

Acceptance and Resolution Studies for Forward Tracking Stations

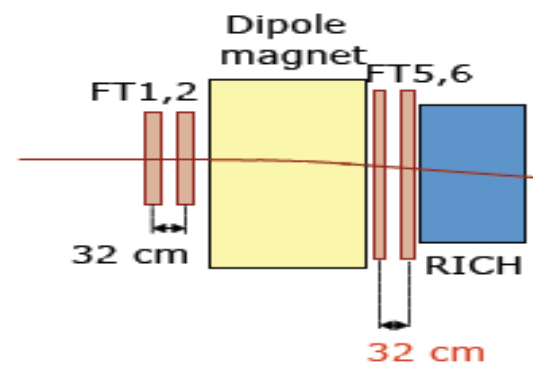
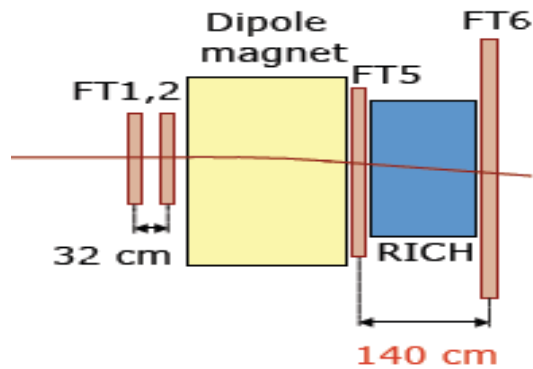
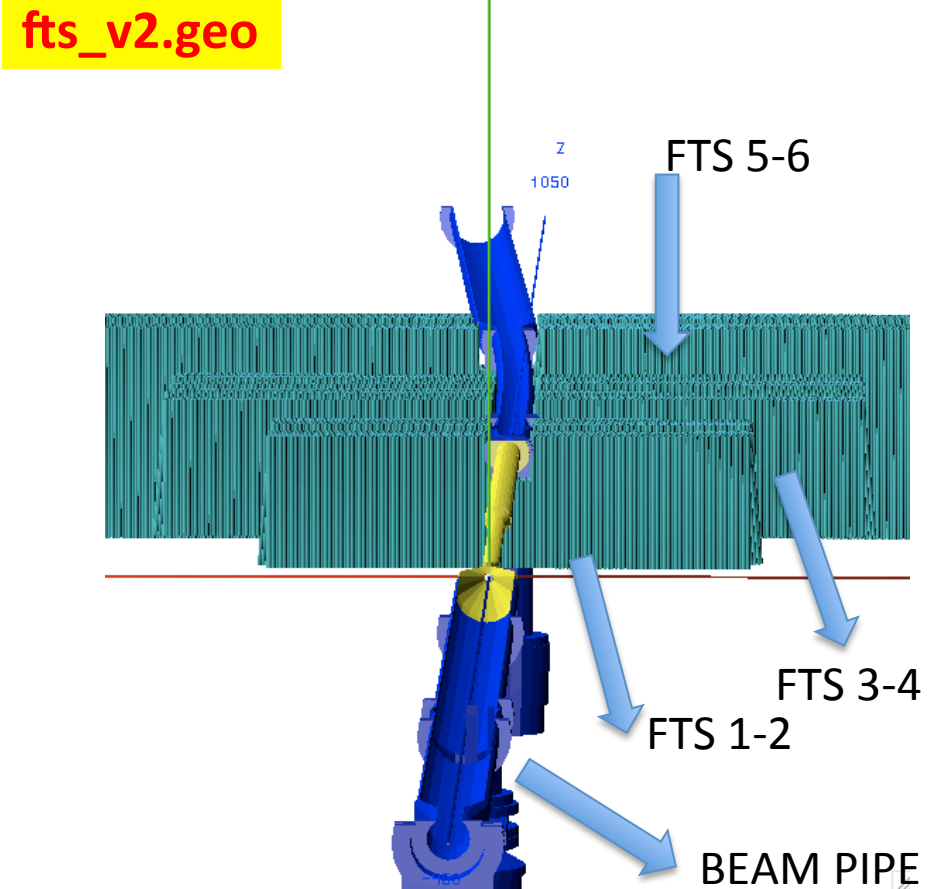
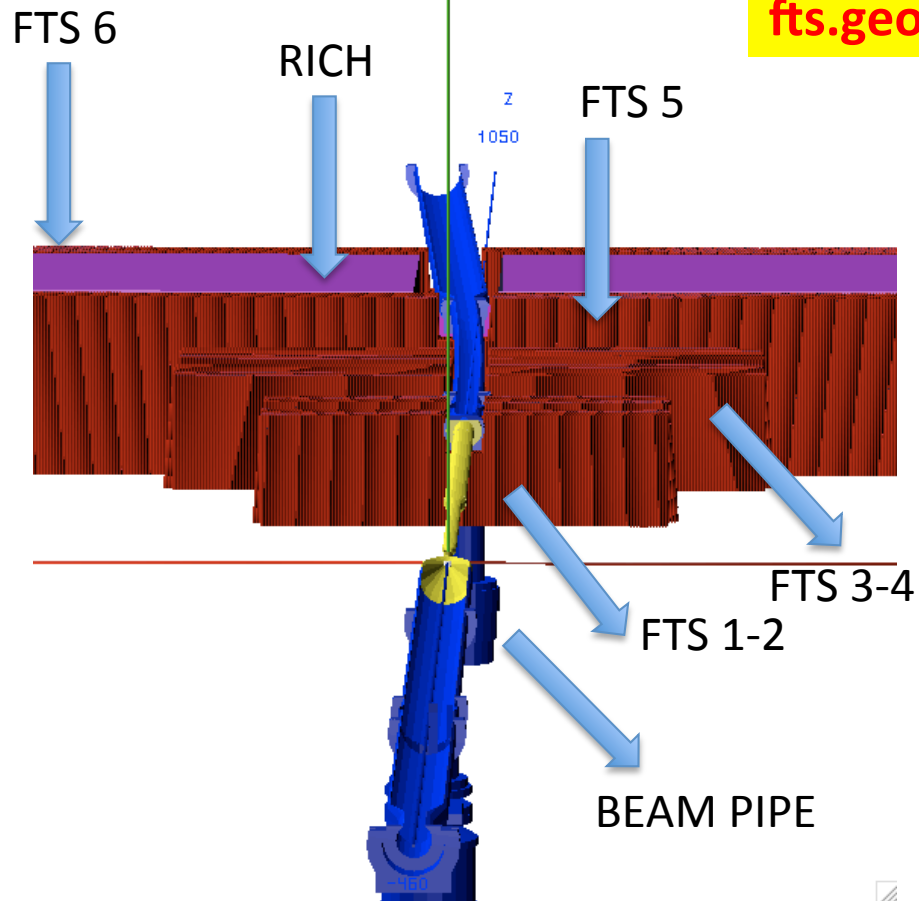
09th December 2013

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INFN Ferrara

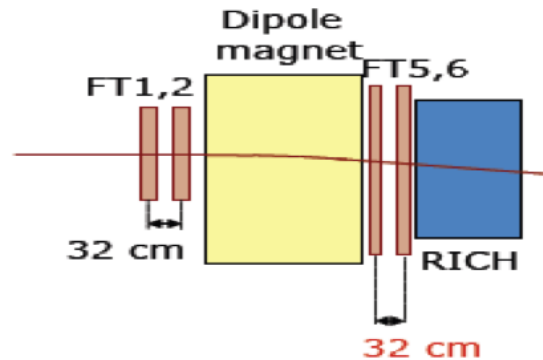
Outline:

- Geometries configurations
- Acceptance Studies
- Resolution Studies for FTS standalone
- Conclusions

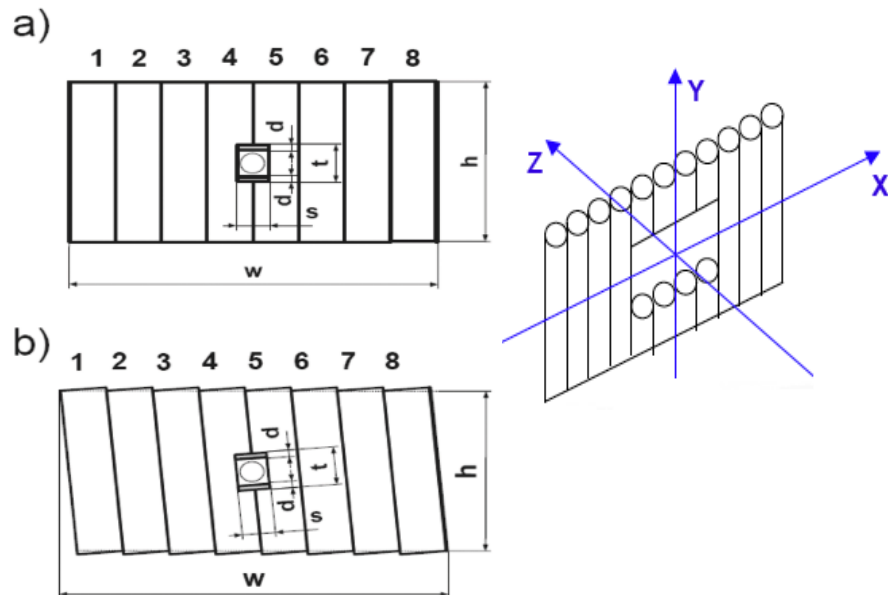
Three geometry configurations available



New geometry: 4-10-2013



- Design of FT6 is identical with FT5.
- A distance between the centers of FT5 and FT6 equals 320 mm and is the same as in the FT1-2 pair
- Slight changes of active areas of the stations and of the openings for the beam pipe
- In the new geometry, the FT4 is by two modules (around 32 cm) wider than FT3 which better corresponds to deflection of trajectories of low momentum particles in the field of the dipole magnet.



New geometry: 4-10-2013

OLD

Tracking station	Double layer	Straw inclination	Number of modules (straws)	z-coordinate [mm]	Active area	
					w [mm]	h [mm]
FT1	1	0°	8 (2x128)	2954	1297.9	640
	2	+5°	8 (2x128)	3004	1358.8	640
	3	-5°	8 (2x128)	3054	1358.8	640
	4	0°	8 (2x128)	3104	1297.9	640
FT2	1	0°	8 (2x128)	3274	1297.9	640
	2	+5°	8 (2x128)	3324	1358.8	640
	3	-5°	8 (2x128)	3374	1358.8	640
	4	0°	8 (2x128)	3424	1297.9	640
FT3	1	0°	12 (2x192)	3945	1944.3	690.3
	2	+5°	12 (2x192)	4019.75	2013.2	703.4
	3	-5°	12 (2x192)	4165	2015.4	728.8
	4	0°	12 (2x192)	4239.75	1944.3	741.9
FT4	1	0°	12 (2x192)	4385	1944.3	767.3
	2	+5°	12 (2x192)	4459.75	2020.0	780.4
	3	-5°	12 (2x192)	4605	2022.2	805.8
	4	0°	12 (2x192)	4679.75	1944.3	818.9
FT5	1	0°	25 (2x400)	6075	4045.1	1180.0
	2	+5°	25 (2x400)	6125	4163.7	1180.0
	3	-5°	25 (2x400)	6175	4163.7	1180.0
	4	0°	25 (2x400)	6225	4045.1	1180.0
FT6	1	0°	37 (2x592)	7475	5984.3	1480.0
	2	+5°	37 (2x592)	7525	6136.6	1480.0
	3	-5°	37 (2x592)	7575	6136.6	1480.0
	4	0°	37 (2x592)	7625	5984.3	1480.0

NEW

Table 1. Active areas of double layers.

Tracking station	Double layer	Straw inclination	z-coordinate of double layer [mm]	Active area	
				w [mm]	h [mm]
FT1	1	0°	2954	1338.25	640
	2	+5°	3004	1287.37	640
	3	-5°	3054	1287.37	640
	4	0°	3104	1338.25	640
FT2	1	0°	3274	1338.25	640
	2	+5°	3324	1287.37	640
	3	-5°	3374	1287.37	640
	4	0°	3424	1338.25	640
FT3	1	0°	3945	1782.65	690.3
	2	+5°	4019.75	1727.92	703.4
	3	-5°	4165	1725.70	728.8
	4	0°	4239.75	1782.65	741.9
FT4	1	0°	4385	2105.85	767.3
	2	+5°	4459.75	2045.62	780.4
	3	-5°	4605	2043.40	805.8
	4	0°	4679.75	2105.85	818.9
FT5	1	0°	6075	3923.85	1200.0
	2	+5°	6125	3833.85	1200.0
	3	-5°	6175	3833.85	1200.0
	4	0°	6225	3923.85	1200.0
FT6	1	0°	6395	3923.85	1200.0
	2	+5°	6445	3833.85	1200.0
	3	-5°	6495	3833.85	1200.0
	4	0°	6545	3923.85	1200.0

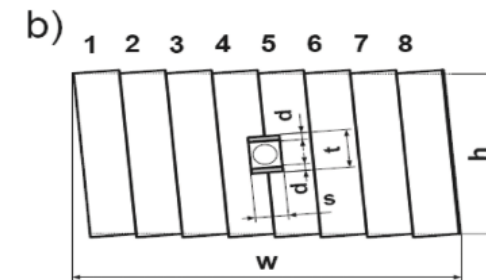
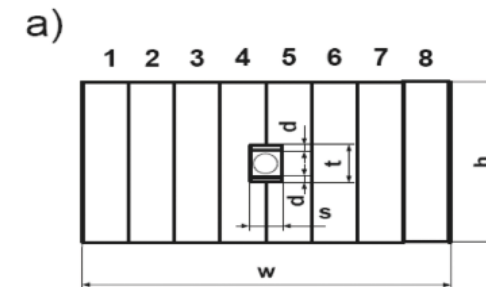
New geometry: 4-10-2013

OLD

Tracking station	Double layer	Straw affected by opening (split straws) 1 st layer/2 nd layer	s [mm]	t [mm]
FT1	1	59-70 / 59-70	116	172
	2	59-70 / 59-70	116	172
	3	59-70 / 59-70	116	172
	4	59-70 / 59-70	116	172
FT2	1	59-70 / 59-70	116	172
	2	59-70 / 59-70	116	172
	3	59-70 / 59-70	116	172
	4	59-70 / 59-70	116	172
FT3	1	91-102 / 91-102	116	166
	2	91-102 / 91-102	116	166
	3	91-102 / 91-102	116	166
	4	91-102 / 91-102	116	166
FT4	1	91-102 / 92-103	116	166
	2	91-102 / 92-103	116	166
	3	91-102 / 92-103	116	166
	4	91-102 / 92-103	116	166
FT5	1	197-215 / 197-215	187	238
	2	197-215 / 197-215	187	238
	3	197-215 / 197-215	187	238
	4	197-215 / 197-215	187	238
FT6	1	298-316 / 299-317	187	238
	2	298-316 / 299-317	187	238
	3	298-316 / 299-317	187	238
	4	298-316 / 299-317	187	238

NEW

Tracking station	Straws affected by opening	s [mm]	t [mm]
FT1	61-72	116.15	192
FT2	61-72	116.15	192
FT3	81-96	156.55	204
FT4	97-112	156.66	204
FT5	189-212	237.35	258
FT6	189-212	237.35	258



Aim:

Study the x-y intensity distribution for pions at the z-position of tracking stations.

Strategy:

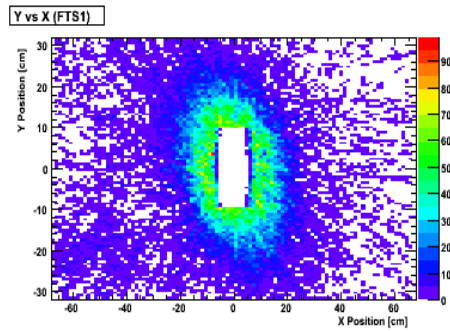
- BoxGenerator is used for the simulation
- **10.000 Pions** simulated with different momentum:
200 MeV, 500 MeV, 1 GeV, 2 GeV, 3 GeV, 4 GeV, 5 GeV
- Uniformly in phi: [0,360°]
- **Uniformly in theta: [0,10°]**
- **Uniformly in cos(theta) (NEW)**
- Multiple scattering and energy losses included
- Detectors included: MDV+GEM+FTS
- Beam Momentum = 15 GeV/c
- Pandaroot version: 22776
- **Not only primary tracks selected**

New geometry

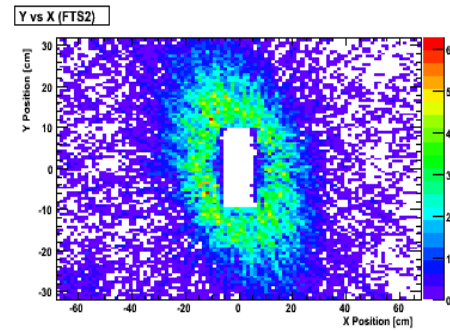
x: x stations dimensions
y: y stations dimensions

Pion momentum: 200 MeV

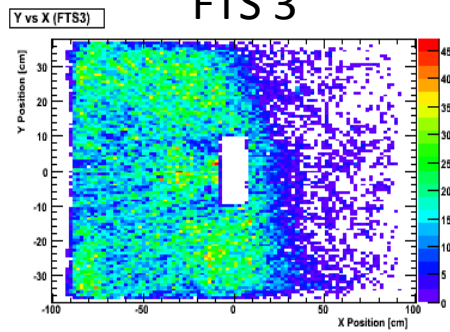
FTS 1



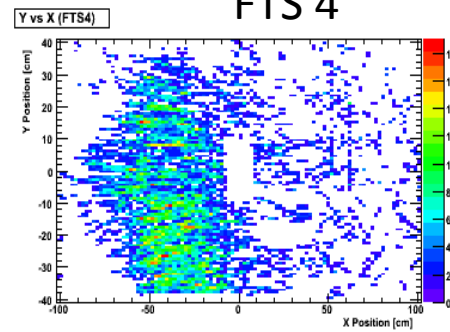
FTS 2



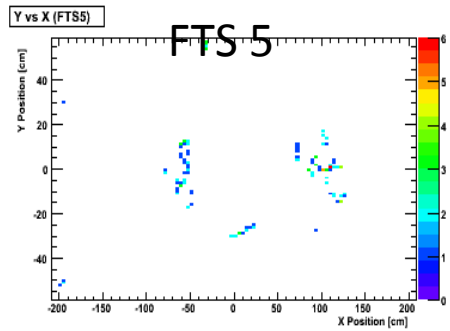
FTS 3



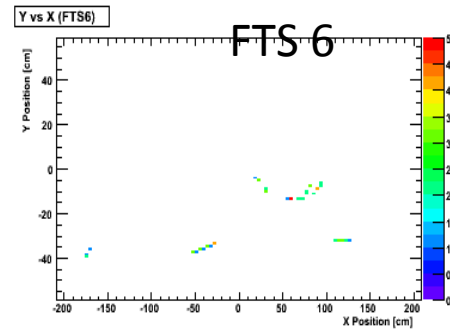
FTS 4



FTS 5

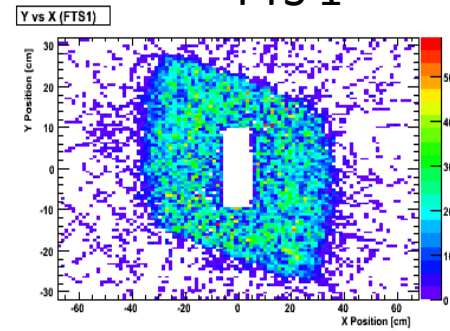


FTS 6

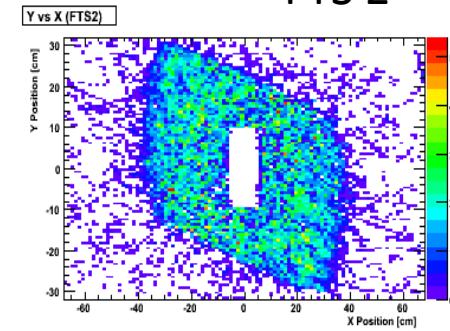


Pion momentum: 500 MeV

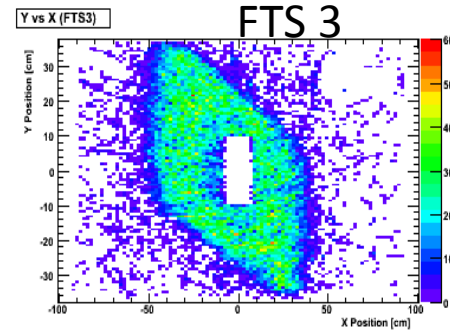
FTS 1



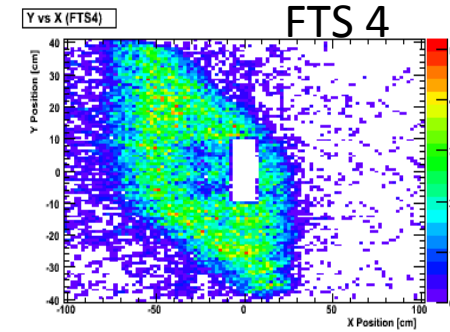
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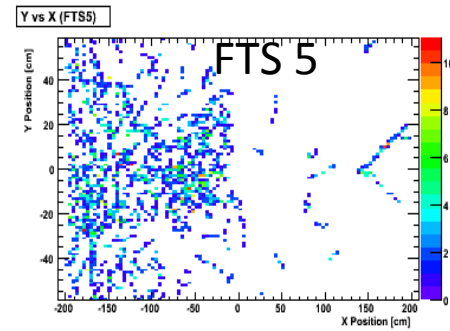
FTS 3



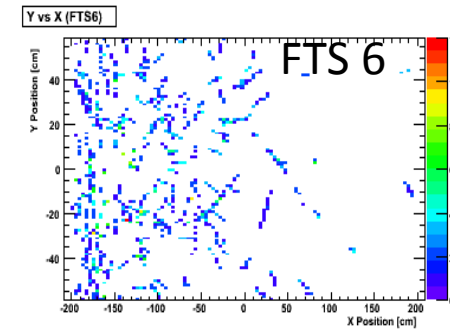
FTS 4



FTS 5



FTS 6

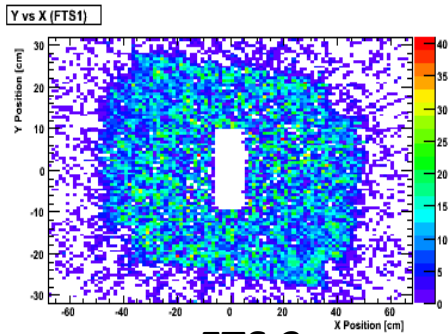


New geometry

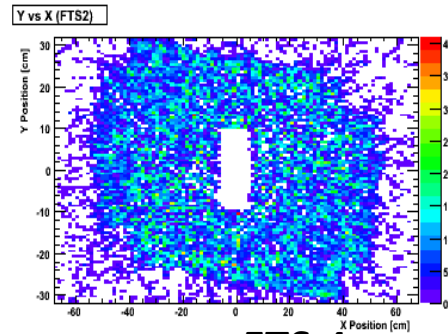
x: x stations dimensions
y: y stations dimensions

Pion momentum: 1 GeV

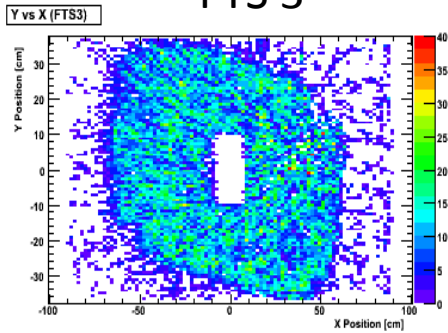
FTS 1



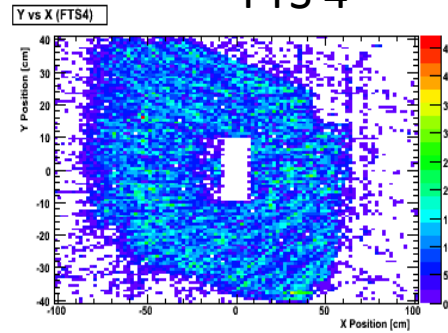
FTS 2



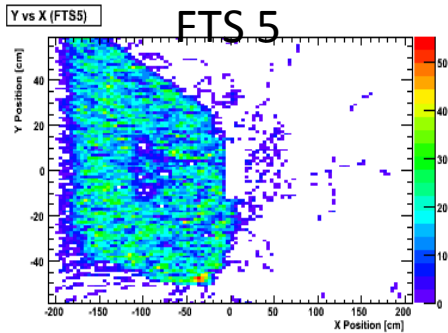
FTS 3



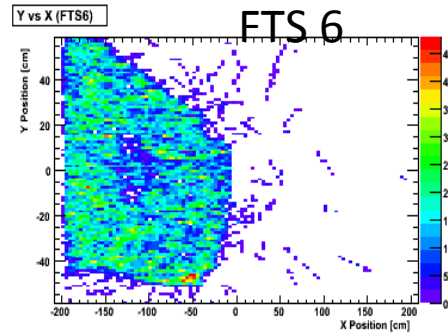
FTS 4



FTS 5

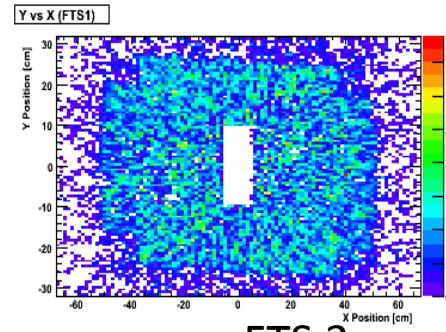


FTS 6

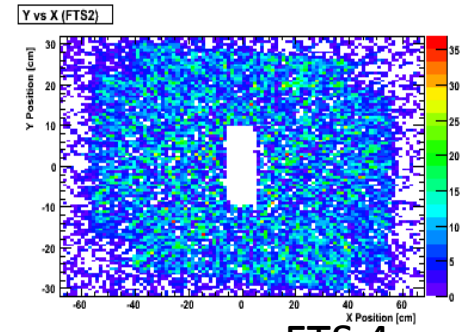


Pion momentum: 2 GeV

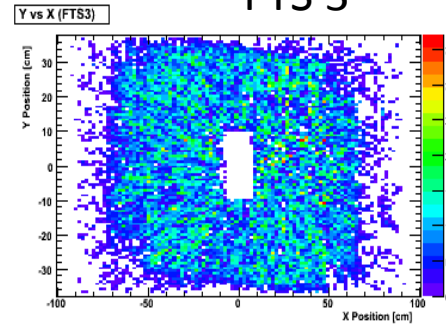
FTS 1



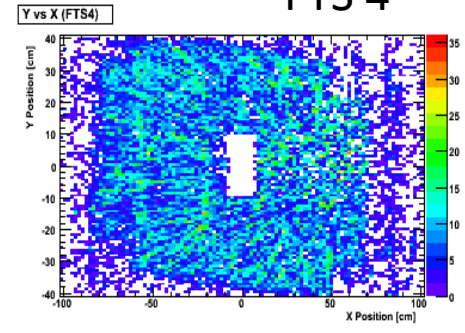
FTS 2



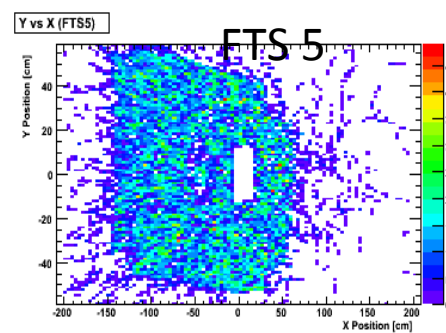
FTS 3



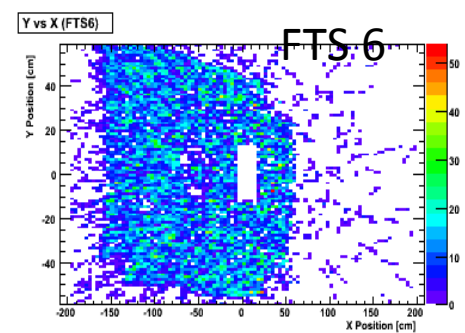
FTS 4



FTS 5



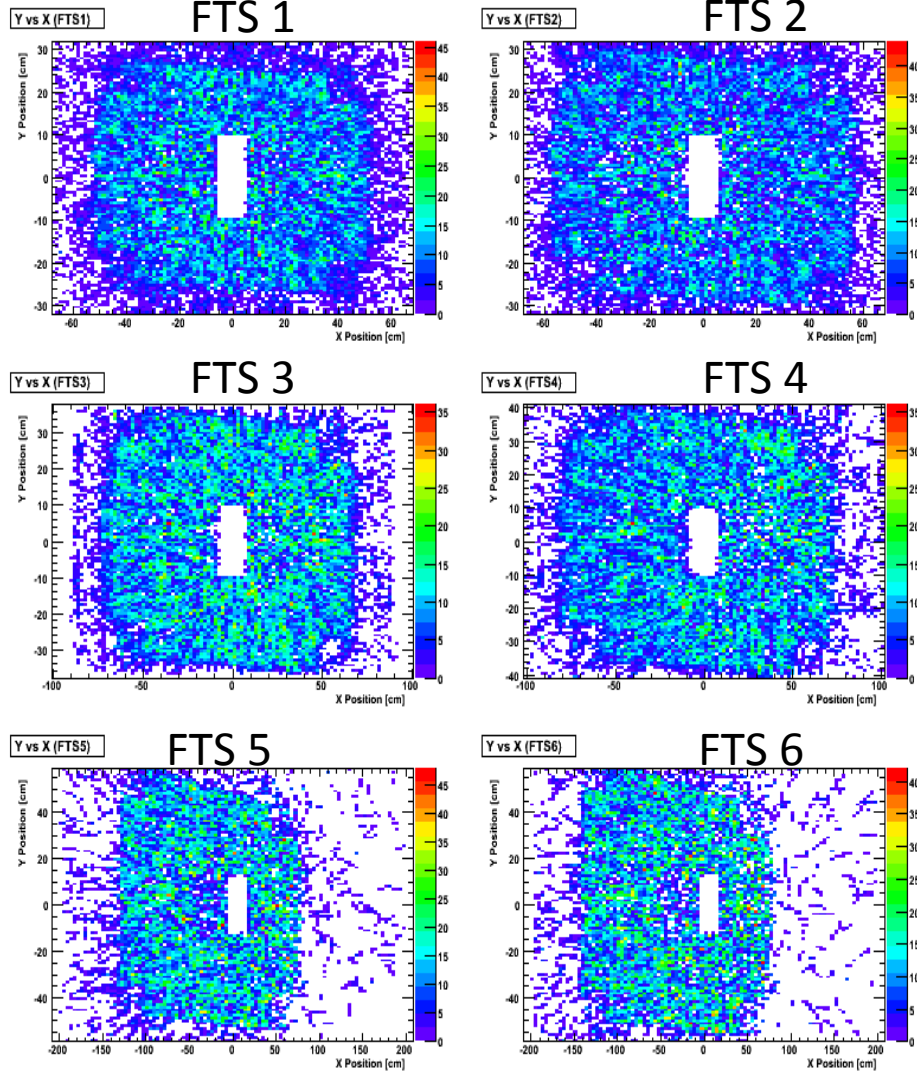
FTS 6



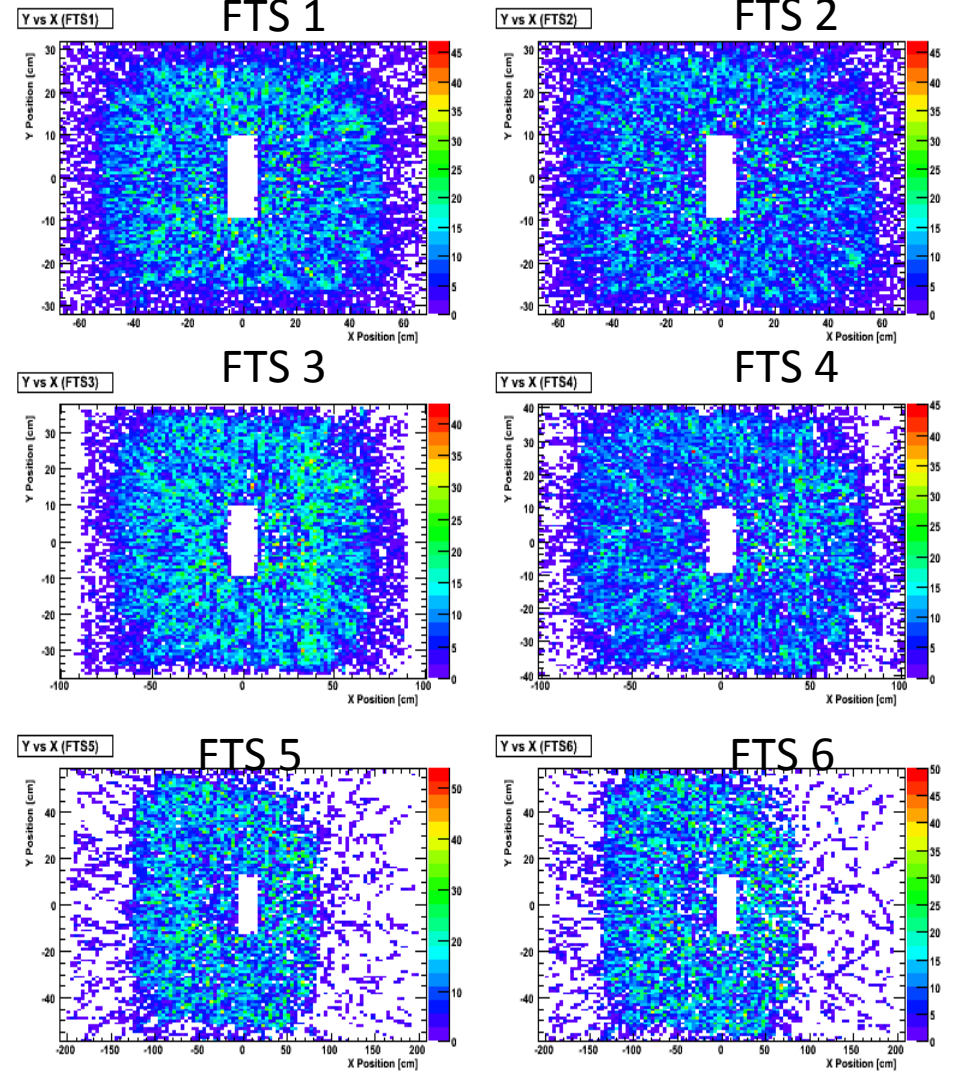
New geometry

x: x stations dimensions
y: y stations dimensions

Pion momentum: 3 GeV



Pion momentum: 4 GeV

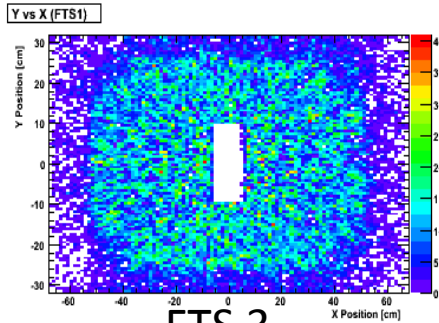


New geometry

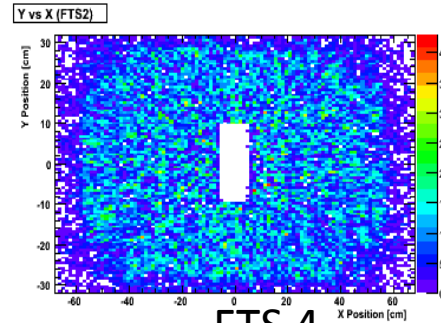
x: x stations dimensions
y: y stations dimensions

Pion momentum: 5 GeV

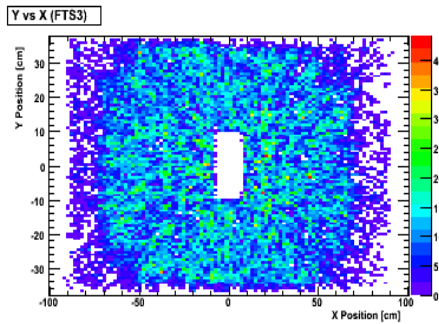
FTS 1



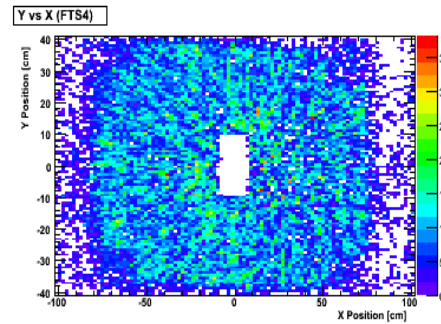
FTS 2



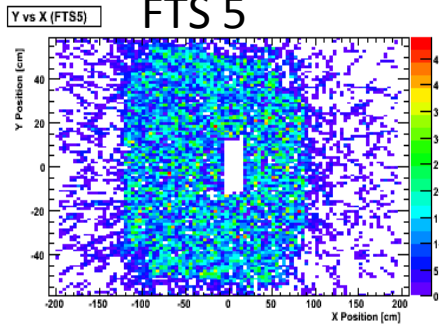
FTS 3



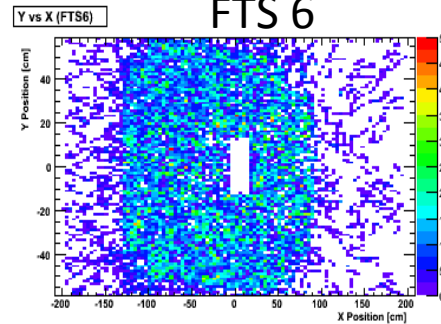
FTS 4



FTS 5



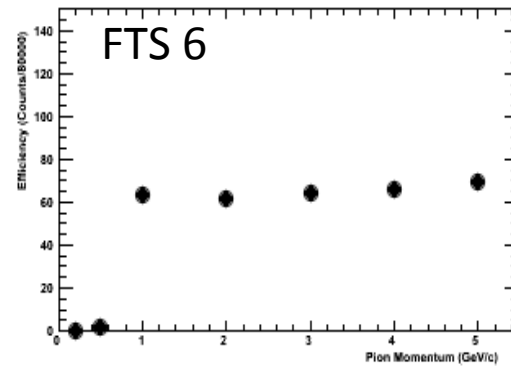
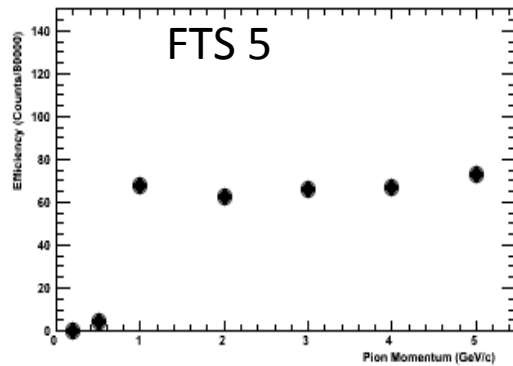
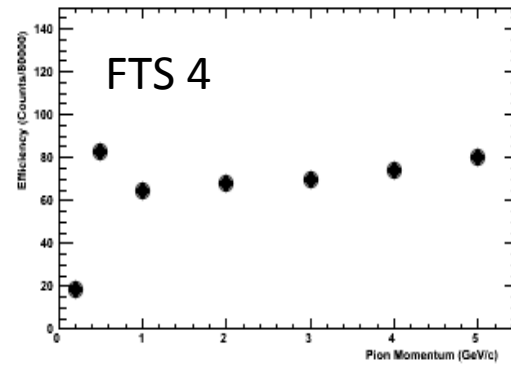
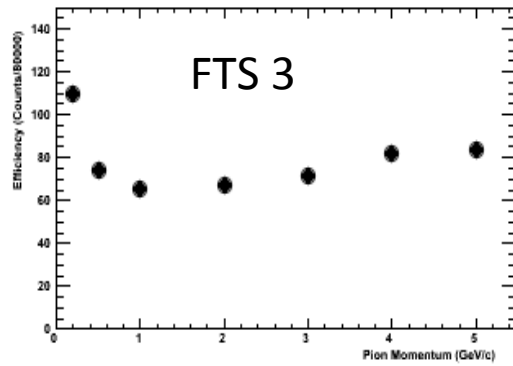
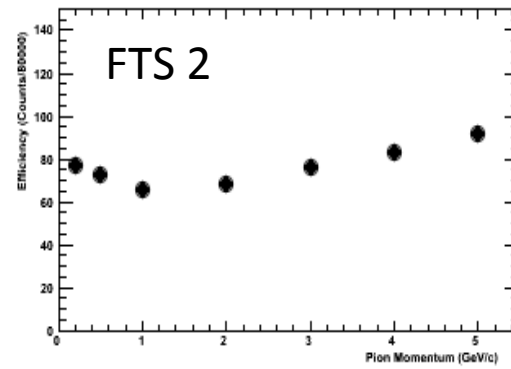
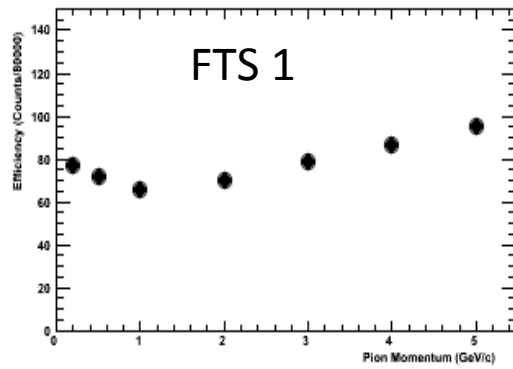
FTS 6



NEW GEOMETRY

04-10-2013

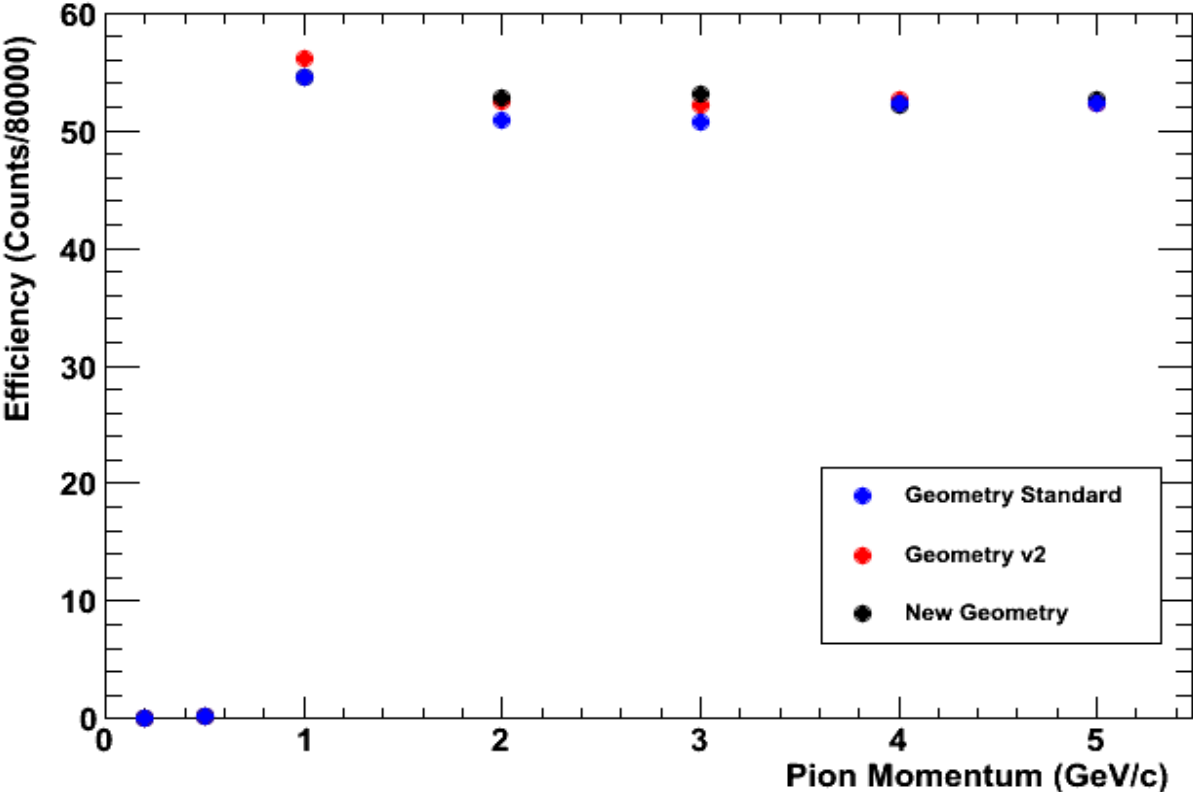
x axis: Pion Momentum
y axis: Efficiency [counts/(10000*8)]



Only FTS6

Efficiency [counts/(10000*8)]

Only primary tracks



	Standard Geometry	Geov2	New Geometry
200 MeV	0 %	0 %	0 %
500 MeV	0.1 %	0.2 %	0.2 %
1 GeV	54.6 %	56.2 %	54.5 %
2 GeV	50.9 %	52.4 %	52.8 %
3 GeV	50.8 %	52.2 %	53.1 %
4 GeV	52.3 %	52.7 %	52.2 %
5 GeV	52.3 %	52.3 %	52.6 %

News on the reconstruction code

- Ideal Forward Tracking MVD+GEM+FTS (It is possible to set the Momentum and Vertex Smearing and the tracking efficiency)
- Only the fitted tracks are registered (`GetFitStatus()`>0)
- If the Number of Fts Hit > 5 the tracks are reconstructed
- The hit tubes by the tracks which are going backward are not considered in the reconstruction

Aim:

Study the **Momentum and Position Resolution** (x, y, z) of the **FTS Standalone** for muons at different momentum. The study is done for the standard straws inclinations of 5 degrees. Fit with a double gaussian function

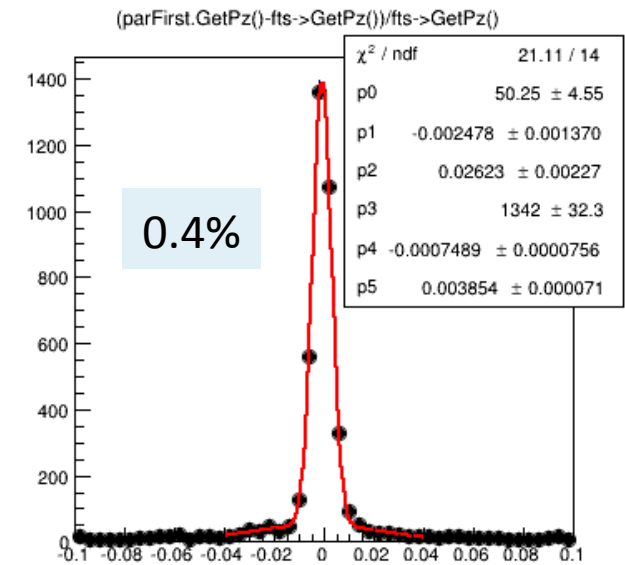
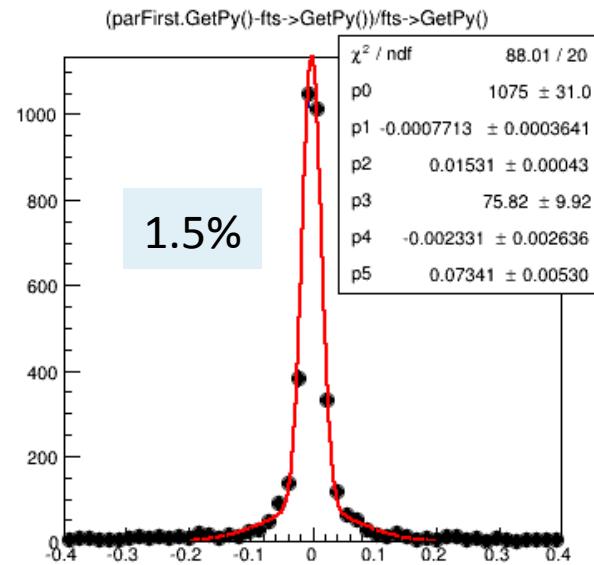
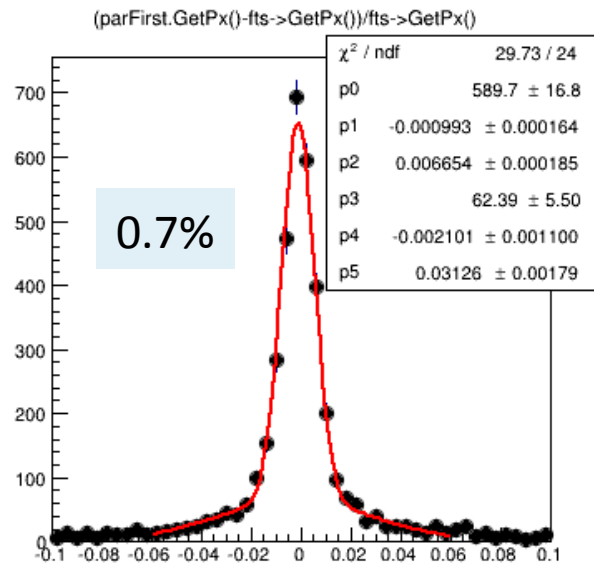
Strategy:

- BoxGenerator is used for the simulation
- **1.000 Muons** simulated with different momentum:
500 MeV, 1 GeV, 2 GeV, 3 GeV, 5 GeV
- **Straws inclinations**: 5 degrees
- Uniformly in phi: [0,360°]
- **Uniformly in theta: [0,5°]**
- **Uniformly in cos(theta) (NEW)**
- Detectors included: **FTS standalone**
- Beam Momentum = 15 GeV/c
- **Only primary tracks selected**
- Ideal Forward Tracking
- **Vertex smearing: (0.1, 2, 0.1) cm**
- **Momentum smearing: 10%**
- SetPropagateToIP(kFALSE) **(NEW)**
- SetBackPropagate(kFALSE) **(NEW)**

Momentum Resolution

Muon 3 GeV/c
Theta: [0,5]°
Skew Angle: 5°
Geov1
(standard)

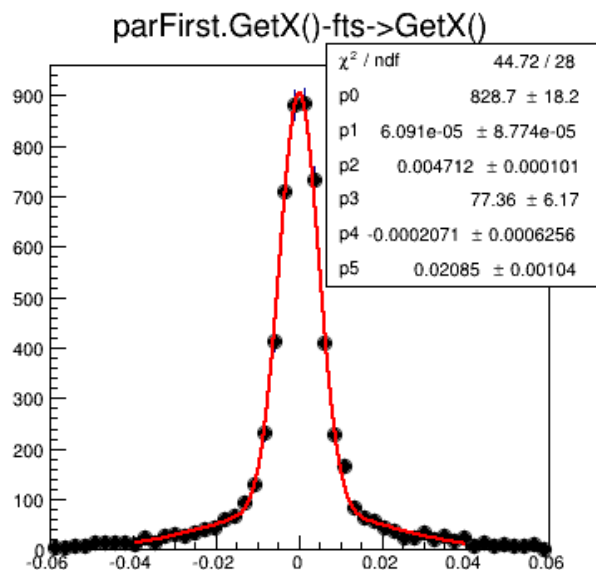
Residual distribution of the first parameter of the track



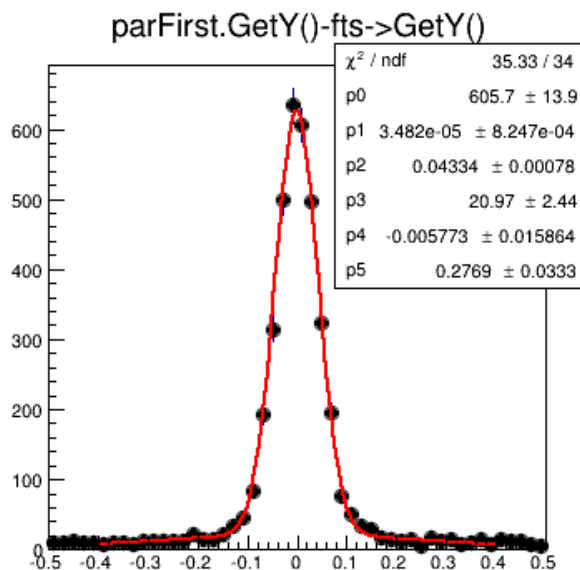
Position Resolution

Muon 3 GeV/c
Theta: [0,5]°
Skew Angle: 5°
Geov1
(standard)

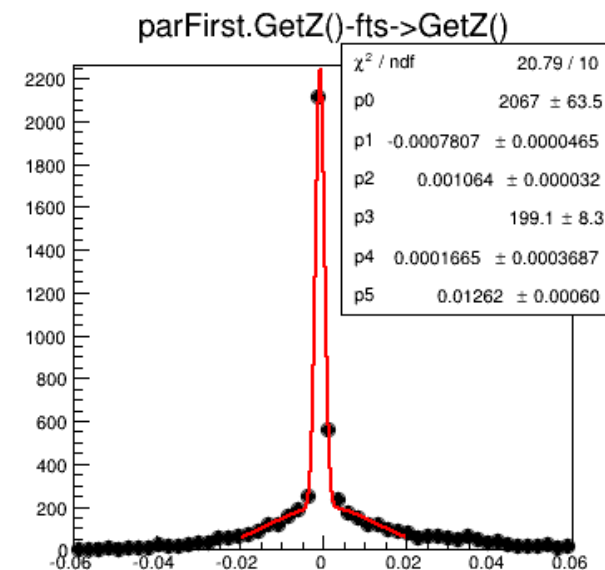
Residual distribution of the first parameter of the track



0.005 cm



0.043 cm

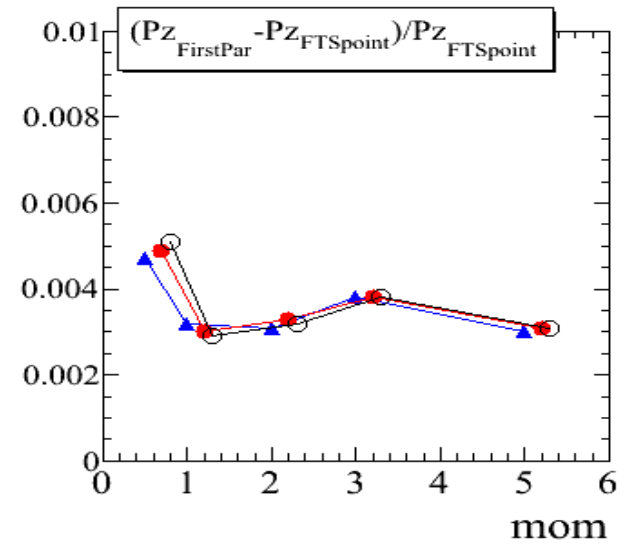
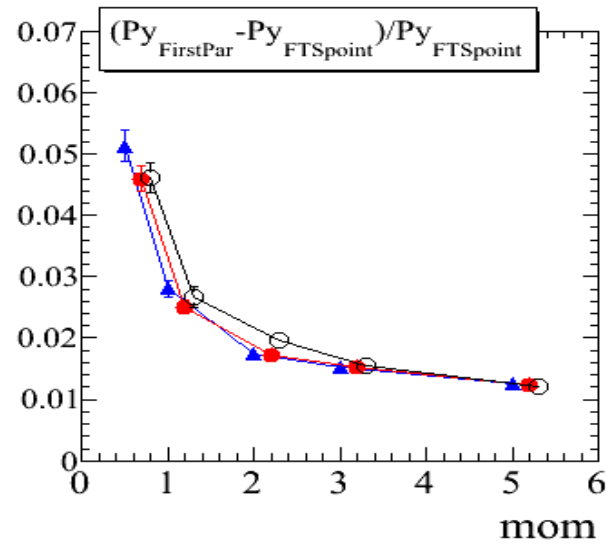
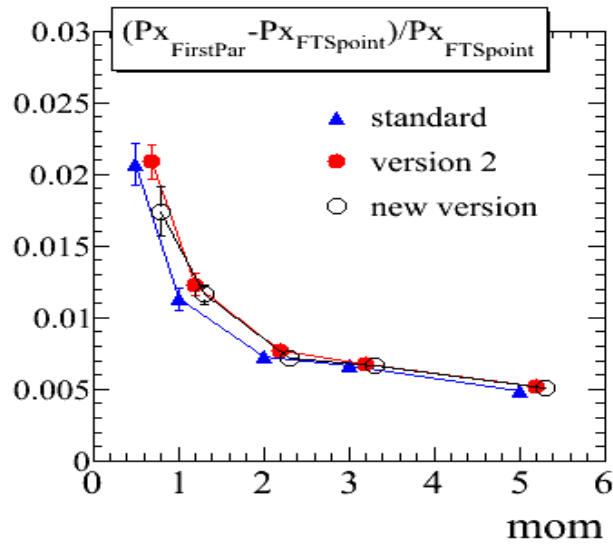


0.001 cm

Momentum Resolution

x axis: Momentum (GeV);

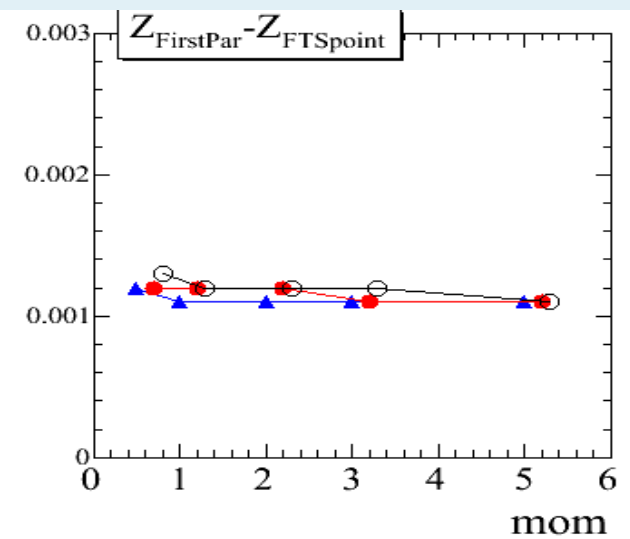
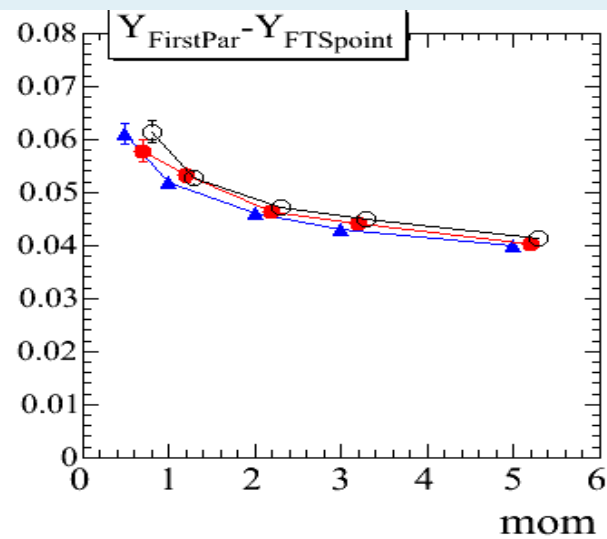
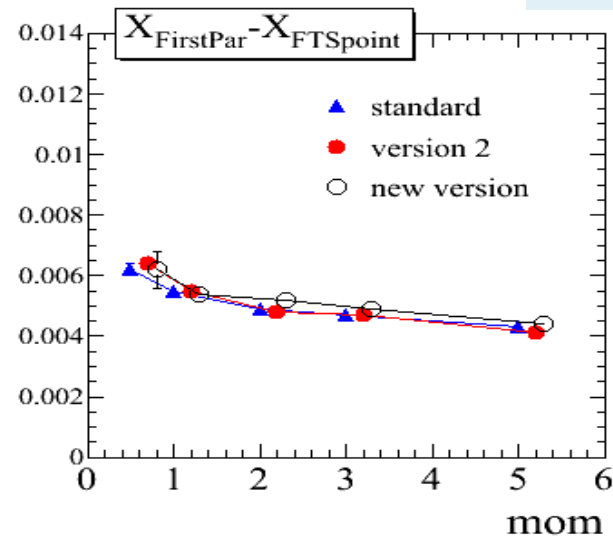
Y axis: x,y,z Momentum Resolution (*100) calculated for the first parameter of the track



Position Resolution

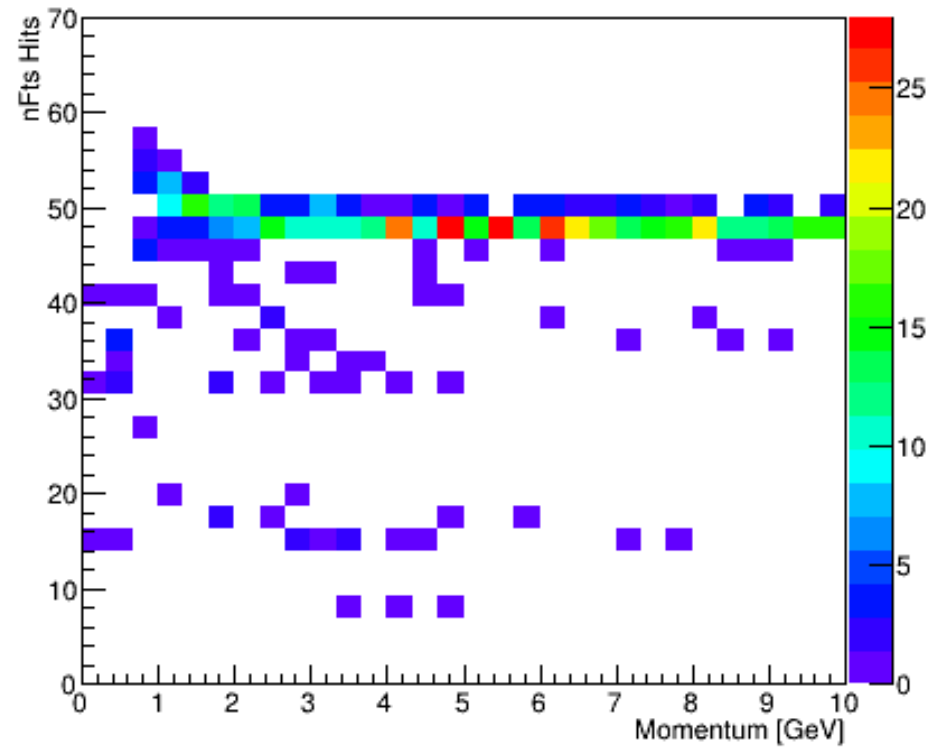
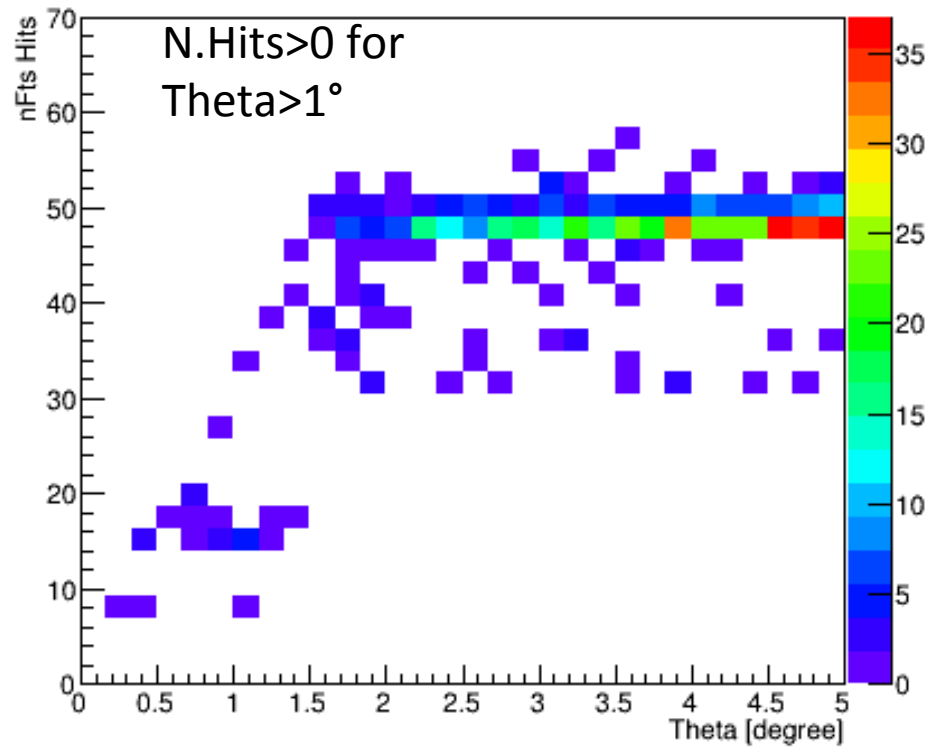
x axis: Momentum (GeV)

Y axis: x,y,z Position Resolution (cm) calculated the first parameter of the track



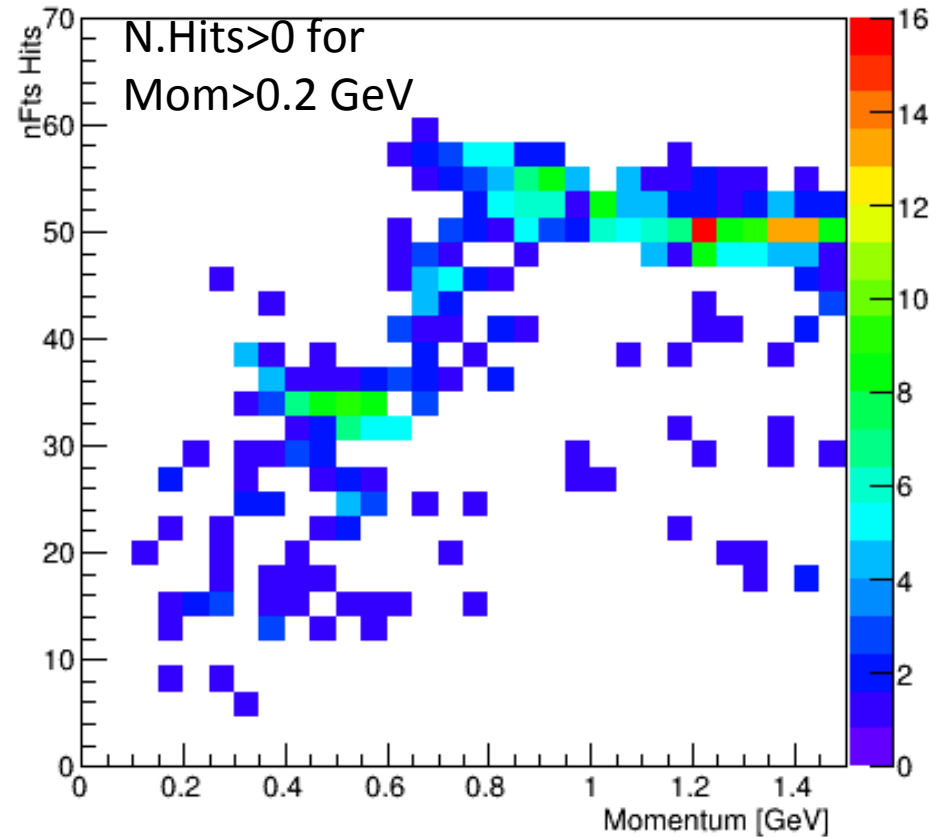
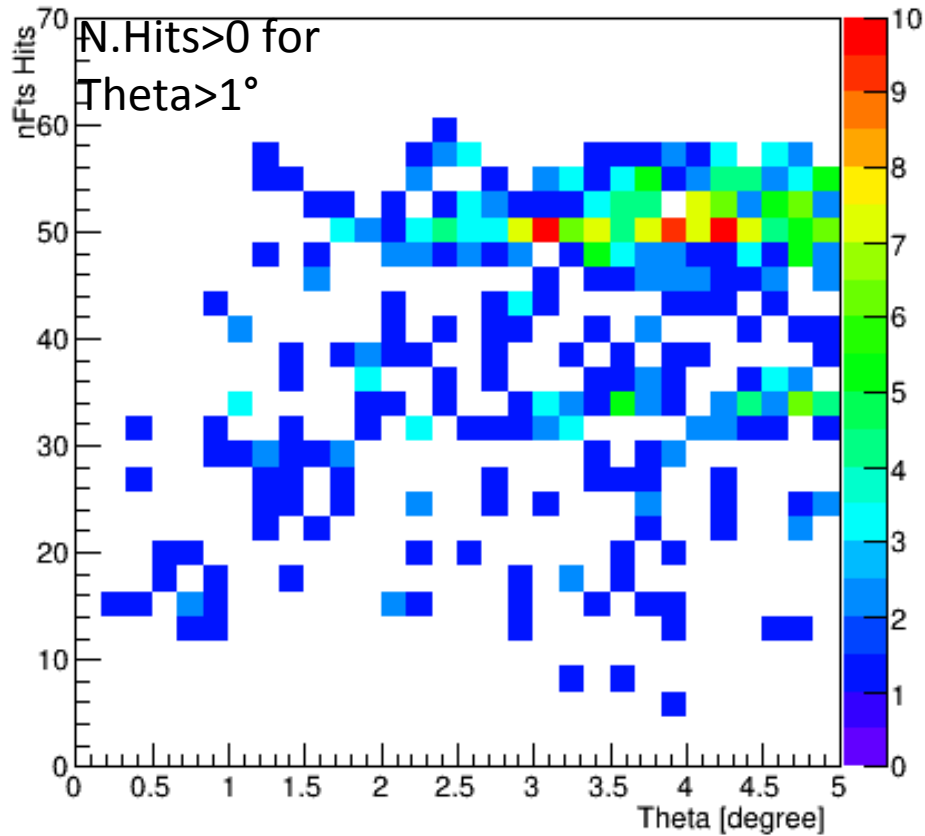
Which is the number of Fts Hits in function of theta (mc) and momentum (mc)?

New Geometry
Muon 0-10 GeV/c
Theta: [0,5]°



**Which is the number of Fts Hits
in function of theta (mc) and momentum (mc)?**

New Geometry
Muon 0-1.5 GeV/c
Theta: [0,5]°



Conclusions

The new approved geometry configuration is now available on the code.

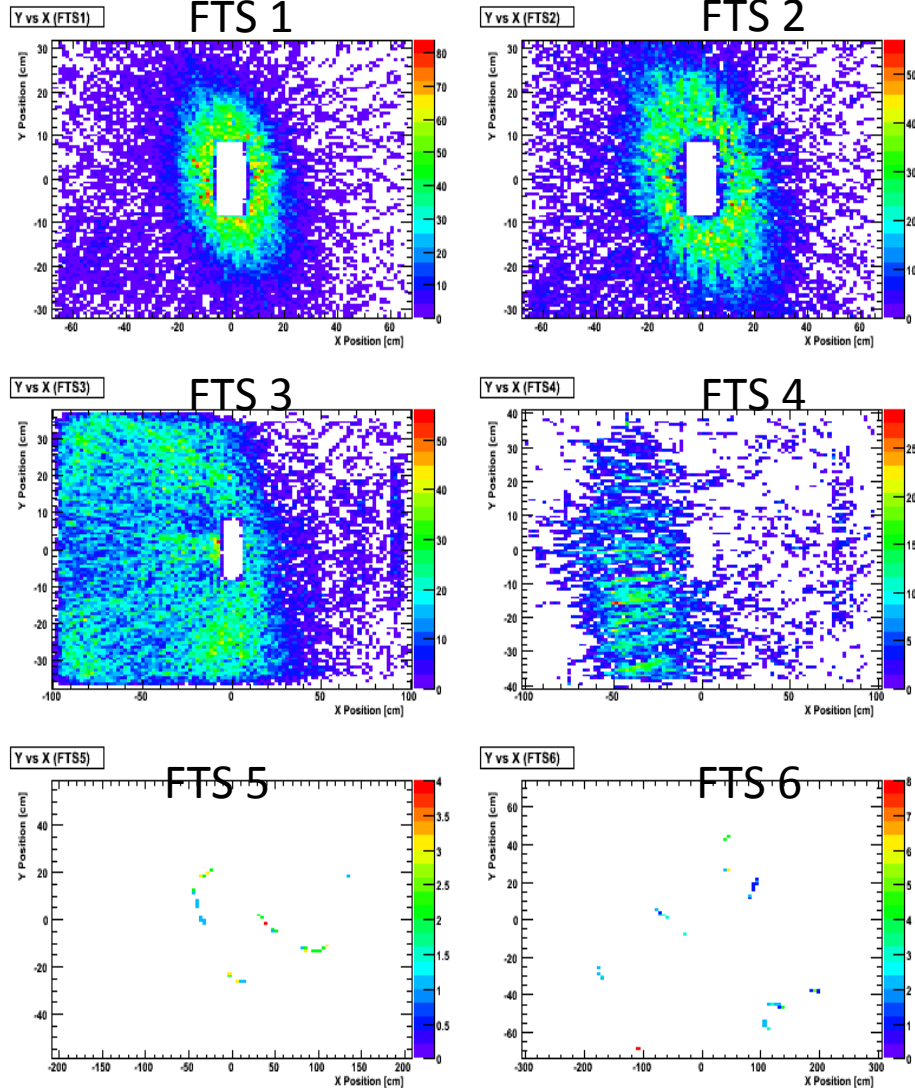
Ferrara group is doing different studies about:

- **Resolution studies** on momentum (x,y,z) and position (x,y,z) for pions and muons (for different **geometry configurations**) for FTS standalone and for MVD+GEM+FTS.
- **Acceptance studies**

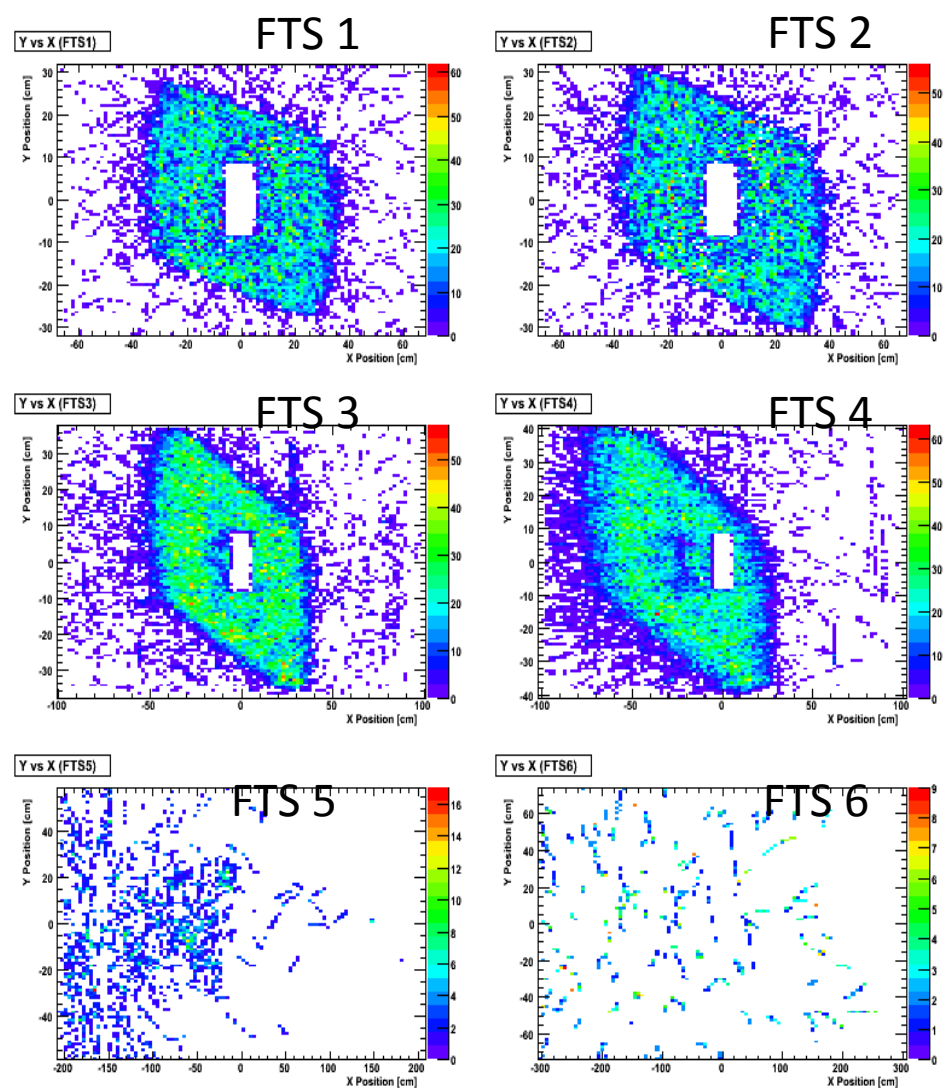
THANKS FOR YOUR ATTENTION

BACKUP SLIDES

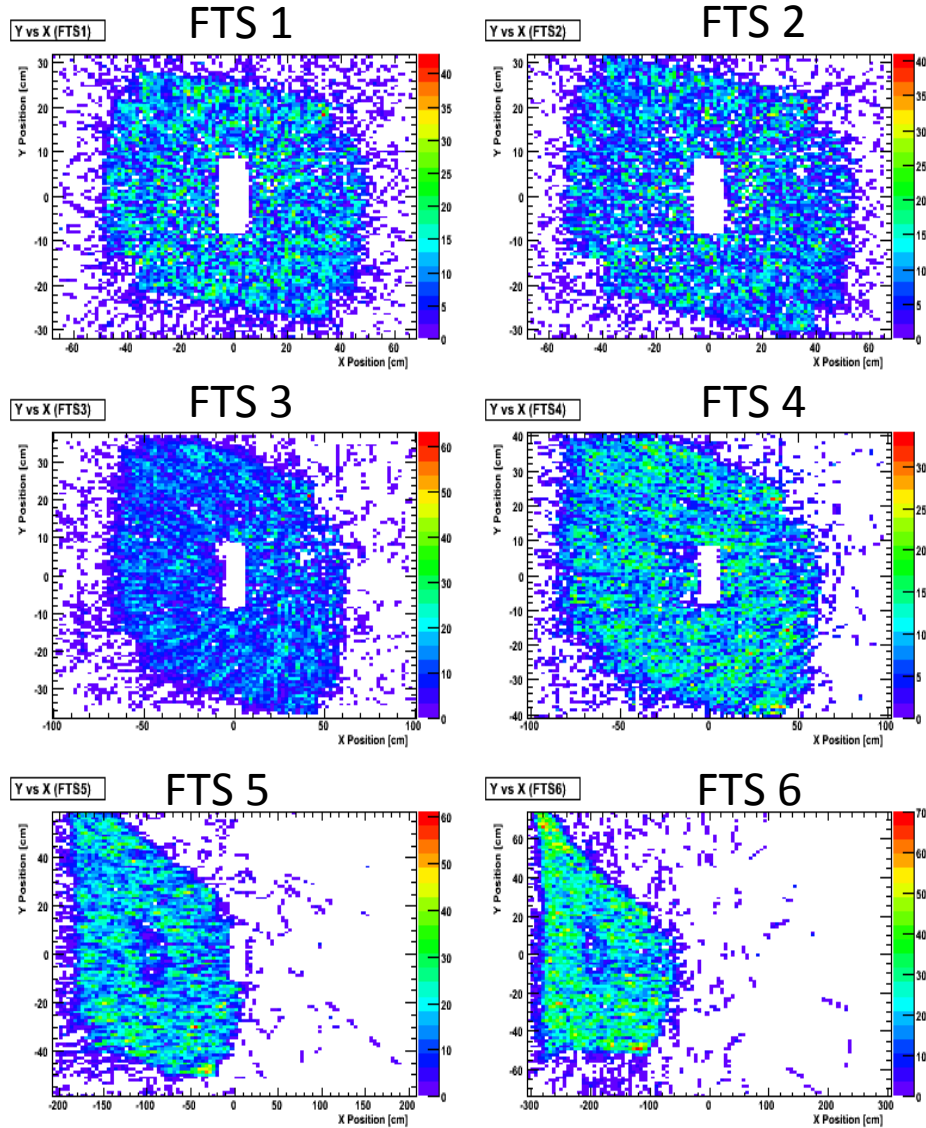
Pion momentum: 200 MeV



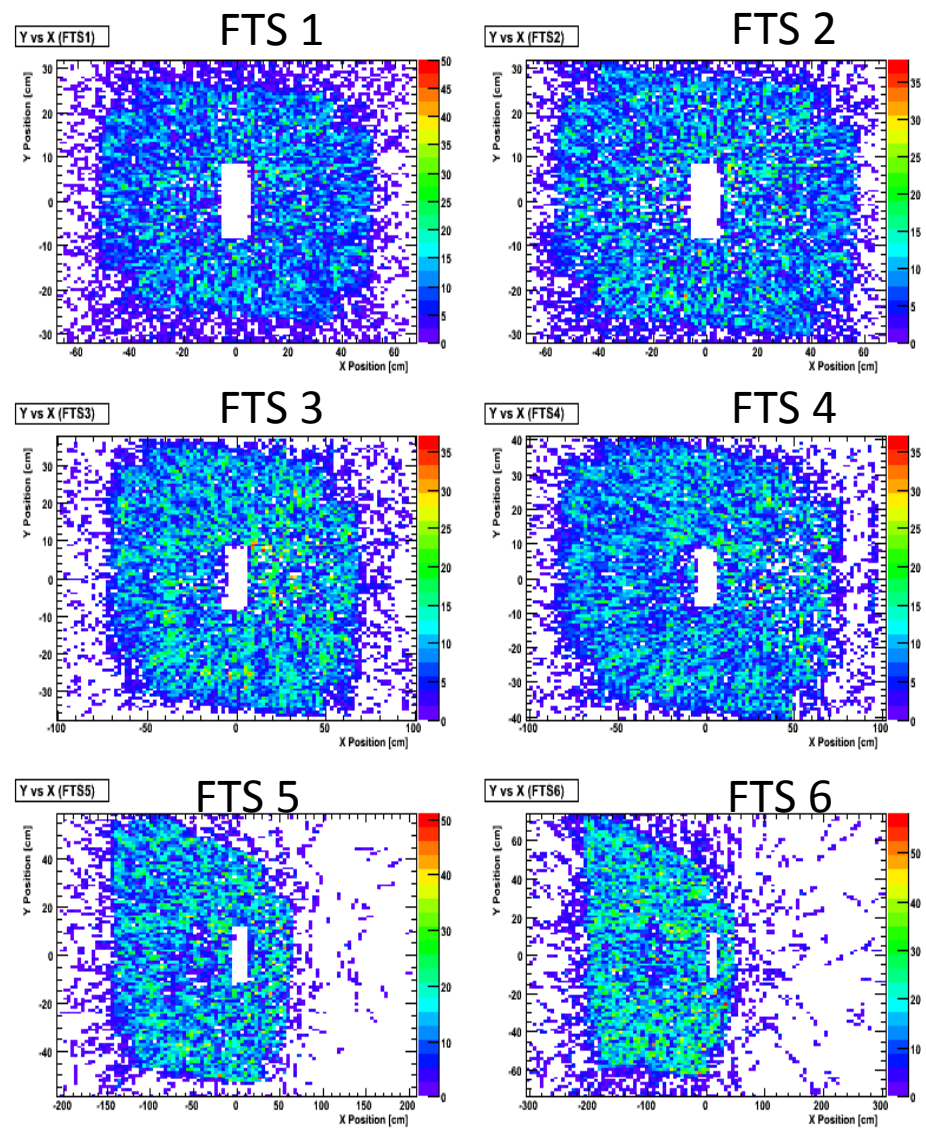
Pion momentum: 500 MeV



Pion momentum: 1 GeV

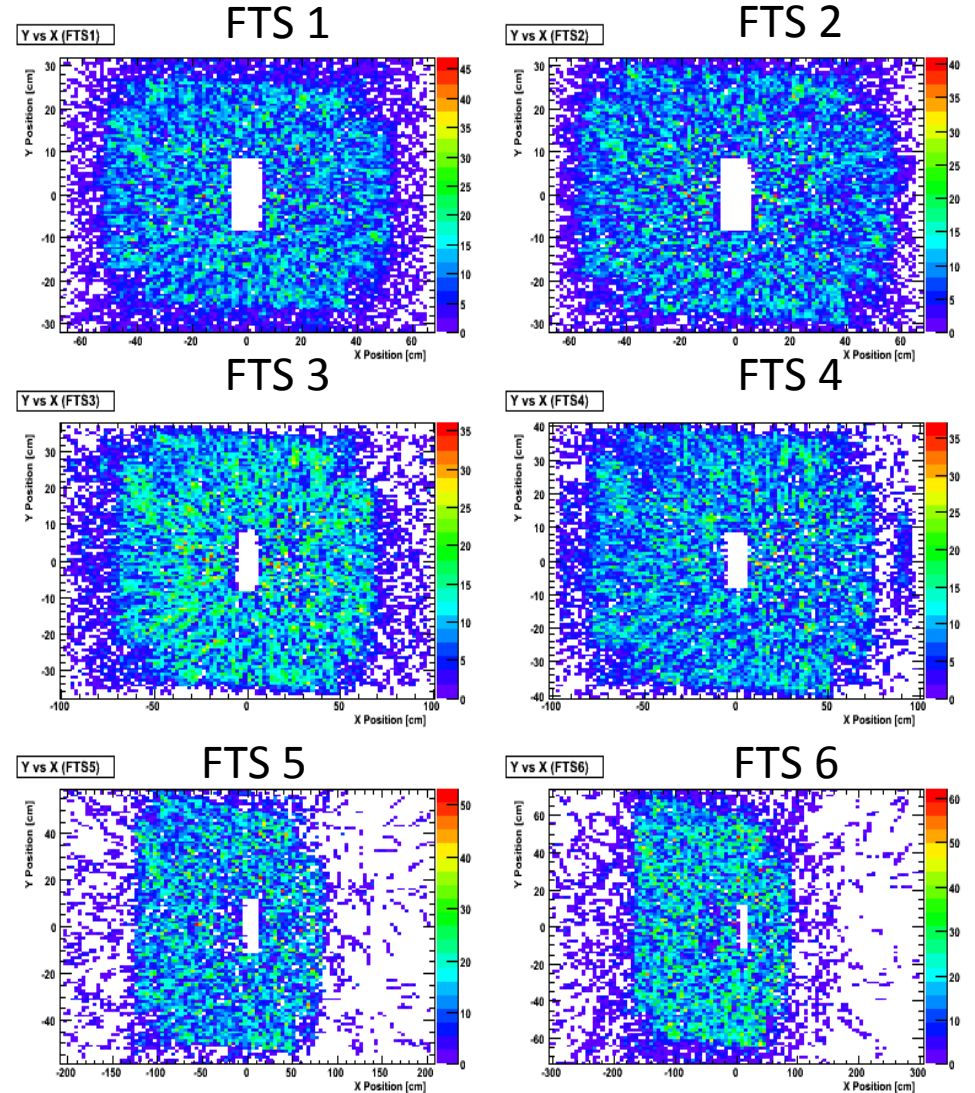
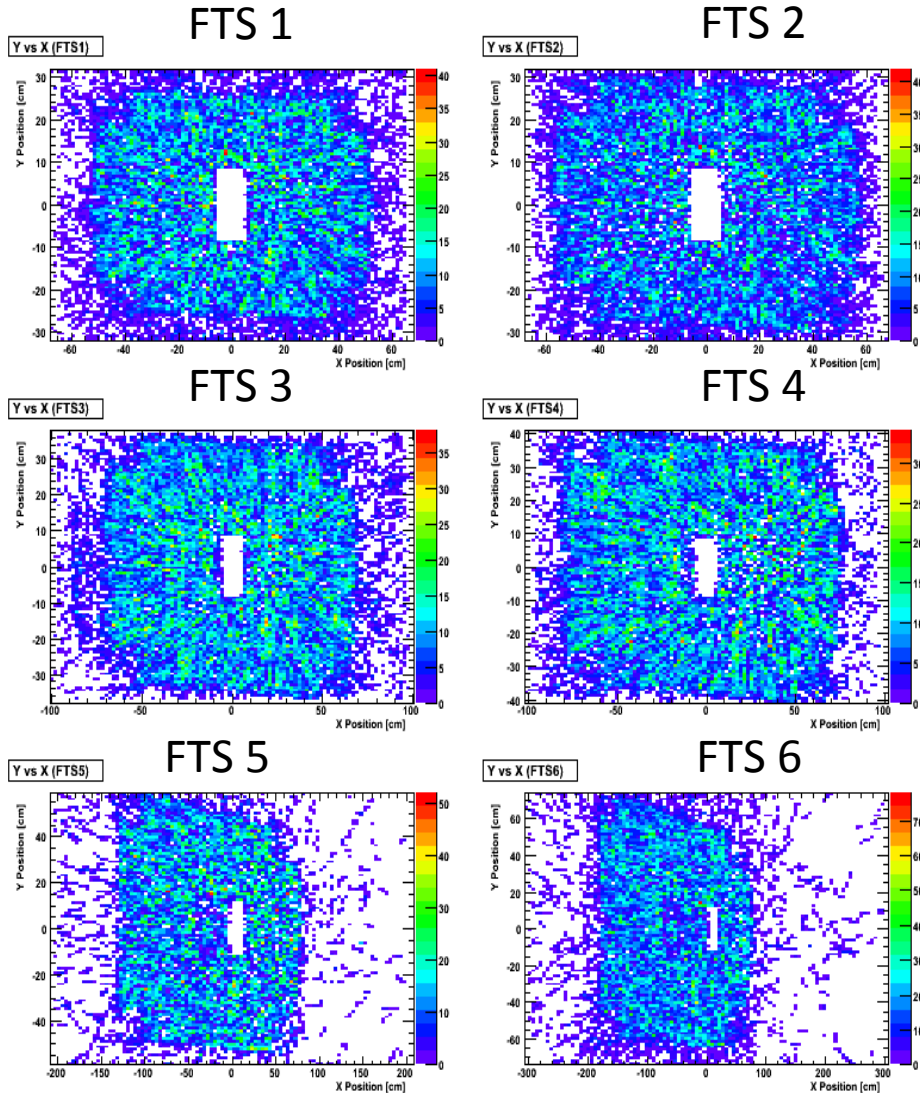


Pion momentum: 2 GeV



Pion momentum: 3 GeV

Pion momentum: 4 GeV



Geometry v1 (Rich between FTS 5 and FTS 6)

x: x stations dimensions
y: y stations dimensions

Pion momentum: 5 GeV

