

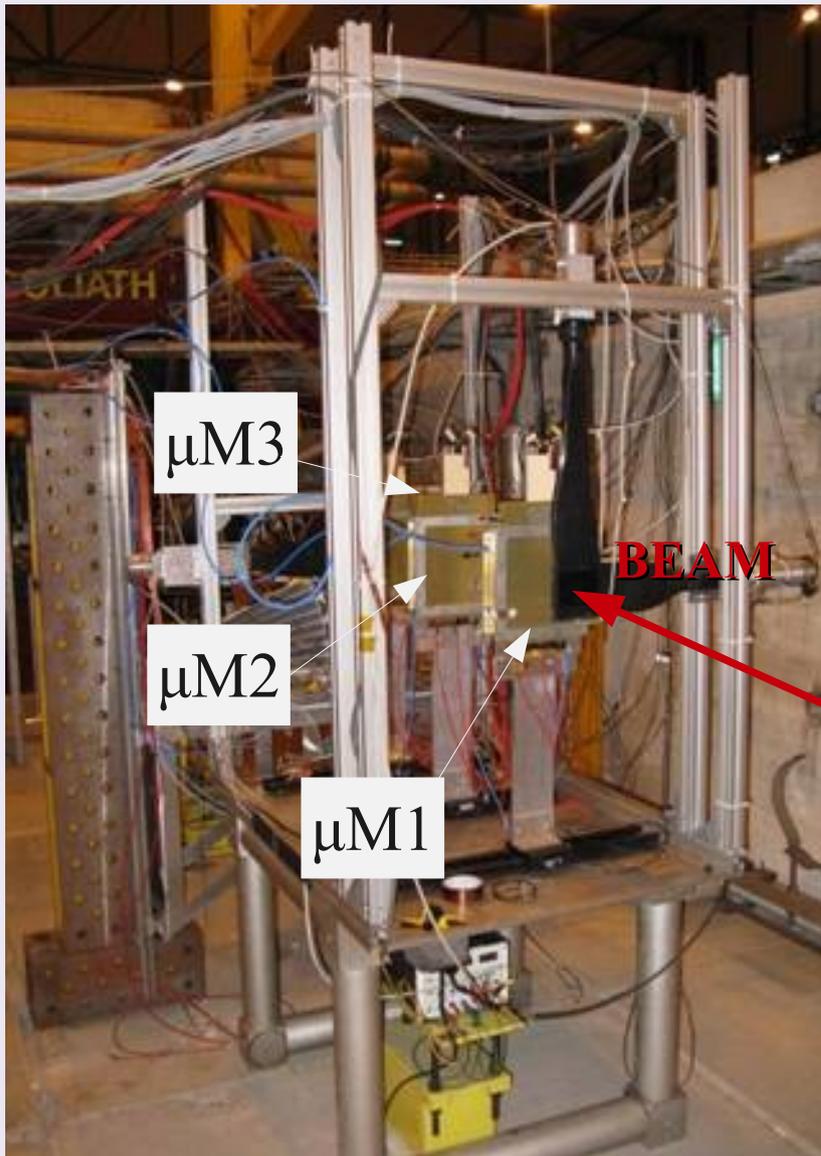
Micromegas telescope for the RD51 Test Beams

XXVIII Workshop on Recent
Advances in Particles Physics
and Cosmology

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Micromegas telescope for RD51 Test Beams



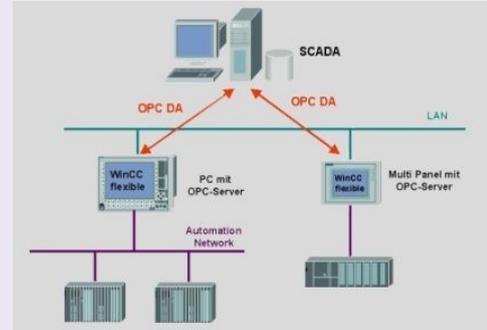
For the needs of RD51 Test Beams a beam telescope was developed by NTUA & Demokritos.

We developed:

- a program in PVSS (slow control system) for the remote control and the monitoring of the HV channels
- a complete read-out system (see Eleni Ntomari presentation)
- a tracking algorithm

Micromegas telescope for RD51 Test Beams

➤ In order to connect to the SY2527 CAEN mainframe we used an OPC server (internet).



The screenshot shows the main window of the Vision_1 software. The window title is "Vision_1: main.pnl". The interface includes a menu bar (Module, Panel, Scale, Help), a toolbar, and a main data table. The table has columns for vMon and iMon values in uA. The data is color-coded: green for normal, yellow for warning, and red for error. The table is titled "RD51" and has buttons for View, Settings, Archive, Export, and Close. A gold coin logo is visible in the top right corner of the window.

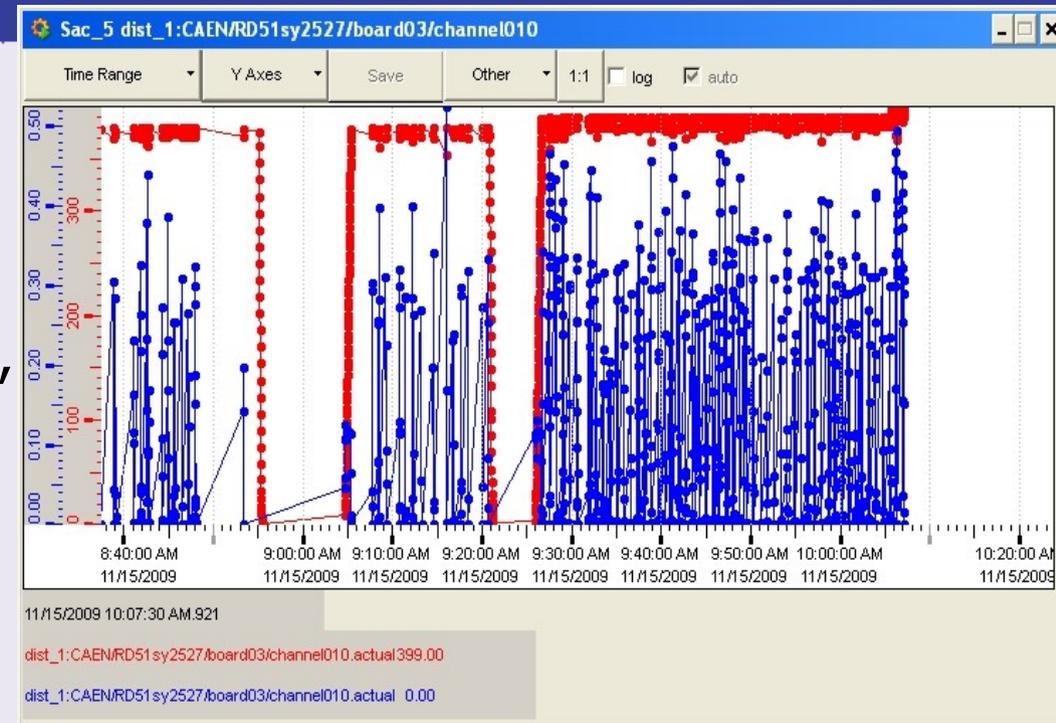
Beam ID	vMon	iMon	uA	Beam ID	vMon	iMon	uA	Beam ID	vMon	iMon	uA
03_03	0.00	0.000	uA	03_06	0.00	0.000	uA	03_09	3.00	0.000	uA
03_11	0.00	0.000	uA	03_17	0.00	0.000	uA	03_21	1.00	0.000	uA
03_23	0.00	0.000	uA	03_28	0.00	0.000	uA	03_32	1.00	0.000	uA
03_43	0.00	0.000	uA	Sac_6	393.25	0.150	uA	03_44	0.00	0.000	uA
Mesh	539.00	0.000	uA	Sac_5	389.25	0.418	uA	03_47	0.00	0.000	uA
Drift	999.50	0.000	uA	03_11	0.00	0.000	uA	03_12	1.00	0.000	uA

Main Window

- ✓ Status of all (color code)
- ✓ vMon
- ✓ iMon
- ✓ Settings
- ✓ Initialization
- ✓ Export data
- ✓ Direct online plots

Micromegas telescope for RD51 Test Beams

- Online plots per channel (iMon, vMon)
- Archiving and exporting iMon, vMon, vSet values
- Mass configuration of the channels (v0, i0, rUp, rDwn, trip), custom naming. All password protected
- Logbook automatically kept up
 - ✓ User
 - ✓ Date-time stamp,
 - ✓ Channel(s) Configuration



configAll.pnl

Alias	Channels	v0	i0	rUp	rDwn	trip
			0.000			
BNLdri	board03/channel000	666	10.000	100	100	2
BNLtop	board03/channel001	1350	10.000	100	100	2
BNLbot	board03/channel002	750	10.000	100	100	2
BNLmes	board03/channel003	430	10.000	100	100	2
Mesh	board03/channel004	570	4.000	50	100	2
Drift	board03/channel005	870	4.000	50	100	2
LargeH	board03/channel006	530	10.000	20	50	2
LargeY	board03/channel007	520	1.000	5	50	2
Cathod	board03/channel008	730	10.000	5	50	5
Sac 6	board03/channel009	400	0.500	10	25	10
Sac 5	board03/channel010	400	0.500	10	25	10
	board03/channel011	400	0.500	10	25	10
	board04/channel000	0	2.000	25	50	1
	board04/channel001	0	2.000	25	50	1
	board04/channel002	0	2.000	25	50	1
	board04/channel003	0	2.000	25	50	1
test 1	board04/channel004	0	5.000	50	50	1
test 2	board04/channel005	0	5.000	50	50	1

RD51

Username

Password

Cancel Ok

v0 i0 (uA) rUp rDwn tripTime Alias

Alias

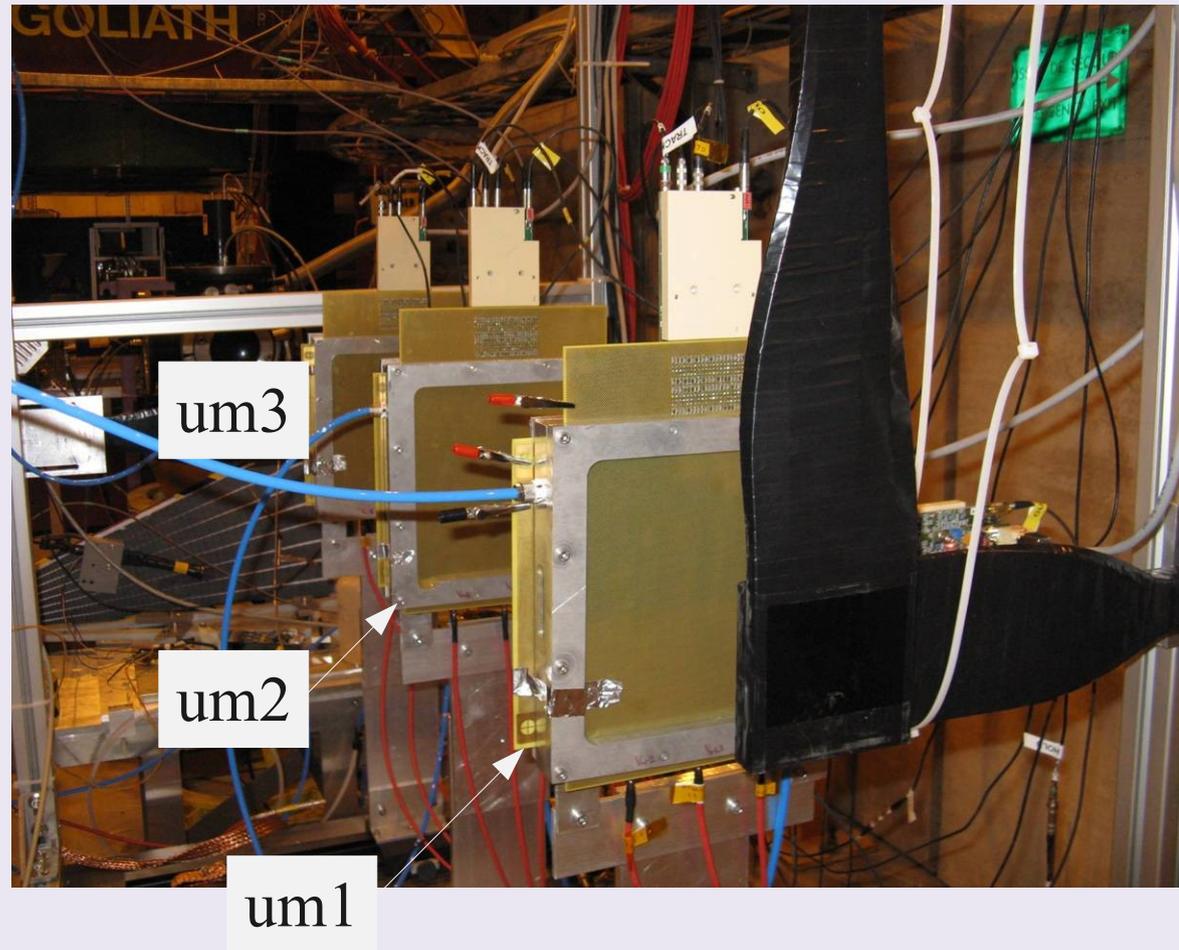
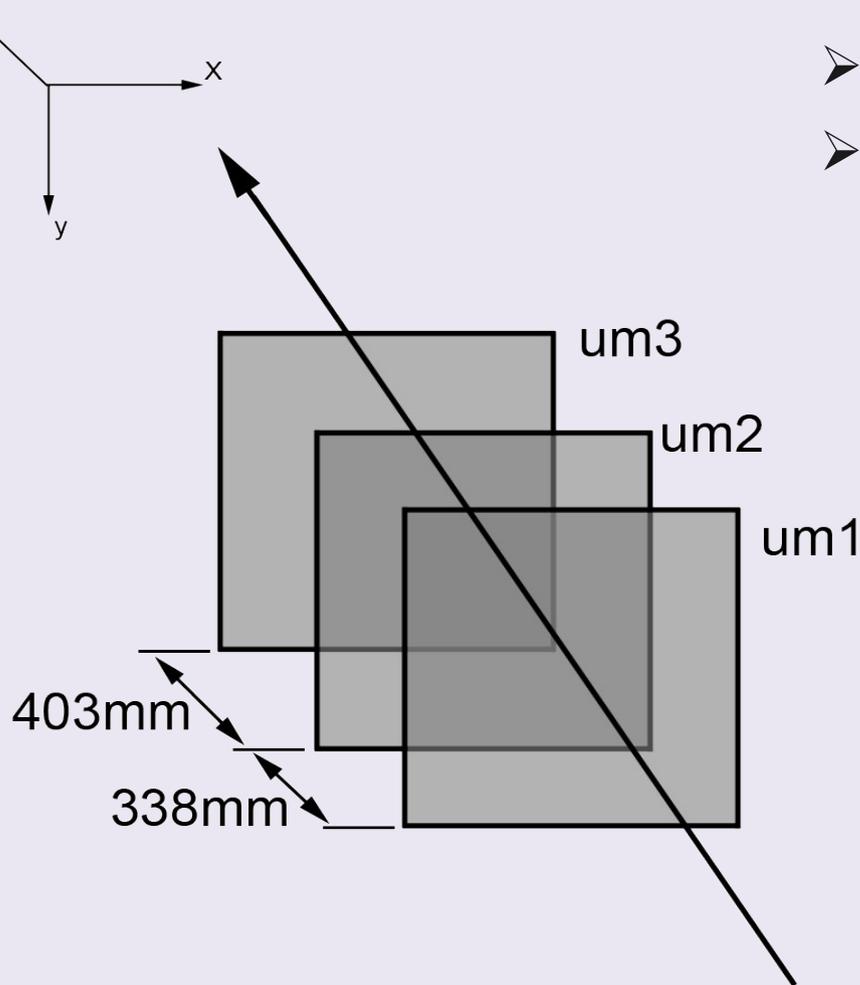
Set Config Refresh

Channel On Channel Off Close

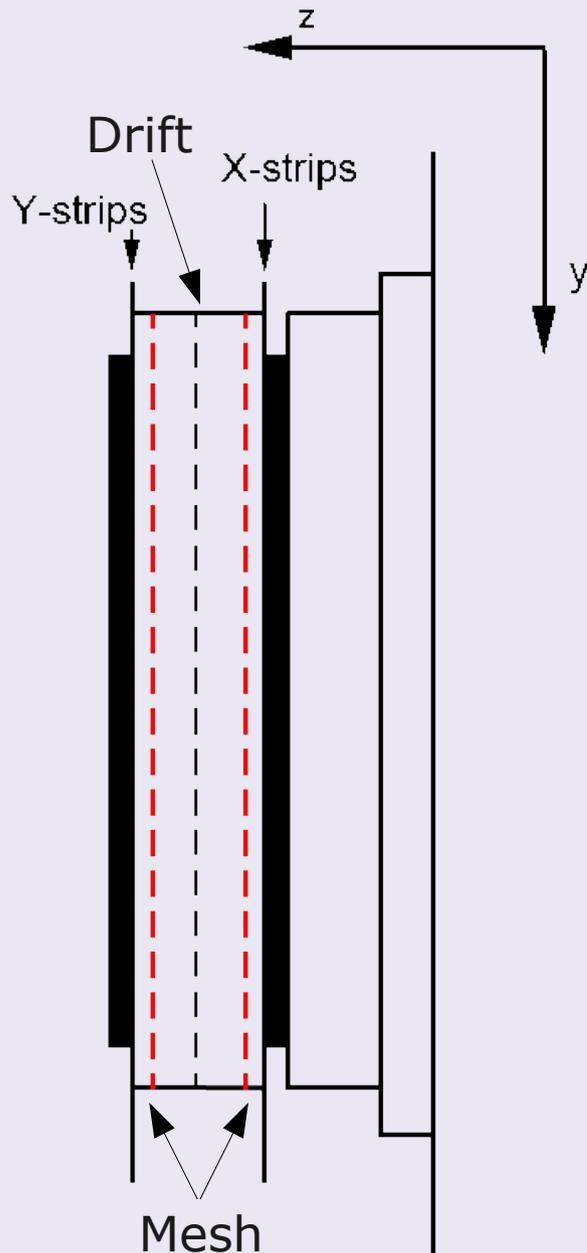


Micromegas telescope for RD51 Test Beams

- 3 pairs of identical μM detectors
- Parallel and movable (x & y)



Micromegas telescope for RD51 Test Beams

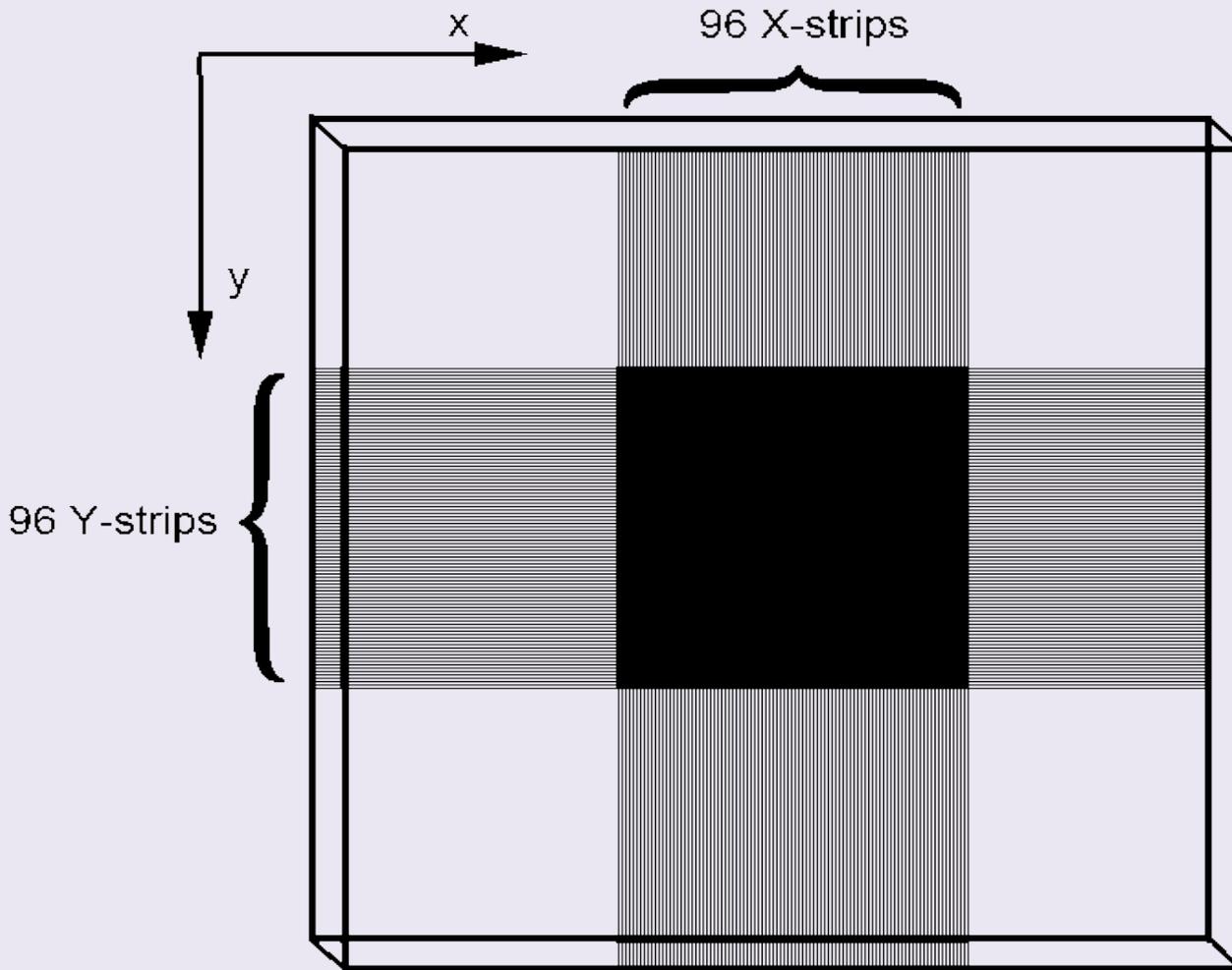


- 2 PCBs per detector (one with the X-strips and the other with the Y-strips)
- Common drift and different mesh for each pair (3 HV channels per detector)

Technical information

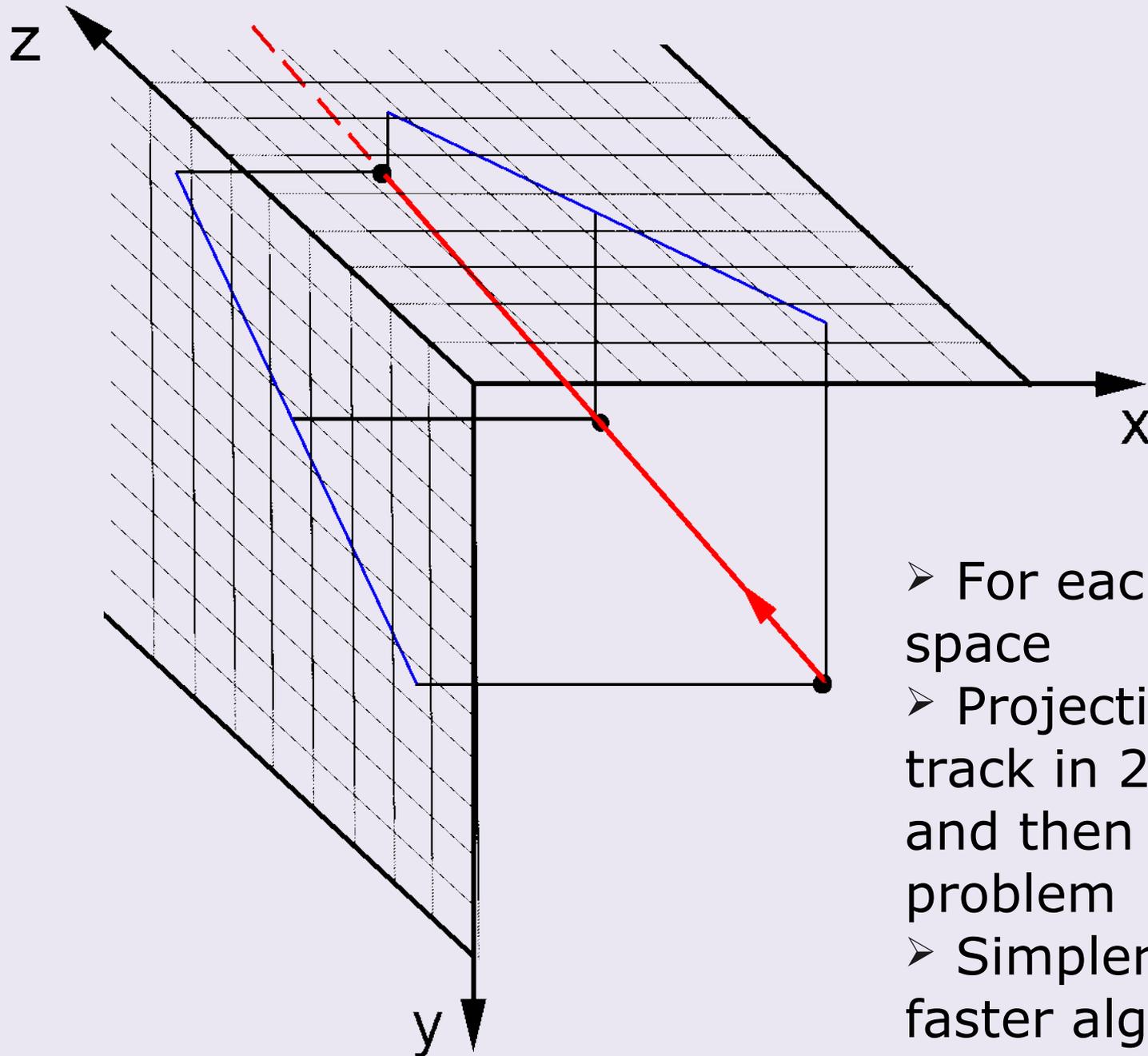
- Amplification gap = 128 μm
- Conversion gap = 7 mm
- Strip pitch = 250 μm
- Resolution = $\sim 50 \mu\text{m}$

Micromegas telescope for RD51 Test Beams



- 96 strips for each direction
- Active area 2.4cm x 2.4cm (96 strips x 250um)
- The beam first cross the X-plane and afterwards the Y-plane

Micromegas telescope for RD51 Test Beams

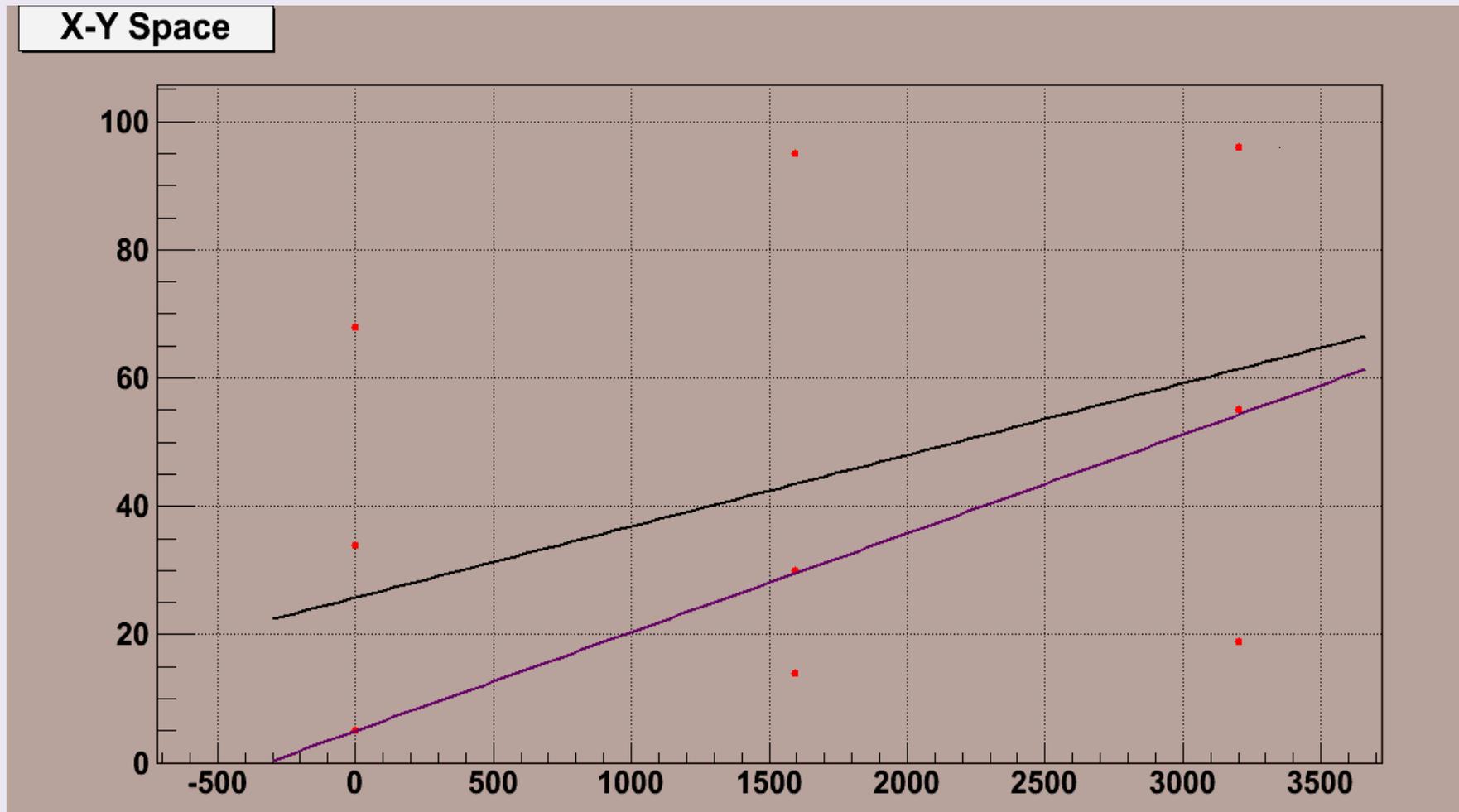


- For each track: 3 points in space
- Projection of the real track in 2 planes (xz , yz) and then facing a 2D problem
- Simpler approaches and faster algorithms.



Micromegas telescope for RD51 Test Beams

χ^2 line fitting \rightarrow Disadvantages: the fitting line depends on all given points and checking all available combination of 3 points (1 per detector) we can go up to 125 lines-candidates per some event!



χ^2 fitting (black), for 9 points (red) with purple the real track.



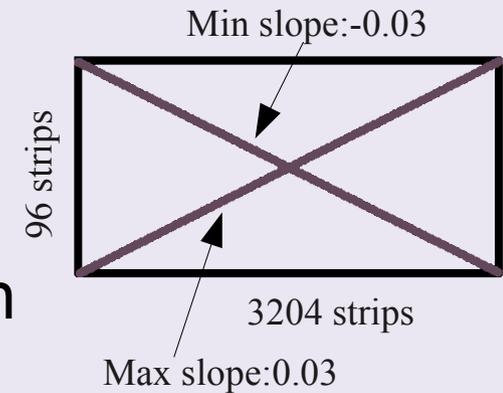
Micromegas telescope for RD51 Test Beams

- Hough Transformation for line detection.

- Basic concept

eq. line: $y=ax+b$

$b=y-ax$ for a given point (x,y) we scan on the range of a



- From X-Y space \sim Hough Space (a,b)

- The line does **not** depend on points irrelevant to the track

- Filling a 2D histogram for the Hough space

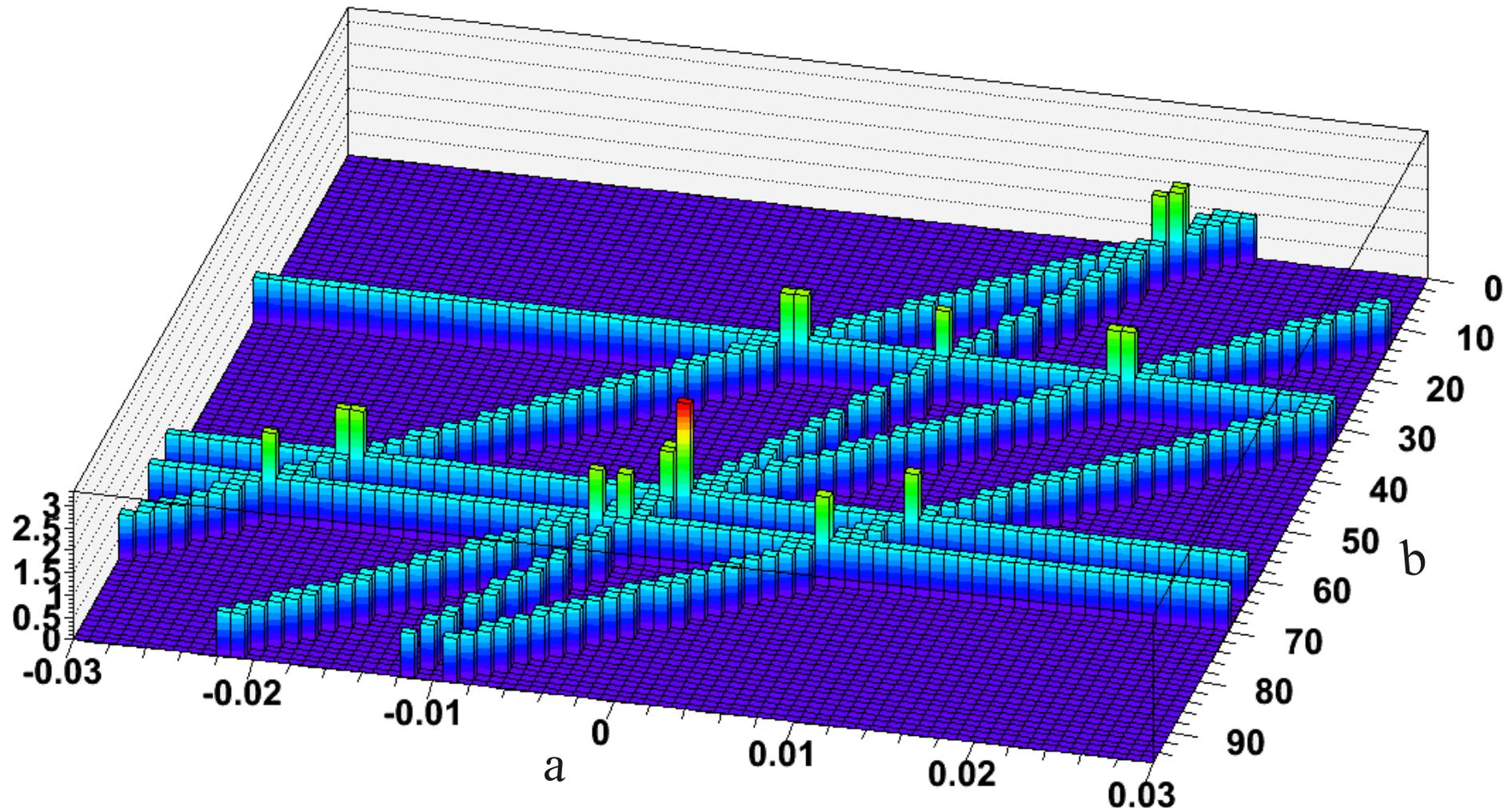
- Where 2 (or more) lines are crossed is a potential candidate for our track

- Example from real events...

(Run:6244, $V_m=510$ V, $V_d=810$ V, Ar:CO2 90:10 @ 28/10/09)

2D Hough accumulator for 7 points.

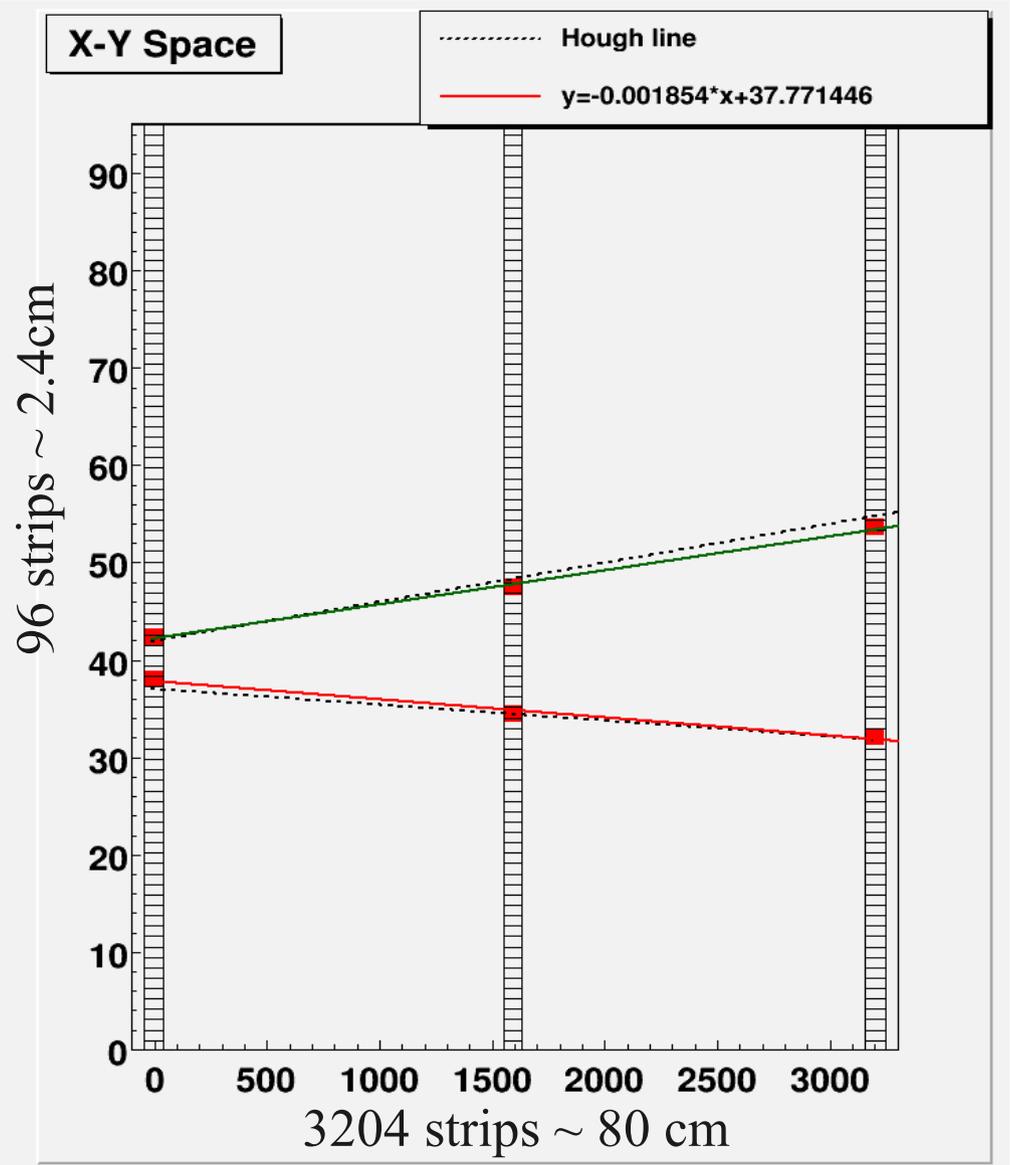
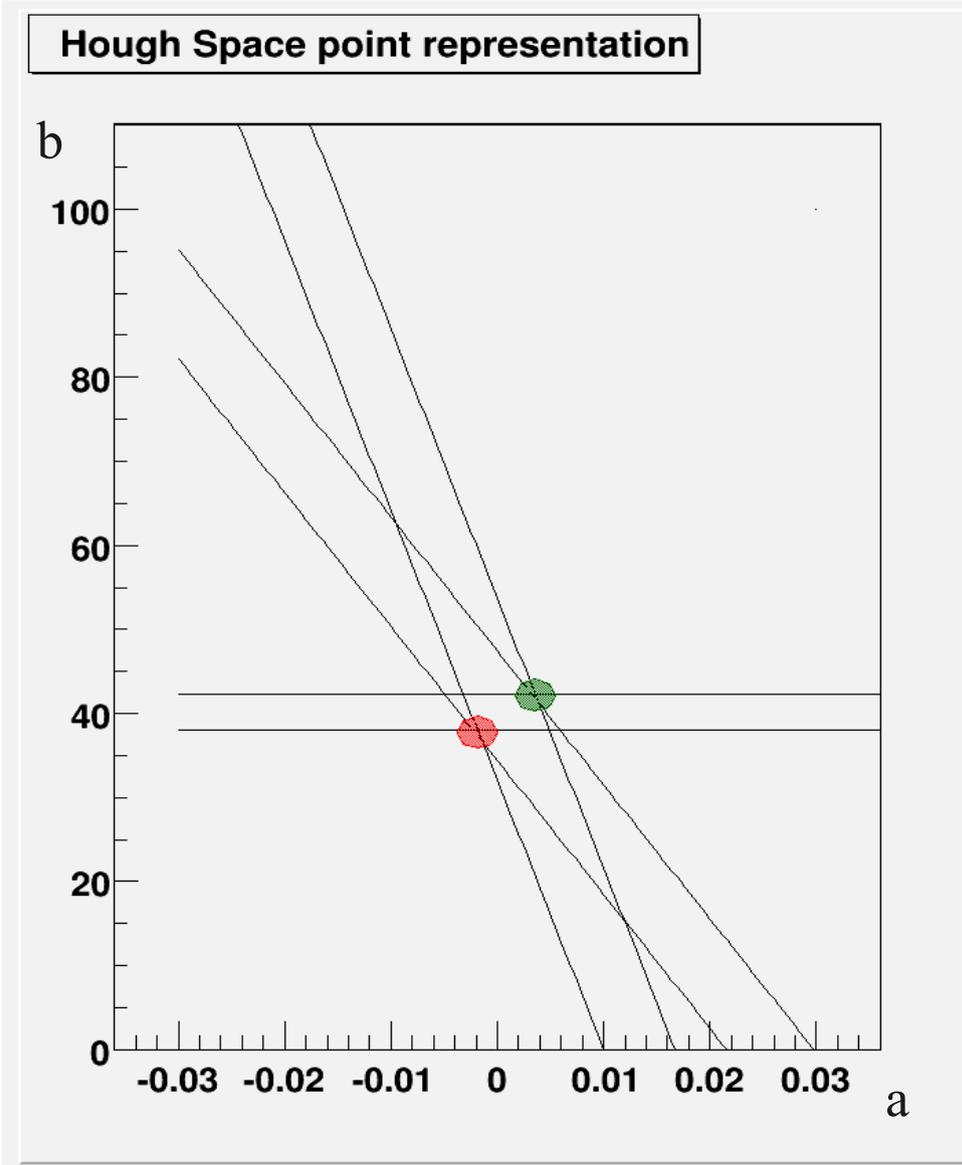
Hough Transform Accumulator



Micromegas telescope for RD51 Test Beams

➤ Hough Space (2D).

First track, second track.



Summary

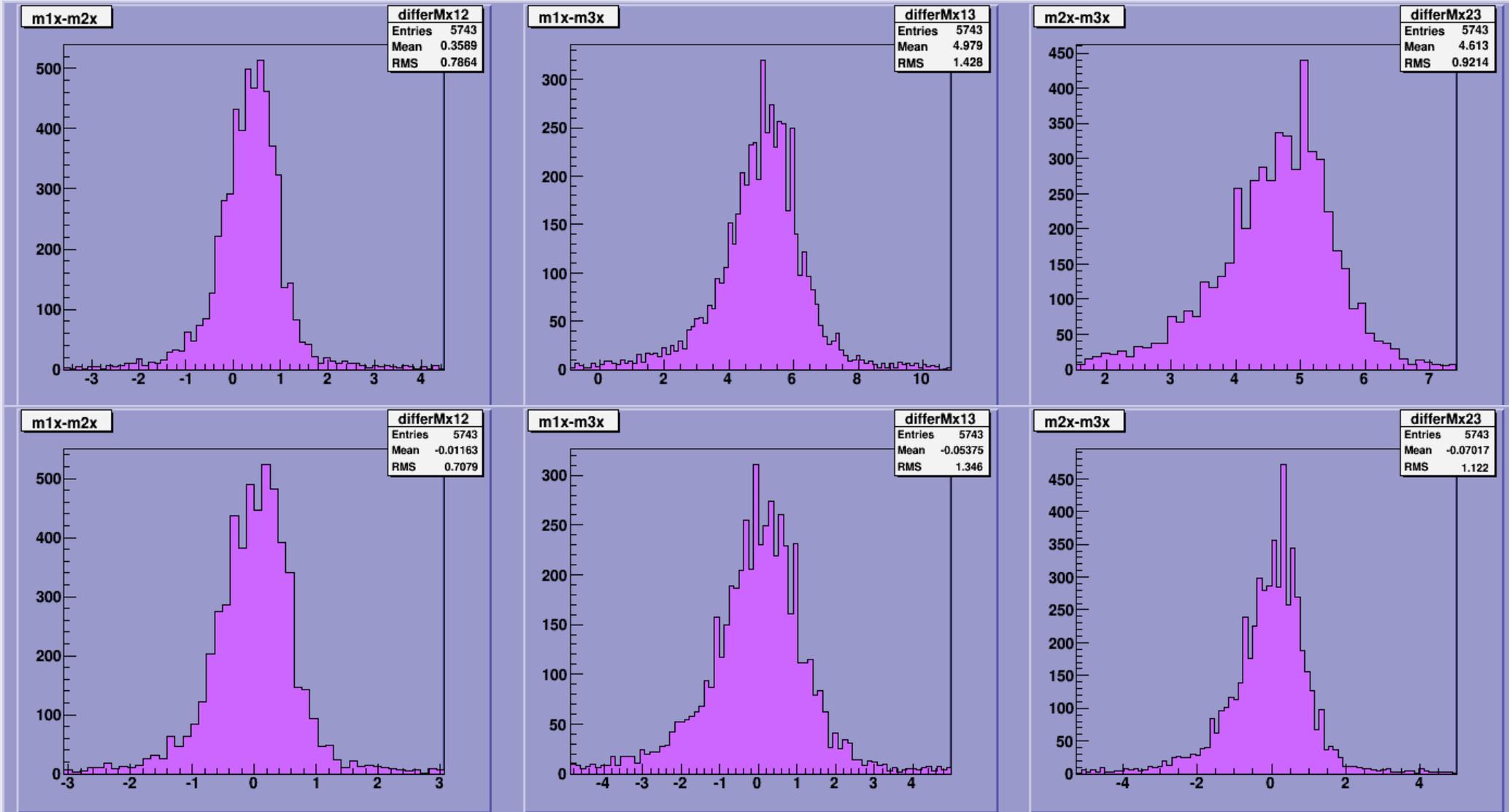
- We developed:
 - the micromegas beam telescope for the RD51 test beam line
 - a slow control system, which was used also by other participants during RD51 Test Beam and MAMMA Test Beam
 - ✓ Future plans include the expansion of this tool to monitor and control also temperature, external and internal pressure, gas etc
- 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



Back Up Slides

Micromegas telescope for RD51 Test Beams

➤ Displacements for X plane, before & after alignment.

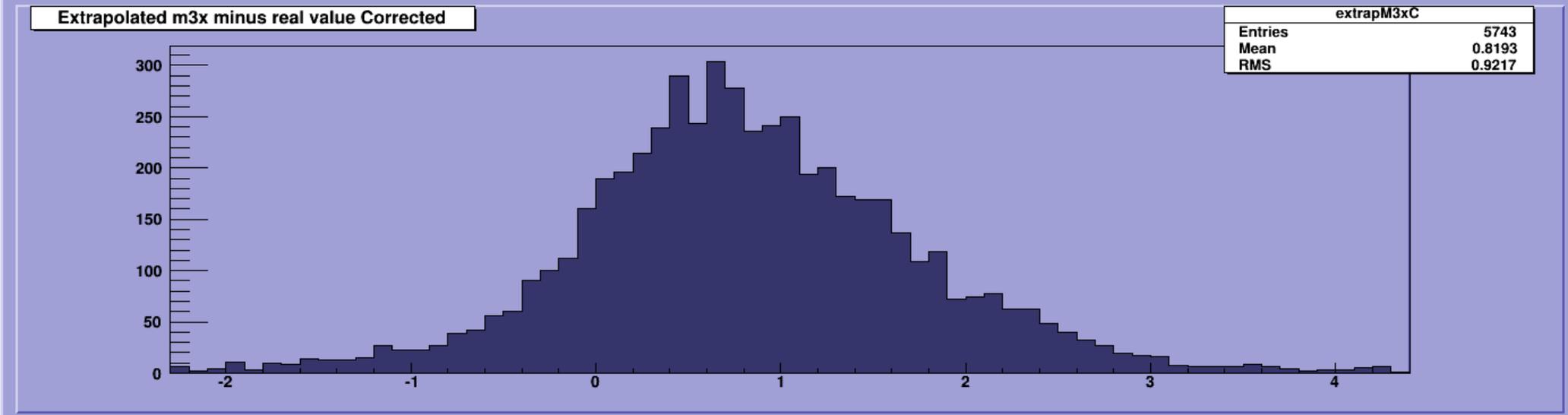
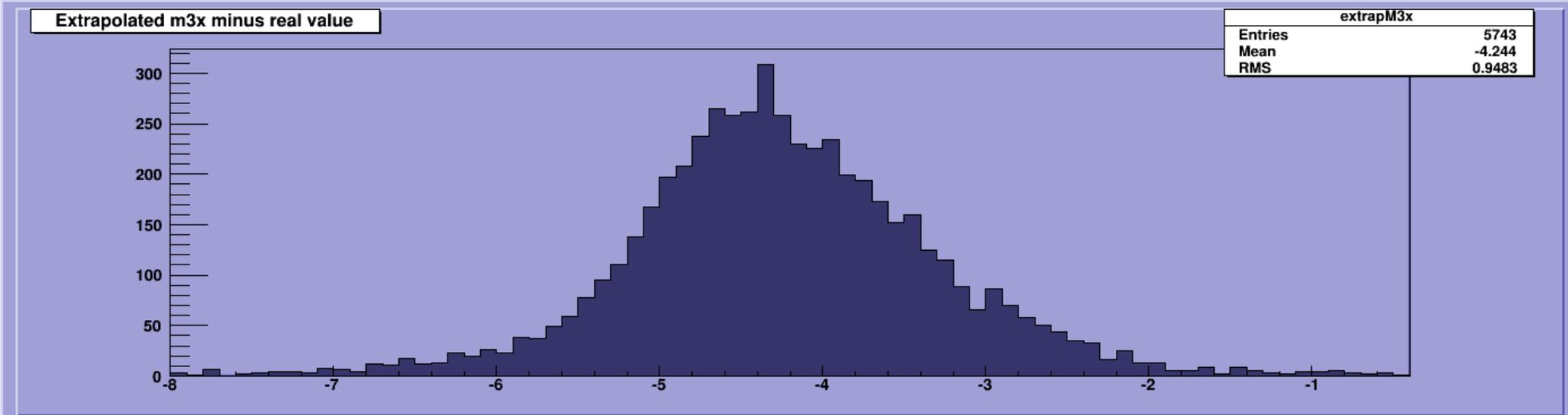


➤ All X-Axis are in strips (1 strip \sim 250 μ m).



Micromegas telescope for RD51 Test Beams

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



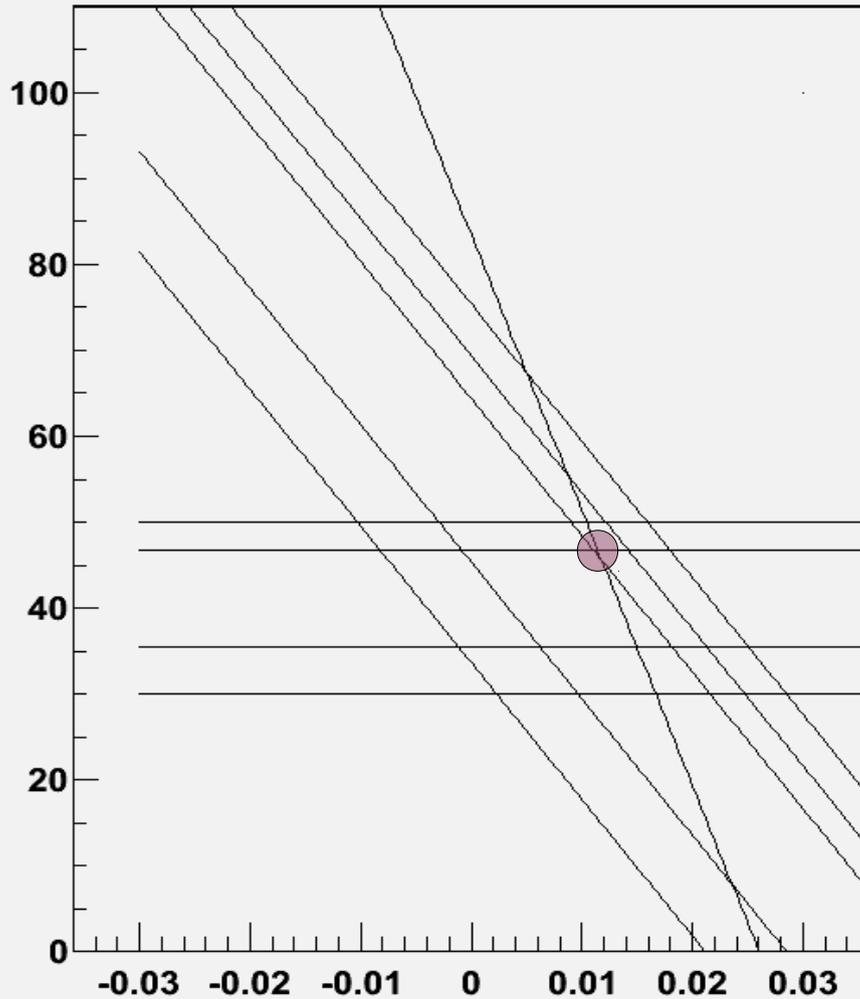
- All X-Axis are in strips (1 strip \sim 250 μ m).



Micromegas telescope for RD51 Test Beams

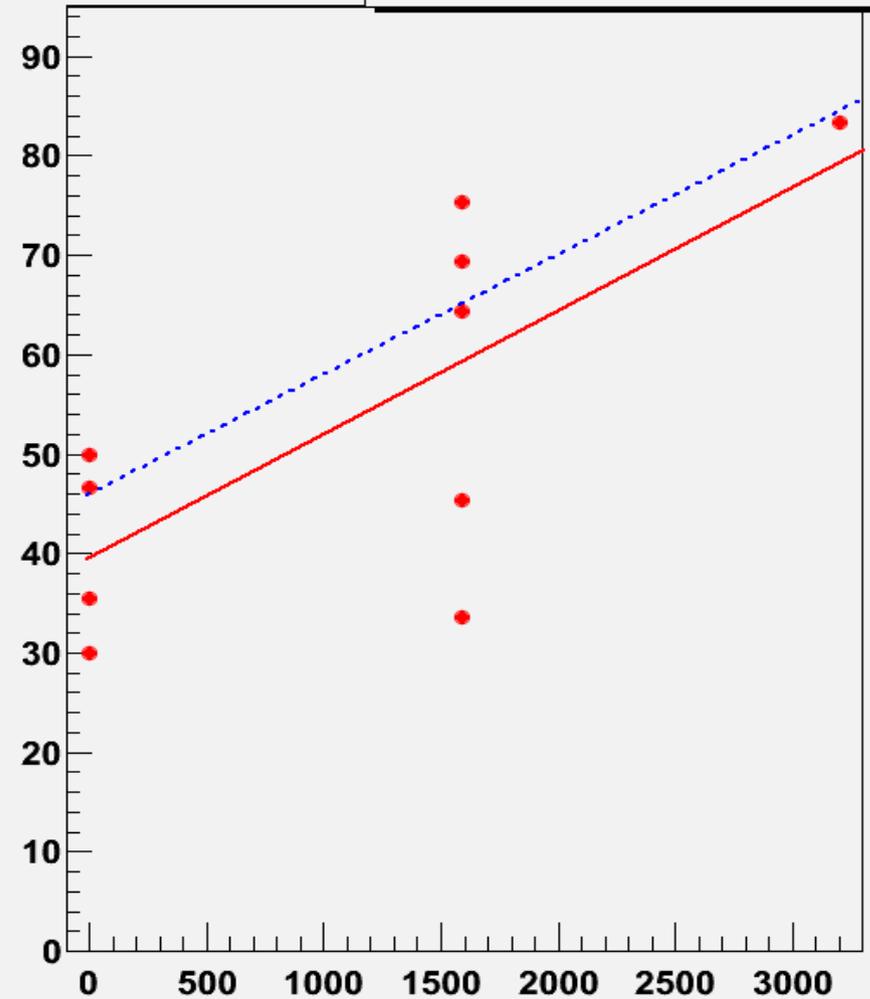
- Hough Space (2D). HT line , chi square line.

Hough Space point representation



X-Y Space

--- Hough line
— $y=0.012417*x+39.504976$



Micromegas telescope for RD51 Test Beams

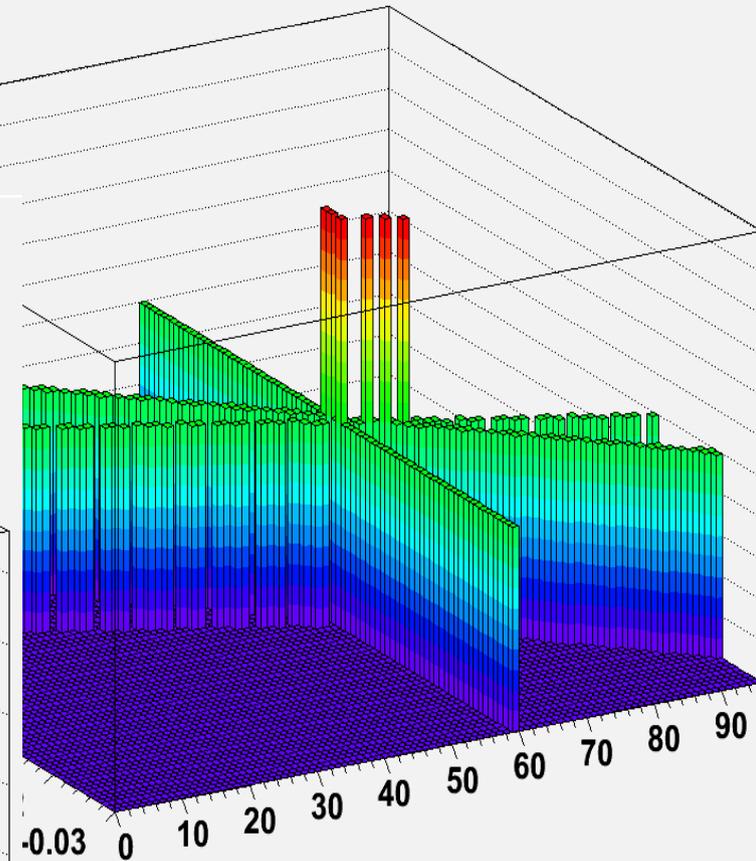
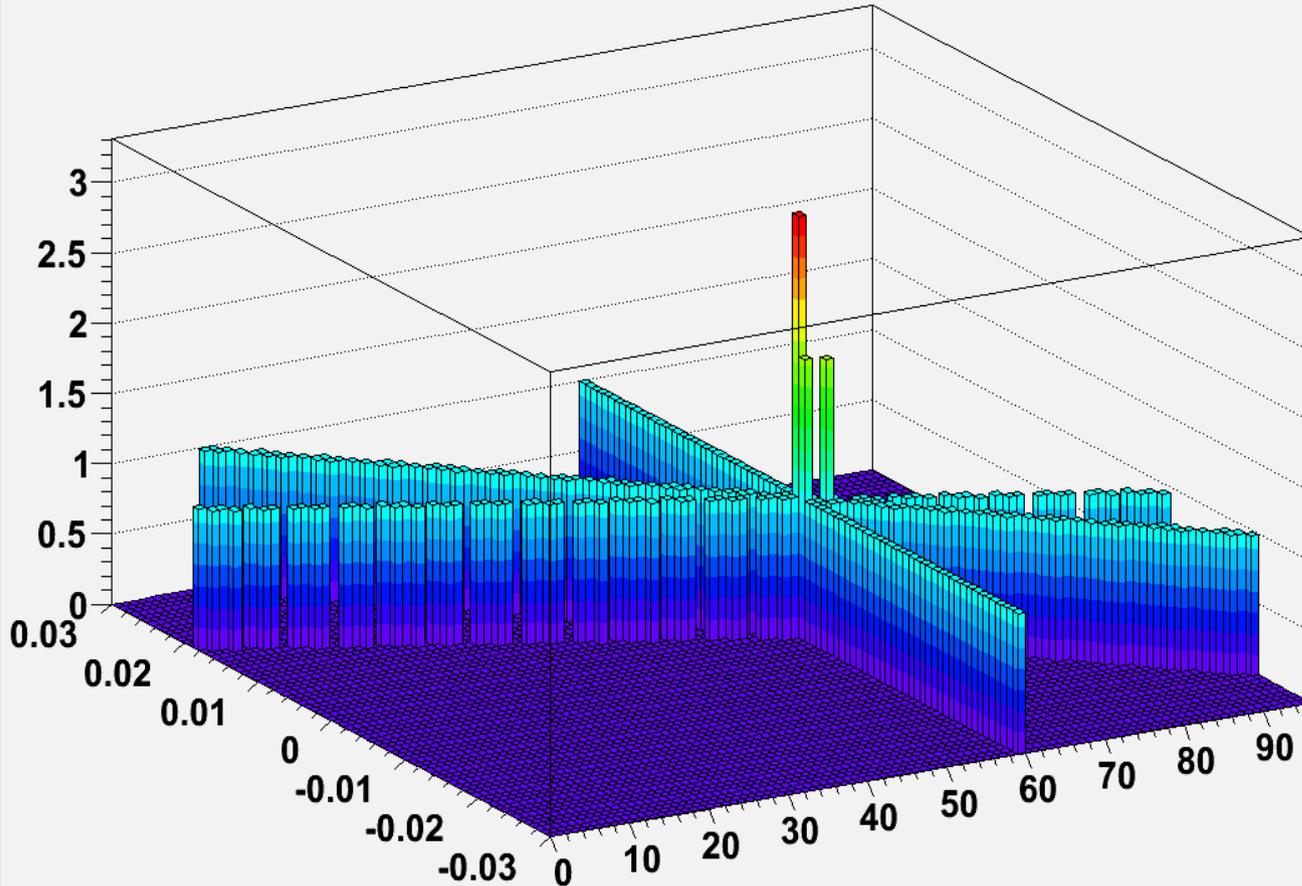
➤ The effect of corrections.

Before →

Hough Transform Accumulator

2.2
2

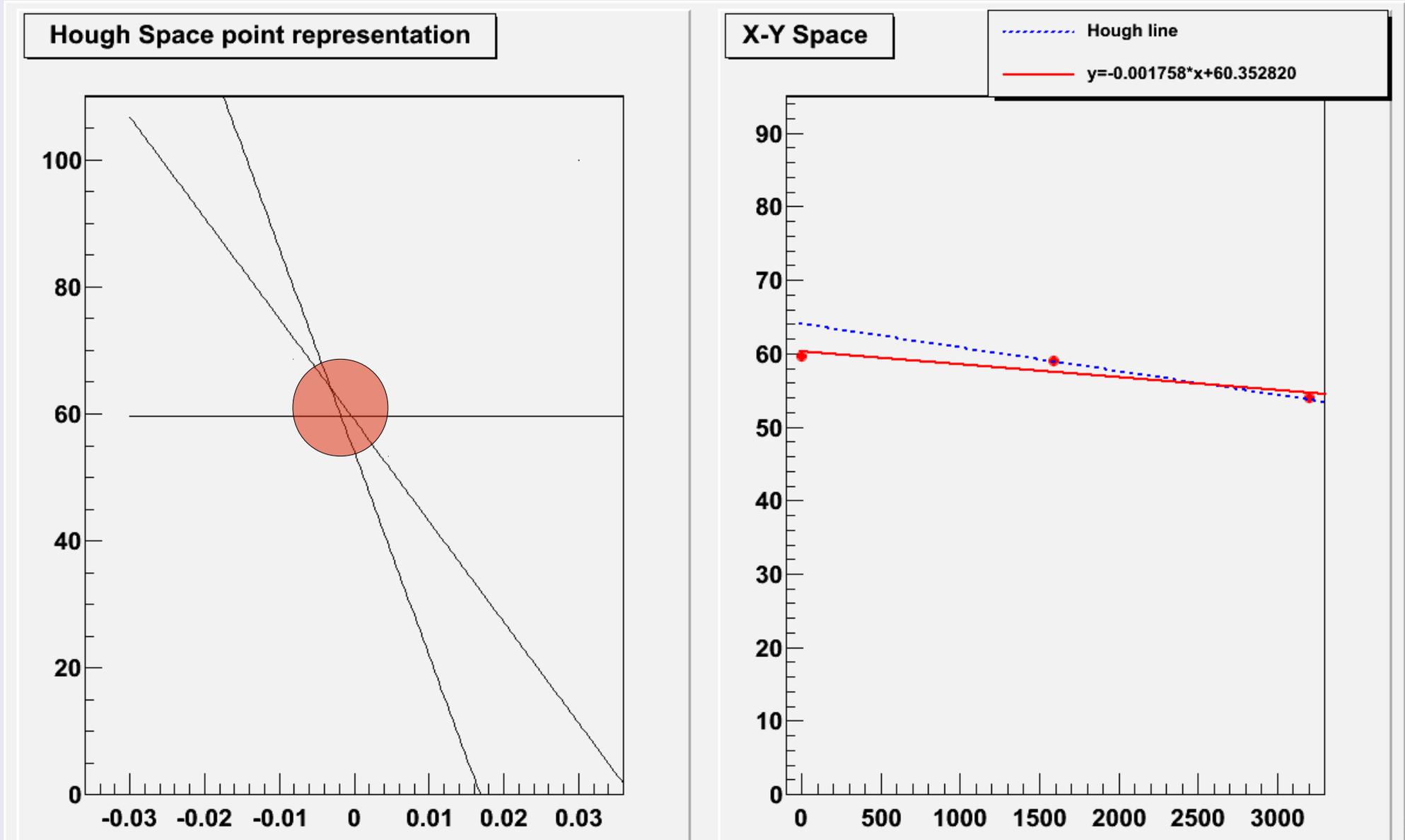
Hough Transform Accumulator



← **After**

Micromegas telescope for RD51 Test Beams

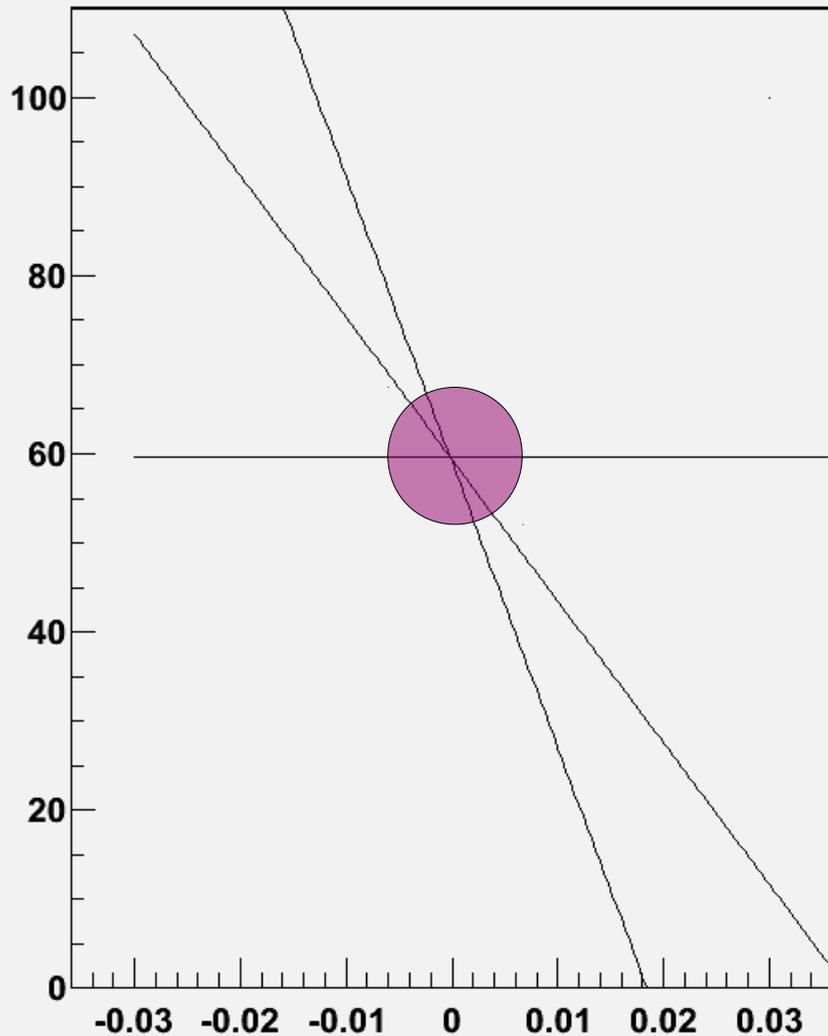
- The effect of corrections **before**



Micromegas telescope for RD51 Test Beams

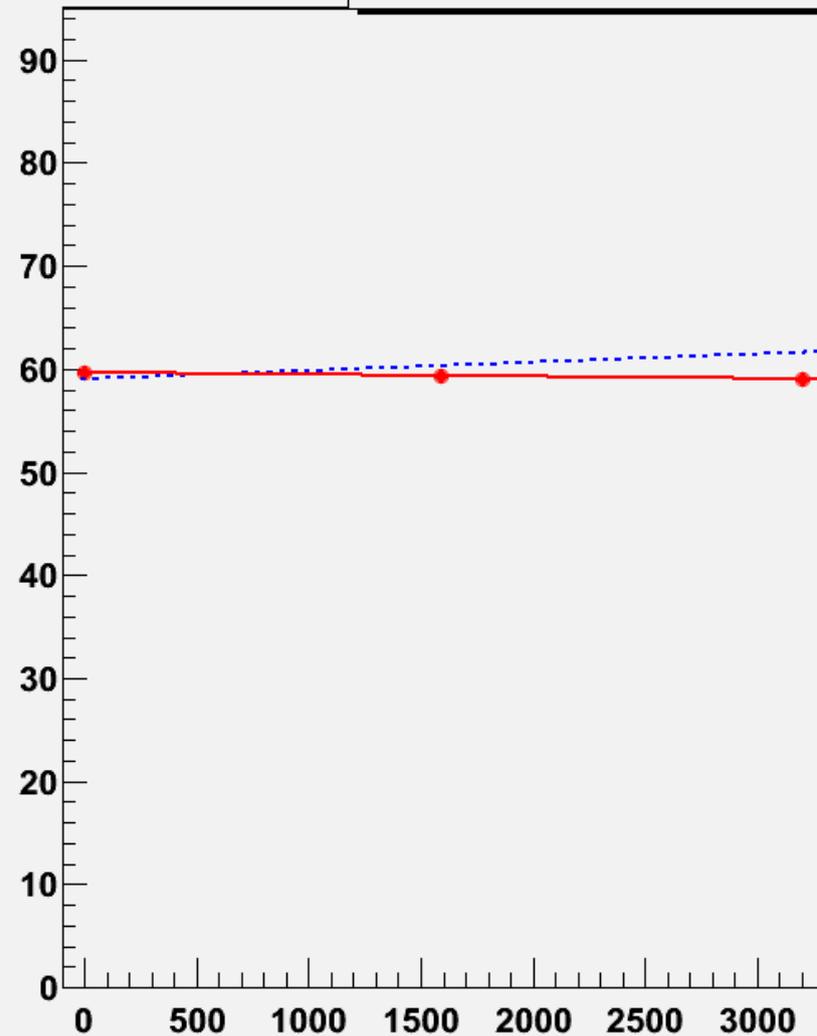
➤ The effect of corrections **after**

Hough Space point representation



X-Y Space

..... Hough line
— $y = -0.000182x + 59.632044$



Micromegas telescope for RD51 Test Beams

Exporting Data

- ✓ Multiple channel selection.
- ✓ Start/End time stamps.
- ✓ Custom folder name (also structure is available)
- ✓ Export iMon, vMon, vSet or all together.

exportAll.pnl

Alias	Channels
BNLdri	board03/channel000
BNLtop	board03/channel001
BNLbot	board03/channel002
BNLmes	board03/channel003
Mesh	board03/channel004
Drift	board03/channel005
LargeH	board03/channel006
LargeV	board03/channel007
Cathod	board03/channel008
Sac 6	board03/channel009
Sac 5	board03/channel010
	board03/channel011
	board04/channel000
	board04/channel001
	board04/channel002
	board04/channel003
test 1	board04/channel004
test 2	board04/channel005

Select Start time.

Day: 20, Month: 11, Year: 2009, Hour: 12, Minute: 4

Select End time.

Day: 20, Month: 11, Year: 2009, Hour: 12, Minute: 4

Folder Name: folder_name

Export iMon vMon vSet

Export iMon Export vMon Export vSet

Close

Exported Data

- ✓ Date separated with "_".
- ✓ Time (with spaces) and milliseconds.
- ✓ Value.

```
File Edit View Search Tools Documents Help
Open Save Undo
iMon_board03_channel004_16_11.dat
2009_11_15 00 00 31 0072 1.0260000228882
2009_11_15 00 00 31 0994 2.808000087738
2009_11_15 00 00 32 0963 0.17599999904633
2009_11_15 00 00 33 0431 0.0040000001899898
2009_11_15 00 00 33 0900 0
2009_11_15 00 01 11 0775 2.7279999256134
2009_11_15 00 01 12 0228 1.2300000190735
2009_11_15 00 01 12 0682 0.037999998778105
2009_11_15 00 01 13 0166 1.9739999771118
2009_11_15 00 01 14 0072 1.7999999523163
2009_11_15 00 01 14 0994 0.06599999642372
2009_11_15 00 01 15 0463 3.5659999847412
2009_11_15 00 01 16 0369 0.42399999499321
2009_11_15 00 01 16 0838 0.014000000432134
2009_11_15 00 01 17 0291 0
2009_11_15 00 01 59 0854 0.64200001955032
2009_11_15 00 02 00 0338 3.0339999198914
2009_11_15 00 02 00 0791 0.2119999974966
2009_11_15 00 02 01 0260 0.0040000001899898
2009_11_15 00 02 02 0166 0
2009_11_15 00 02 03 0104 3.0659999847412
2009_11_15 00 02 03 0557 0.82200002670288
2009_11_15 00 02 04 0932 2.9119999408722
2009_11_15 00 02 05 0432 1.0800000429153
2009_11_15 00 02 05 0901 0.035999998450279
2009_11_15 00 02 06 0823 0
2009_11_15 00 02 44 0479 4.3379998207092
2009_11_15 00 02 44 0932 3.23600000610352
2009_11_15 00 02 45 0854 0.28799998760223
2009_11_15 00 02 46 0307 0.012000000104308
2009_11_15 00 02 46 0776 1.3839999437332
2009_11_15 00 02 47 0229 2.3659999370575
2009_11_15 00 02 48 0151 0.1159999666214
Plain Text Tab Width: 8 Ln 1, Col 1 INS
```



Micromegas telescope for RD51 Test Beams

