Tracking of micromegas telescope

RD51 Collaboration

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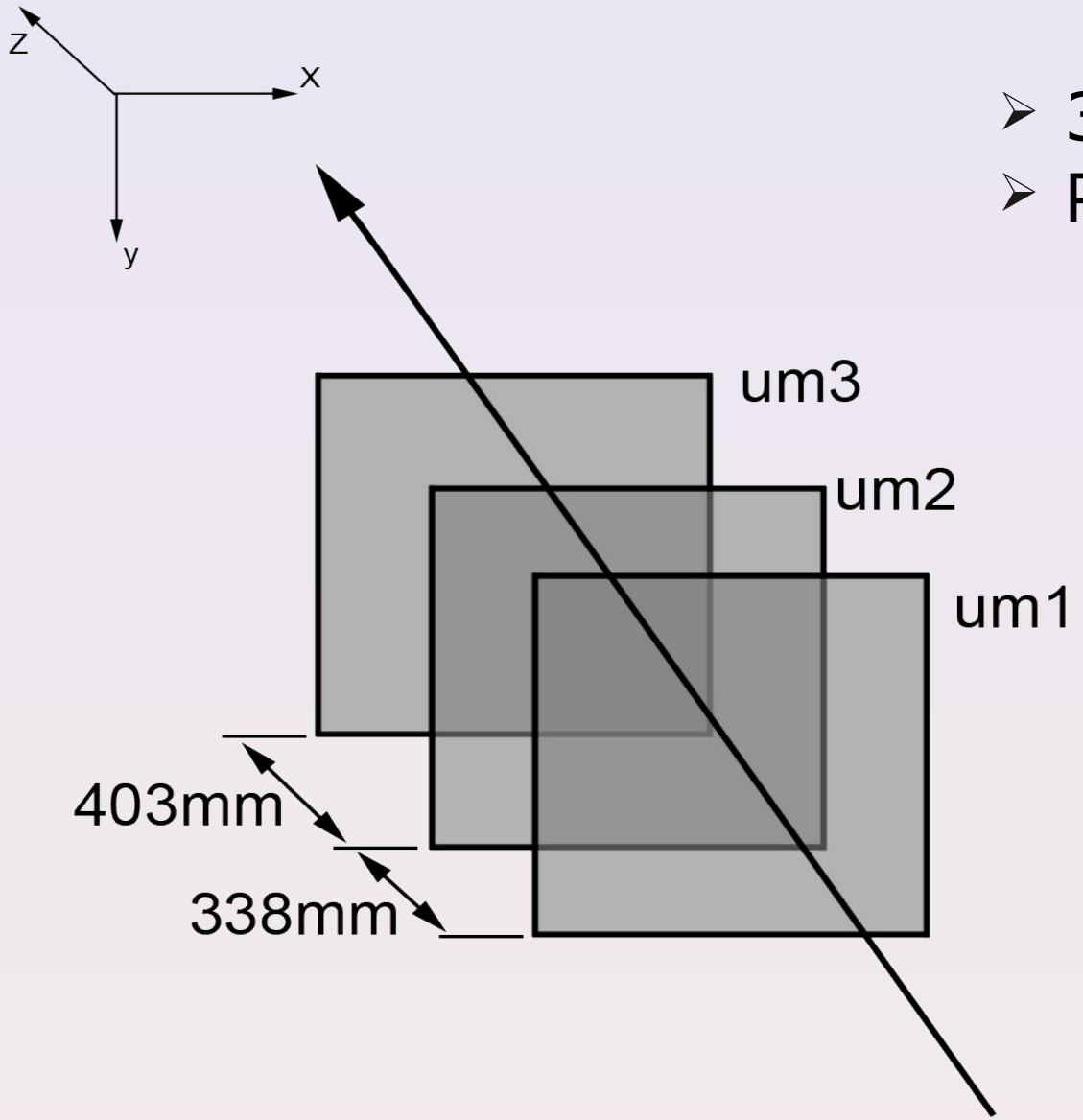
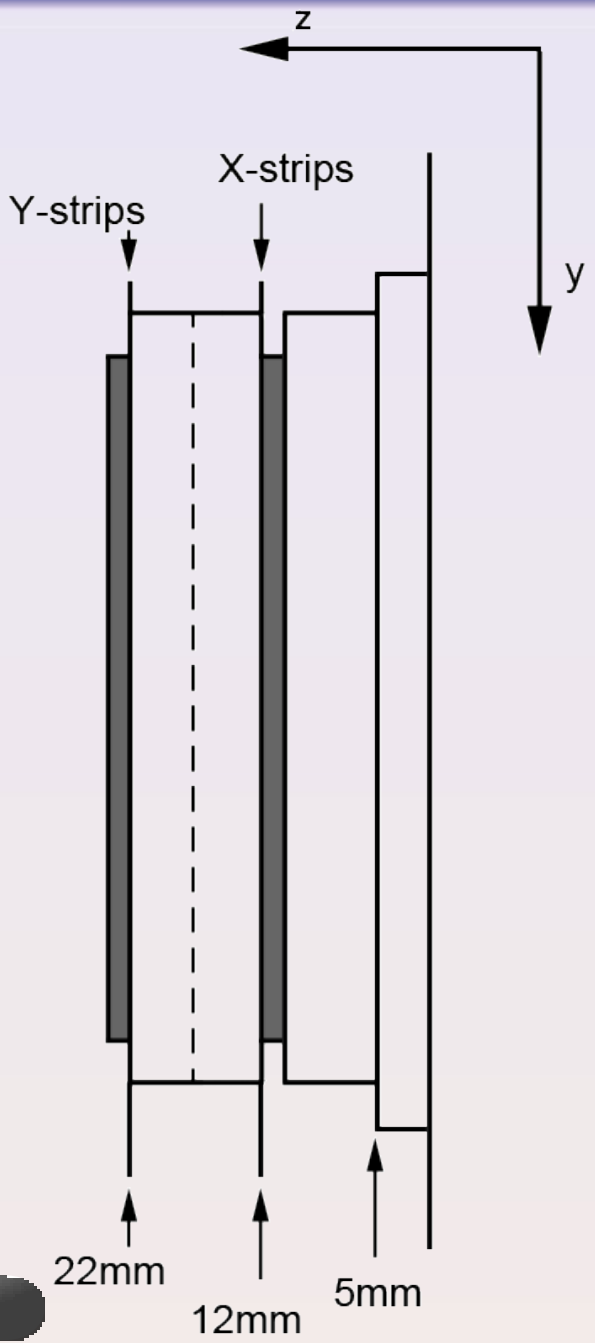
Tracking of micromegas telescope



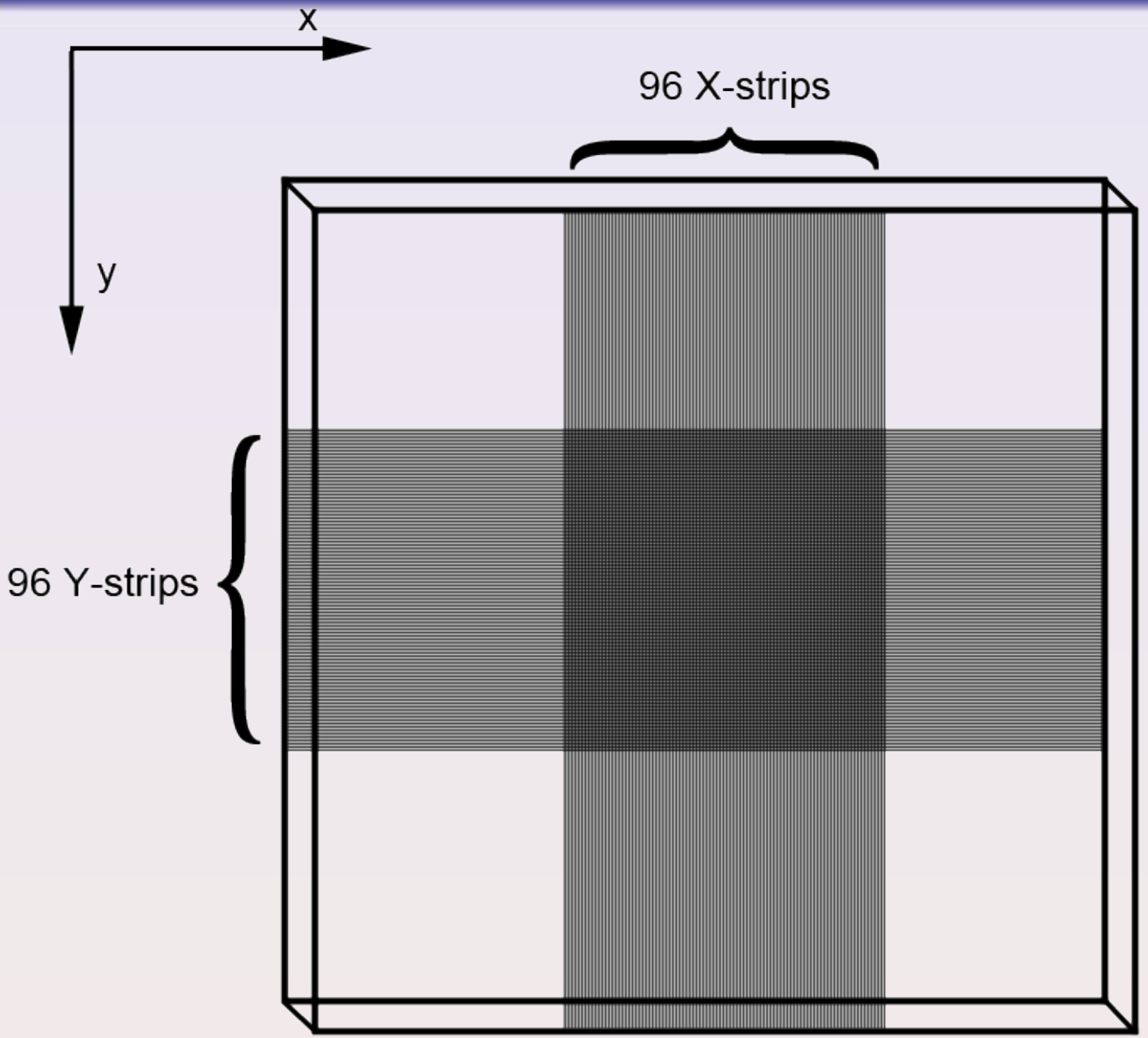
- 3 Sets of uM detectors.
- Parallel and movable.

Tracking of micromegas telescope



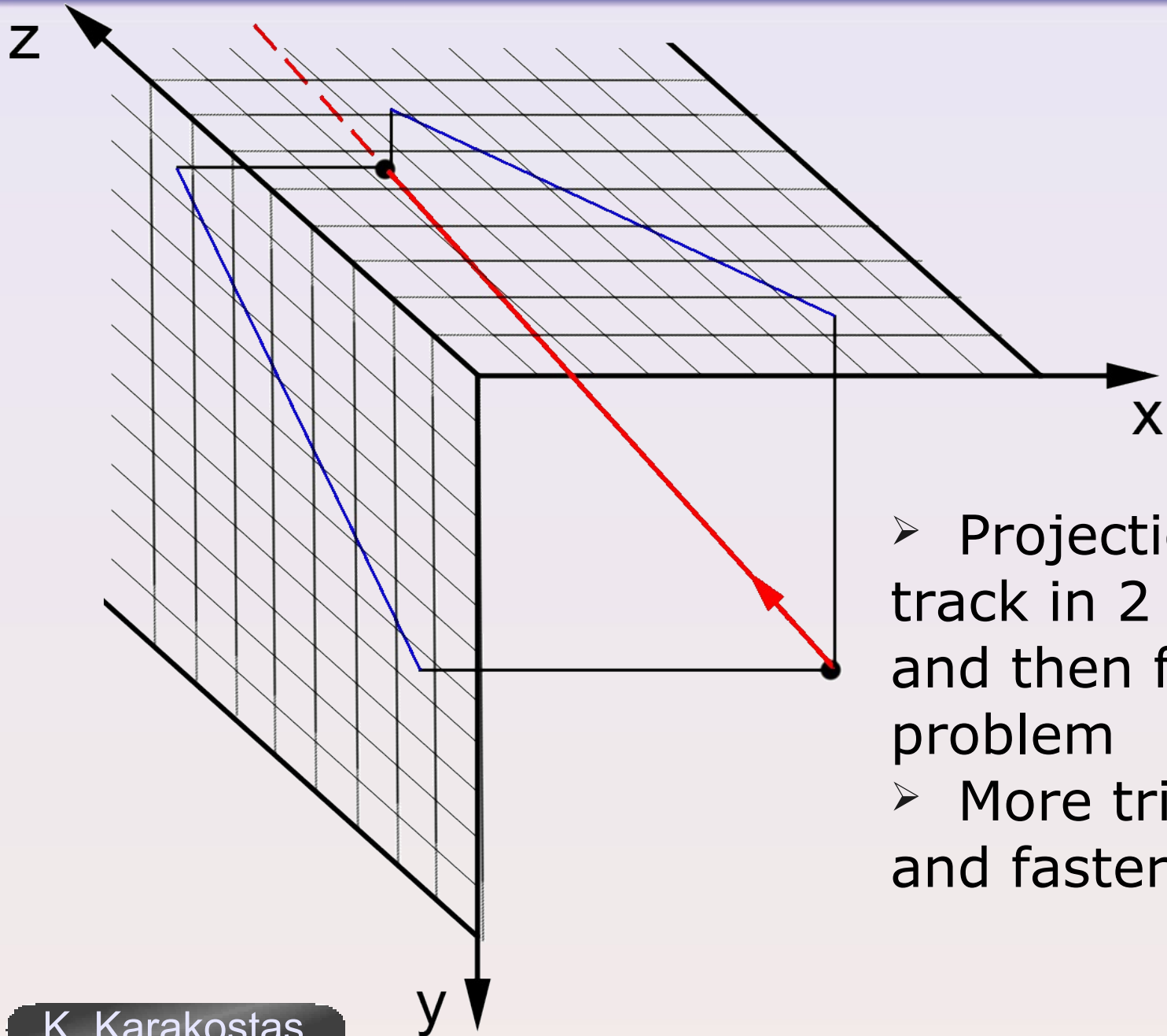
- 2 PCBs per detector (one with the X-strips and the other with the Y-strips).
- Common drift and different mesh for each direction.
- All 3 detector are identical.

Tracking of micromegas telescope



- 10cm x 10cm but only 2.5cm x 2.5cm active area (96 stripsx250um).
- 96 strips for each direction.
- The beam first cross the X-plane and afterwards the Y-plane.

Tracking of micromegas telescope



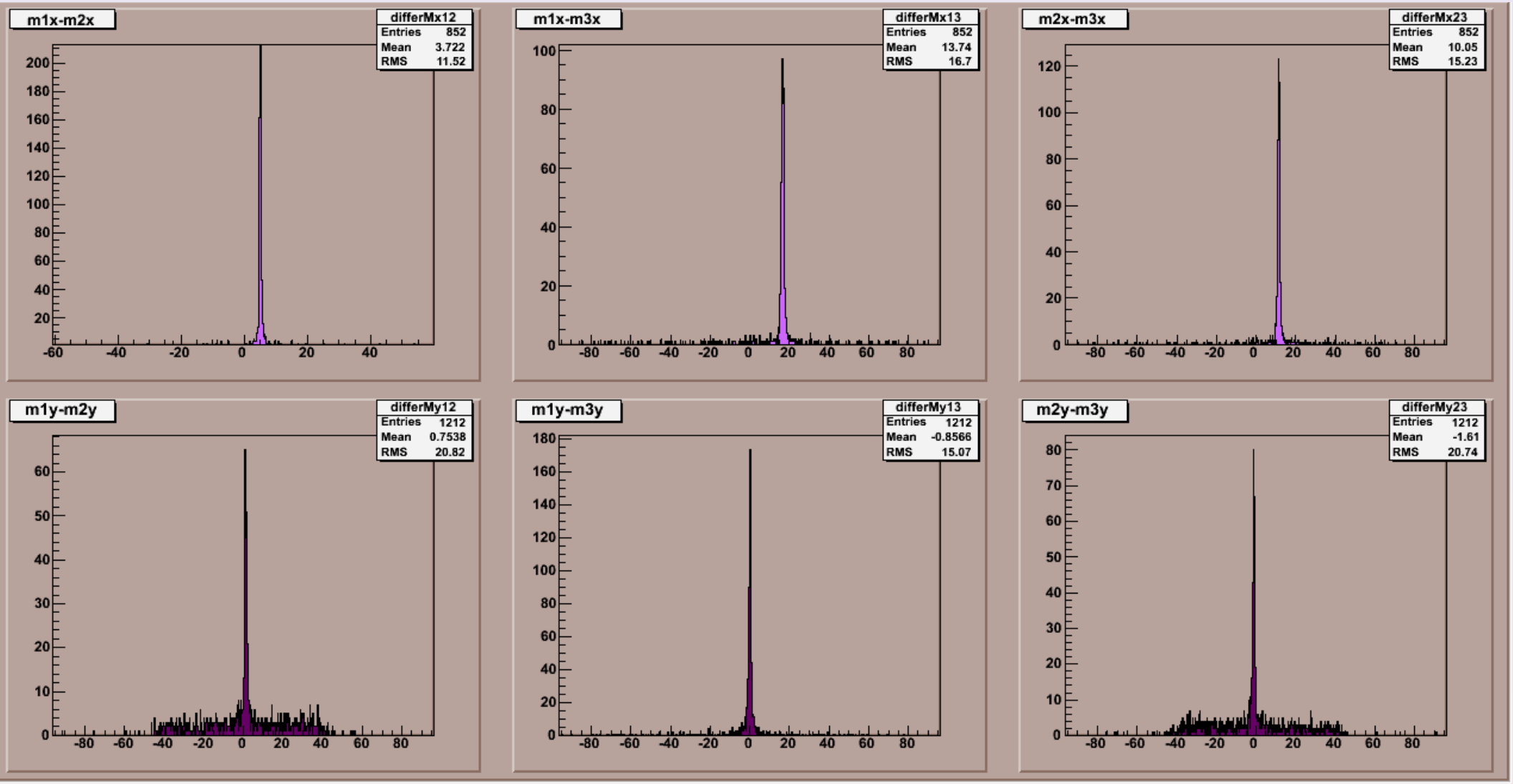
- Projection of the real track in 2 planes (xz, yz) and then facing a 2D problem
- More trivial approaches and faster algorithms.

Tracking of micromegas telescope

- Geometric approach based on construction of the telescope.
- Similar triangles provide one-line formula based on 2 points to extrapolated the third.
- Need to get better aligned detectors for the tracking.
- Ability to use the offset correction on the offline analysis.

Tracking of micromegas telescope

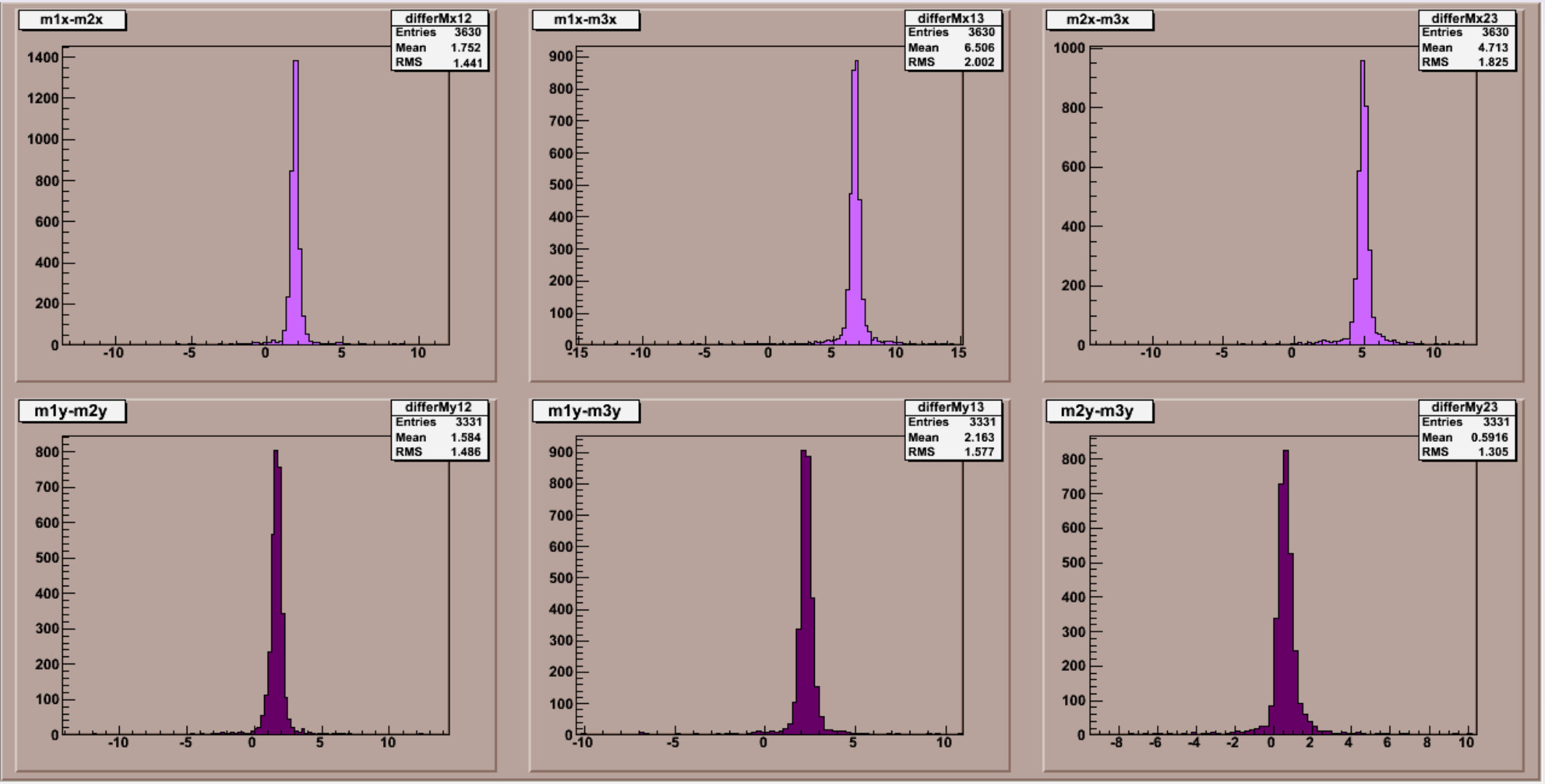
- Displacements for all planes, for each direction before alignment.



- All X-Axis are in strips.

Tracking of micromegas telescope

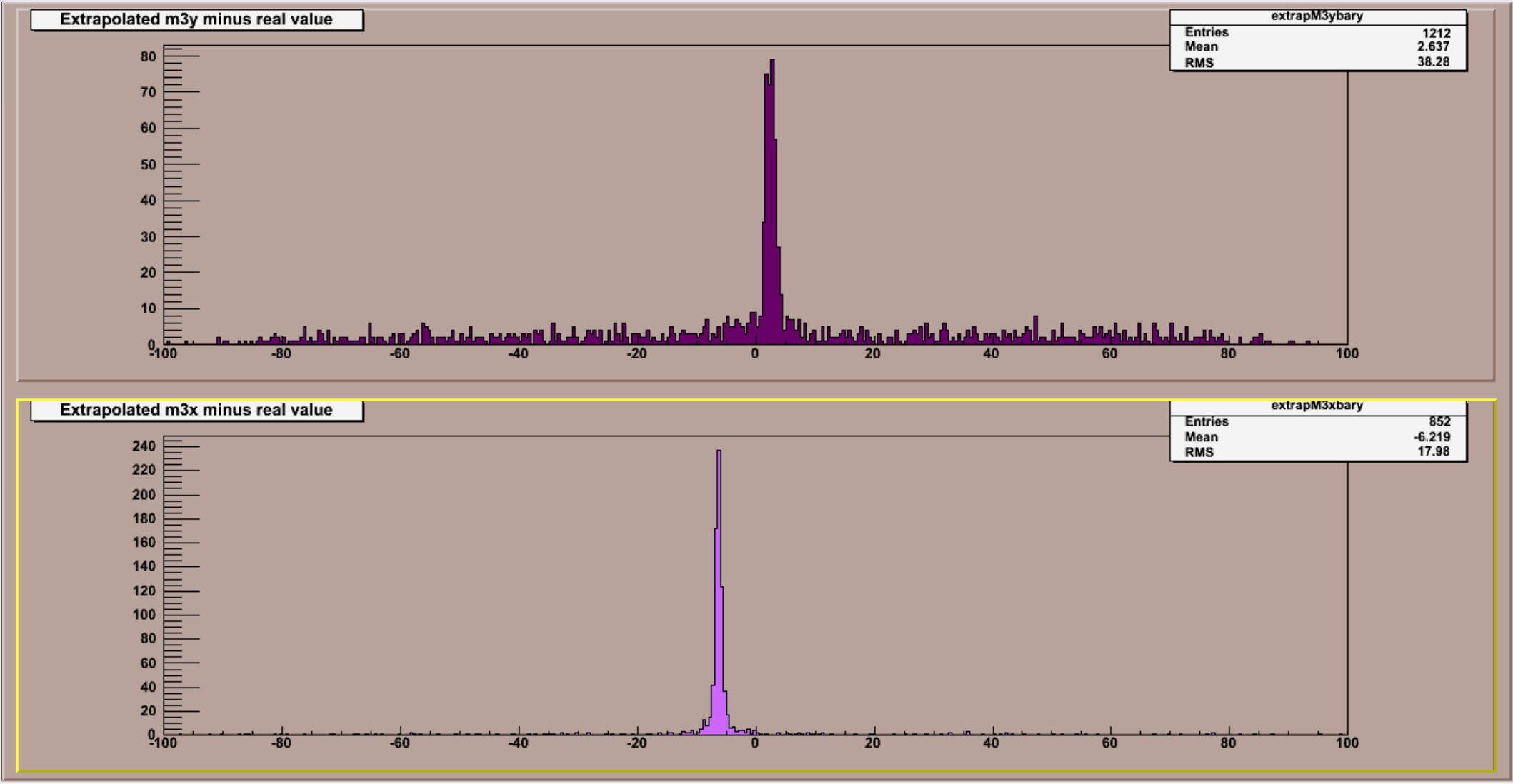
- Displacements for all planes, for each direction after alignment.



- All X-Axis are in strips.

Tracking of micromegas telescope

- Extrapolated value for um3 – real value, before alignment.



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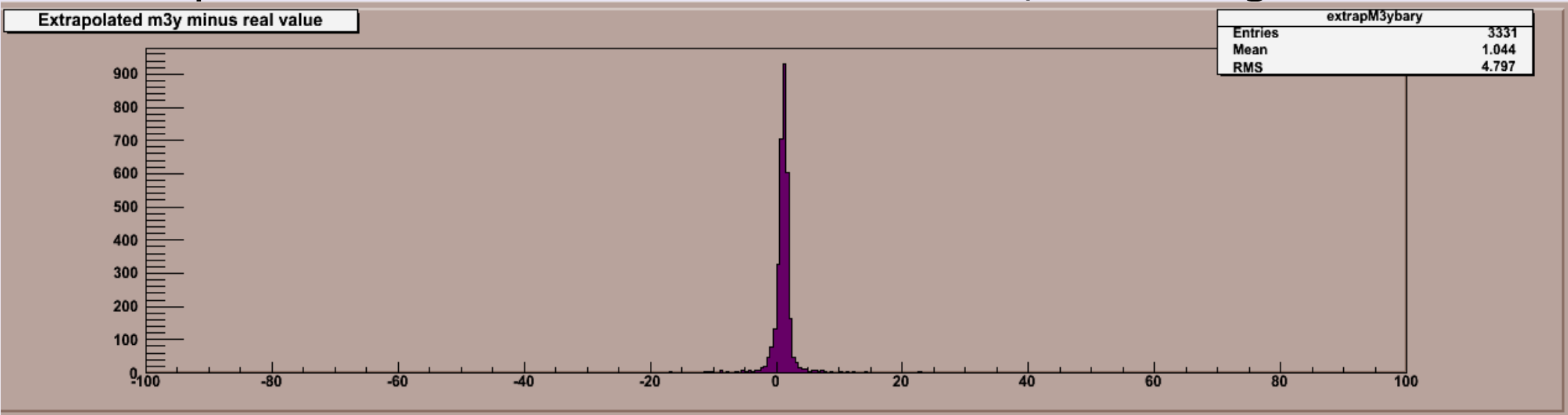
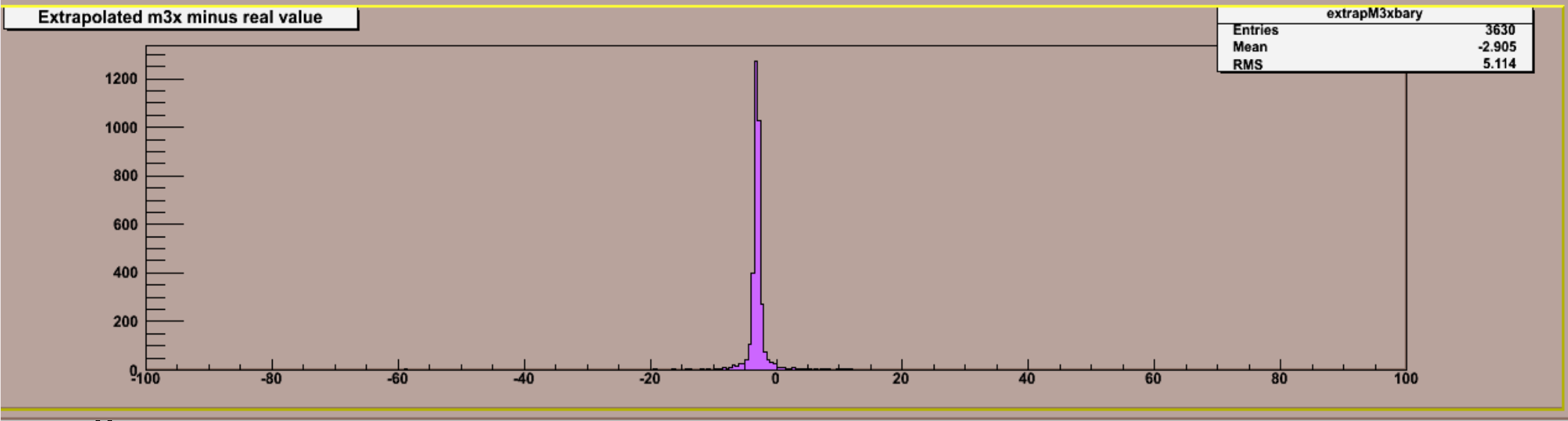
Tracking of micromegas telescope

- Extrapolated value for um3 – real value, after alignment.





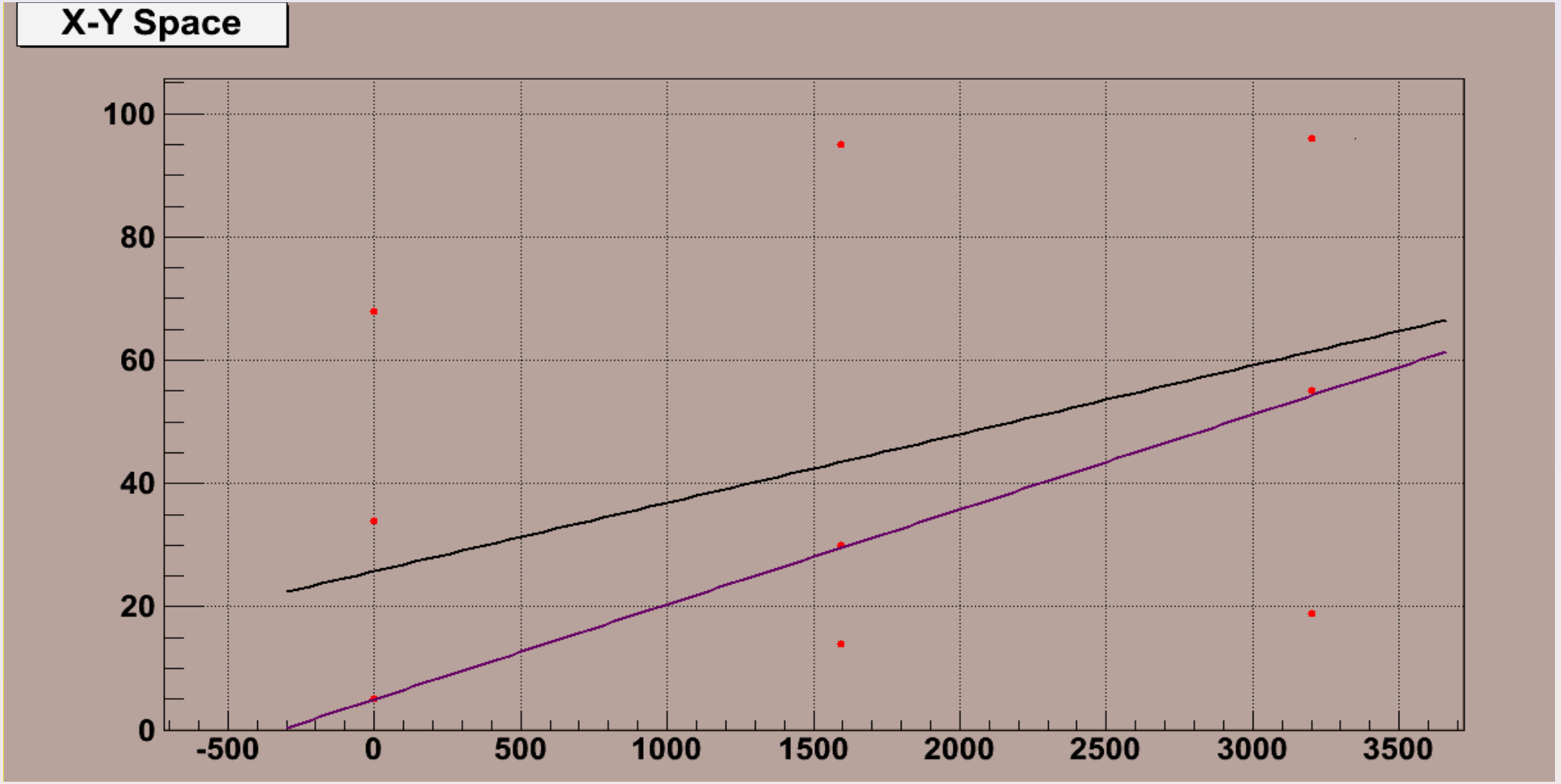
- All X-Axis are in strips.

- Disadvantage of geometric tracking it works only for a given set of 3 points (1 per detector).
- Need for an algorithm that can handle more points.

- Chi square line fitting.
- Disadvantage: the fitting line depends on all given points.
- example...

Tracking of micromegas telescope

- Chi square fitting (black), for 9 points (red) with purple the real line.



Tracking of micromegas telescope

- Hough Transformation for line detection.
- Basic concept

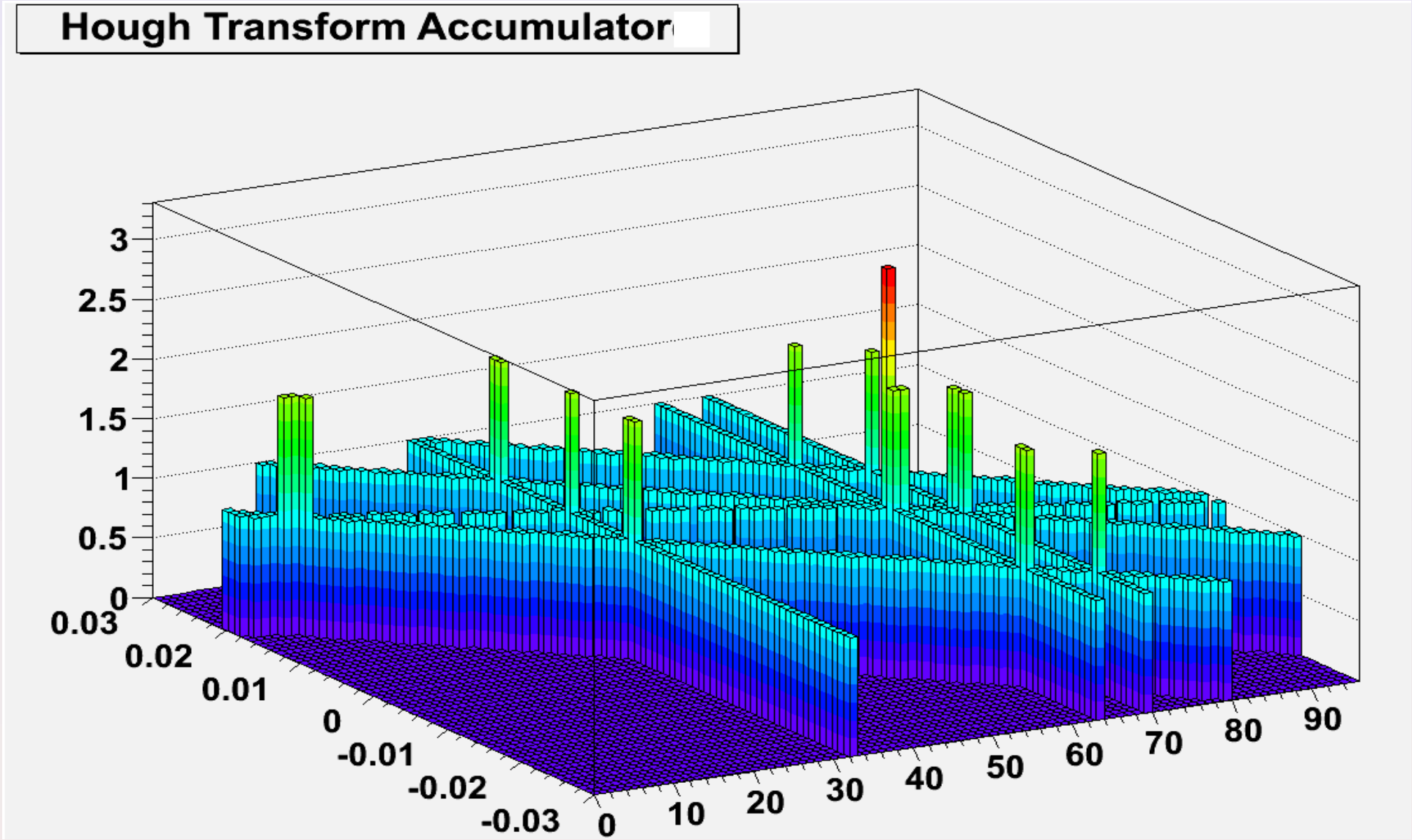
  eq. line: y=ax+b

  b=y-ax scanning on our range for a.
- From X-Y space ~ Hough Space (a,b).
- It does not depend on noisy points or points irrelevant to the line.
- Filling a 2D histogram for the Hough space where 2 (or more) lines are crossed is a potential candidate for our track.
- Example from real events...

  (Run:6250, Vm=490 V, Vd=790 V, Ar:CO2 90:10 @ 28/10/09)

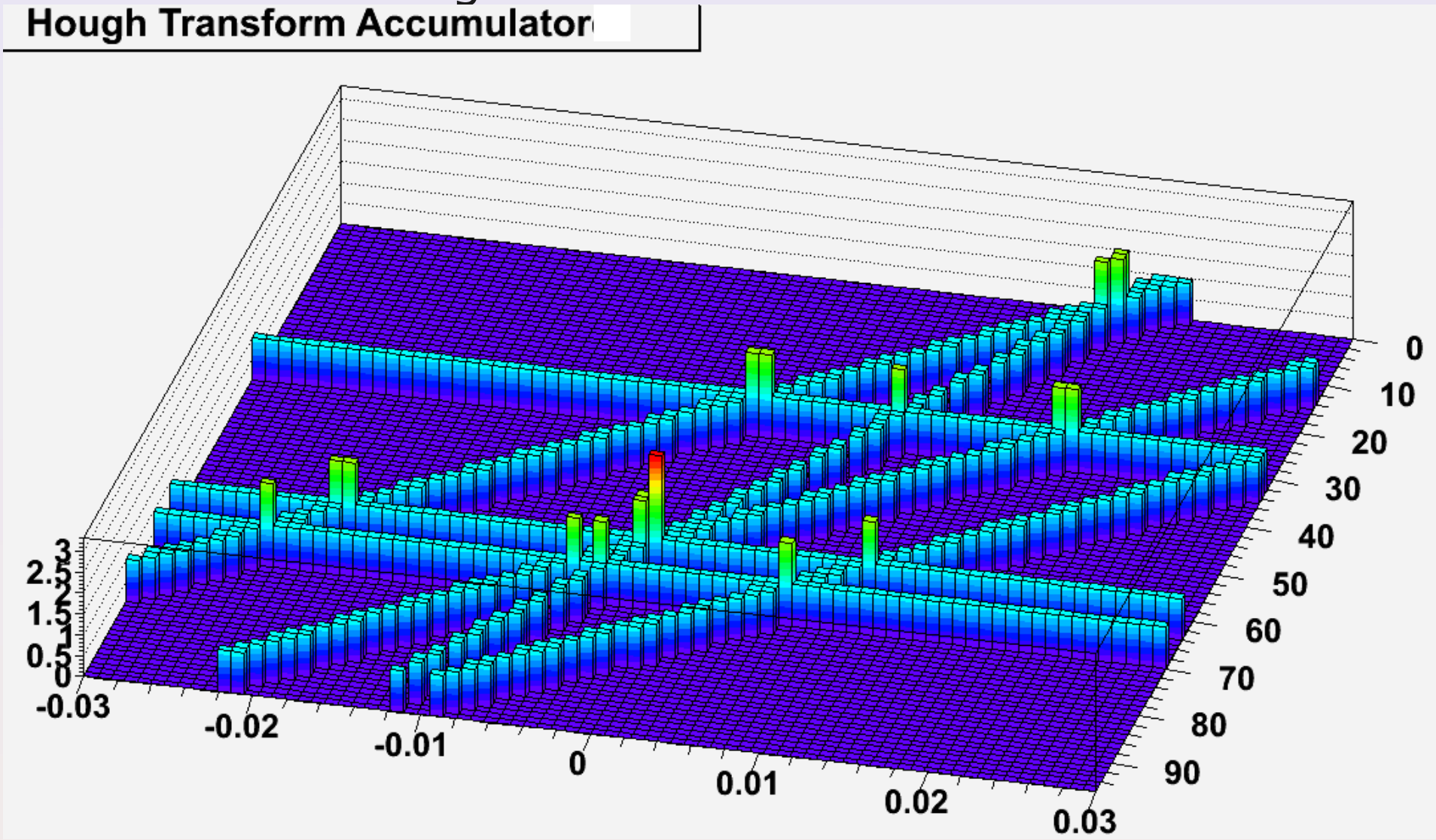
Tracking of micromegas telescope

- 2D Hough accumulator for 7 points.



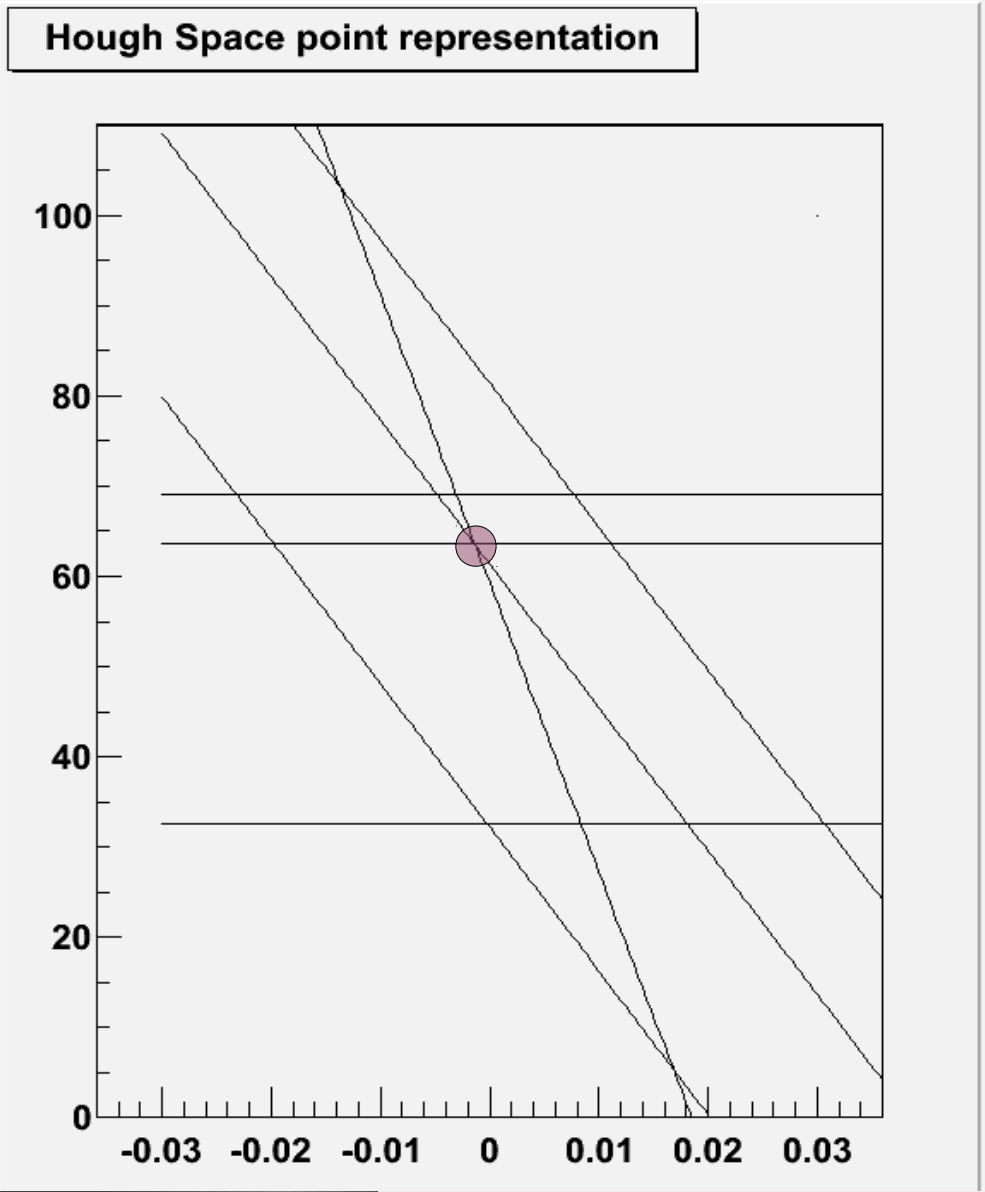
Tracking of micromegas telescope

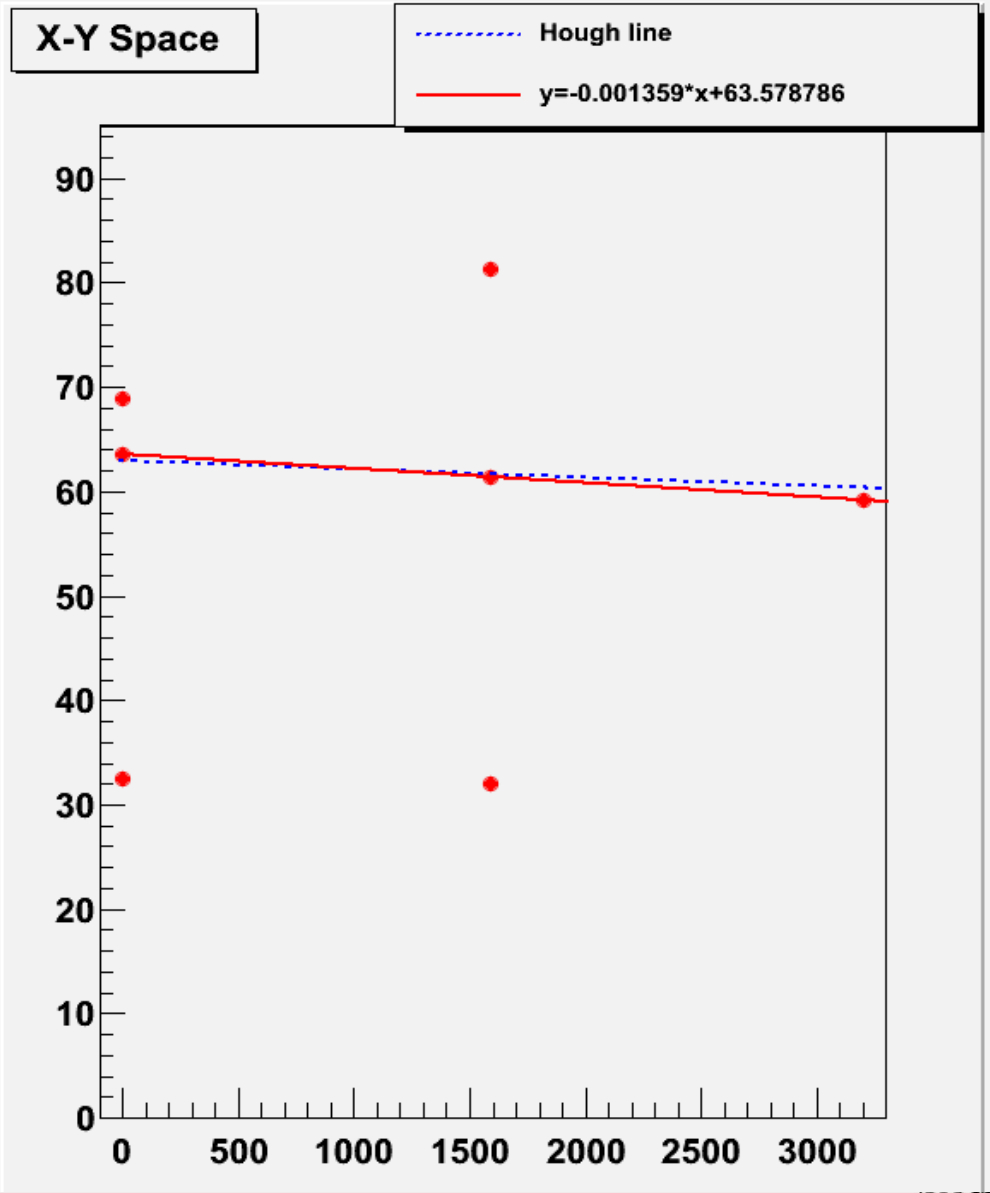
- ...from different angle.



Tracking of micromegas telescope

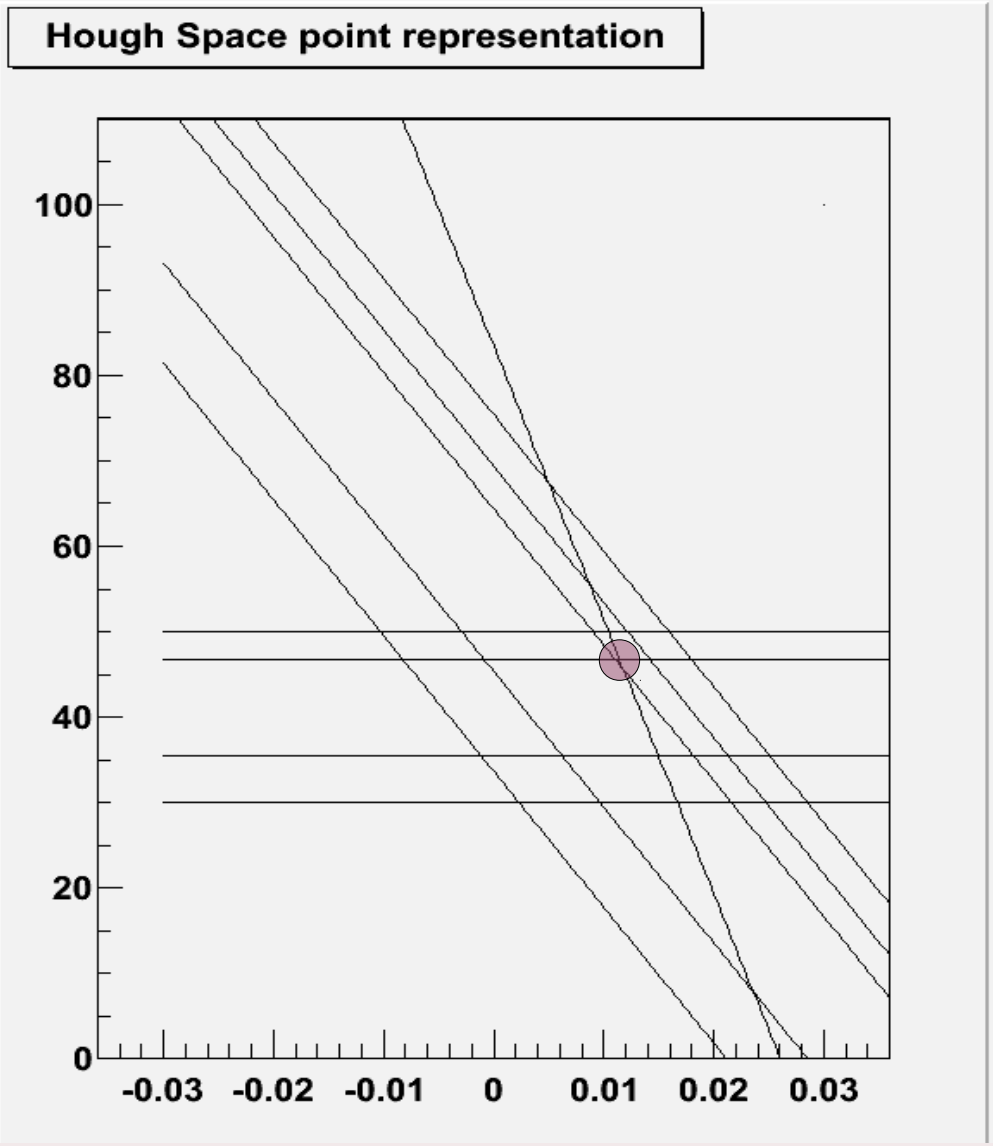
- Hough transform and then chi square for "close" points.

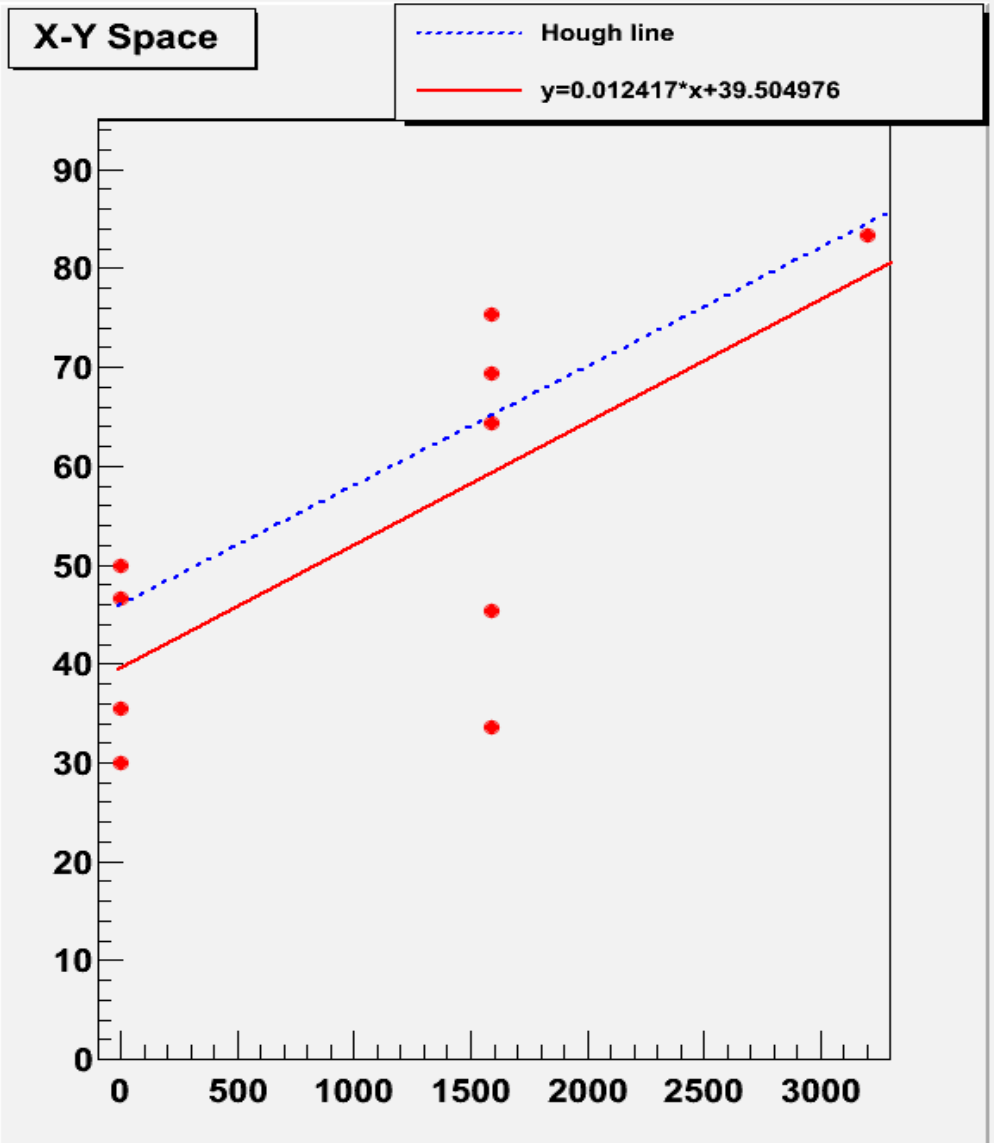




Tracking of micromegas telescope

- Hough Space (2D). HT line , chi square line.



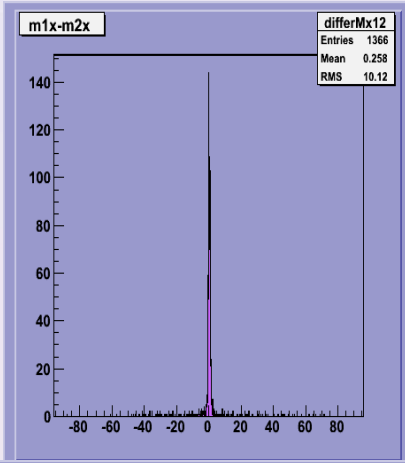


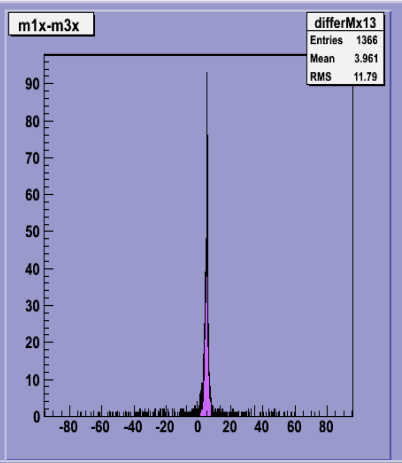
Tracking of micromegas telescope

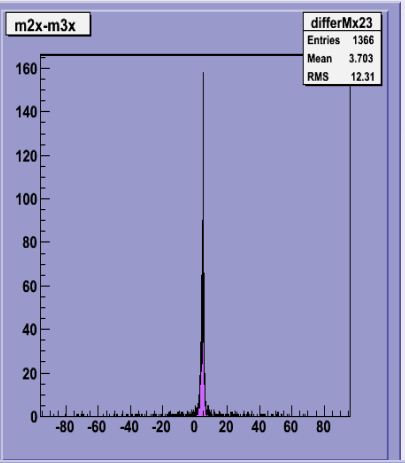
- Flow of the final program for the telescope.
  - Offset finding for "clean" tracks (first order correction)
  - Tracking and calculate the residuals of the distance of the points from the track (second order correction)
  - Using the above and also a desirable cut in the energy to calculate the tracks for all events.
  - During the whole process any plots (offsets, residuals, Hough accumulator, Hough Space) can be saved (as gif, jpg, eps, ps, pdf), debug information per process, per event can be print out, tolerance of the fit and various parameters can be set via a separate file (vars.h).

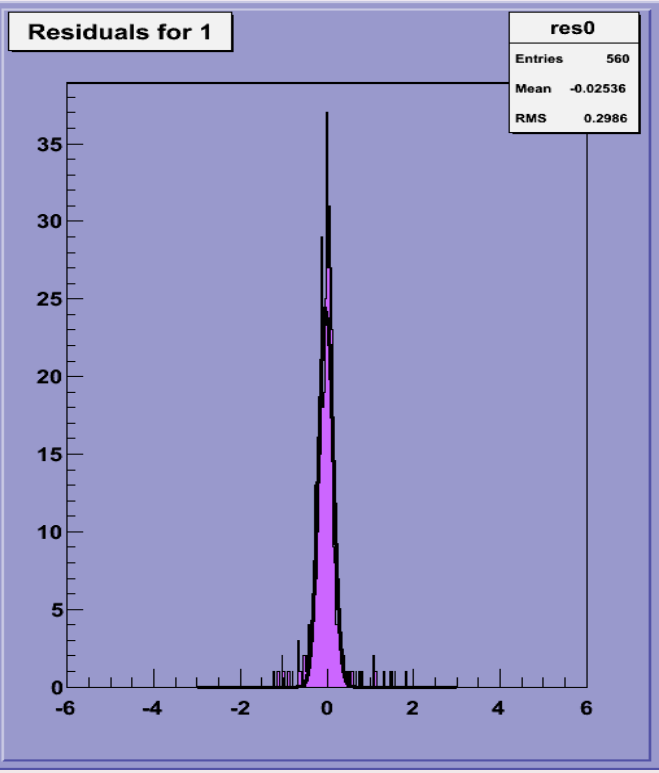
Tracking of micromegas telescope

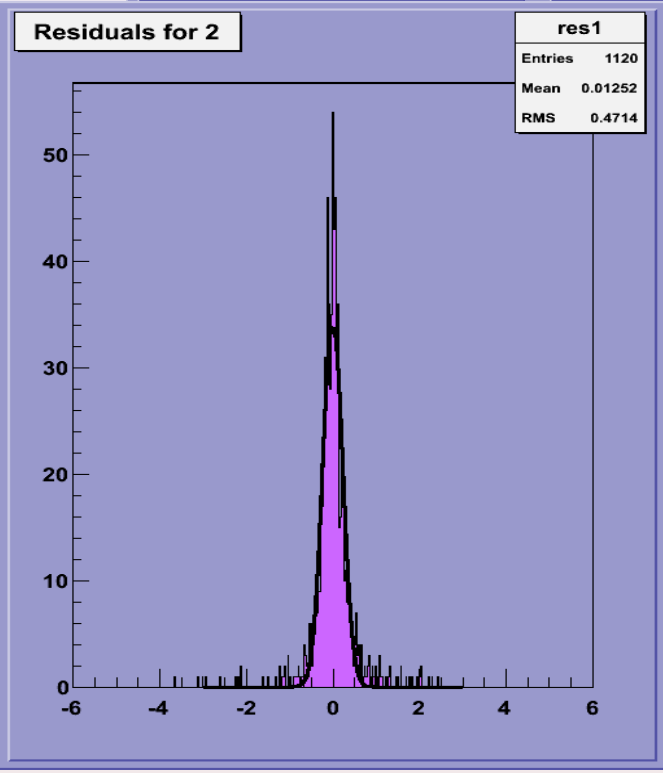
- Offset and residual plot.

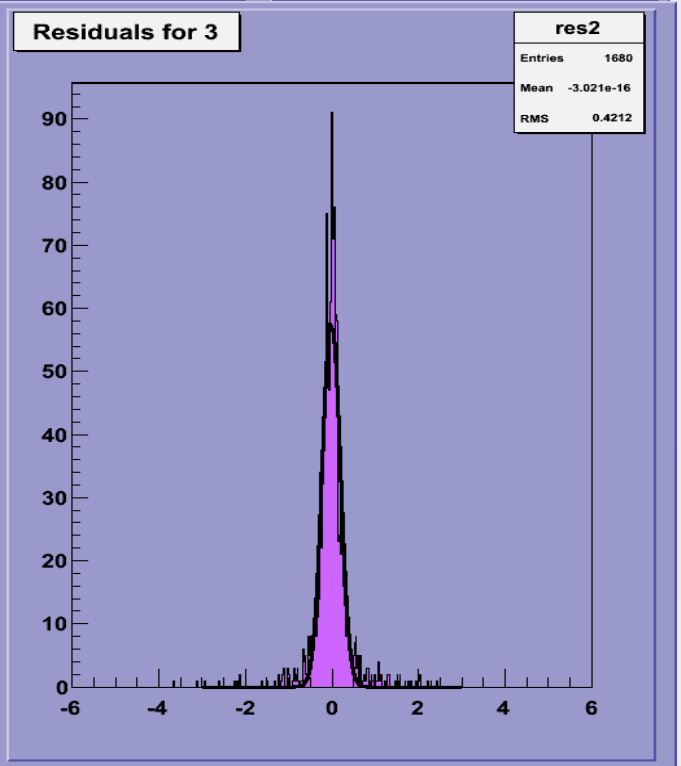








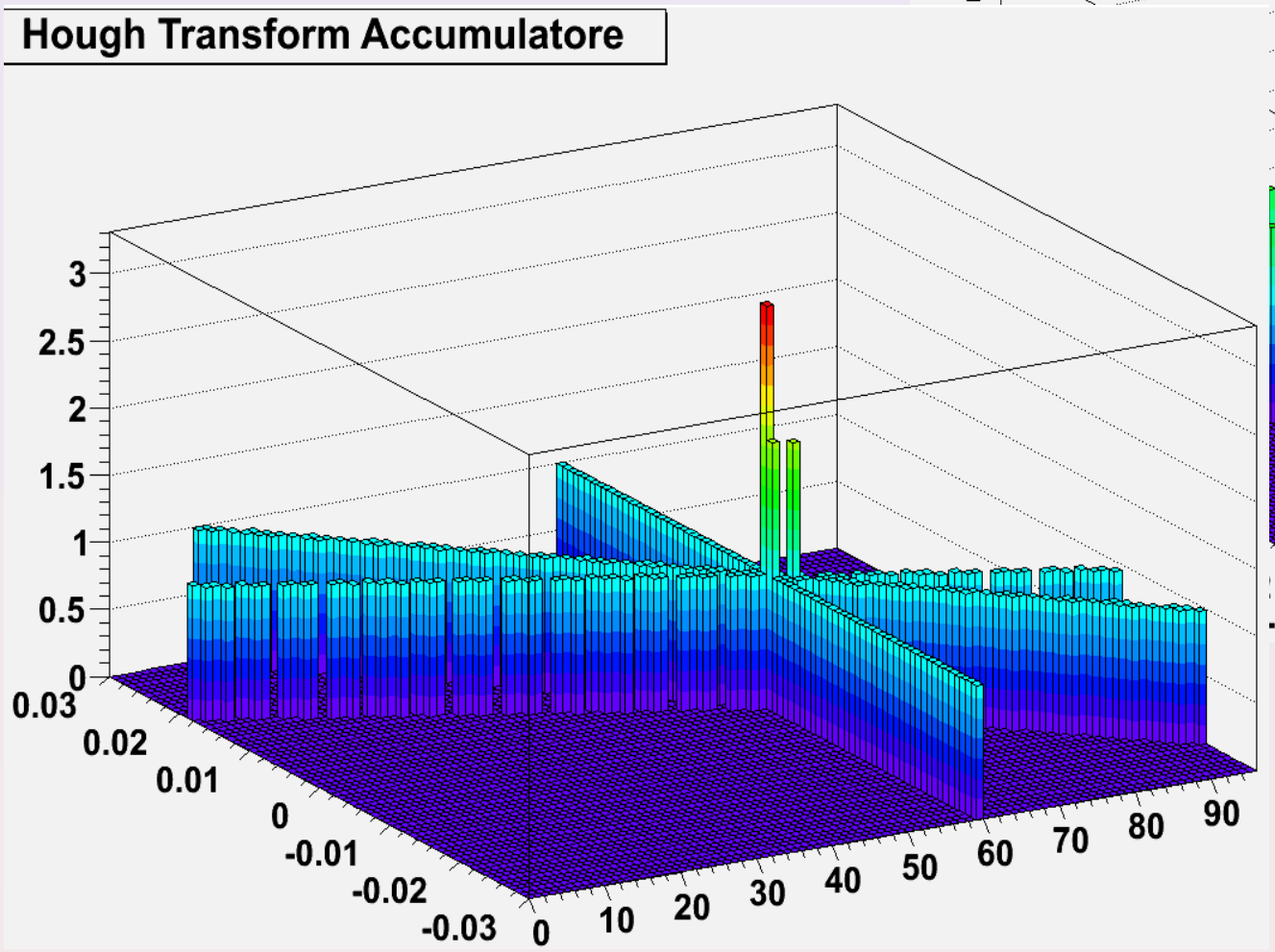


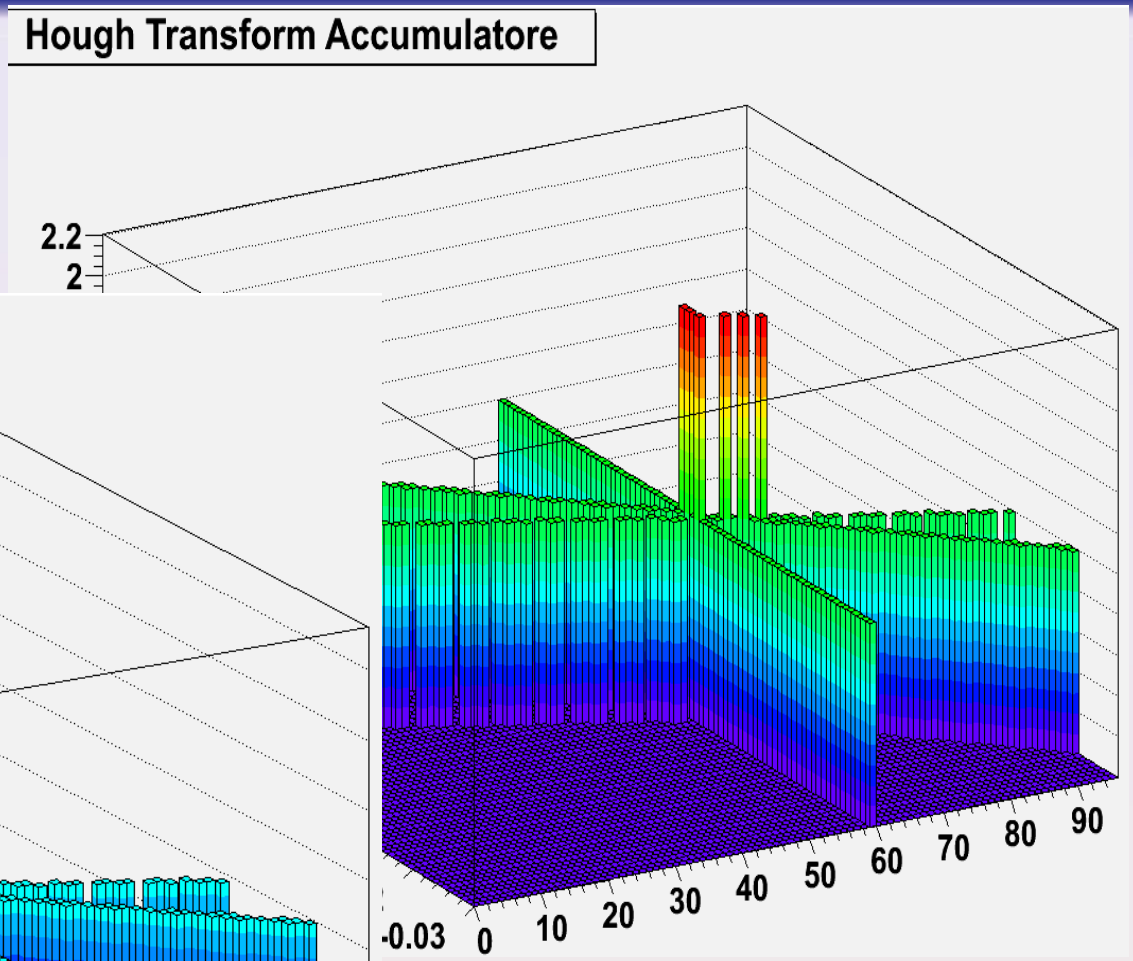


Tracking of micromegas telescope

- The effect of corrections.

Before →

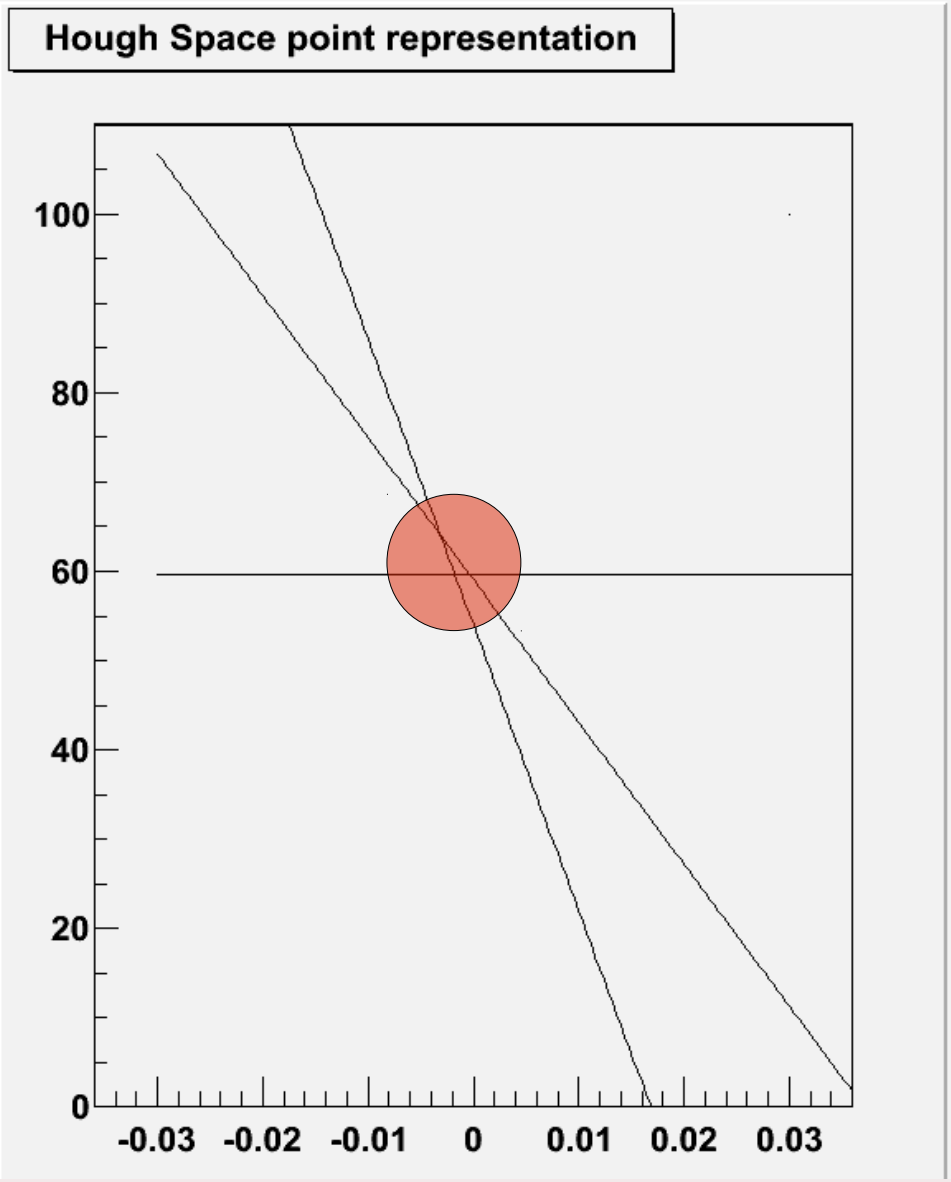


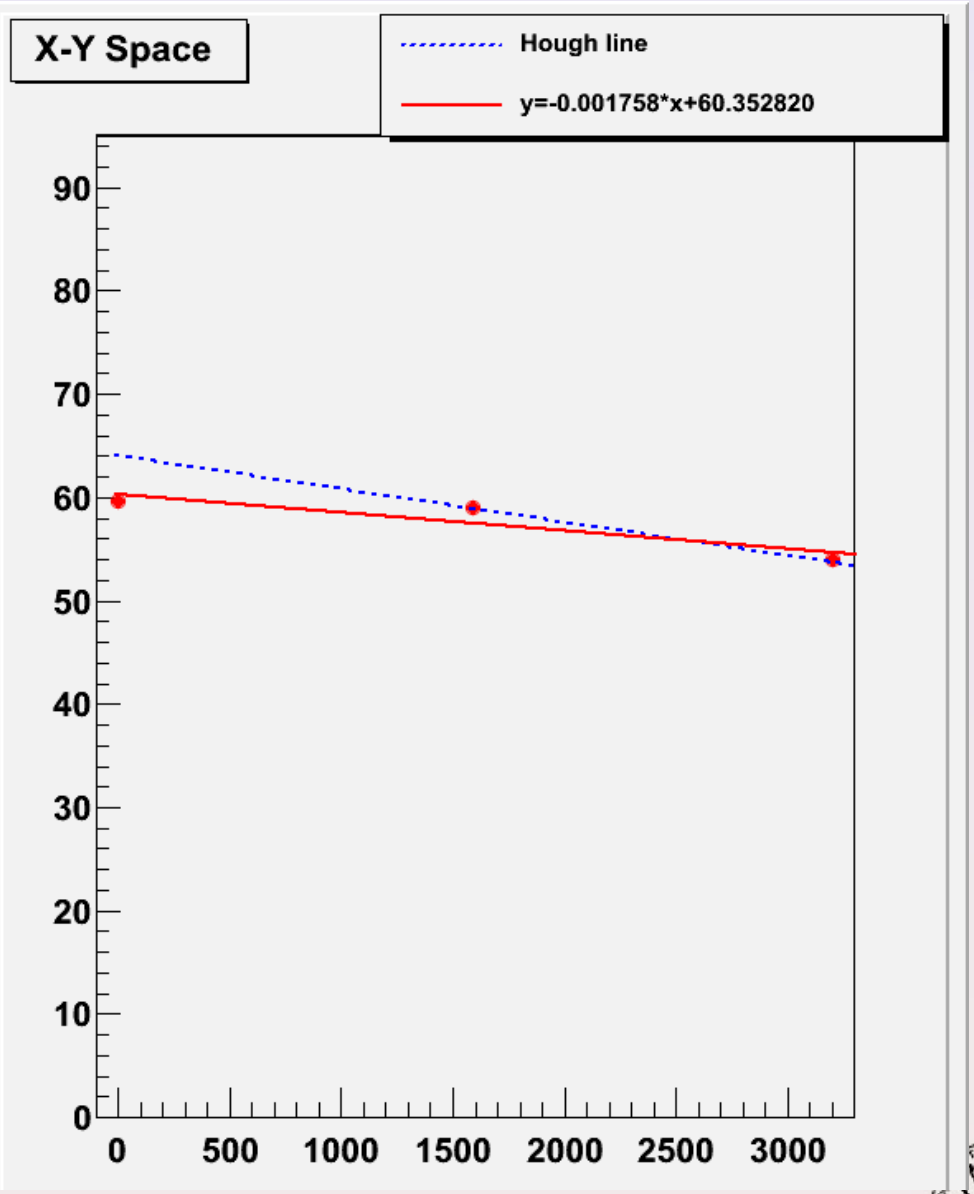


← After

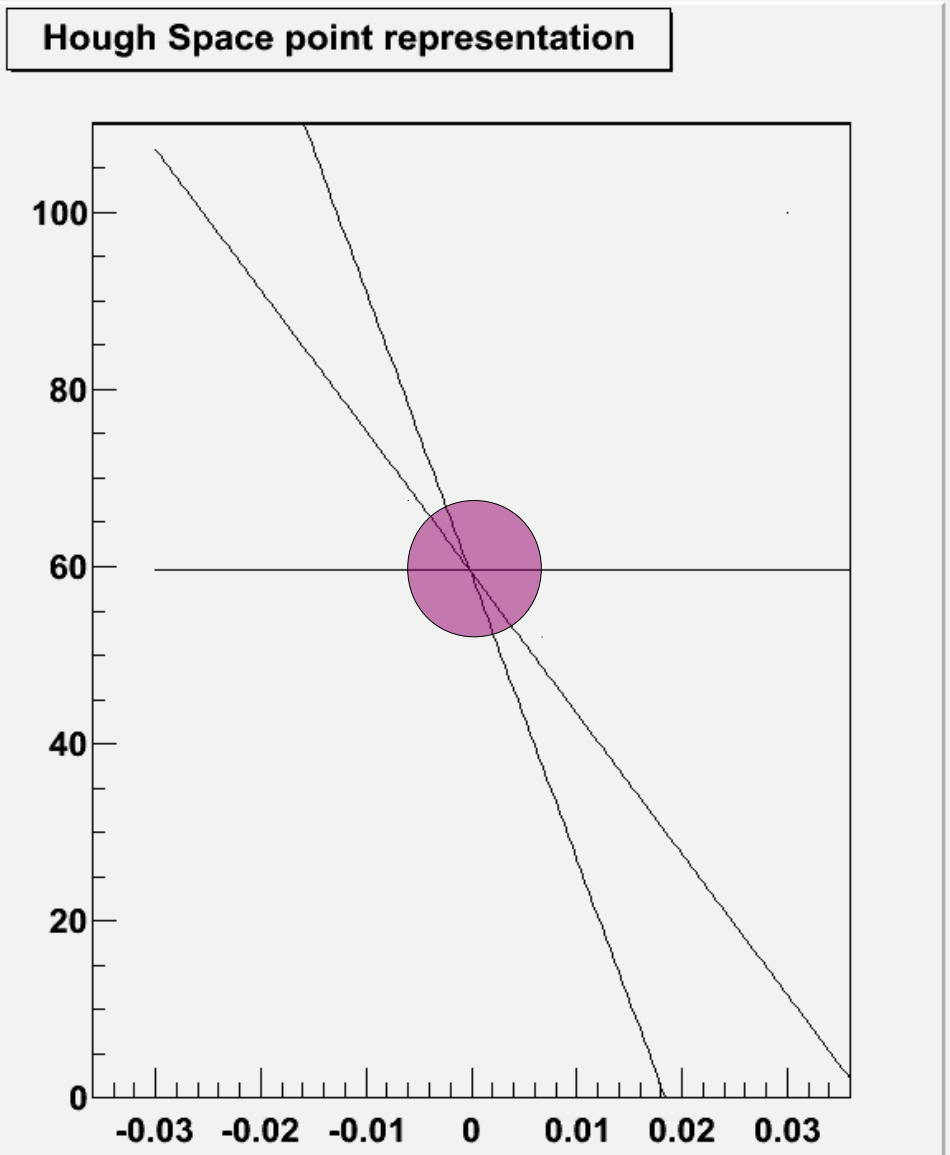
Tracking of micromegas telescope

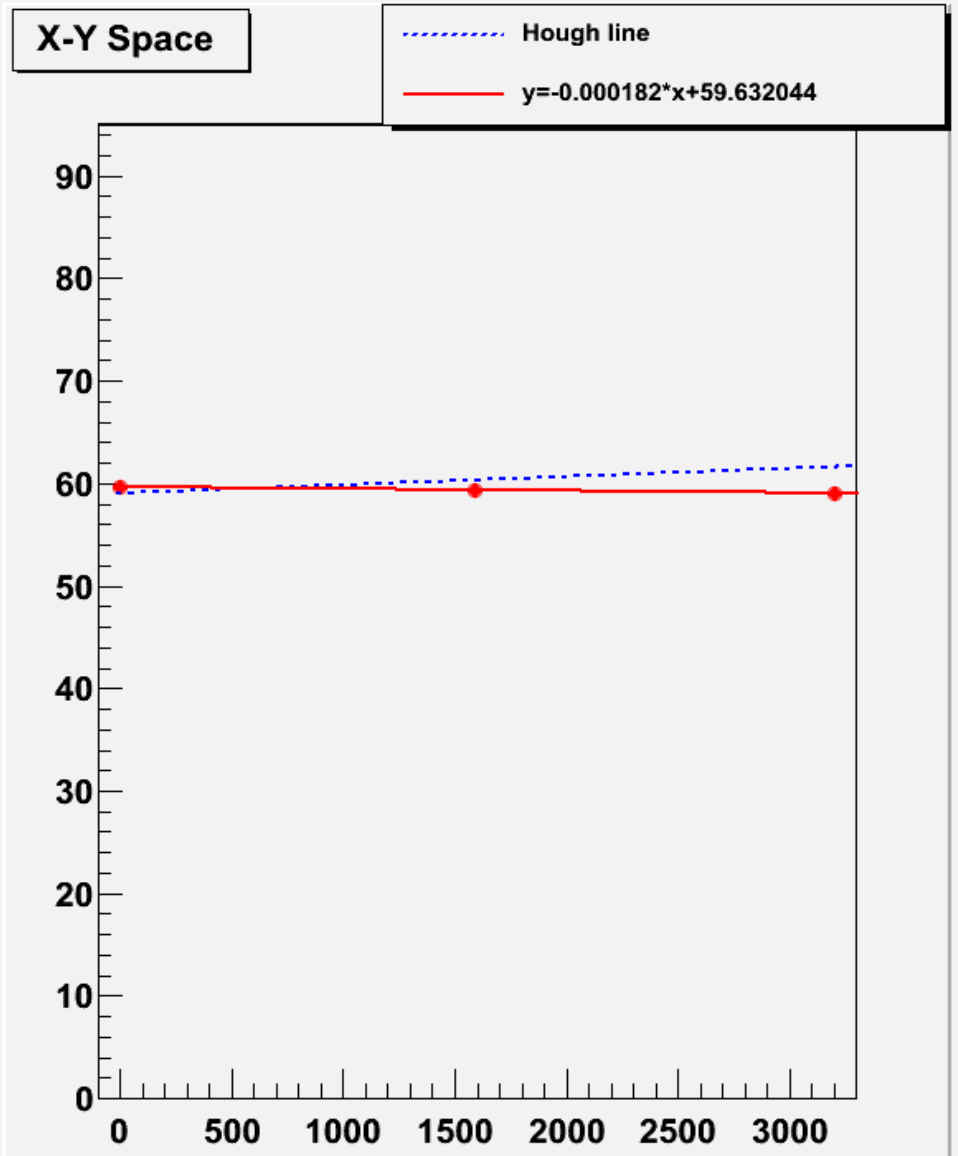
- The effect of corrections **before**





- The effect of corrections **after**



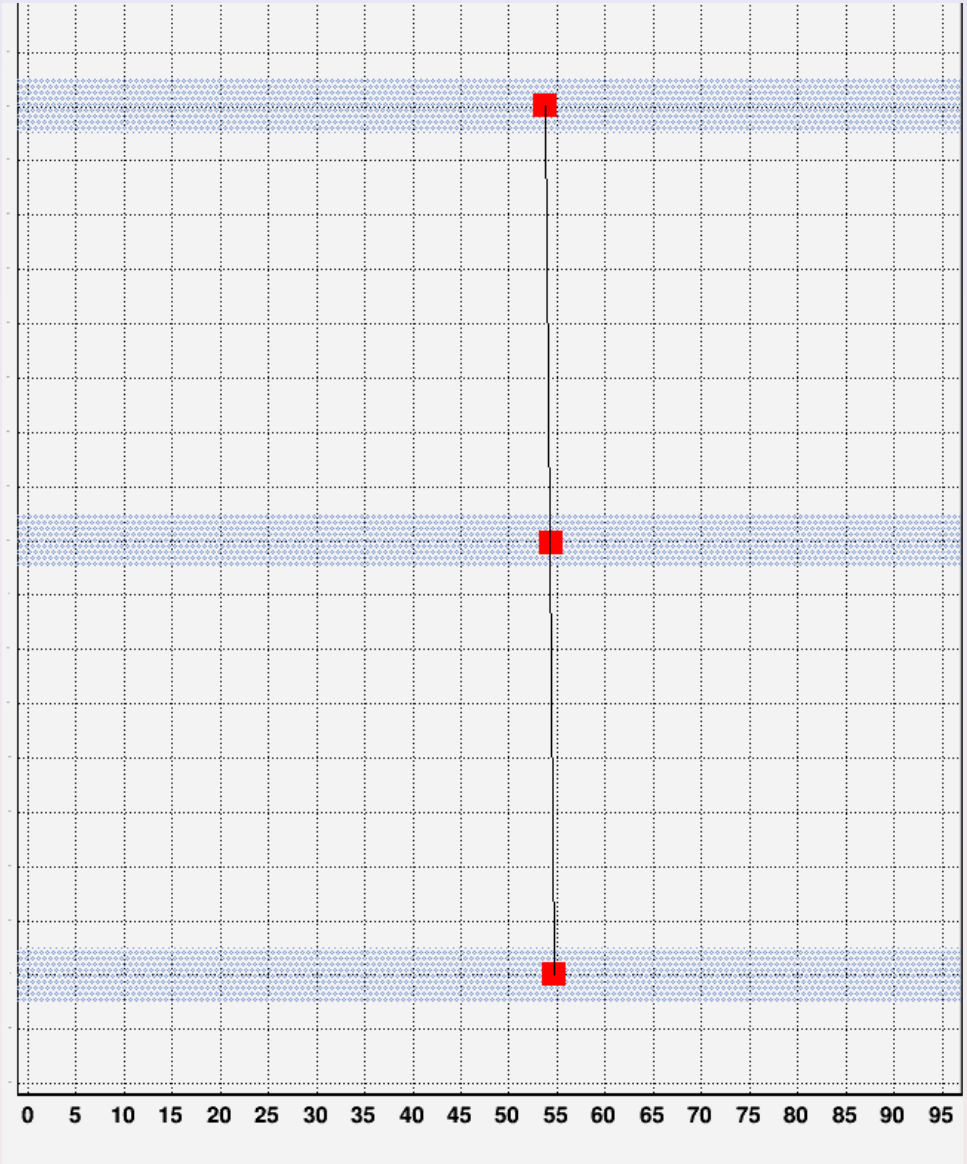
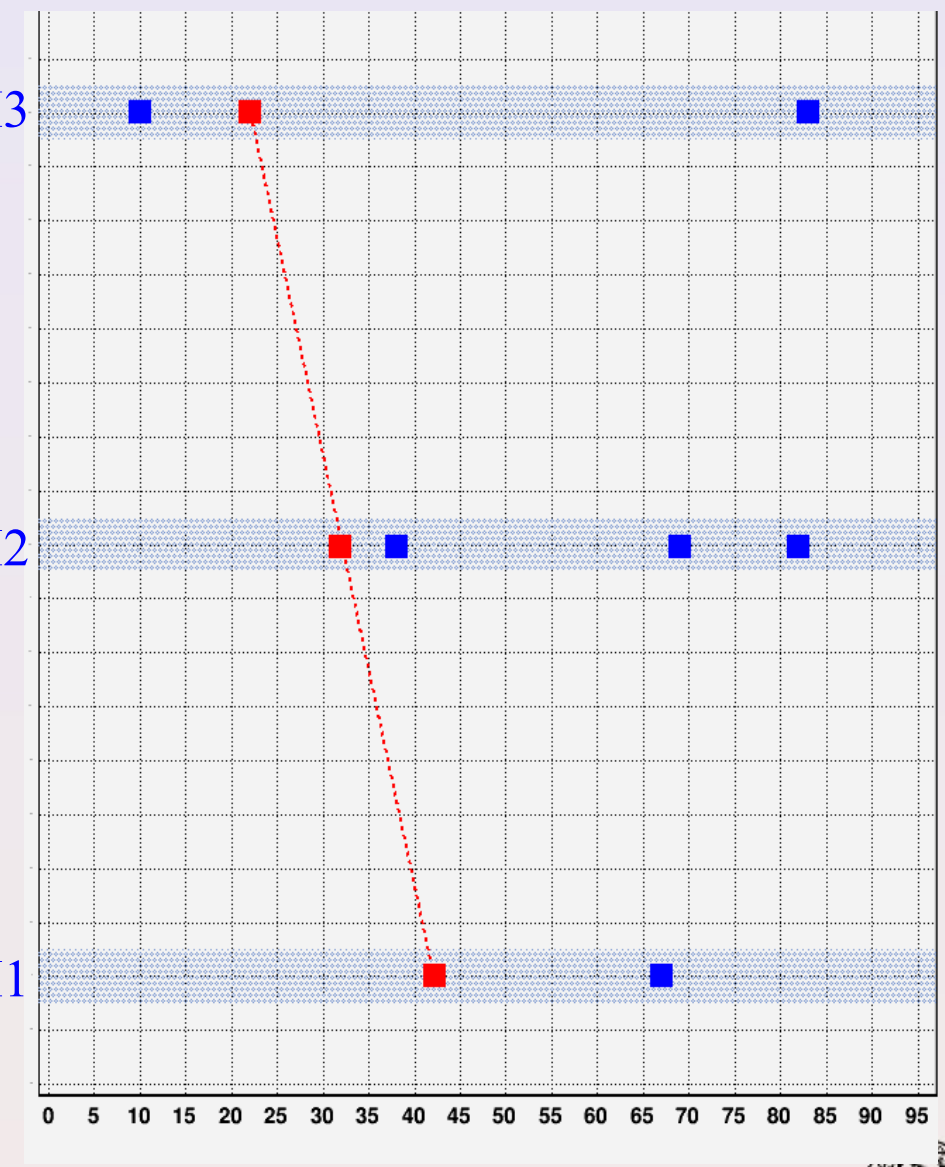


Tracking of micromegas telescope

- Information per track.
  - After the fit several informations are available and stored in a root file.
  - Slope, intercept, error of slope, error of intercept, event number, time of the event (unix time), points of the track, goodness of the fit.
  - Finally a synchronization method must be established in order to be able to use the tracks from the telescope with other read-outs from other PCs.

Tracking of micromegas telescope

- Status Report.
  - We have a tracking algorithm that provides tracks from the micromegas telescope for the users to use for their detector under test.
  - The algorithm is flexible and soon will be used also for the gem telescope of the RD51.

Tracking of micromegas telescope

- Event Display Clean Typical