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FT code structure

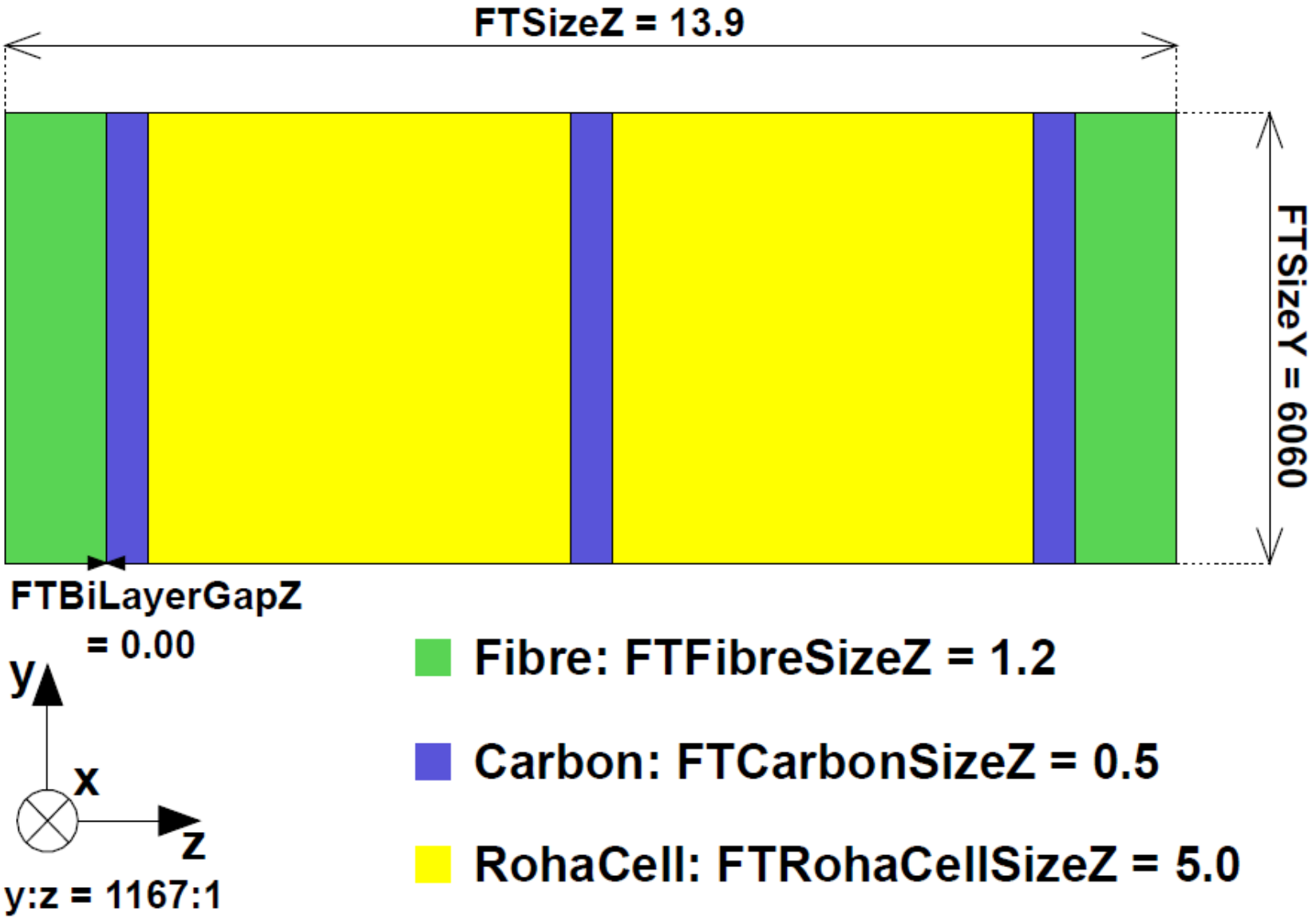
- Detector description
- Digitisation
- DAQ coding/decoding

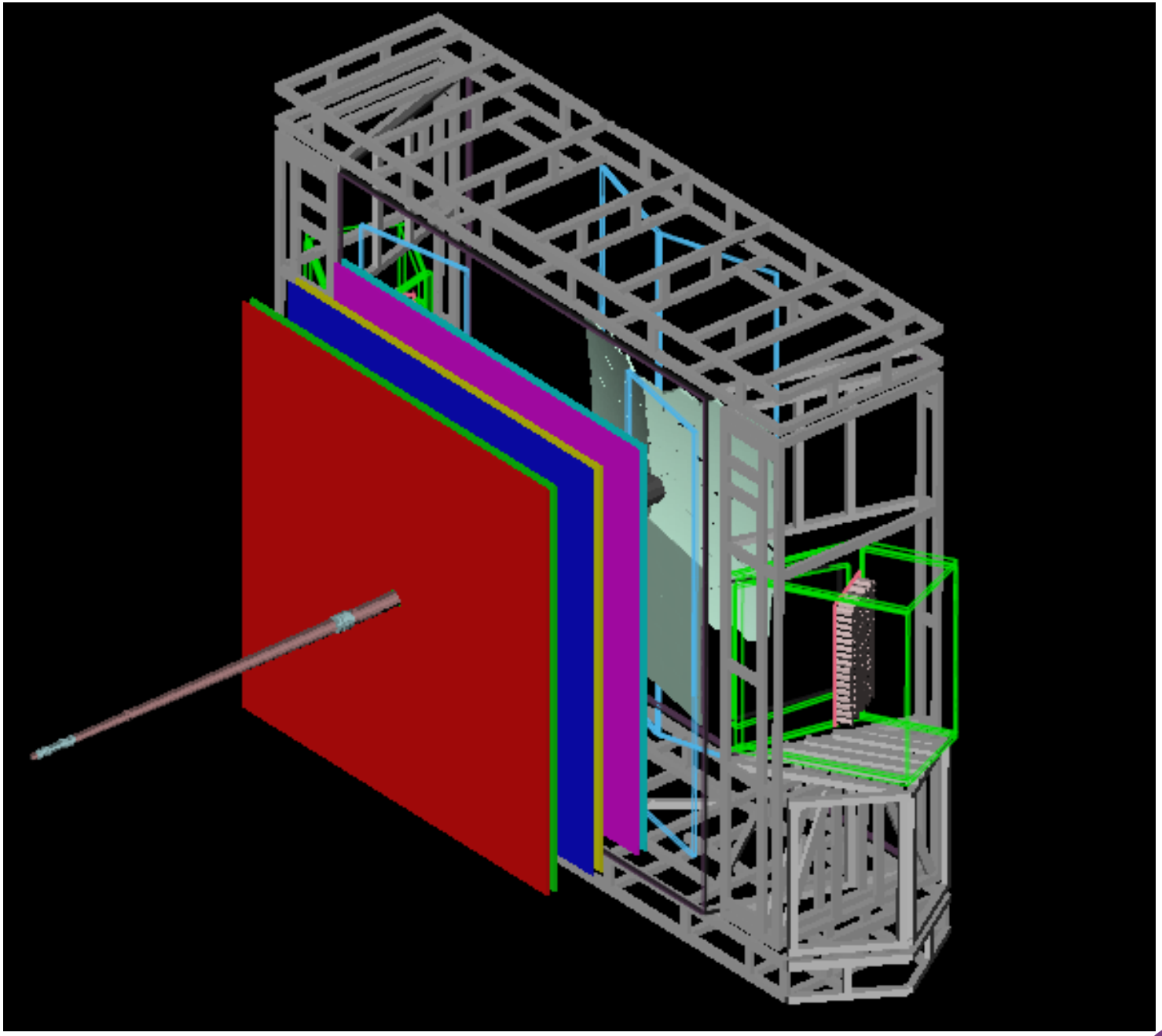
FT detector geometry

- **Purpose: Replaces OT and IT as tracking after the magnet**
  - It may be that we need some IT, this is expensive and will add some material in the acceptance
  - We want first to see what can be done with a very clean detector, i.e. no cable / electronics / supports in the acceptance

- **Overall layout**
  - 3 stations, 4 layers per stations, x-u-v-x as now, vertical (not at constant z), positionned where the OT C-frames are.
  - Mechanically we hope to build bi-layers, with two sensitive layers separated by a carbon fibre-rohacell sandwich.
  - Each sensitive layer is 1.2 mm thick scintillating fibre layer.

lvBilayer# (# = 0..5)

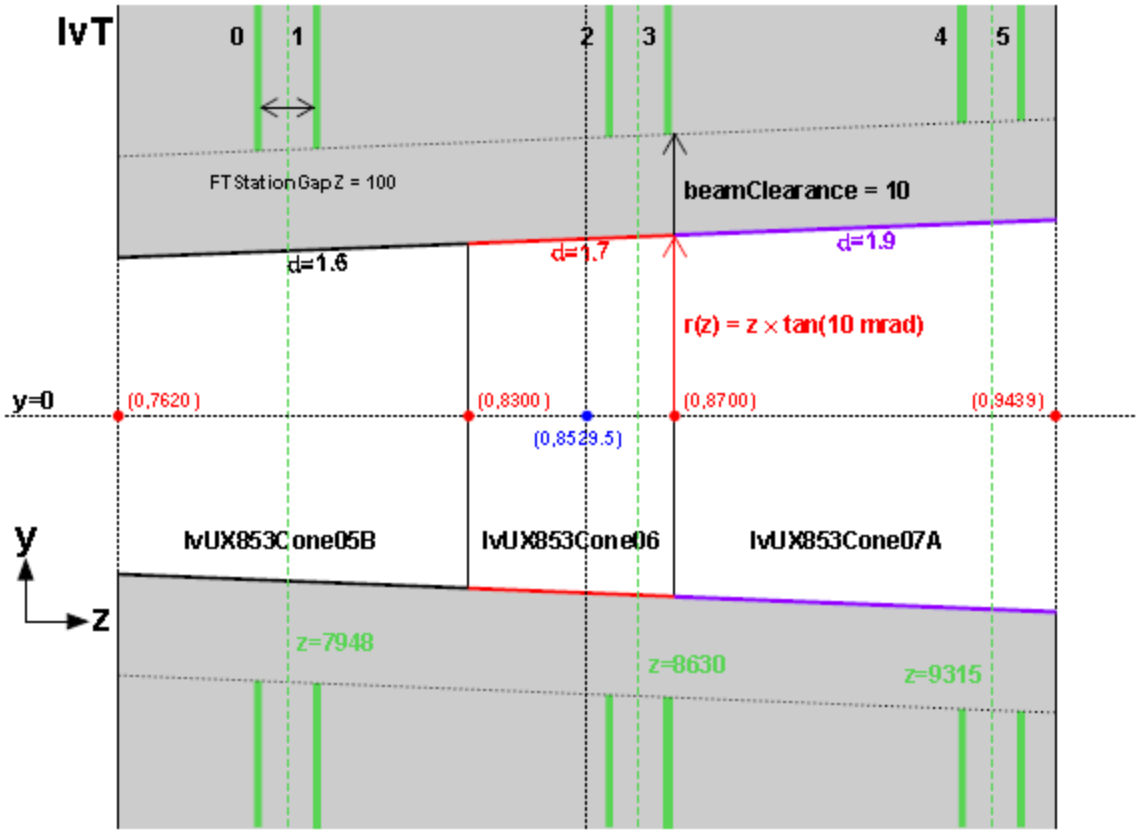




News

- Stations T1-3 now are centerd at the same place like the OT stations
- Stations T1-3 now have same x-y dimensions like the OT stations ($L_x = 8180, L_y = 6060$)
- Stations T1-3 are tilted along x-axis, $\phi = 3.601\,\text{mrad}$ (like OT)
- Hole-radius in BiLayers are now in dependence of z:

$$h(z) = z \times \tan(10\,\text{mrad}) + 10 + BeamPipeThickness(1.6, 1.7, 1.9)$$



Gauss

- **No specific code**
  - MCHits generated in the sensitive volume, i.e. the scintillating fibres.
  - Put in a dedicated MCHit container for FT

Boole

- **Digitisation is at the prototype stage**
  - Convert the position of a MC hit (entry, exit) to a list of channels fired, with the average position in the cell.
  - Convert the energy in each cell to digits
  - Cluster the digits, compute a barycentre
  - Store in the Raw Event
  - Store also the truth cluster -> MCParticles with a standard Linker.

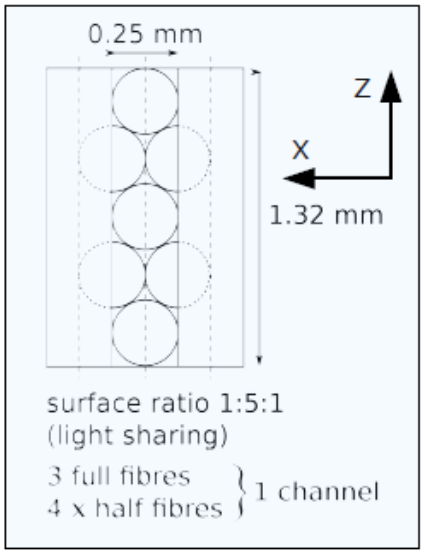
- **A bit more on the geometry: The detector elements**
  - 4 level structure, but only first and last used
  - DeFTDetector made of 3 stations, made of 2 biLayers, made of 2 DeFTLayer.
  - The detector is mainly a collection of layers, plus access to them.

geometry

- **Each layer is divided in 4 quarters**
  - Like OT: Top/Bottom, Right and Left.
  - Each quarter is readout by a number of SiPM
    - Each SiPM has 128 channels, in two groups of 64
    - Each cell is reading out 0.25 mm of the scintillating fibre layer
    - There is a gap of .25 mm between channels 63 and 64
    - There is a gap of .25 mm before channel 0 and after channel 127
  - In short, an SiPM covers 128+3 cells of 0.25 mm, but reads out only 128.
  - The geometry of the SiPM is defined inside the DeFTLayer detector element code
  - Two xml parameters: Layer ID and stereo angle.
  - Debugging algorithm released with the package

Digitisation

- **Simplified for the time being**
  - Light sharing from the fibre layer to the SiPM not taken into account
    - Fibre boundary are not aligned with cell boundaries
    - But this will be less 'perfect' than here
    - Average sharing depends on the local position in the cell
      - ➔A deposit at the boundary gives 50% on each side, a deposit in the centre gives 0% outside…
  - Conversion to ADC just linear
    - Need to convert to the expected number of photo electrons, get a real number from a Poisson distribution, convert to ADC, add noise.



readout

Process the list of cells + ADC to clusters

- Very simplified algorithm
  - The ADC will probably be 5 bits, no need for very complex processing
- First channel over threshold, continue until one channel below threshold
  - No clustering between channel 63 and 64 as there is a real gap
  - No clustering between SiPM as the hardware won't allow it, and there is an even bigger gap.
  - Maximum cluster size limited by readout format
    - ➔ Maximum 8 cells in a cluster
- Create the FTCluster objects and put them in a container

Convert the FTClusters to banks

- Assume one TELL40 per quarter layer
- Assume we would like to have also empty SiPM in the bank

Simple format

- Each bank is a list of SiPM blocks, coming from the front-end electronics.
- Each SiPM start s with a simple 16 bit word
  - SiPM number (7 bits), number of clusters (4 bits)
- Each cluster encodes the barycentre as a cell number (7 bits) and a fractional part (3 bits), the number of cells-1 in the cluster (3 bits) and the remaining 3 bits are foreseen as indicator of total charge, to identify clusters with several particles.

This format is a first attempt

- This is a basis for discussion in the SciFi group
  - Is it technically feasible in the front-end, in the TELL40
  - Is the accuracy too high? Too low?
  - Should we remove empty SiPM completely?

Summary

- **FT is a new detector**
  - Several issues are unclear
  - We had to assume certain responses, but this may change
  - Code is at the draft level, waiting for the review!

- **Thanks for helping us to improve it.**