- A possible R-phi geometry "a la VELO" for FTD disks
- Study of the hits density in FTD

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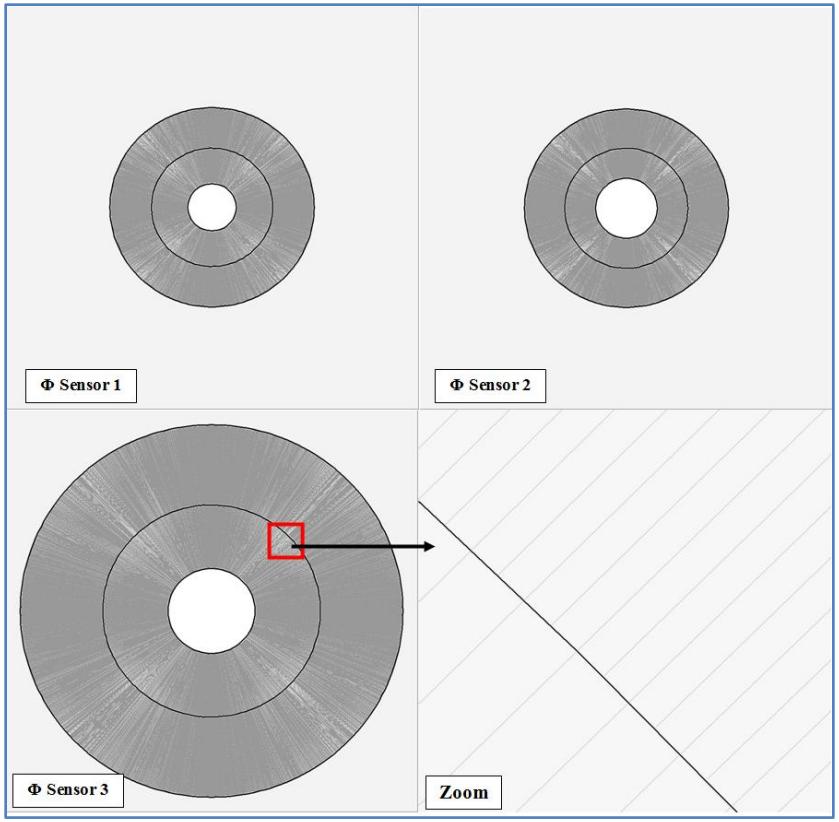
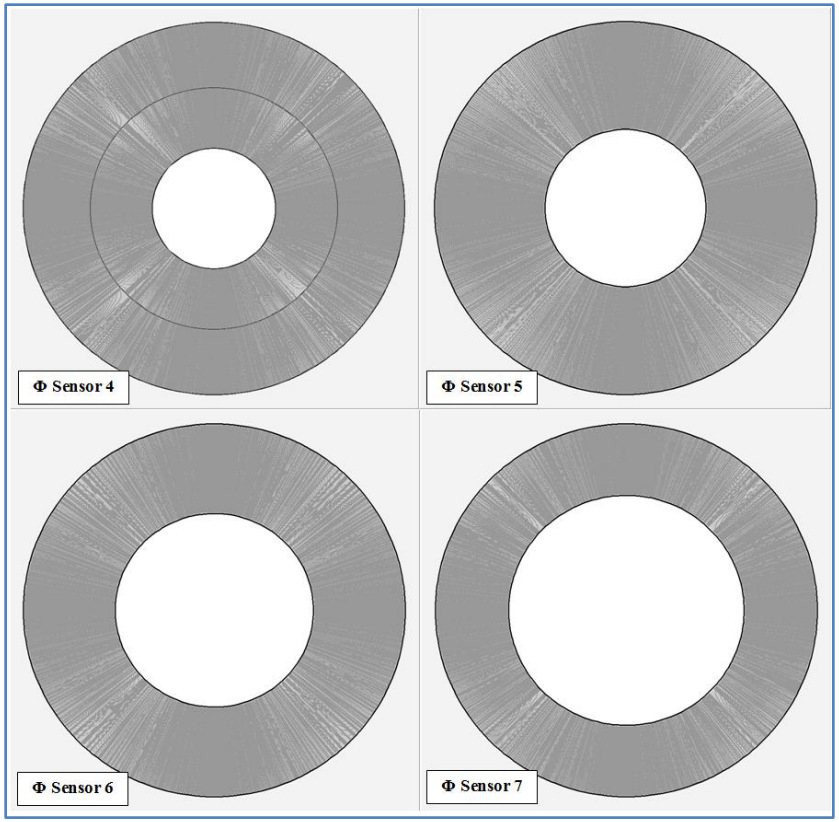
(Thanks to Xabi Cid and Bernardo Adeva)

A possible R-phi geometry "a la VELO" for FTD

- A idea is a set of 7 pairs of sensors in r and phi:
  - The **r-sensors** will be placed in a concentric way with a constant separation of 38 μm (similar to minimum value of VELO design of LHCb)
  - The **phi-sensors** are a little more complex. We will suppose silicon strip placed in radial way.

    As the pitch will be larger with r, we decided implement some “stages” in r (similar to VELO). In each stage, the pith will be change from 38 to the maximum value. The number of strips will be the maximum (filling the whole 360 degrees), and leaving always the minimum pitch of 38 μm.





Phi Parameters:

No attempt was made to decrease minimum pitch with respect to the LHCb 38 micron value.

- The máximum pitch will be 2.5*PITCHmin for 1,3,5,6,7 disks:
  - **PITCHmin**=38 micras
  - **PITCHmax**=2.5*38=95 micras
- The máximum pitch will be 2*PITCHmin for 2,4 disks:
  - **PITCHmin**=38 micras
  - **PITCHmax**=2.5*38=76 micras

	R_inner (mm)	R_outer (mm)	Z (mm)	PITCHmin (μm)	PITCHmax (μm)
FTD_1	39	164	220	38	95
FTD_2	40.6308	164	371.309	38	76
FTD_3	70.1393	308	644.906	38	95
FTD_4	100.298	309	1046.12	38	76
FTD_5	130.372	309	1447.33	38	95
FTD_6	160.447	309	1848.54	38	95
FTD_7	190.54	309	2250	38	95

Resolution in phi

For the 7 disks, the number of “stages” will be: 2,2,2,2,1,1,1, i.e, two stages in the 4 first disks and only one stage in the rest. In this way, the 4 first stations are much more uniform. In each of this stages, the phi resolution will be constant.

	Stage in r	Phi resolution (rad)
FTD_1	39 <r< 97.5	ALPHA* 0.000974358974359
	97.5 <r< 164	ALPHA* 0.000389743589744
FTD_2	49.63 <r< 99.26	ALPHA* 0.000765665927866
	99.26 <r< 164	ALPHA* 0.000382832963933
FTD_3	70.14 <r< 175.35	ALPHA* 0.000541773595666
	175.35 <r< 308	ALPHA* 0.000216709438266
FTD_4	100.3 <r< 200.6	ALPHA* 0.000378863409771
	200.6 <r< 309	ALPHA* 0.000189431704885
FTD_5	130.37 <r< 309	ALPHA* 0.00029147810079
FTD_6	160.44 <r< 309	ALPHA* 0.000236848666168
FTD_7	190.54 <r< 309	ALPHA* 0.000199433189881

with ALPHA=1/sqrt(12)

Some remarks:

1) we think the "VELO" geometry cannot really compete with any reasonable pixel option, for the first 3 disks. We clearly advocate, as a group, for a pixel option for these layers, and intend to pursue R&D along those lines. Pixels are superior (in material, resolution, pattern recognition), so performing a relative comparison "VELO vs. pixels" is probably not worth, at software level.

2) if however double-sided microstrip options (XY+stereo angles) are discussed as baseline for the first 3 disks, then a more thorough comparison "XY vs. VELO" deserves to be made on equal software foot.

In the VELO, the ghost rejection is achieved by the "dog-leg" technique, easily implementable in the software, and viable for construction.

3) for the farmost 4 rings, a microstrip option is rather standard, and really using R-phi or normal-stereo should not give essentially different results.

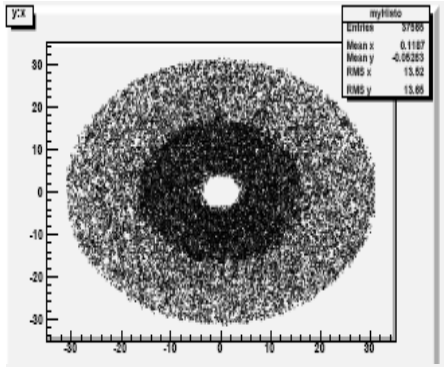
In summary: **we do not advocate "VELO" for the first 3 disks, but in a microstrip-based scenario the software should desirably evaluate both options** on equal foot, including backgrounds. We may have still time, if so decided.

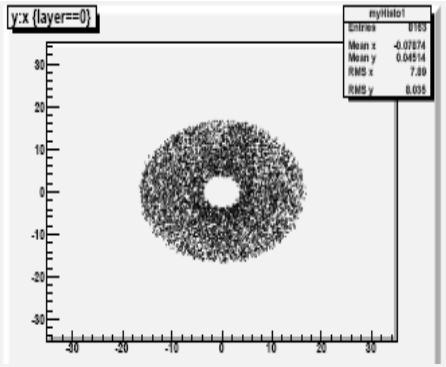
Study of the hits density in FTD

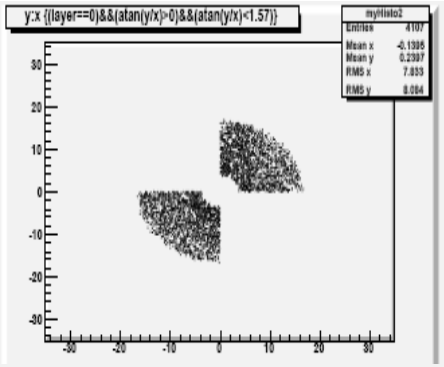
The idea is to analyse the hits density in FTD disks dividing them in sections (petals).
In principle, Disks 1-3 in 4 sections and Disks 4-7 in 16 sections (similar to IFCA design), but…

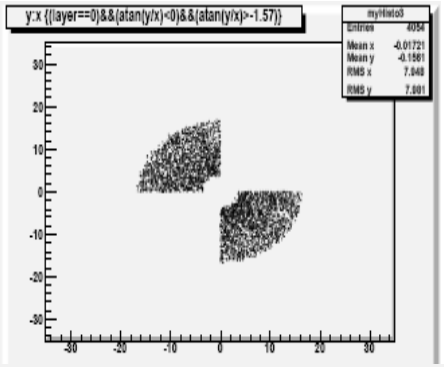
	R_inner (mm)	R_outer(mm)	Z(mm)	Area_disk(cm^2)	Area_Section(cm^2)
FTD_1	39	164	220	797.17	199.29 (1/4)
FTD_2	40.6308	164	371.309	793.09	198.27 (1/4)
FTD_3	70.1393	308	644.906	3318.57	**829.64 (1/4) o 207.41 (1/16)**
FTD_4	100.298	309	1046.12	2683.58	167.72 (1/16)
FTD_5	130.372	309	1447.33	2466.07	154.12 (1/16)
FTD_6	160.447	309	1848.54	2190.87	136.92(1/16)
FTD_7	190.54	309	2250	1859.05	116.19 (1/16)

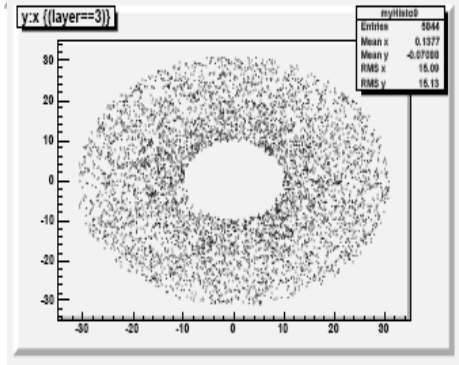
….It's seems better divide the 3 Disk in 16 sections instead of only 4.
Plots show the x-y positions of hits in Forward Disk, for the whole FTD and for Disk 1 and 4, and their sections:

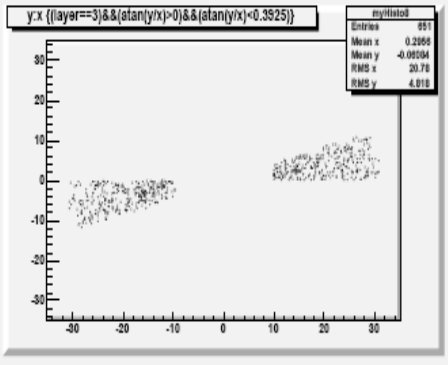


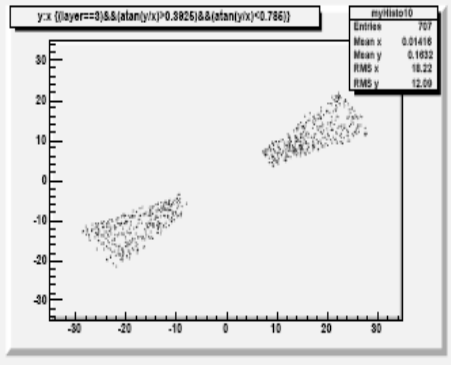


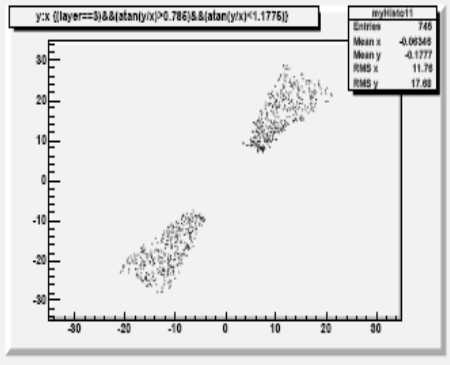












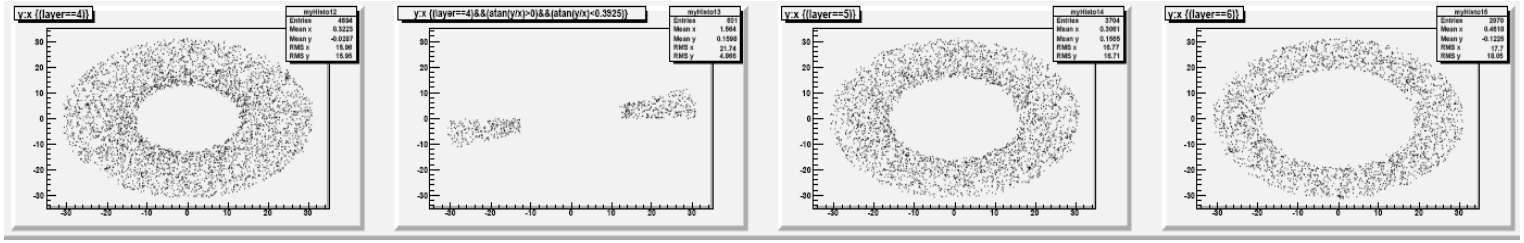
Number of hits

- Due to many problems with code, for now only the total number of hits is obtained.
- With this data only the % of hits in each section can be seen:

Total Entries	**37565**			
	FTD_x (entries)	**FTD_x(%)**	**FTD_section (entries)**	**FTD_section(%)**
FTD_1 (layer=0)	8163	**21.7%**	2053	**5.5%**
FTD_2 (layer=1)	4676	**12.4%**	1175	**3.1%**
FTD_3 (layer=2)	7514	**20.0%**	1870 o 461	**5.0 – 1.2%**
FTD_4 (layer=3)	5844	**15.5%**	325	**0.86%**
FTD_5 (layer=4)	4694	**12.5%**	300	**0.80%**
FTD_6 (layer=5)	3704	**9.9%**	236	**0.63%**
FTD_7 (layer=6)	2970	**7.9%**	168	**0.18%**

→ the most of the hits in 1 and 3 disks, more than 55% in the pixels sensors

→ the number of hist decrease for the farmost 4 rings



- **<u>FUTURE RESULTS</u>**: We will study the density of hits in each event: **n_hits/cm^{2}xBX** using:
  - Samples with **a great ammount of track: ttbar**
  - Beam Background (provided by Katarzyna Wichmann)