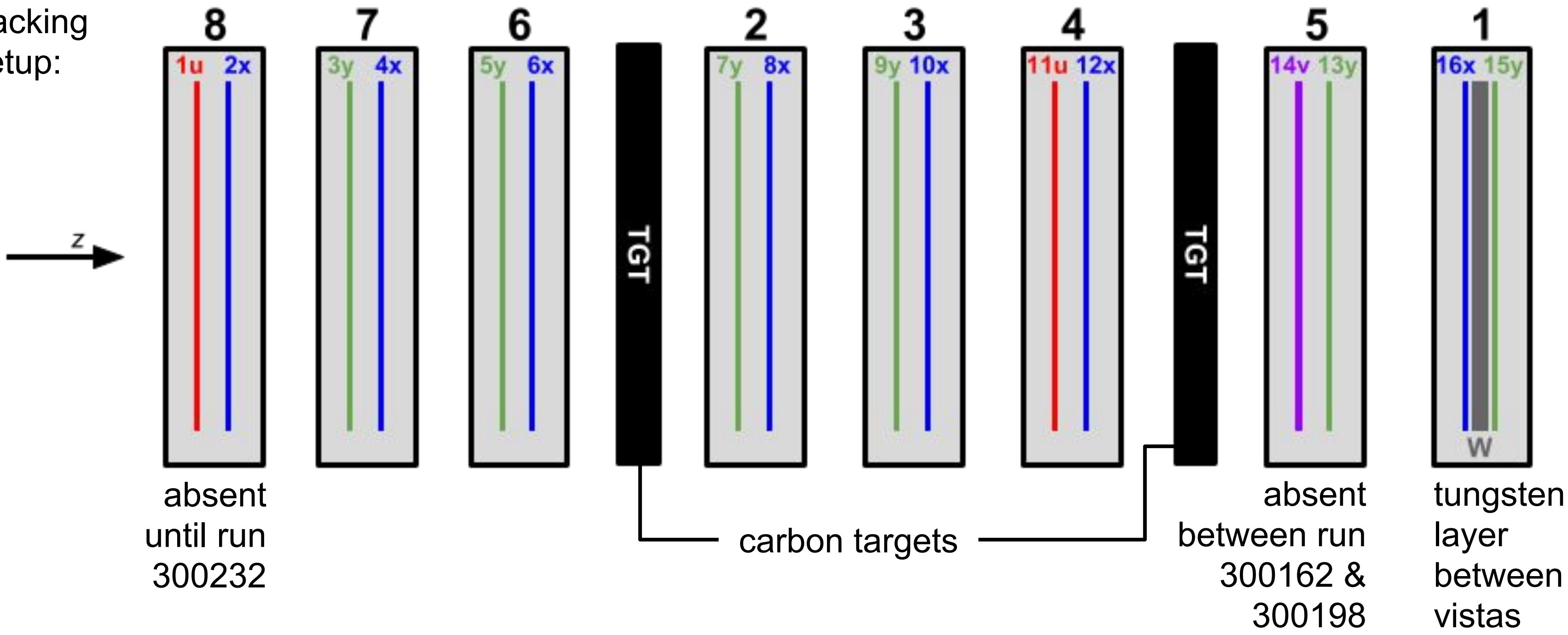
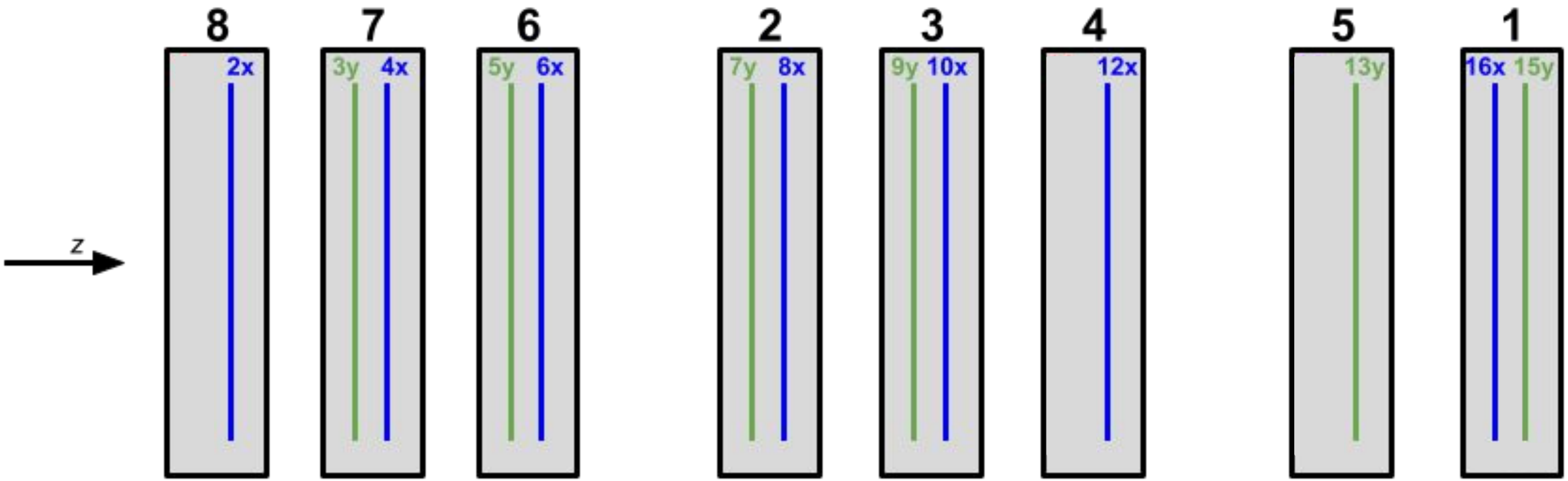
A PRELIMINARY ALGORITHM FOR *x* & *y* LAYERS ALIGNMENT

tracking setup:



1ST OF ALL, LET’S CONSIDER ONLY *x* & *y* VISTAS

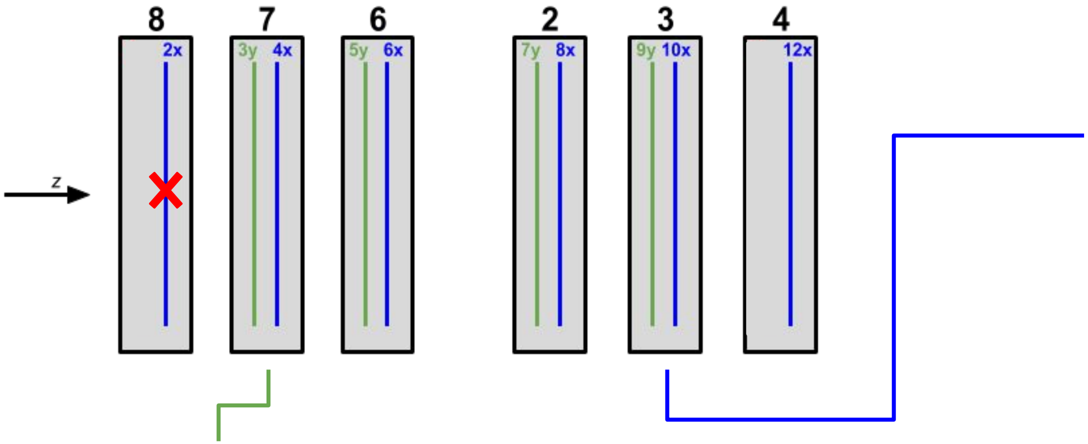


7 x & 6 y vistas in total (6 x & 6 y until run 300232). In particular:

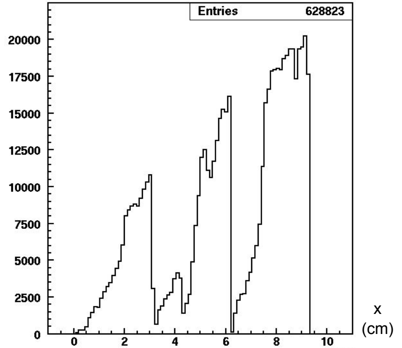
→ 3 x & 2 y for the incoming beam
→ 3 x & 2 y between the 2 targets
→ 1 x & 2 y downstream

In the following, plots show data from run 300133 (1st 3000 files) → 2x absent

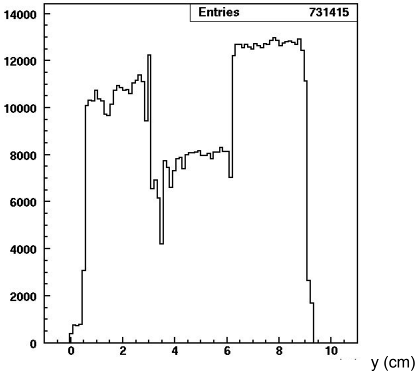
1ST OF ALL, LET'S CONSIDER ONLY *x* & *y* VISTAS



10x: the whole layer exhibits local inefficiencies (this is a minor issue because this vista is redundant since there are 3 x vistas between the targets)

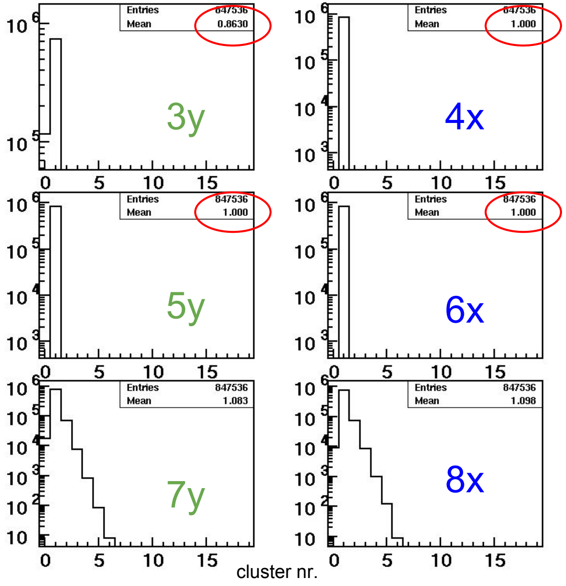


3y: ASIC 2 is a bit inefficient



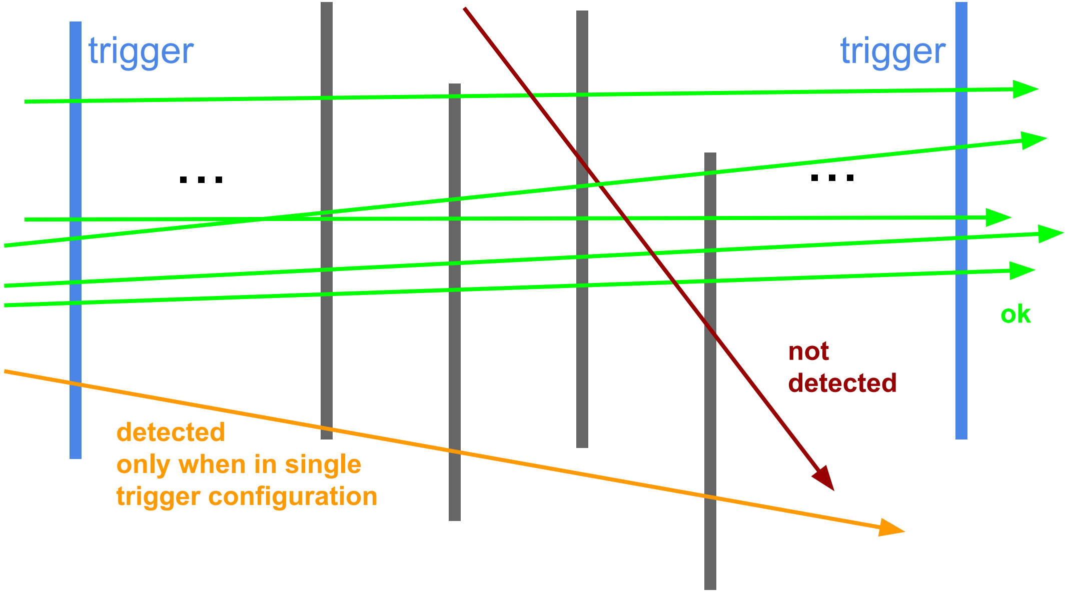
It is important to note that requiring the single (or any nonzero) cluster condition on these two layers would lead to global inefficiencies in detecting tracks passing through 3y & 10x local inefficiencies.

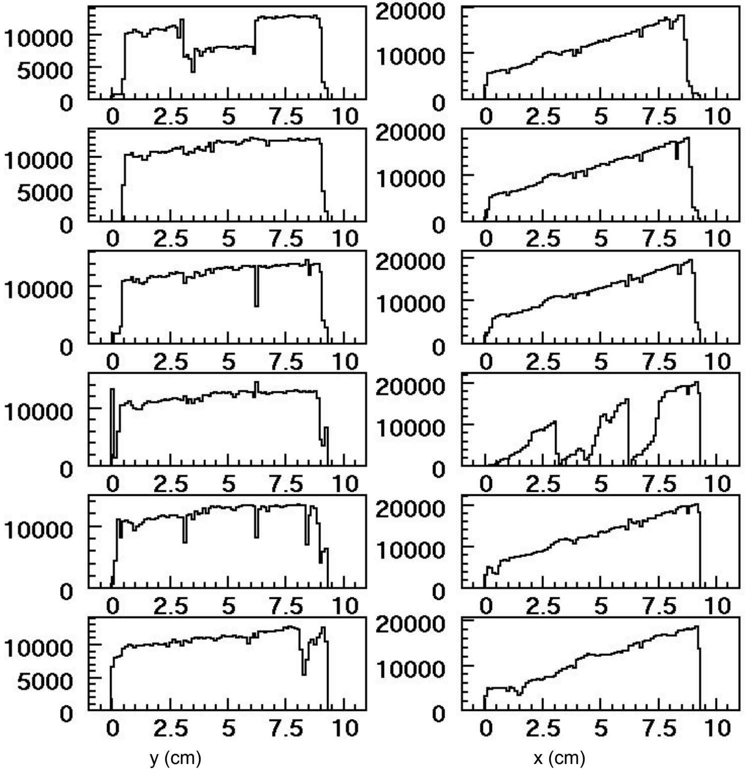
This is why 1st level event selection (which is performed by the ASCII creation algorithm) asks only 4x, 5y and 6x to be single cluster while 3x is asked to be zero <u>or</u> single cluster. (no condition on 2x because it was initially absent and now it is left free for input beam multiplicity control)



BEAM PROFILING & TRACKING PRINCIPLES

Let's consider one particular transverse direction (*x* or *y*) & let's start with the assumption that all the layers haven't any relative tilt about any axis → beam profile for each layer...

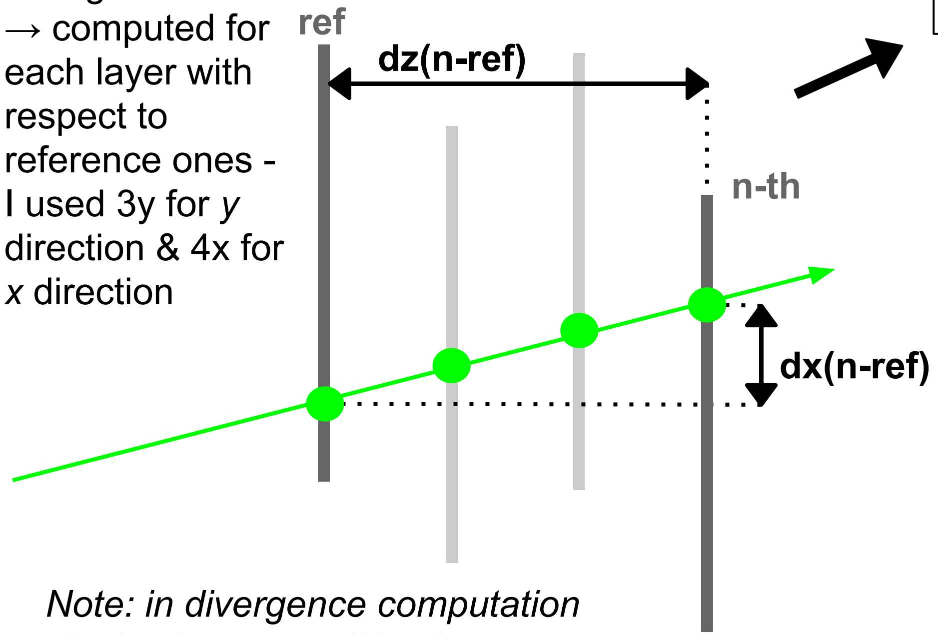




Note: requiring a global multiplicity cut for studying the beam profiles is unnecessary as well as problematic

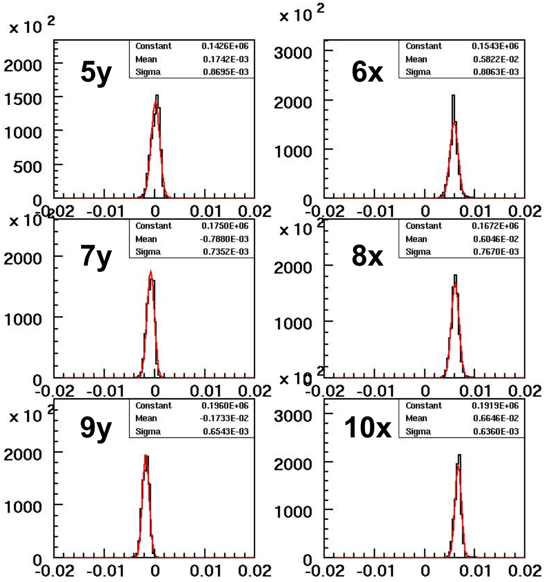
BEAM PROFILING & TRACKING PRINCIPLES

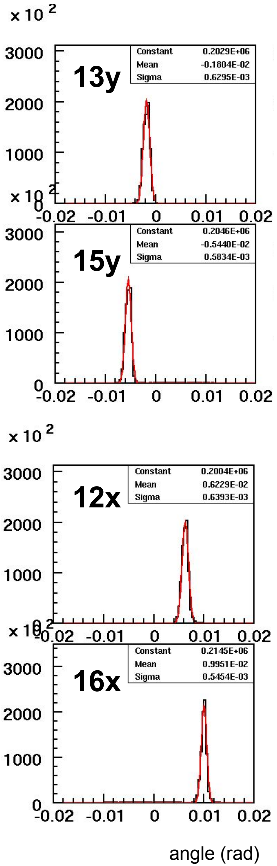
Then, inter-layer divergences → computed for each layer with respect to reference ones - I used 3y for *y* direction & 4x for *x* direction



Note: in divergence computation single cluster condition ***is necessary*** *for both the n-th and the reference layers, in order to make sure to couple points of the same track*

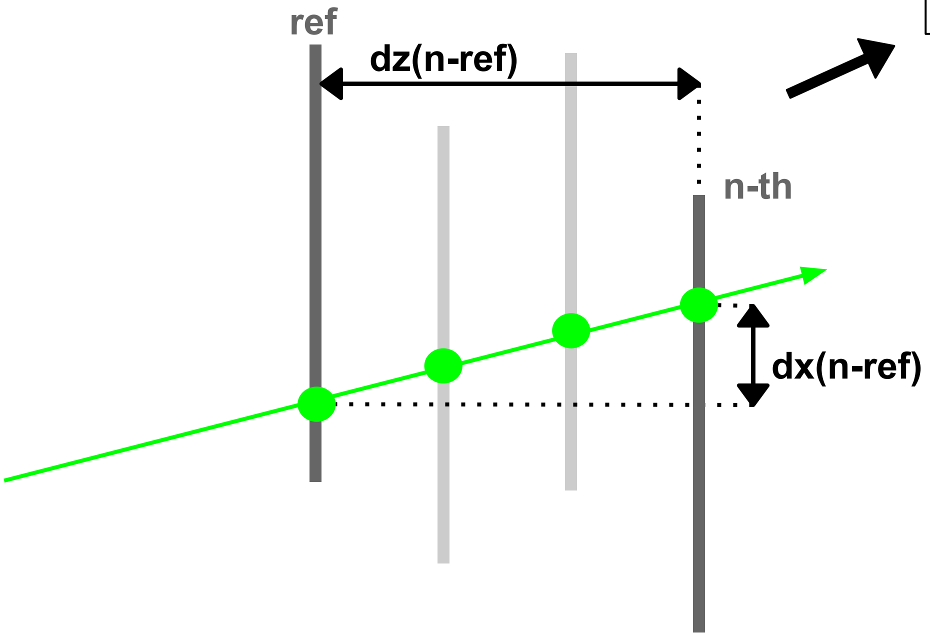
$$\mathrm{div}(n) = \mathrm{atan}(dx(n\text{-}ref)/dz(n\text{-}ref))$$





In general modules show relative shifts in the *xy* plane → this leads to shifts in divergence distributions… **⇒ <div(n)>**

BEAM PROFILING & TRACKING PRINCIPLES



div(n) = atan(dx(n-ref)/dz(n-ref))

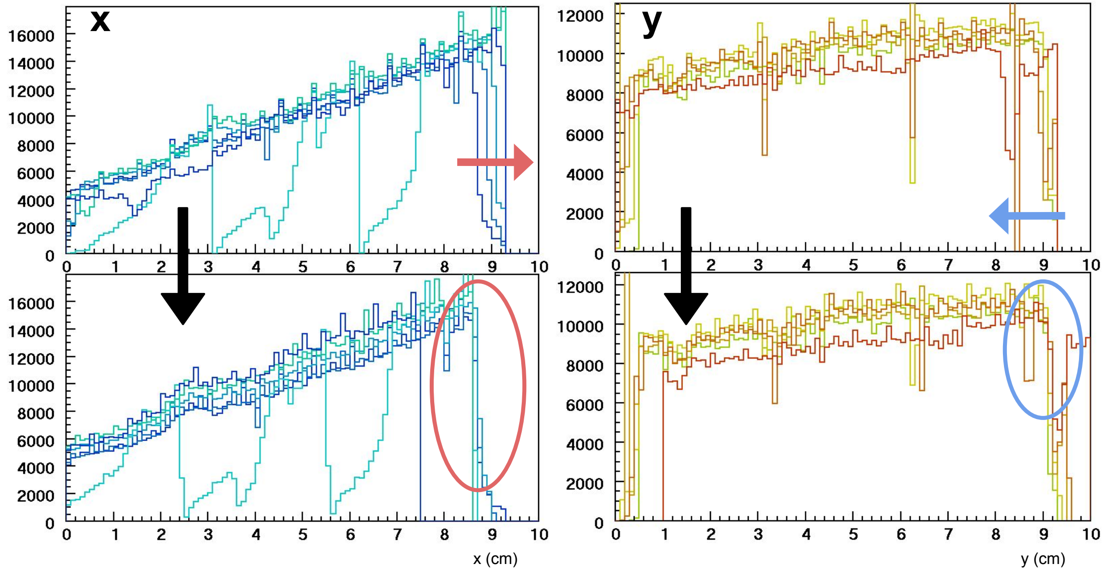
Note: at this point I need *z* positions of each layer; according to my initial hypothesis (no relative tilts) these values are not functions of the position in transverse (*xy*) plane. I used:

z(01) -2.40 → stereo (u)
z(02) -0.30
z(03)= 15.60 -2.50
z(04)= 15.60 -0.50
z(05)= 50.00 -2.50
z(06)= 50.00 -0.50
z(07)= 71.40 -1.50
z(08)= 71.40 -0.33
z(09)=117.00 -2.50
z(10)=117.00 -0.50
z(11)=126.90 -1.83 → stereo (u)
z(12)=126.90 -0.50
z(13)=148.10 -0.34
z(14)=148.10 -1.56 → stereo (v)
z(15)=198.10 -1.00
z(16)=198.10 -2.30

FROM DIVERGENCE TO TRANSVERSE ALIGNMENT

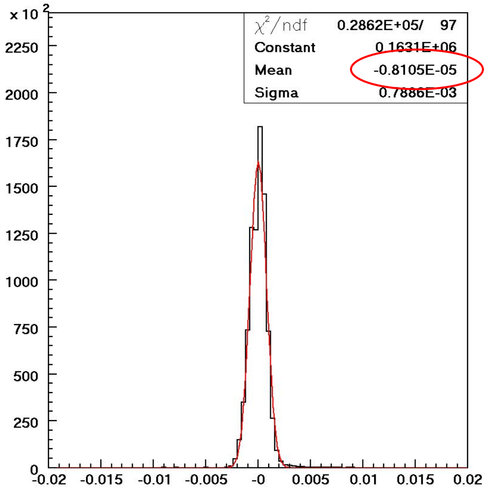
$$x'(n) = x(n) - dz(n\text{-}ref)*\langle div(n)\rangle$$

Now x'(n) profiles are aligned with respect to reference module



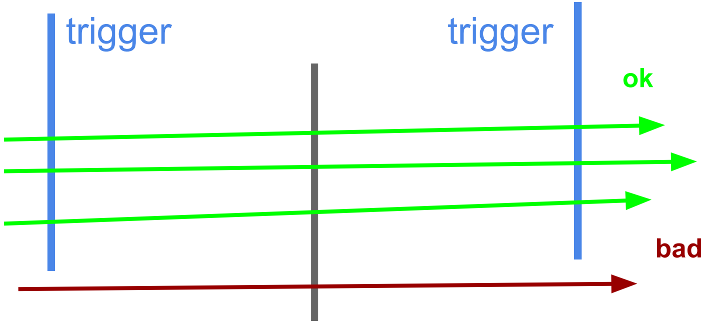
Cross-check: one can recompute inter-layer divergences with these new coordinates → new distributions should have <div(n)> ~ 0

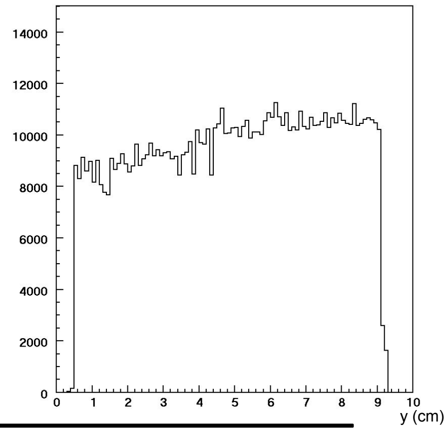
e.g. for 8x:



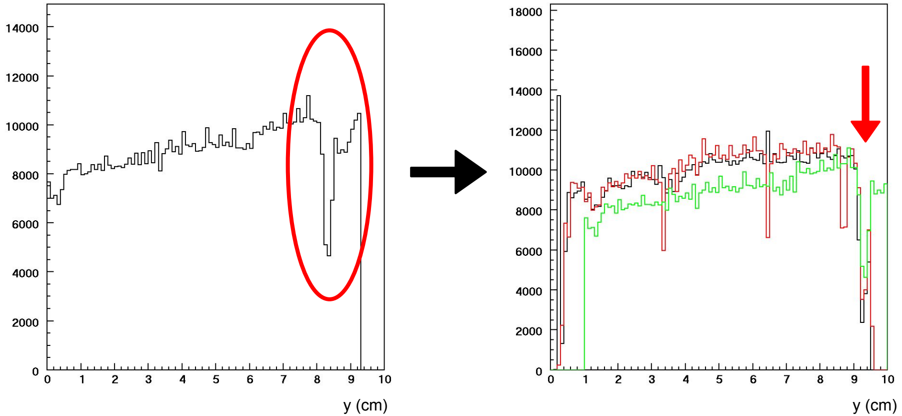
MISCELLANEOUS ON BEAM PROFILES

Consider, for example, the beam profile of module 5y: lack of events left to ~5mm is probably due to a lack of coverage of the trigger detectors

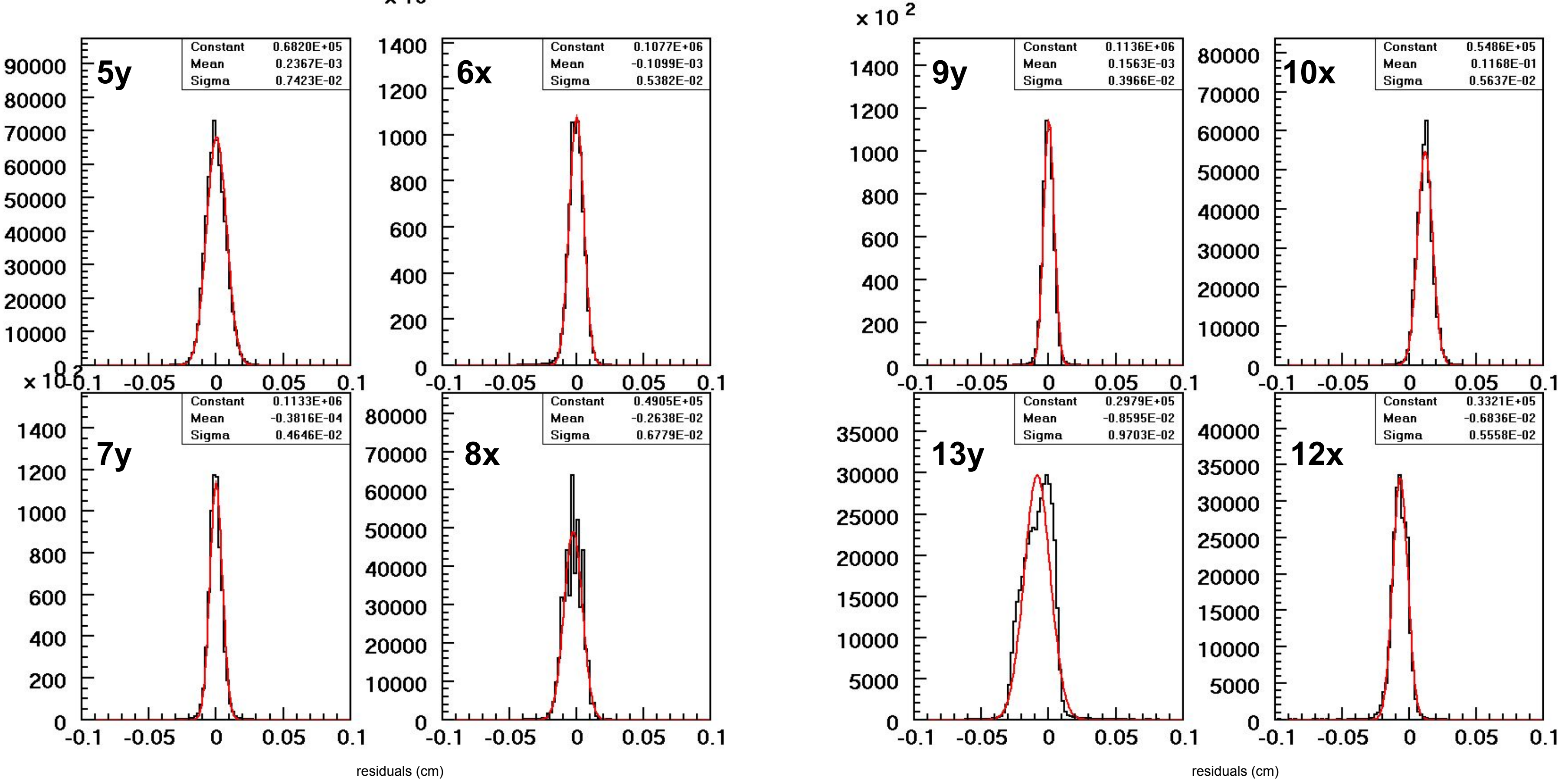




Layer 13y shows a particular structure in the right side (right to ~8cm). At first I thought it was a local inefficiency around ~8.2cm but then I noticed from alignment process results that this structure is present in upstream layers too (9y & 7y) → this needs some investigation...

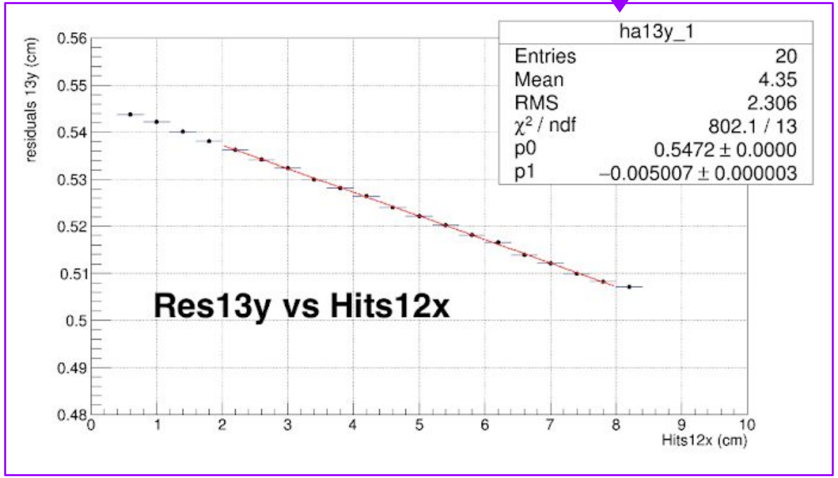


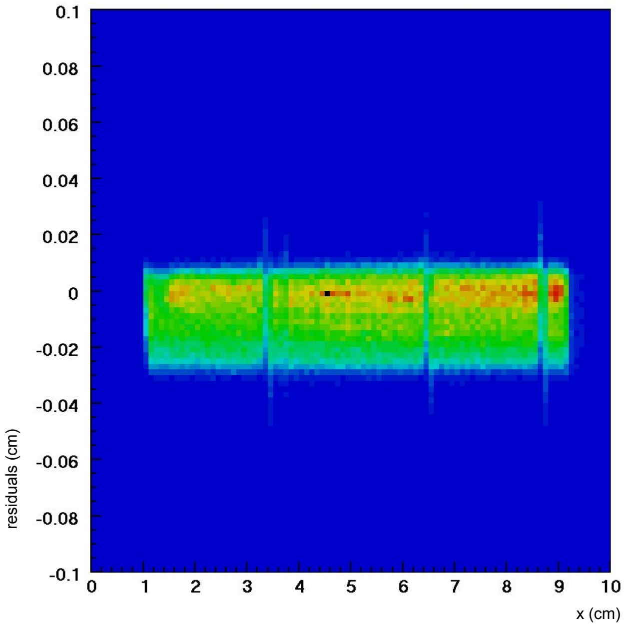
RESIDUALS


5y
Constant 0.6820E+05
Mean 0.2367E-03
Sigma 0.7423E-02
6x
Constant 0.1077E+06
Mean -0.1099E-03
Sigma 0.5382E-02
9y
Constant 0.1136E+06
Mean 0.1563E-03
Sigma 0.3966E-02
10x
Constant 0.5486E+05
Mean 0.1168E-01
Sigma 0.5637E-02
7y
Constant 0.1133E+06
Mean -0.3816E-04
Sigma 0.4646E-02
8x
Constant 0.4905E+05
Mean -0.2638E-02
Sigma 0.6779E-02
13y
Constant 0.2979E+05
Mean -0.8595E-02
Sigma 0.9703E-02
12x
Constant 0.3321E+05
Mean -0.6836E-02
Sigma 0.5558E-02
residuals (cm)
residuals (cm)

RESIDUALS

- ➔ For each layer, the 2 nearest layers of the same vista are used as reference layers - e.g. for 6x the reference layers are 4x and 8x. For 3y, 4x, 15y & 16x results are bad (>~100um), because these layers are at the boundaries of the setup (i.e. they are not sandwitched in their reference system)
- ➔ Layer 10x: residuals distribution is not centered in 0 even if its divergence shift has been taken into account - probably this is due to the malfunctioning of the whole layer
- ➔ Layer 13y: residuals distribution has a strange shape. Might be due to some tilt? Plot of residual versus opposite vista (12x) does not seem to help; what is more, it seems to be different from Antonio's plot.
  ⇒ Further investigation needed...





OUTLOOK

These are just the 1st steps in tracking system alignment… What can be next?

- ➔ Multiple iterations in divergence transverse shift subtraction
- ➔ Study of tilts about x, y and z - how much do they affect the detectors performance?
- ➔ Stereo layers
- ➔ ……….

Calorimeter(s) data are waiting to be studied too!

Thank you!