STS2 quality check

- Status of STS2
- Gas tightness, noise level, uniformity of gain
- Check of geometry (ToT-dt spectra, laser scanner)

JERZY SMYRSKI
JAGIELLONIAN UNIVERSITY, KRAKOW, POLAND

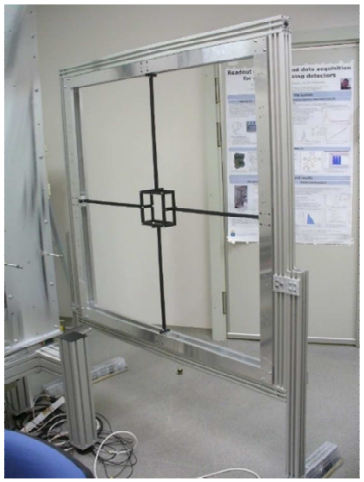
Status of STS2

STS2:

- 4 double layers of straws mounted on two frames and equipped with FEE cards
- double layer: 8 modules, each containing 2x16 straws
- in total: 4x8 = 32 modules (1024 straws)

Double layer 1 2 3 4

0°, 90° +45°, -45°



Operating conditions

- Gas mixture: Ar+CO_2 (90:10) at 2 bar
- Gas flow: ~5 l/h (at 2 bar) – corresponds to exchange of one volume of the double layer (20 l) in 4 hours
- HV: 1700 V, gas gain: ~2×10^4
- FEE: gain 1mV/fC, peaking time 20 ns, disc. threshold 6 mV

Each of the four double layers was tested separately.

Gas tightness

- Each double layer filled with gas mixture Ar+CO_2 (90:10) to 2 bar absolute pressure and a pressure drop after about 24 hours determined.
- The pressure drop per day was: 0.029 bar – double layer 1

  0.034 bar – double layer 2

  0.036 bar – double layer 3

  0.038 bar – double layer 4
- The observed gas leakage is of about 0.2- 0.3% of the planned flow of the gas mixture on the level of 6 gas volumes exchanges per day, and is negligible.

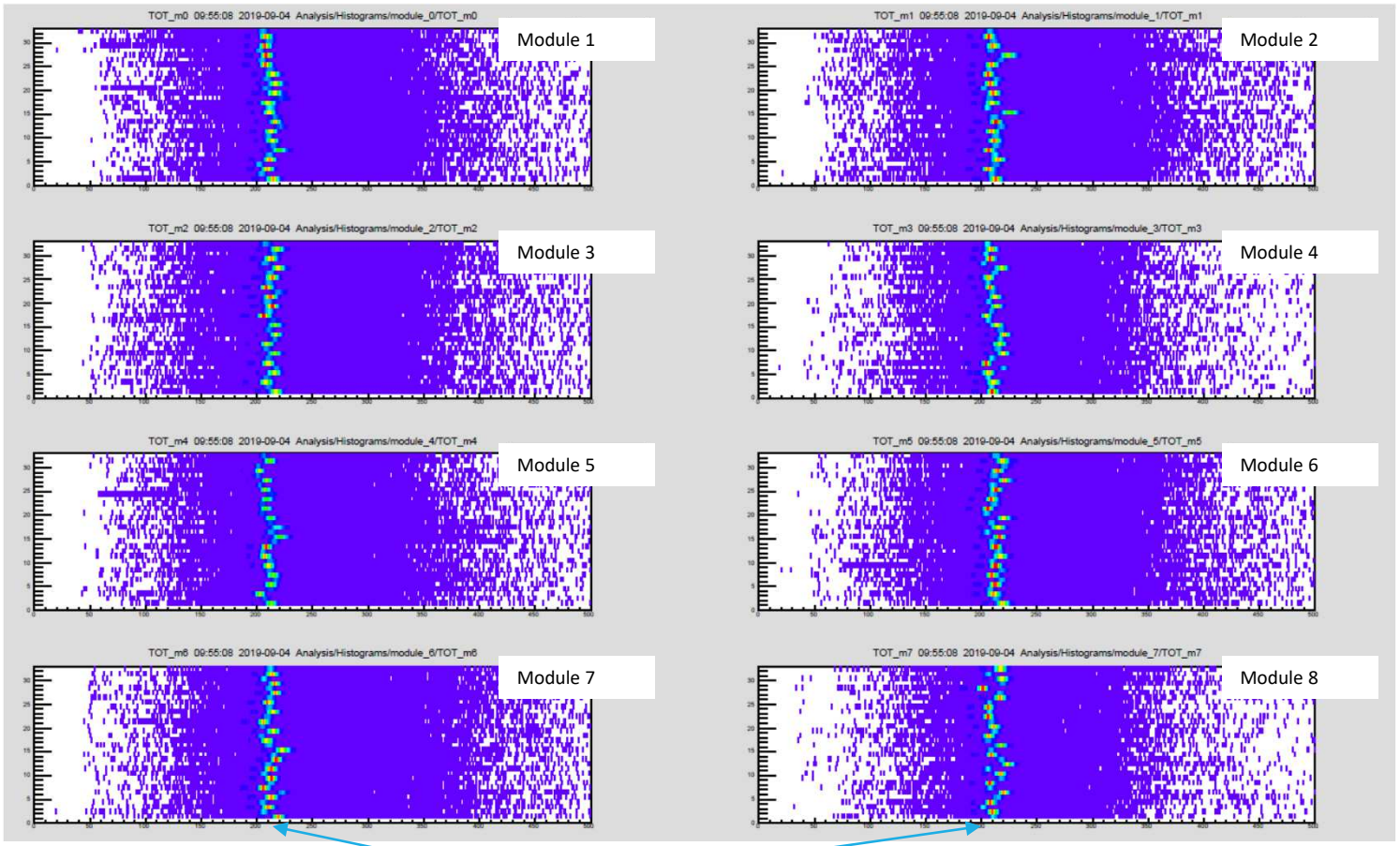
Noise level (HV = +1700 V)

	Channel group														
c000	0	1025		1025		1025		1025		1025		1025		1025	
c001	1	1		2		7		0		3		13		8		3
c002	2	3		7		4		1		5		6		4		3
c003	3	4		6		9		1		5		6		10		0
c004	4	6		5		8		3		6		5		5		2
c005	5	5		3		8		3		6		2		6		2
c006	6	5		1		5		1		2		6		5		3
c007	7	5		4		6		0		5		1		4		1
c008	8	7		5		7		2		7		3		7		3
c009	9	6		4		3		1		4		5		5		2
c00a	10	4		4		4		1		9		7		7		4
c00b	11	4		2		5		0		12		3		9		0
c00c	12	2		6		9		4		11		5		6		3
c00d	13	2		3		6		3		4		7		9		1
c00e	14	4		3		6		3		8		5		8		3
c00f	15	3		2		5		4		11		8		6		0
c010	16	8		3		7		1		6		6		8		3
c011	17	4		6		6		4		3		3		3		2
c012	18	4		1		7		3		8		7		4		4
c013	19	6		6		7		4		9		9		1		3
c014	20	2		3		8		6		6		8		3		3
c015	21	5		4		7		2		8		5		4		2
c016	22	6		2		6		2		9		6		4		2
c017	23	6		5		6		2		5		4		4		1
c018	24	2		9		4		1		7		4		1		2
c019	25	3		5		5		2		7		4		5		2
c01a	26	2		2		3		1		5		9		3		0
c01b	27	3		3		6		1		4		8		4		2
c01c	28	7		4		6		2		8		10		7		1
c01d	29	5		2		5		0		5		6		4		4
c01e	30	1		3		8		3		6		10		4		2
c01f	31	6		6		6		2		5		7		7		2

Reg	Content	6400	6410	6411	6412	6420	6430	6431	6432

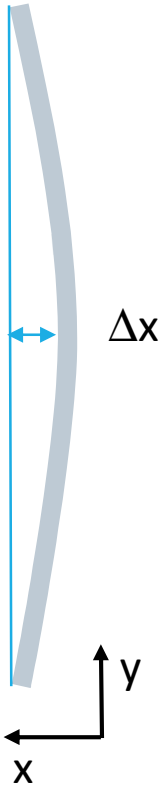
Noise level in the range 1 - 100 Hz

Time-over-Threshold (ToT) spectra with ^{55}Fe for double layer 1

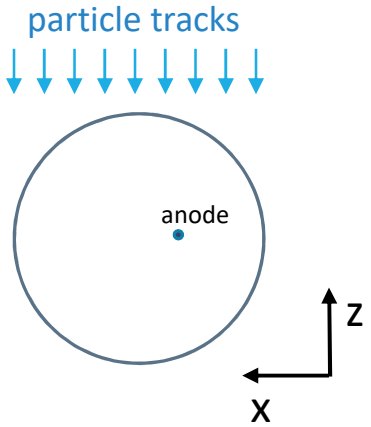


- well aligned baselines in the front-end cards
- uniformity of gas gain

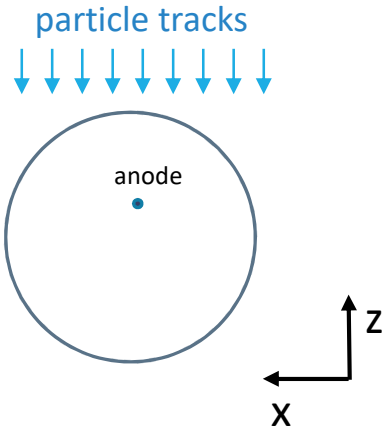
Bending of straws



Straw bent in x direction

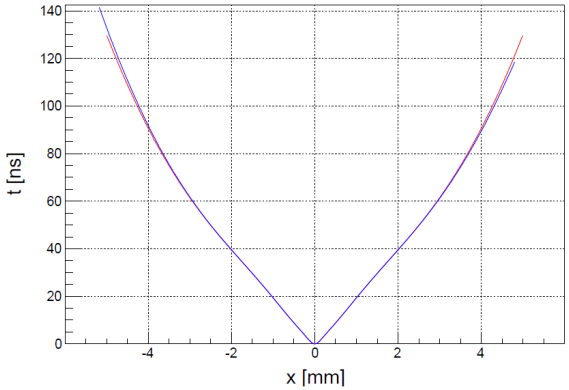


Straw bent in z direction



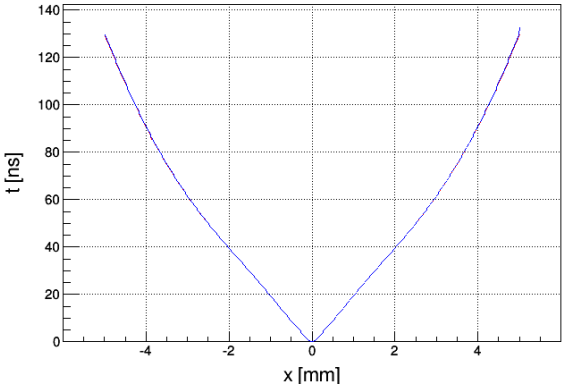
t-x relation for Δx = 0.0 mm

Δx = 0.2 mm



t-x relation for Δz = 0.0 mm

Δz = 0.5 mm

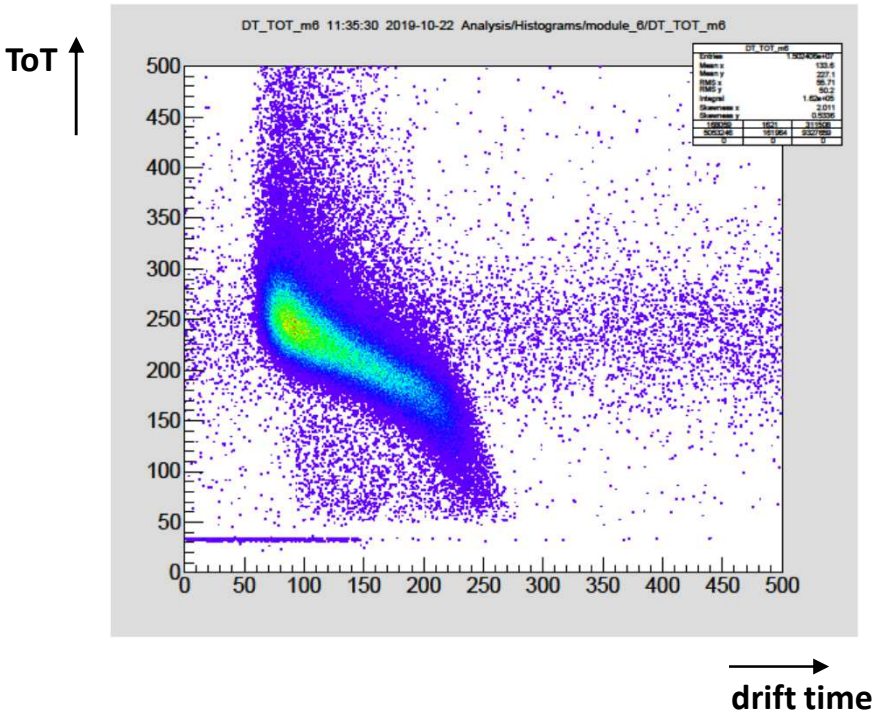


for x = 5 mm is δx = 0.06 mm

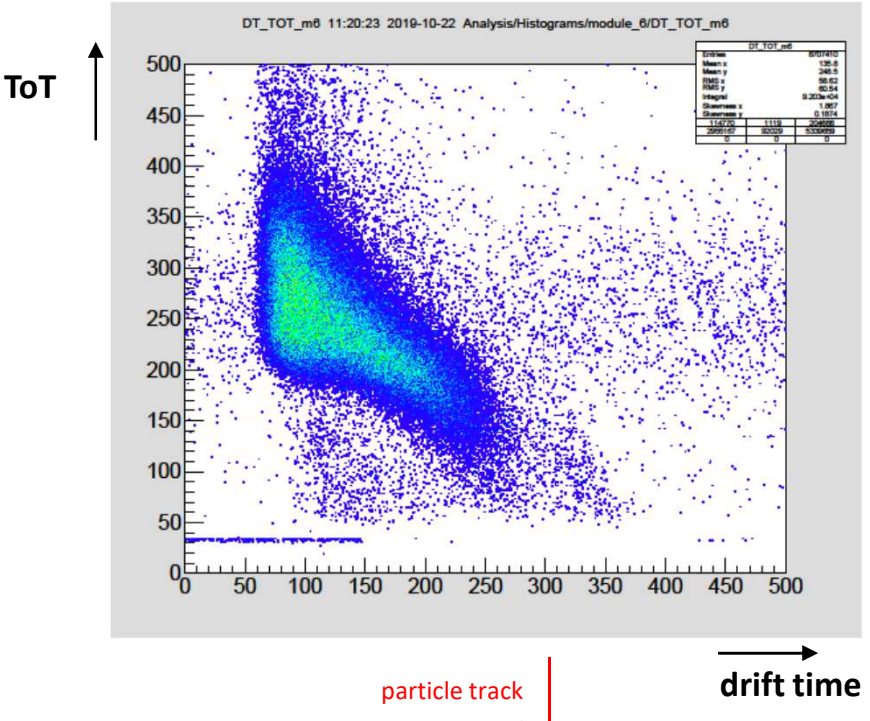
Bending Δx (Δz) of 0.2 (0.5) mm is acceptable.

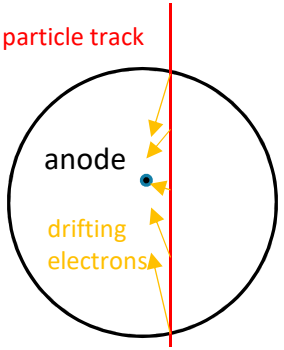
ToT vs. drift time spectrum as a tool for identification of bent straws

straight straw

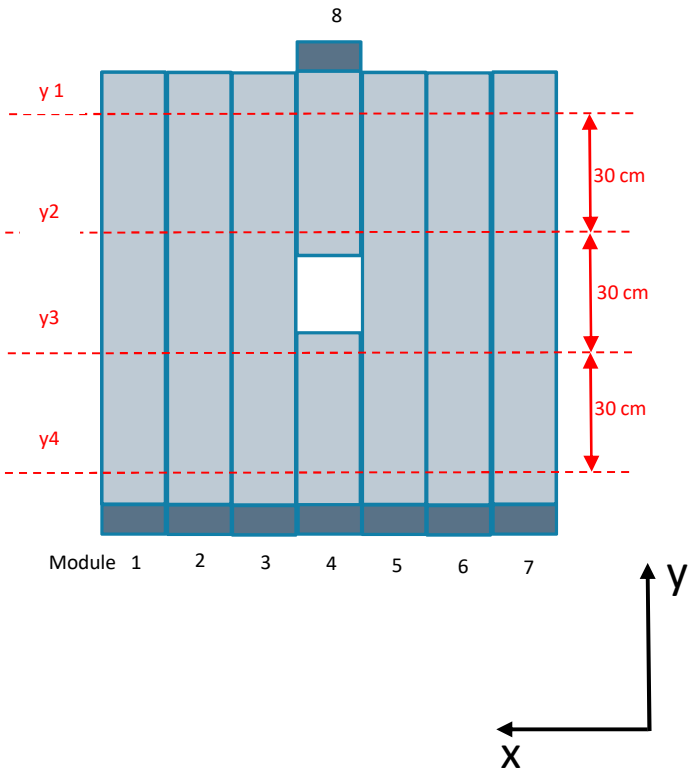


straw bent by $\Delta z = 0.6$ mm



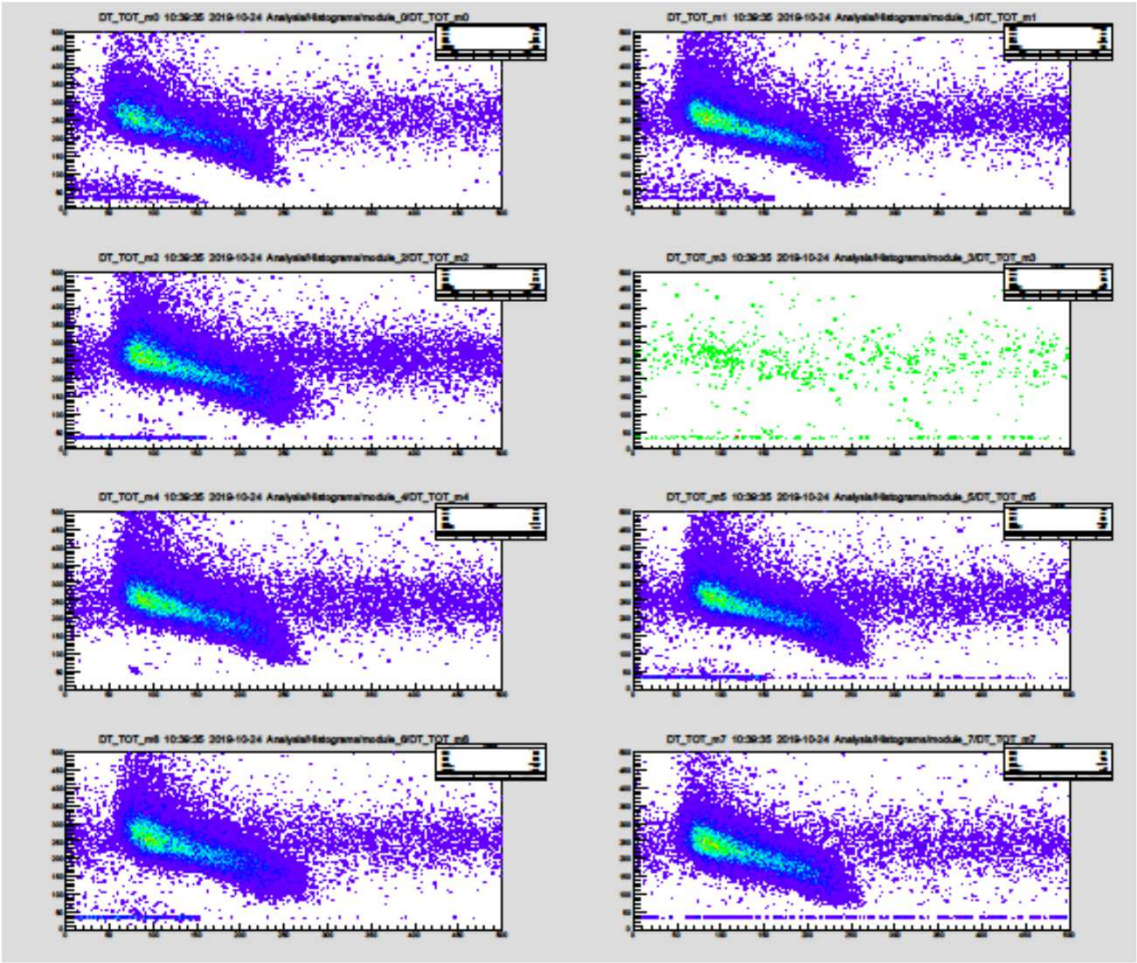


Inspection of ToT-dt spectra

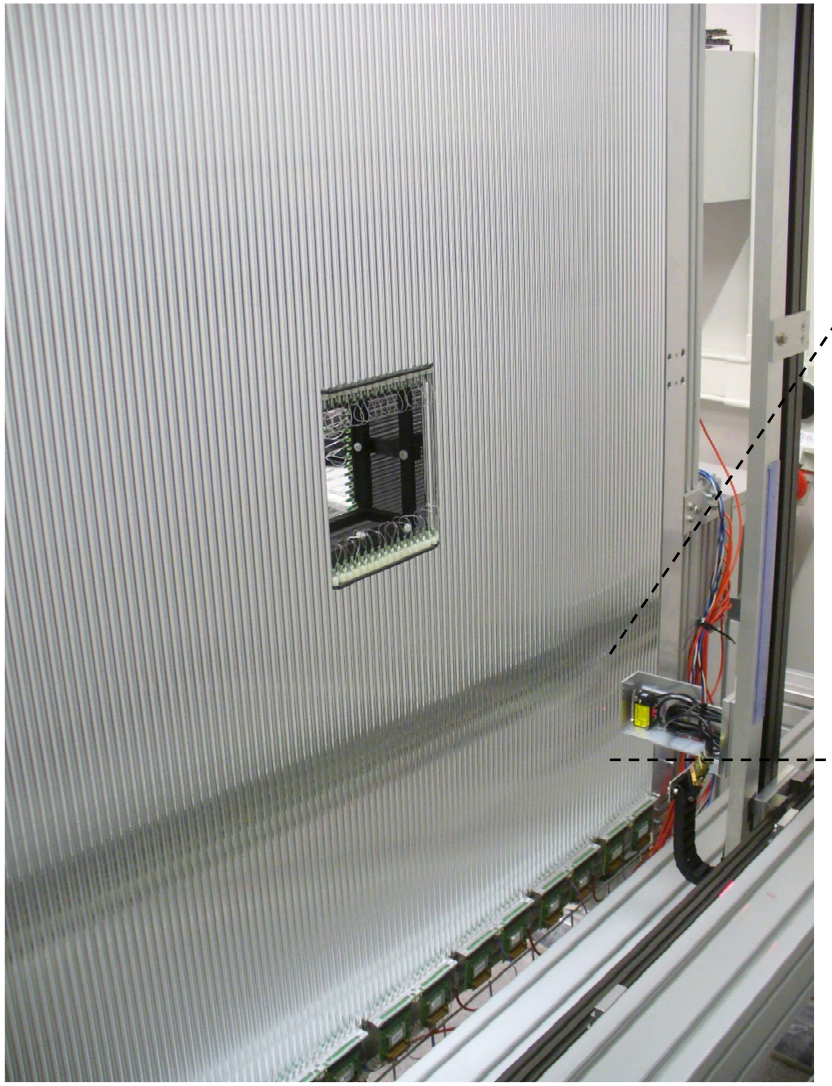


- ToT vs. drift time spectra measured with ^{90}Sr source and scintillation detector (for time reference) moved in x direction across the double layer
- Measurements performer for four values of y coordinate spaced by 30 cm.

ToT vs. dt spectra at y2

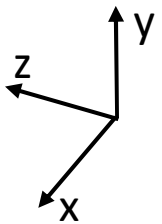


Laser scanner



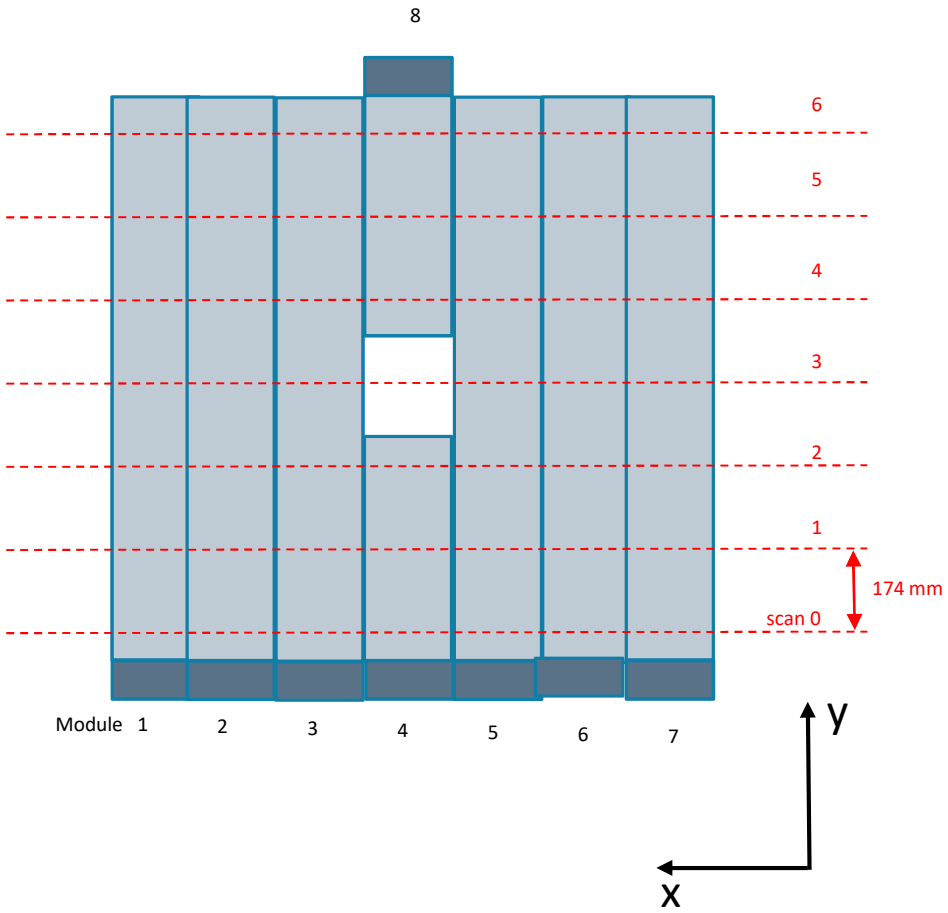
Laser distance sensor: PANASONIC HG-C1050

- measurement range: 50 ± 15 mm
- repeatibility: 30 µm



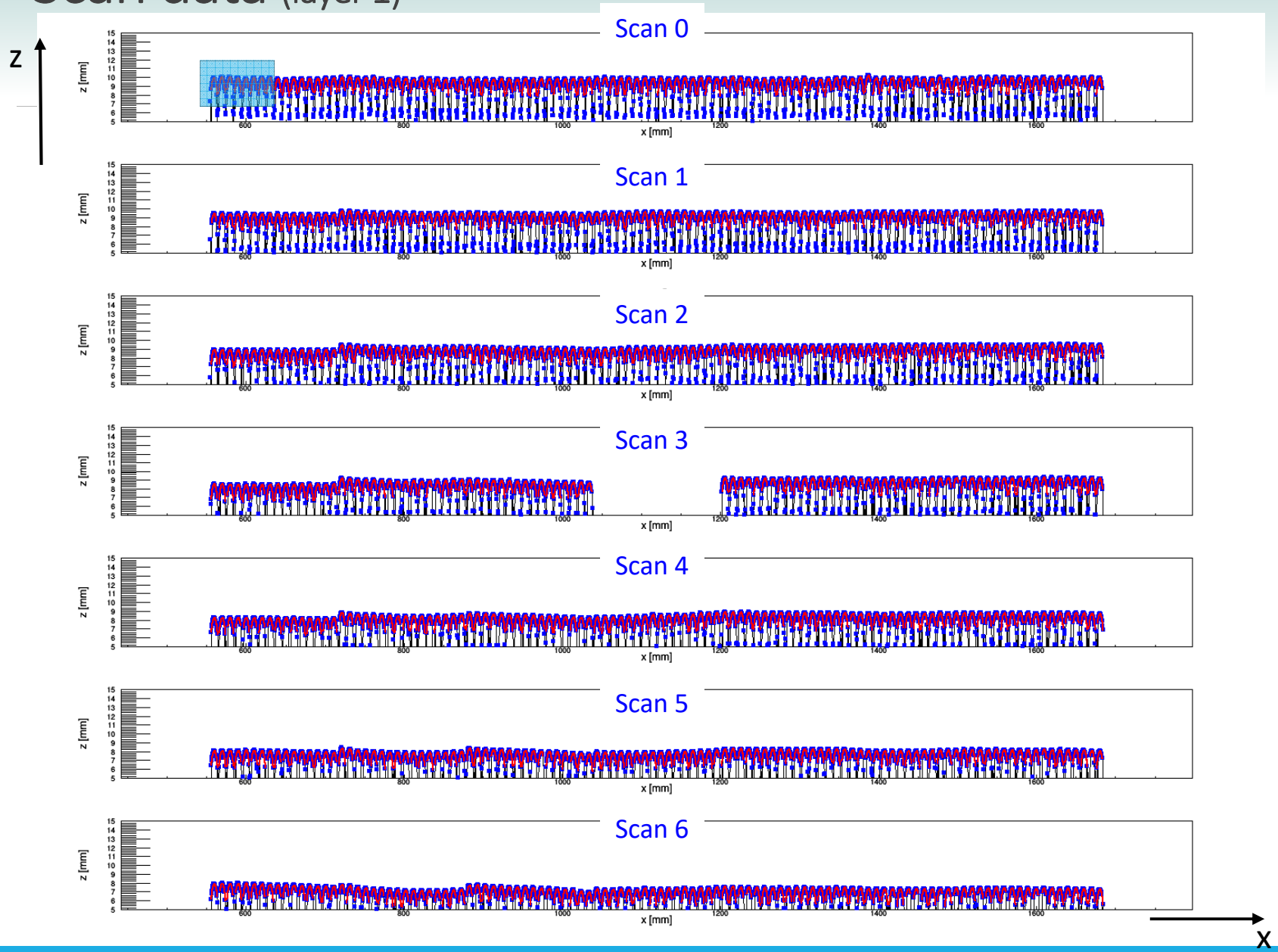
- movement in x and y direction
- distance measured in z direction

Scans

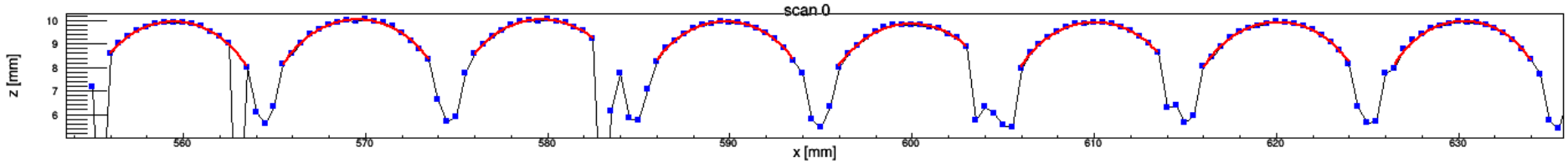


Scans performed with step $\Delta x = 0.5$ mm for 7 y-coordinates differing by $\Delta y = 174$ mm

Scan data (layer 1)



Zoom in on scan data



Measured z distances – blue points

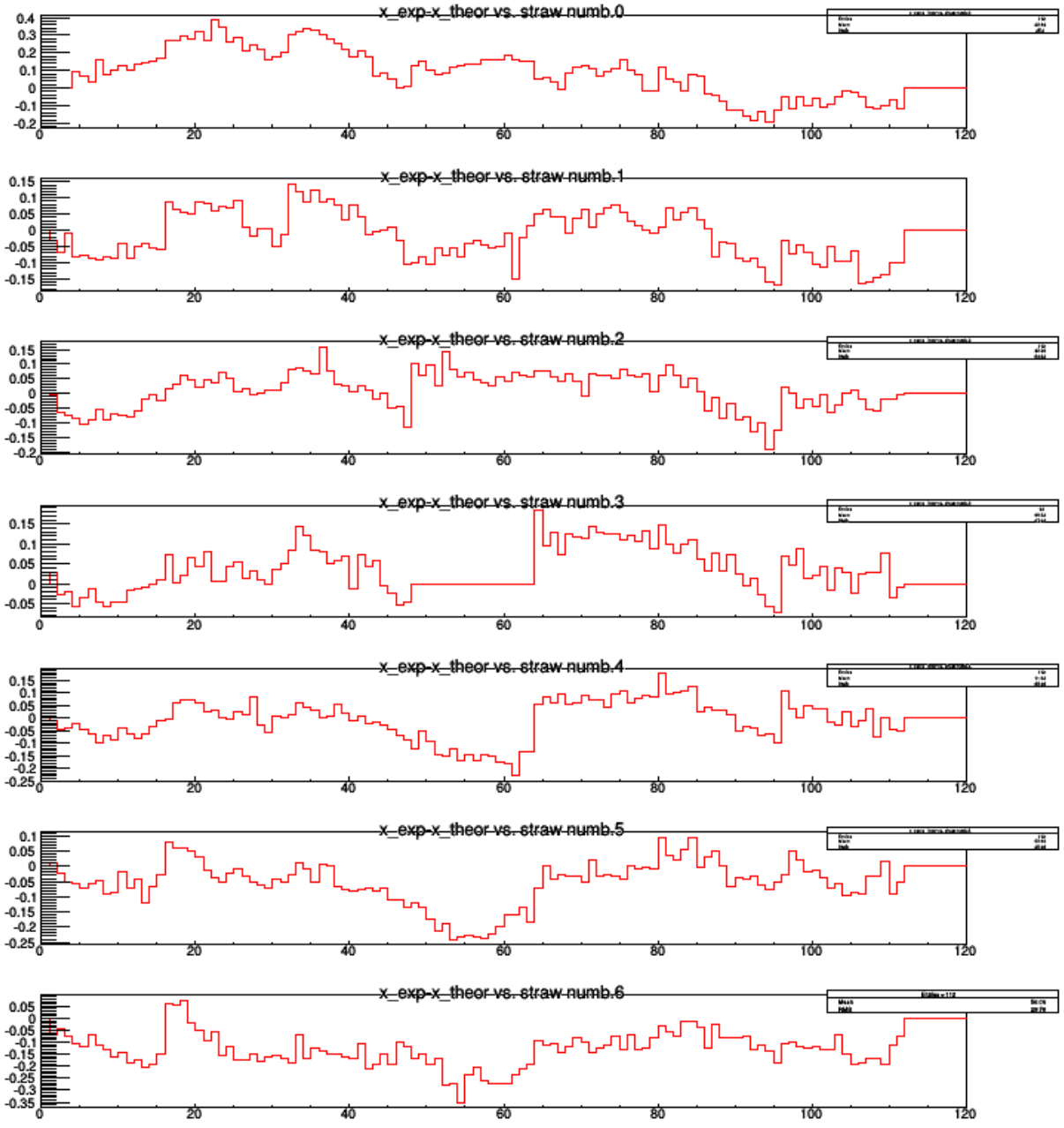
Fitted circles – red lines

The (x,z) coordinates of the centers of fitted circles are the coordinates of straws

Positions of straws in x direction

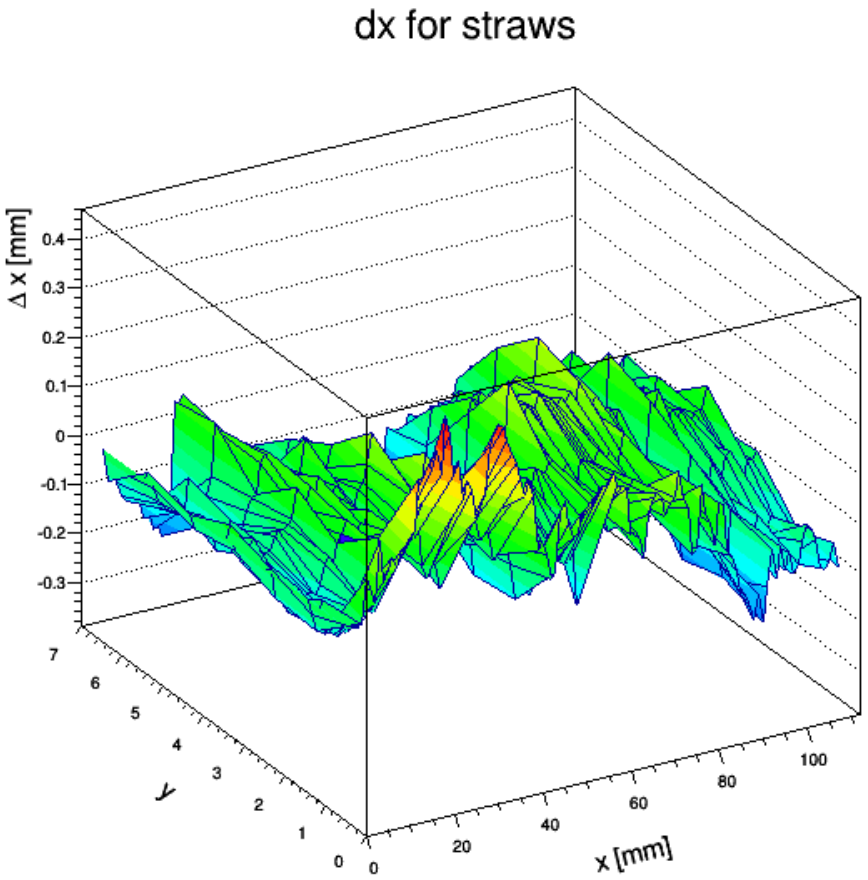
$x_{exp} - x_{theor}$

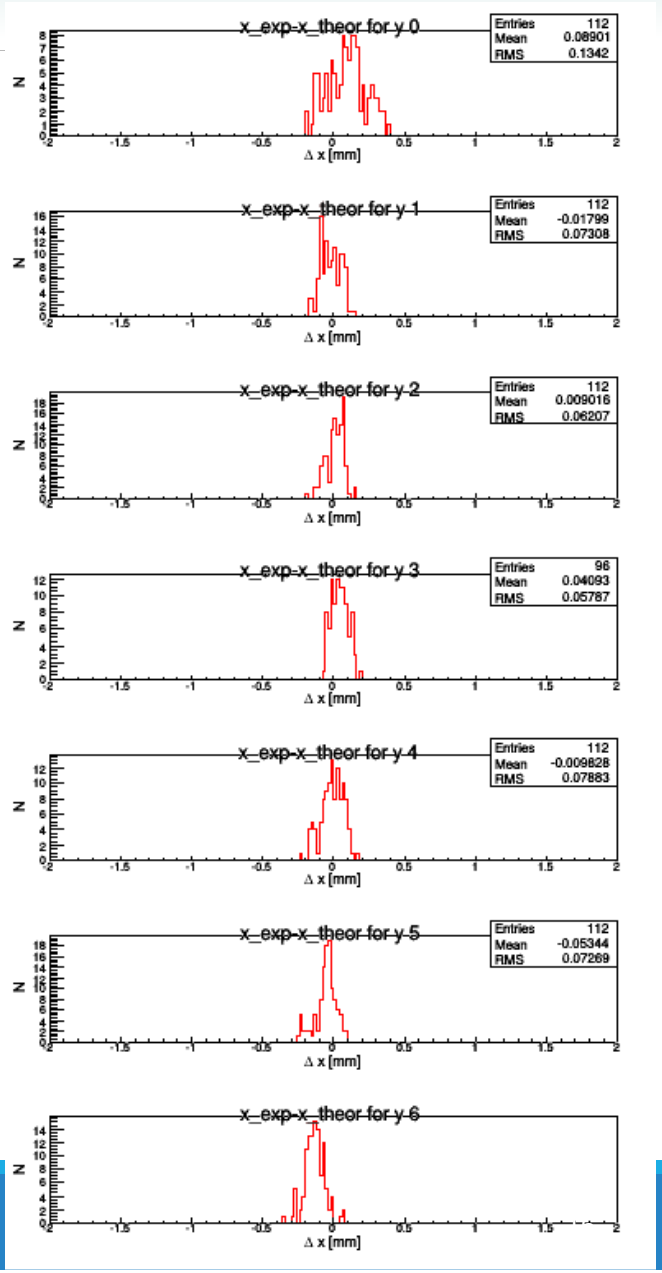
$x_{theor} = x_0 + n \times 10.1$



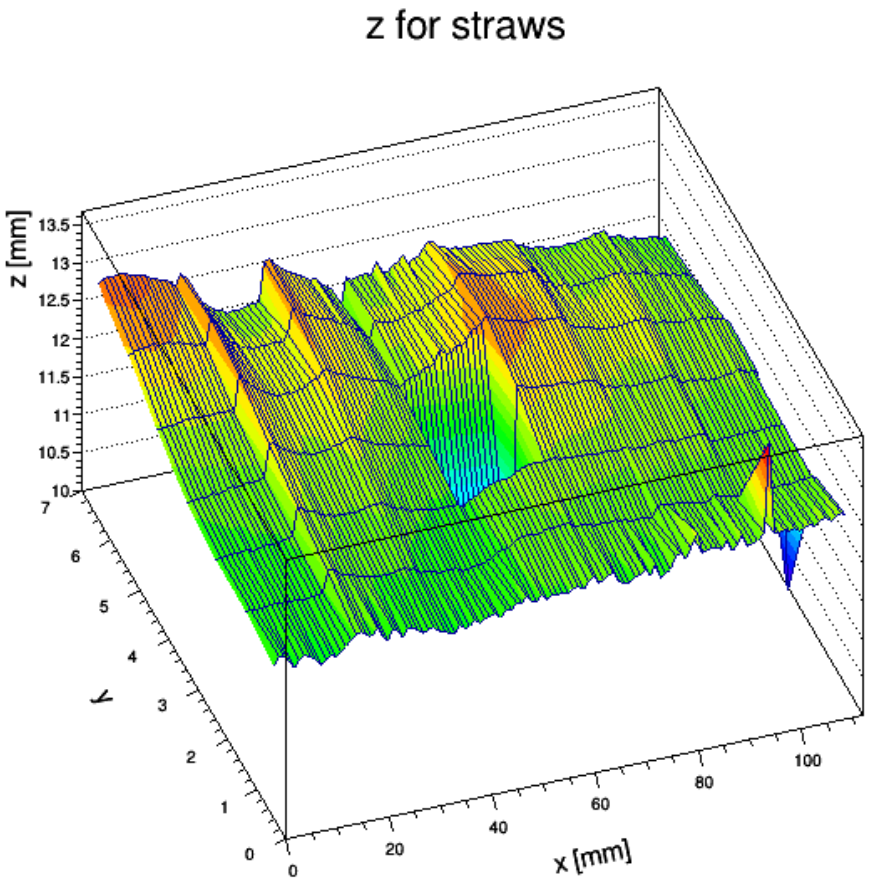
straw number

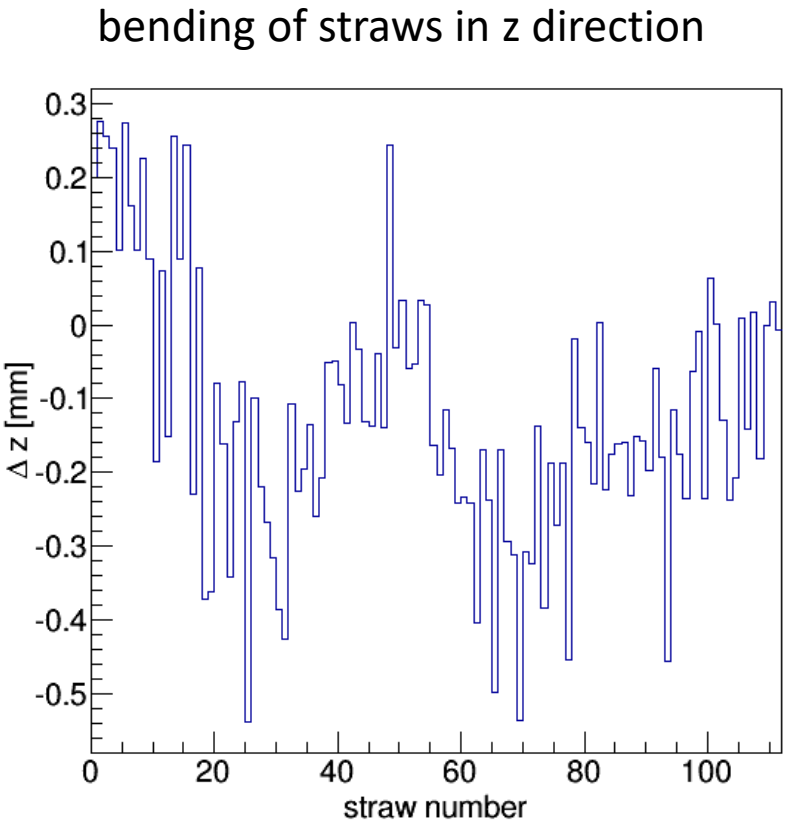
Precision of positions in x direction (plane 1)





Deviations from planarity of layer 1

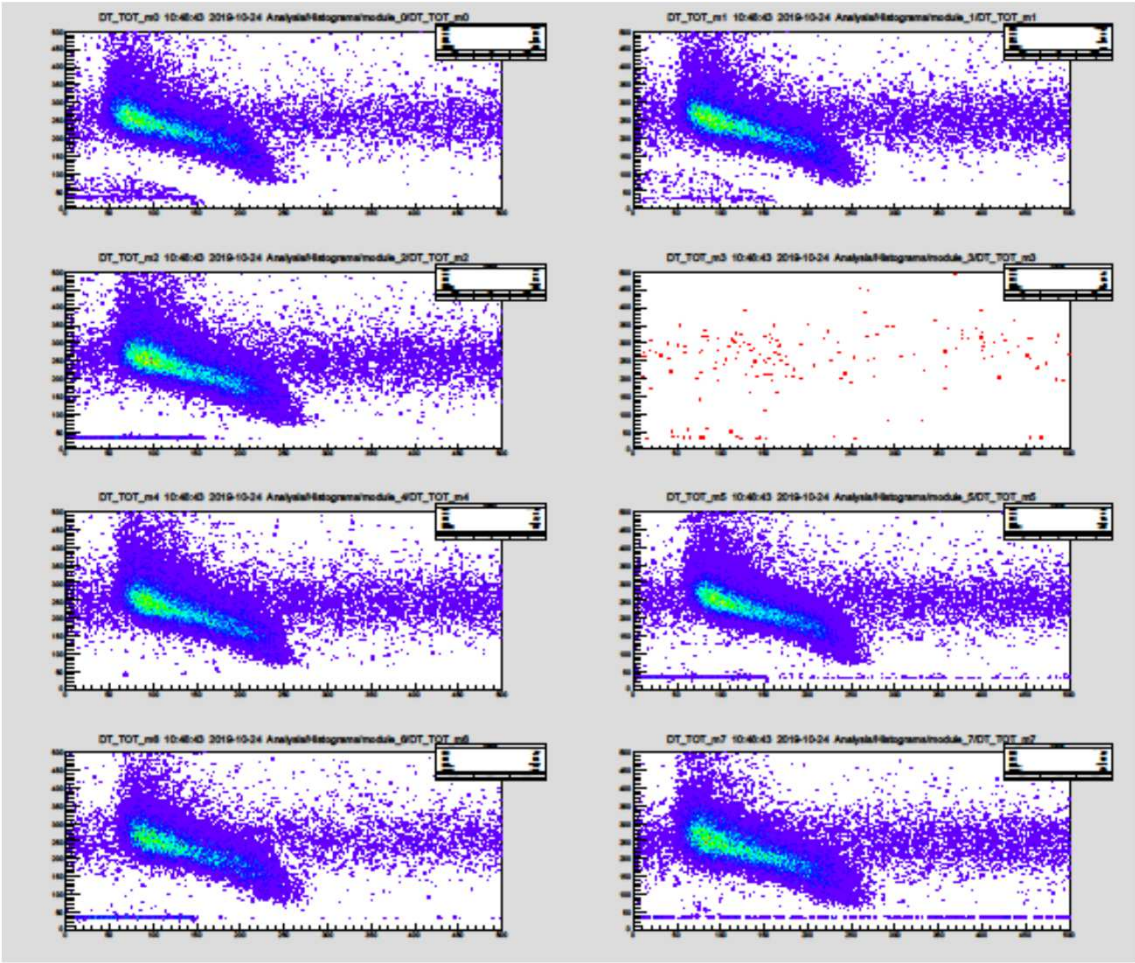




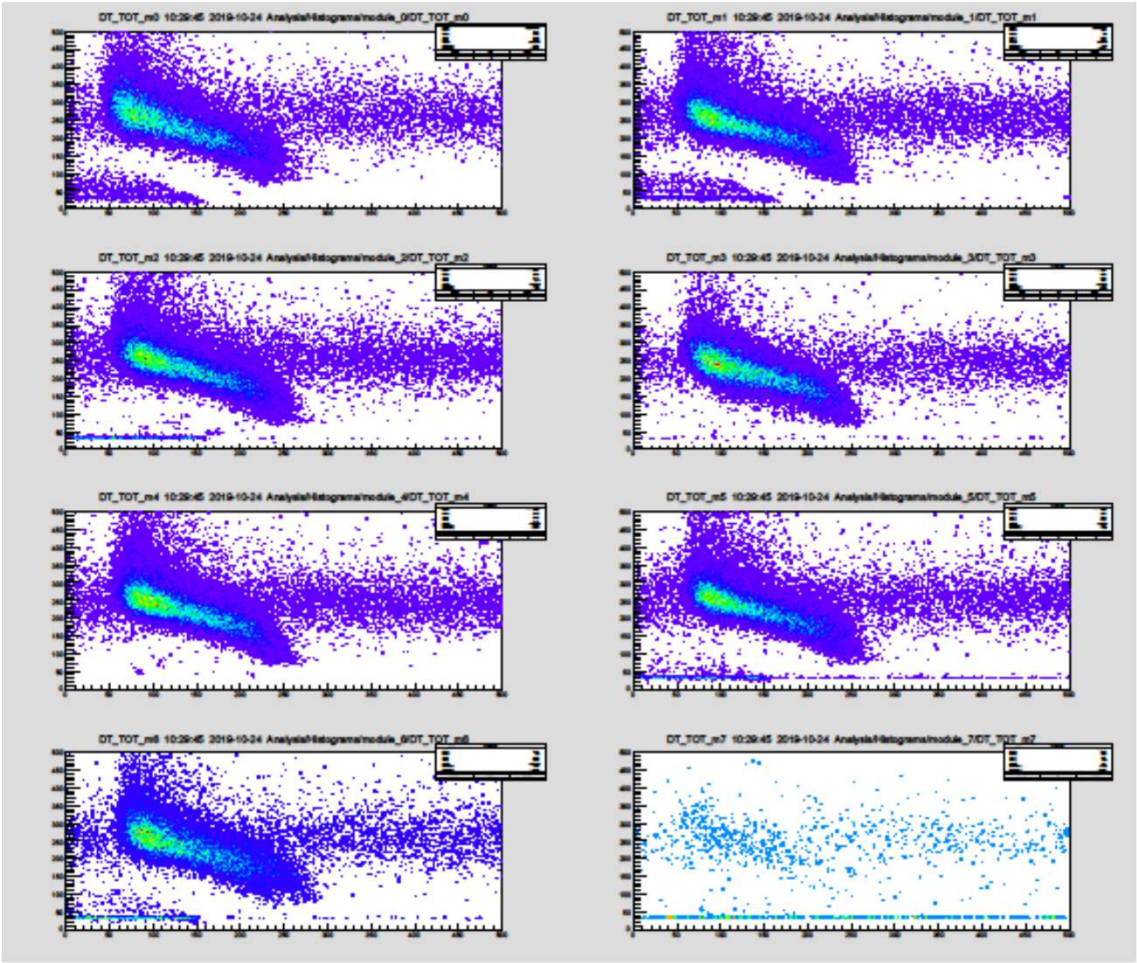
Summary

- Satisfactory results of tests of individual detection layers
- Ongoing test of the full system (STS2+ full readout + new gas system)
- Shipping to GSI – second half of November 2019

ToT vs. dt spectra at y1 (layer 4)



ToT vs. dt spectra at y3



ToT vs. dt spectra at y4 (layer 4)