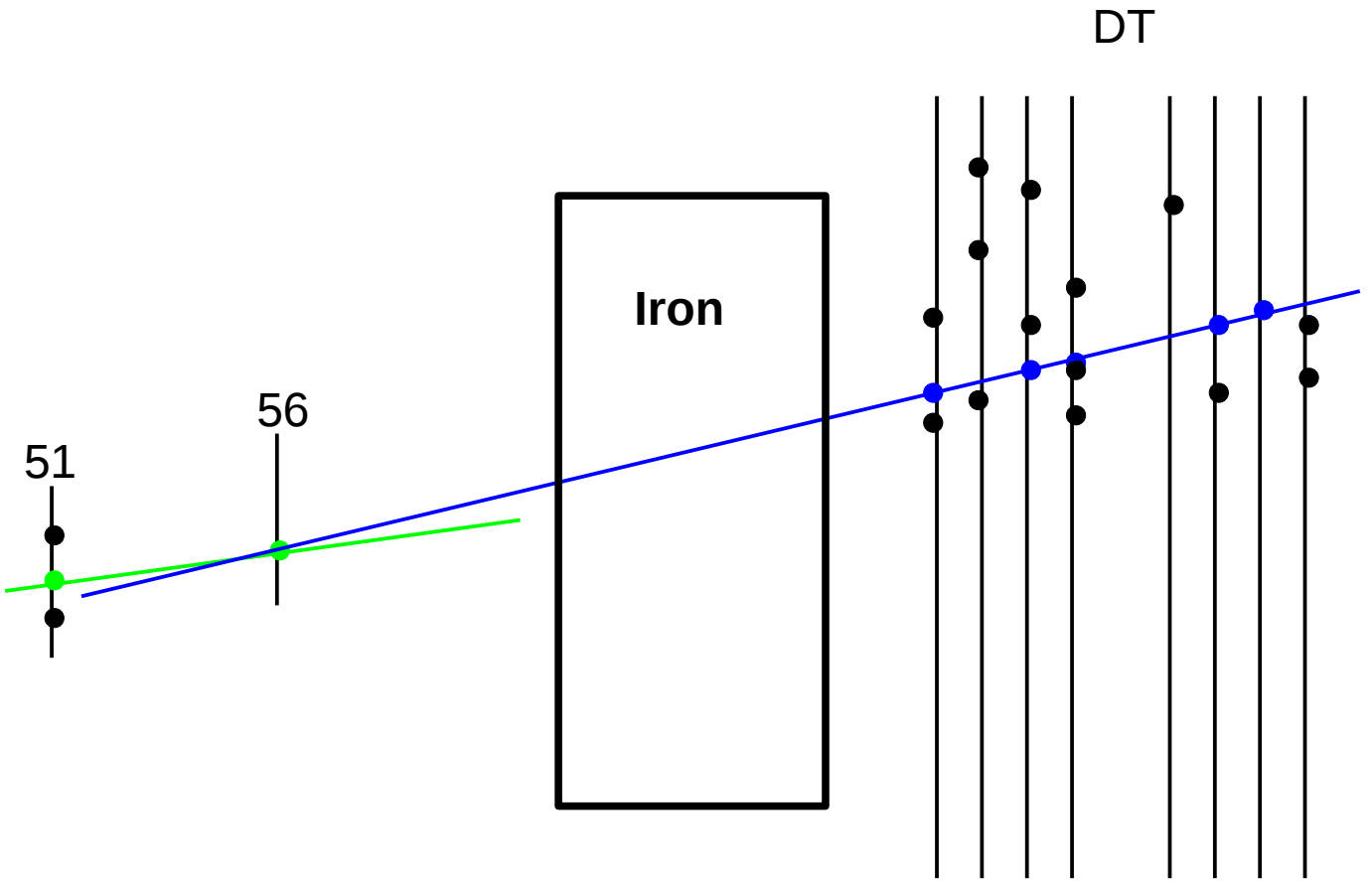
μ+ line tracking algorithm



The μ+ line tracking algorithm goes as follow:

- Events with a good DT track in μ+ side are selected and tagged as μ+ candidates.
- Si tracks with two hits are built and selected in order to satisfy the θ and $x(z_M)$ cuts.

μ+ line tracking algorithm



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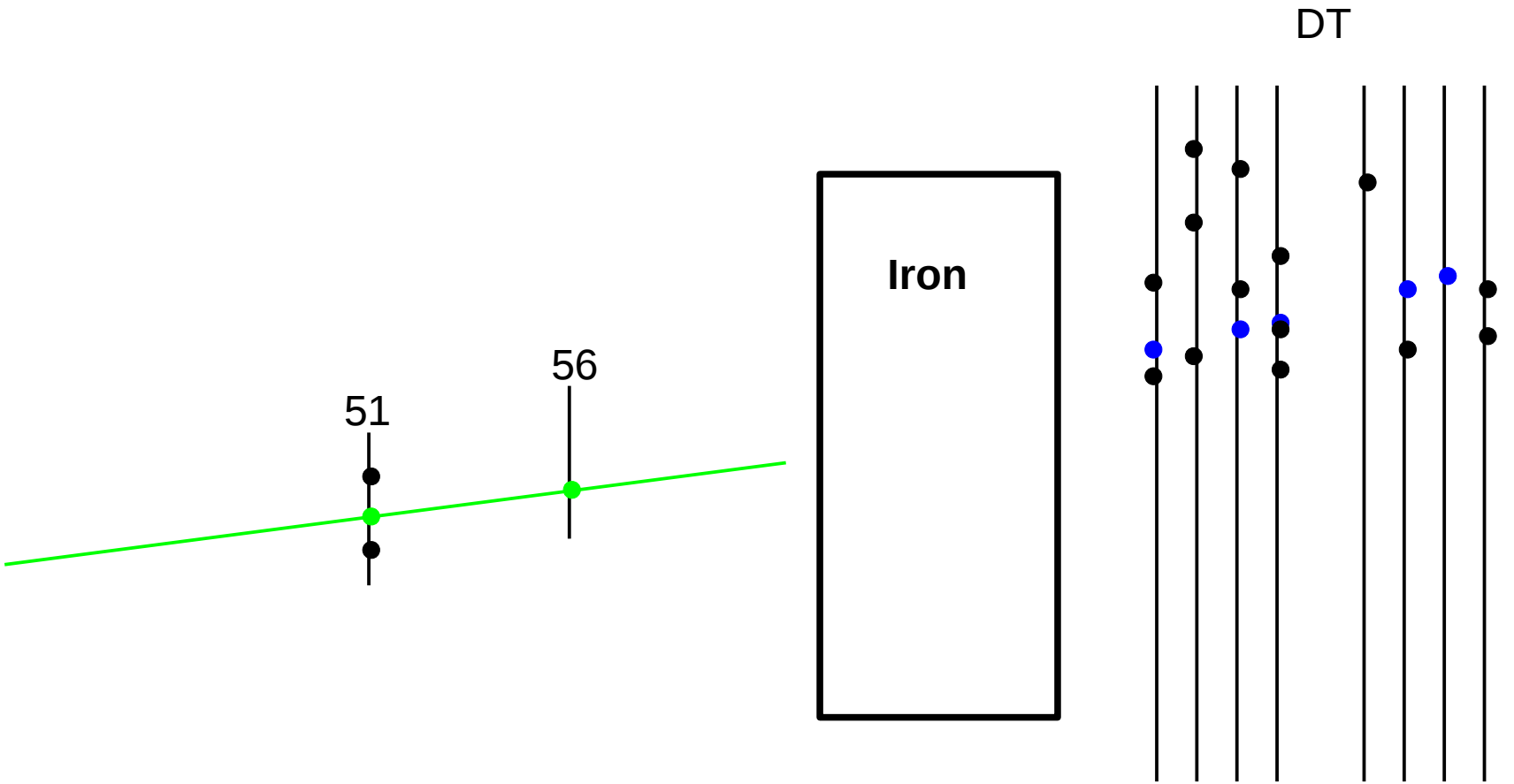
- Events with a good DT track in μ+ side are selected and tagged as μ+ candidates.
- Si tracks with two hits are built and selected in order to satisfy the θ and $x(z_M)$ cuts.
- The Si tracks compatible with the DT tracks is selected (minimum angle between them).

μ+ line tracking algorithm



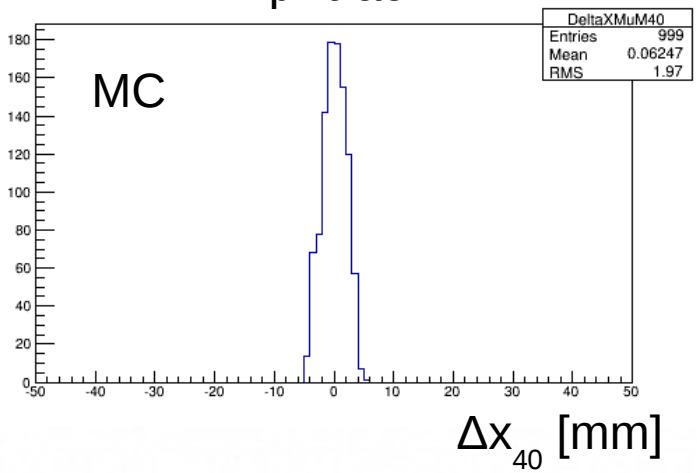
The μ+ line tracking algorithm goes as follow:

- Events with a good DT track in μ+ side are selected and tagged as μ+ candidates.
- Si tracks with two hits are built and selected in order to satisfy the θ and $x(z_M)$ cuts.
- The Si track compatible with the DT tracks is selected (minimum angle between them).
- The Si track is propagated to 40. DT hits are not used in the track fit.

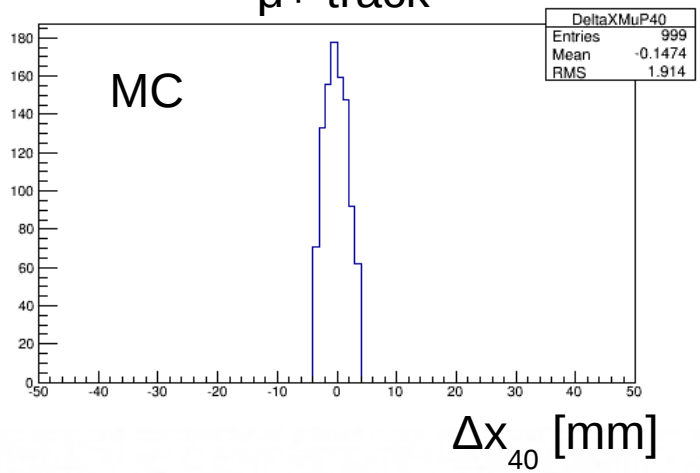
μ+ line tracking algorithm

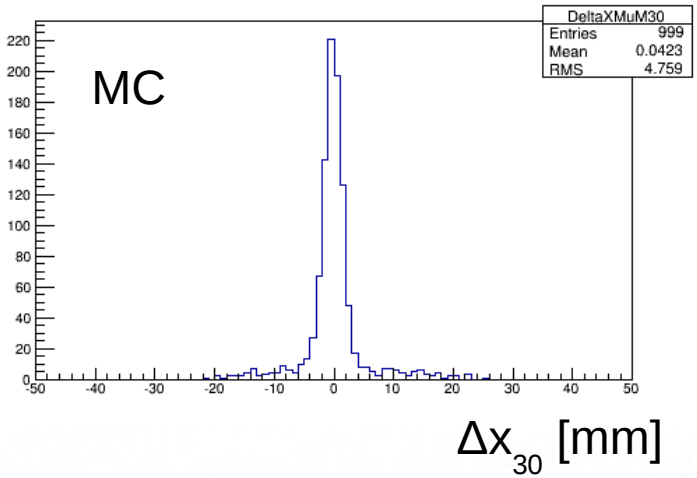
- Hits in 40 and 30 nearest to the track extrapolation are included in the track. Only hits with a distance below 10 mm are selected.
- A hit in 40 cannot belong to both the μ- and μ+ tracks.

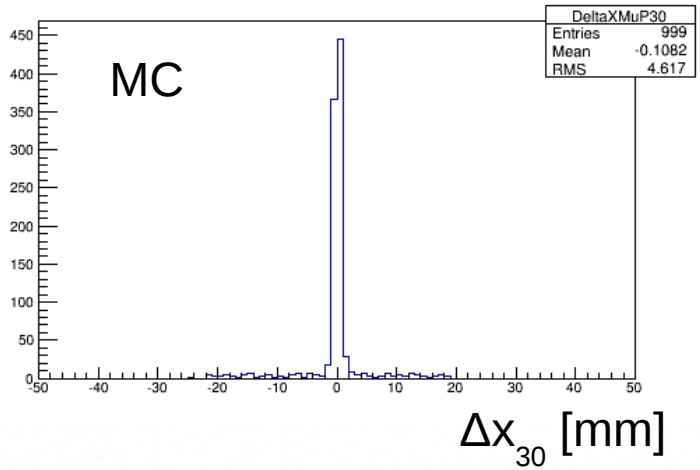
μ- track



μ+ track

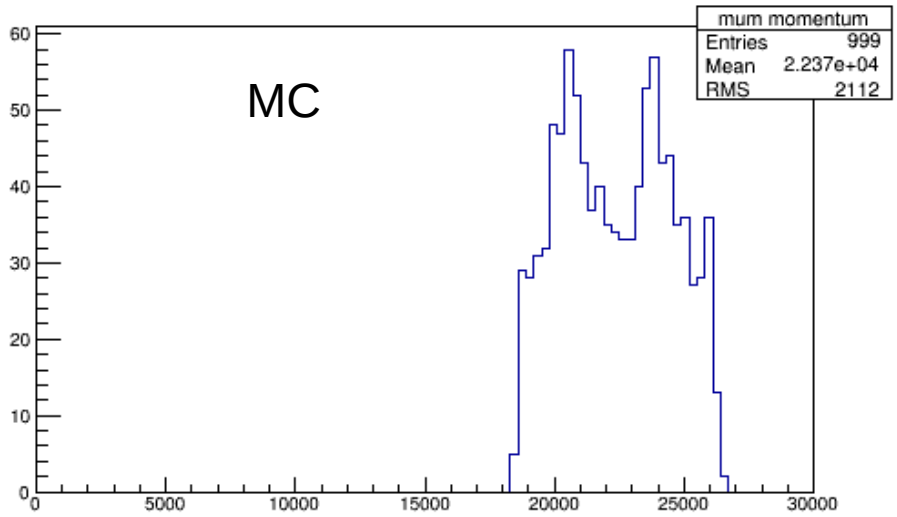




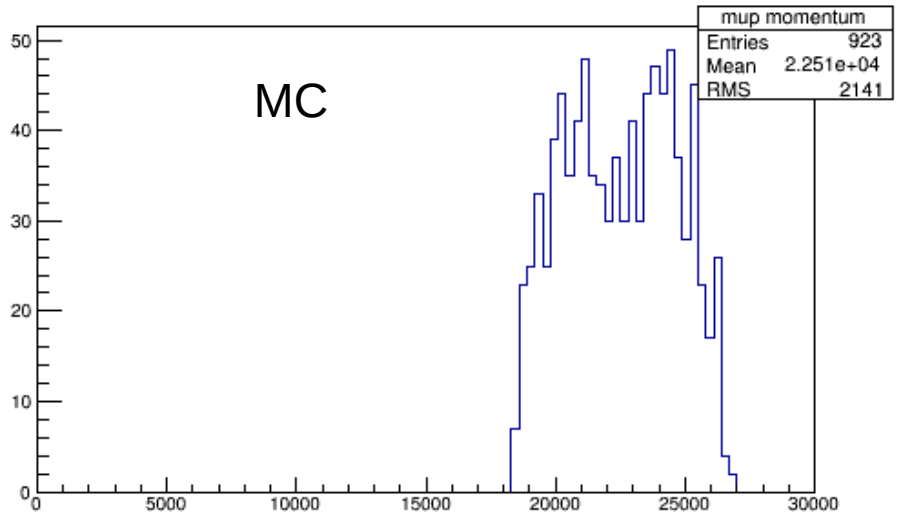


Momentum measurement

- μ+ and μ- tracks are selected if the track has at least a hit in 40.
- μ+ and μ- momenta are measured if the track has hits both in 30 and 40.



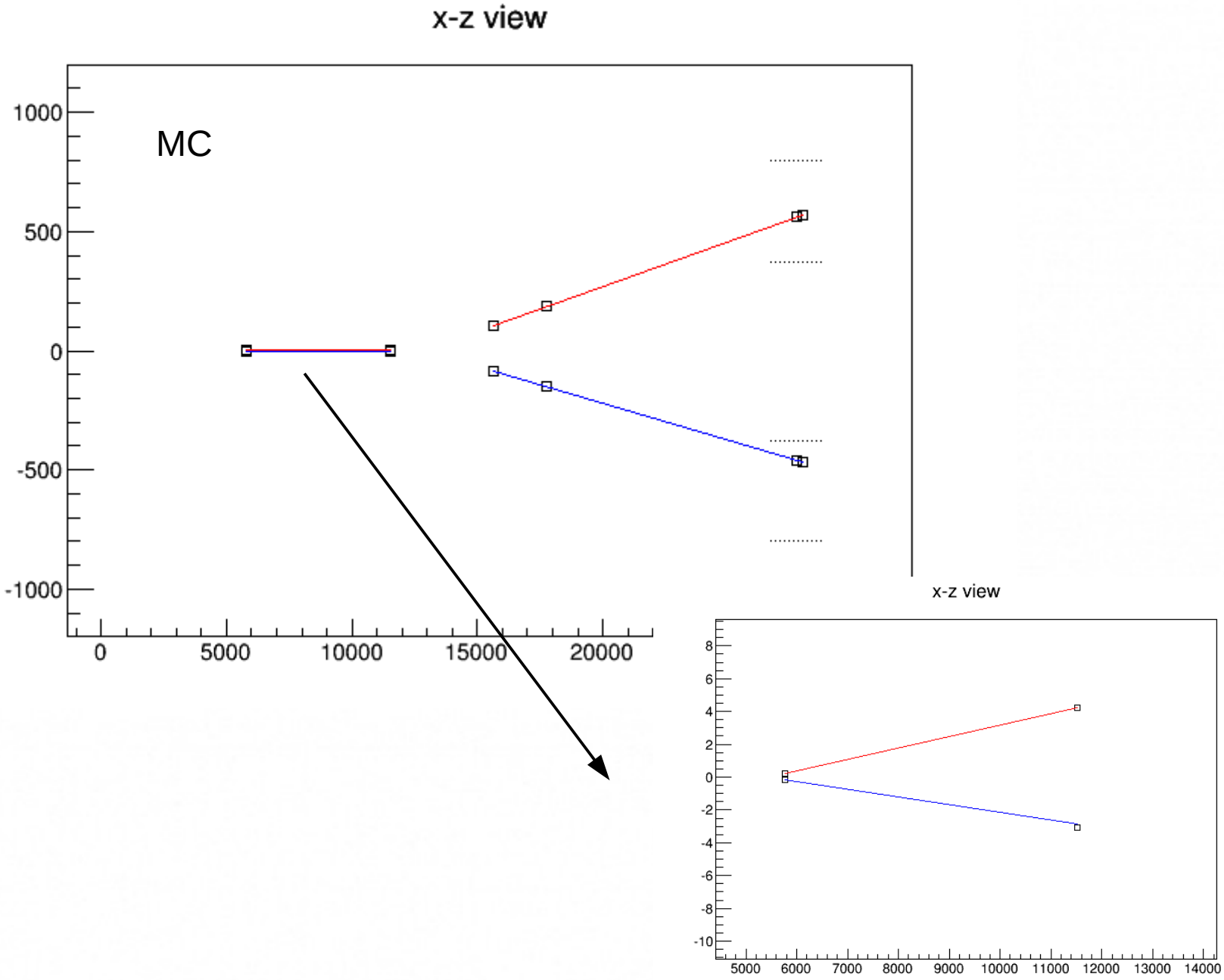
μ- momentum [MeV]



μ+ momentum [MeV]

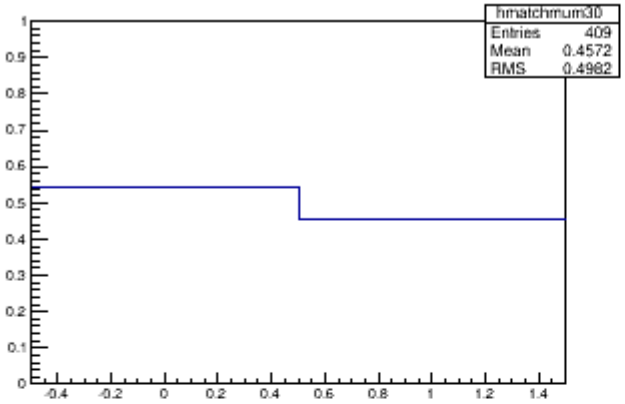
- Cross checks with the MC truth are on-going.

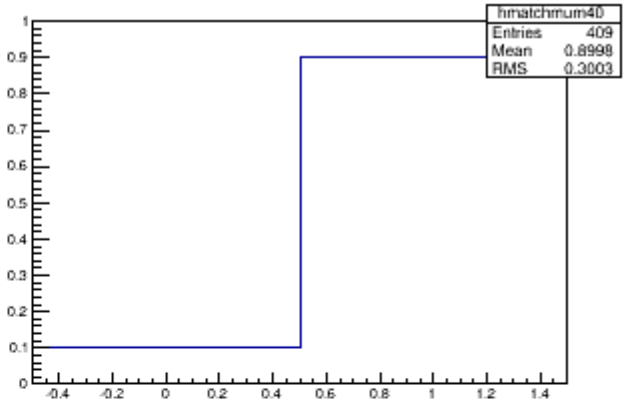
Event display



Hits association

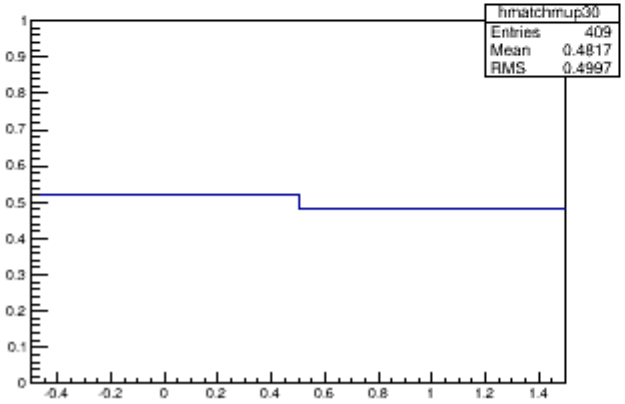
μ- hits in 30 assigned to the correct track ~ 50%

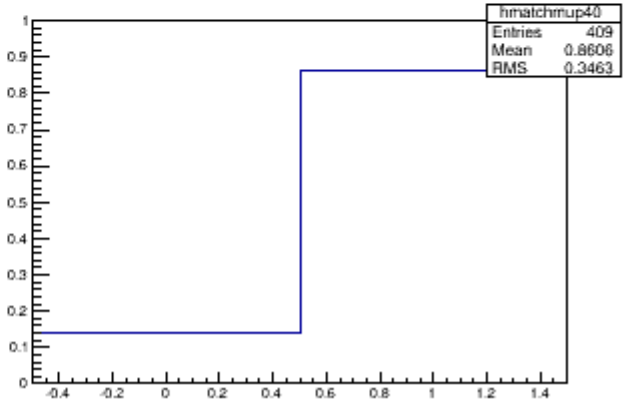




μ- hits in 40 assigned to the correct track ~ 90%

μ+ hits in 30 assigned to the correct track ~ 50%

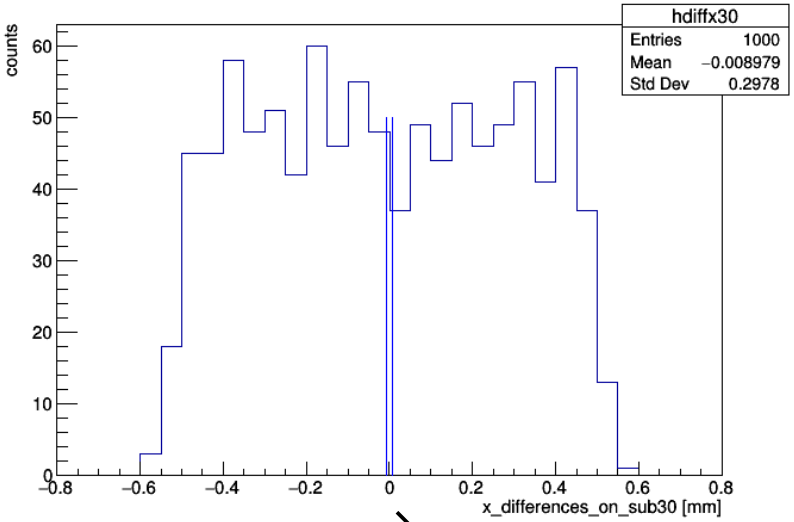


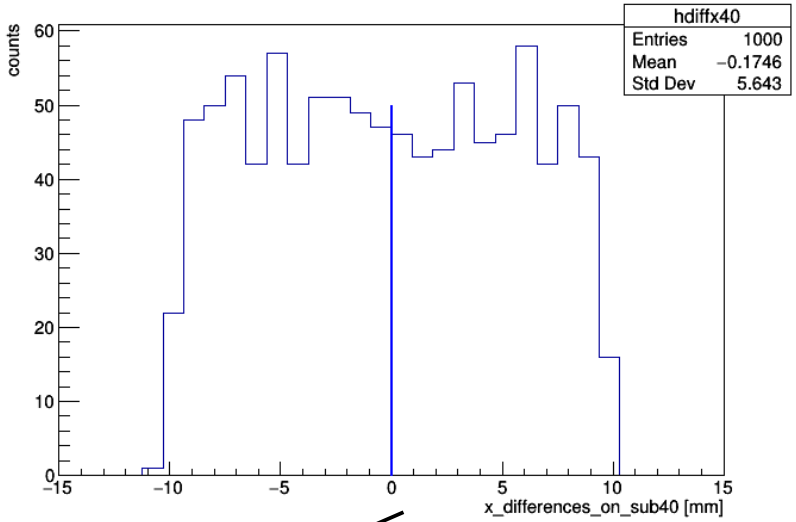


μ+ hits in 40 assigned to the correct track ~ 86%

Hits association

Differences between μ- and μ+ hits in 30 and 40





Blue lines represent the distance between two reading strips (not physical strips)

Data processing and conclusions

- The 2017 data have been processed with the new algorithm.
- Now we have 82 μ+μ- selected candidates.
- We have 38 μ+μ- selected candidates with measured momentum (wrt 56 with the old algorithm).
- Work is in progress to analyze these events.
- Now we can measure the total energy, the separation angle, the invariant mass etc.
- Hits association in detector 30 (first Si after target) is random with the 2017 setup. We are trying to improve the algorithms, but we should avoid this issue in the 2018 testbeam.