CLIC vertex and tracking system: Hardware considerations

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Outline

- How to build the barrel support structures?

  - General concept

  - Static deformation

  - Material budget

  - Advanced ideas

- Arrangement of modules?

- Can we put an additional barrel layer to the design?

- Barrel to endcap transition?

CLIC vertex and tracking system: Hardware considerations

Current tracker layout

- 5 Barrel layers
- 7 Endcap discs
- Support tube for beam pipe divides tracker into inner and outer part

~4.6m

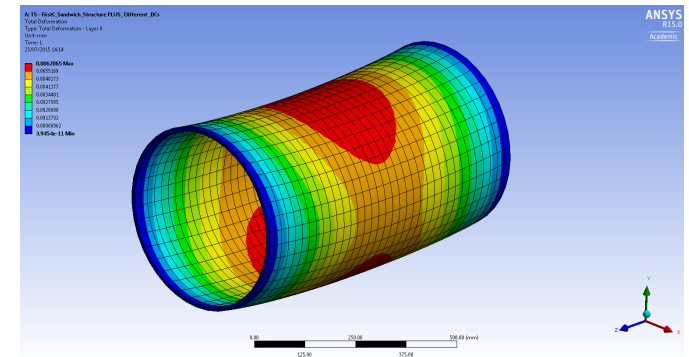~3m

Barrel support structures

CLIC vertex and tracking system:
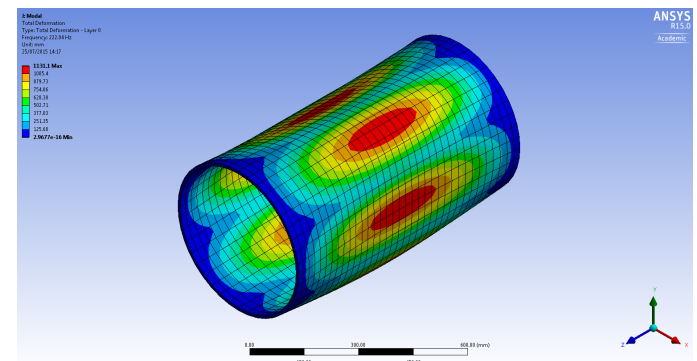Hardware considerations

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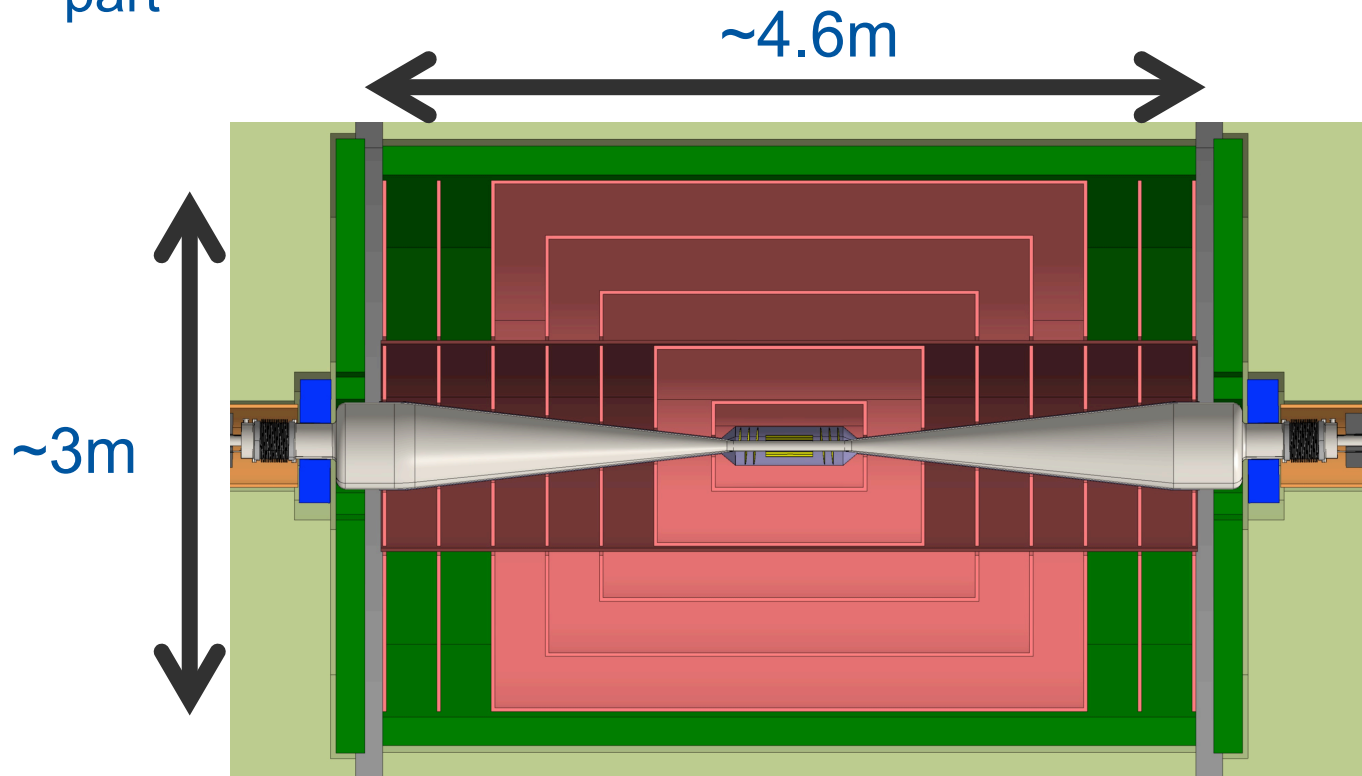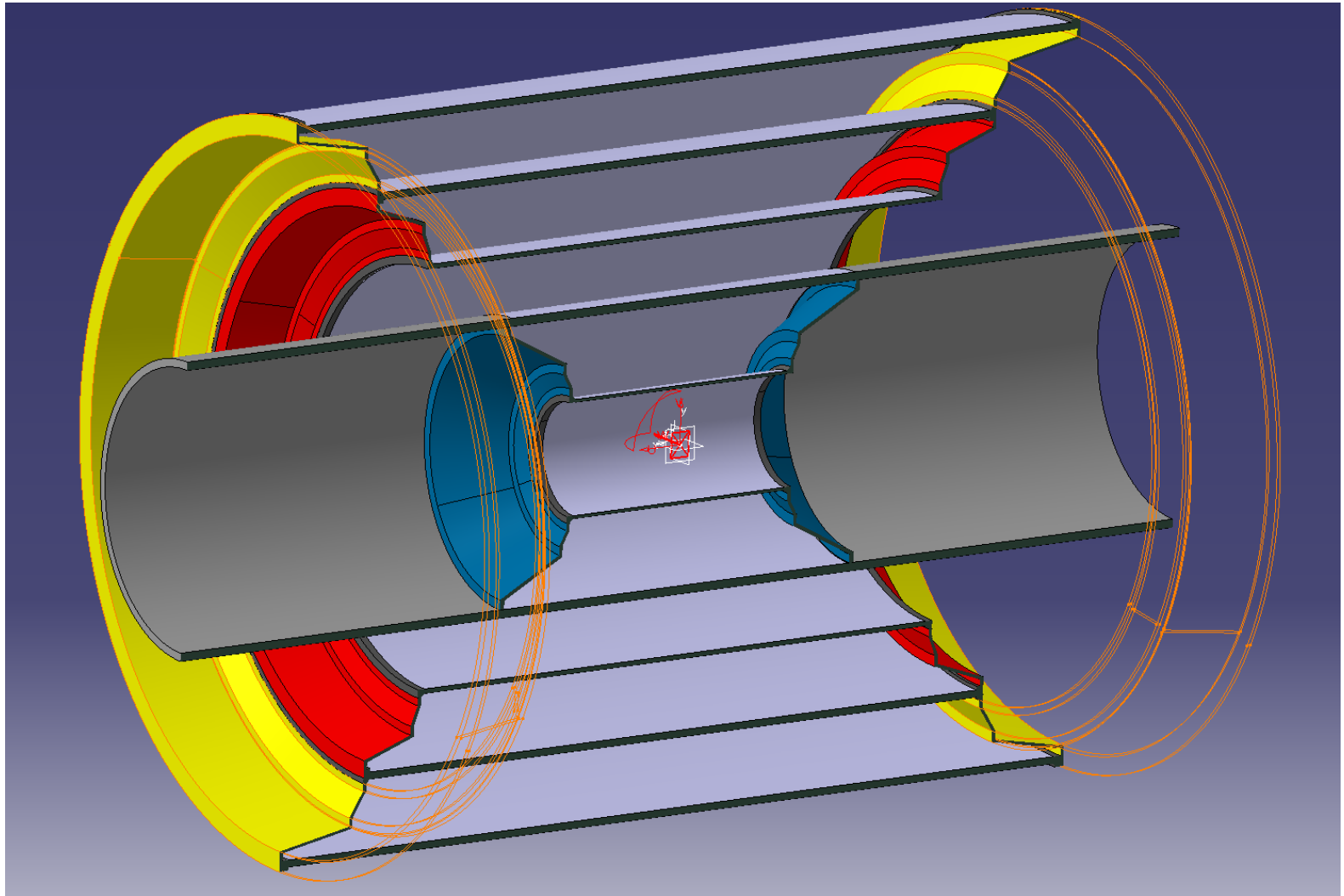
Finite element simulation

- Honeycomb-core + carbon fiber skin

- Finite element analysis of static deflection and vibration modes

- Variation of material parameters
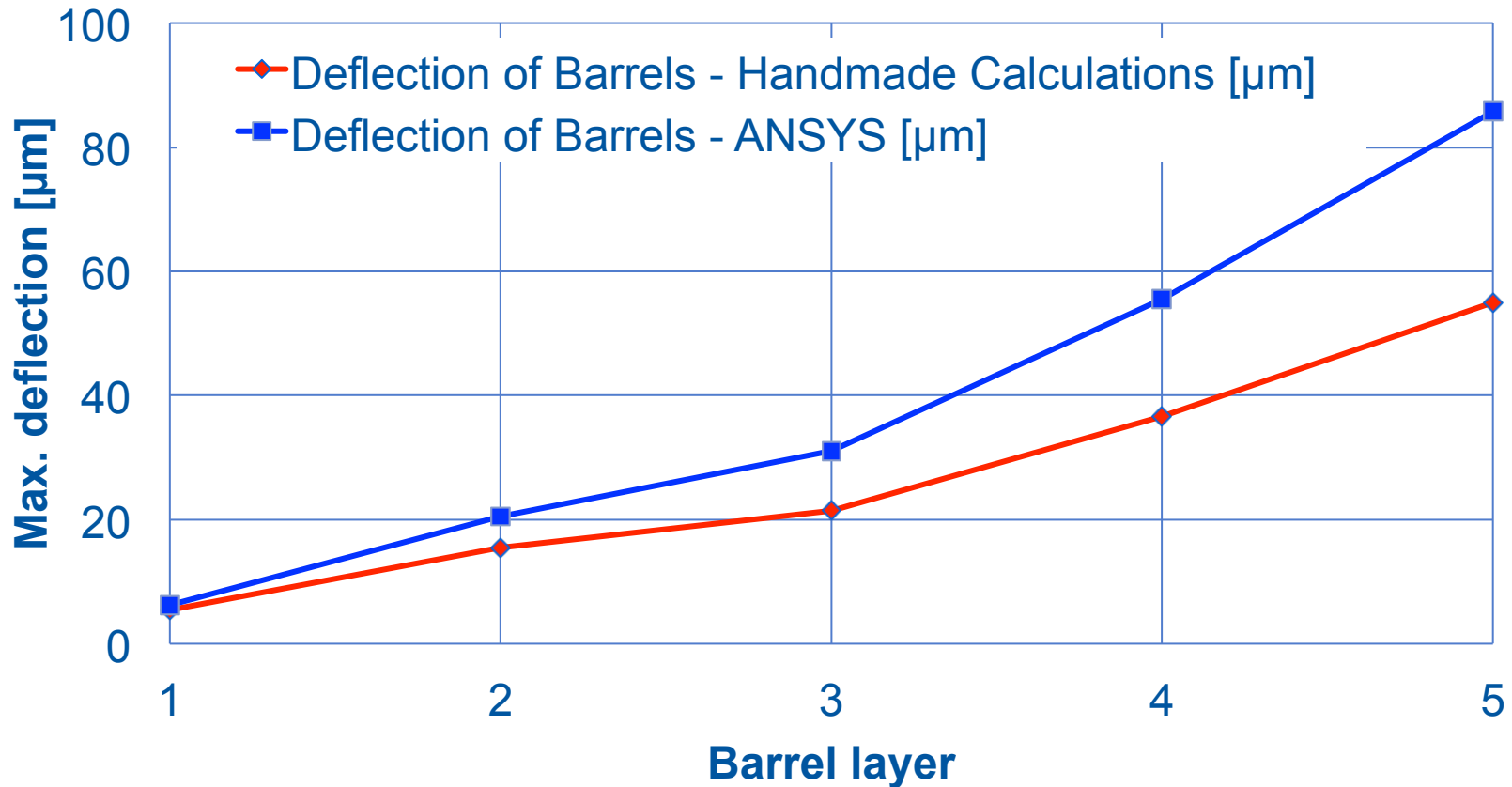
  - Type

  - Thicknesses

  - CF-layup

  - …

Static deformation

Natural 1. vibration mode

Static deformation

- Static deformation below 100μm feasible

Summary on material budget

Layer	Radius [mm]	Length [mm]	Thickness Honeycomb Core [mm]	Thickness CF Skins [mm]	Mass [kg]	X/X0 (Support) [%]	X/X0 (total) [%X0]
1	230	961.3	10	0.6	3.17	**0.54**	1.57
2 (ST)	575	4520	30	1.2	79.2	**1.15**	2.15
3	840	1921.6	15	1.2	44.8	**1.04**	2.06
4	1145	2762.1	25	1.2	93.5	**1.11**	2.13
5	1450	3122.6	25	1.2	134	**1.11**	2.13

- X/X0 in the range of 0.5 to 1.1% per layer for the support structure

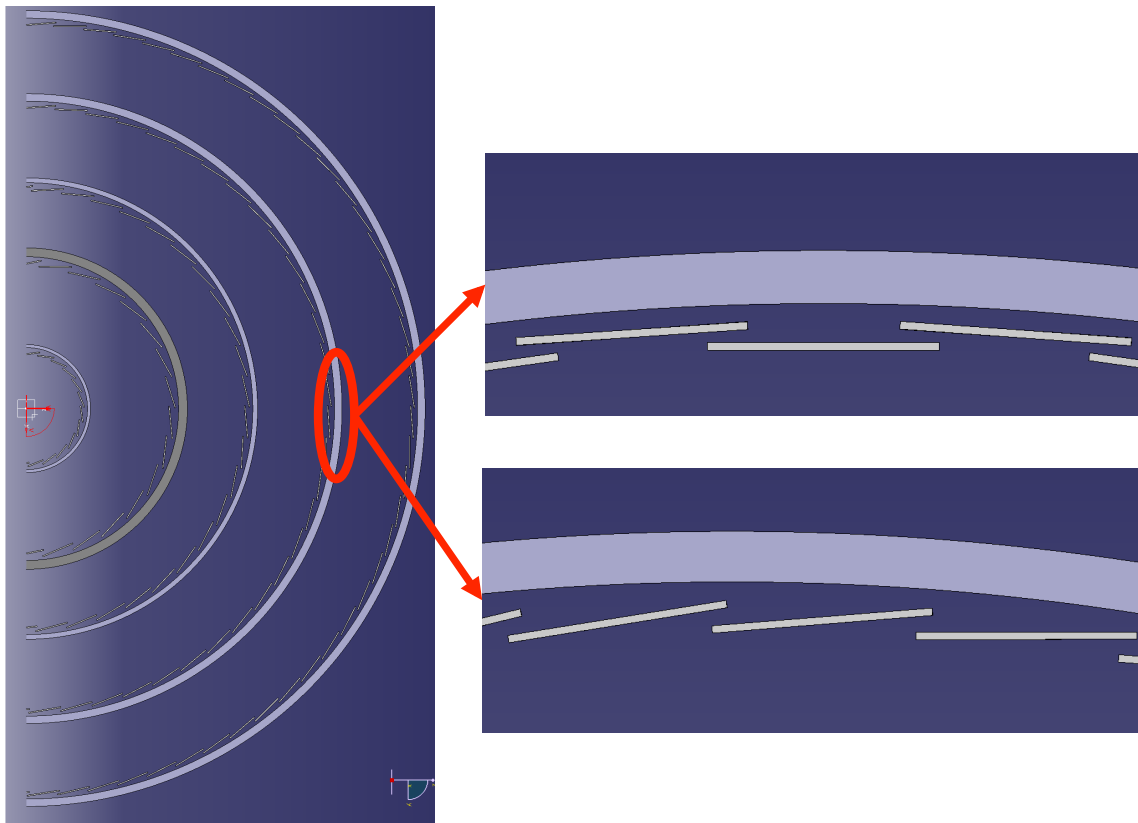# Support structure – looking for inspiration

- First ideas on using Alice ITK space frames to build supports, work in progress
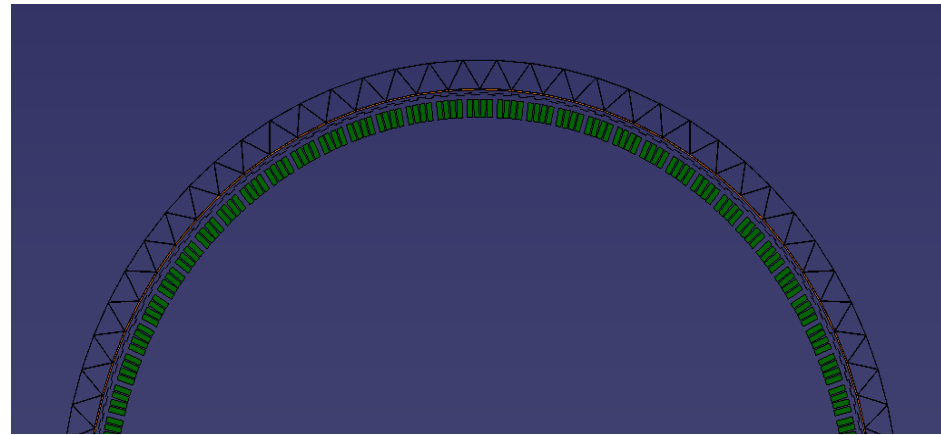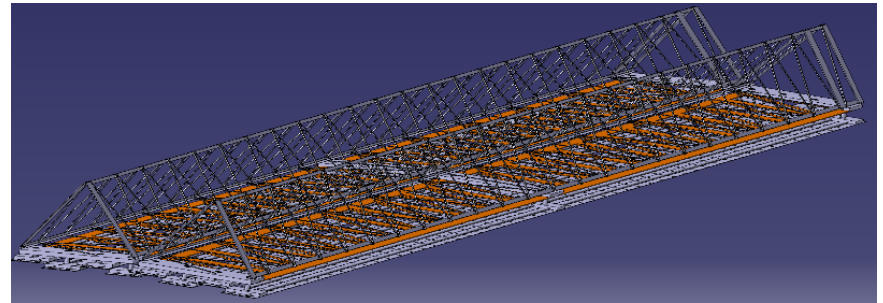
Arrangement of modules?

- Modules will be placed on the support cylinders
- Two options
  - Staggered
  - Windmill
- Points to consider:
  - Nb. of modules
  - Overlap in rφ
  - Overlap in z?
  - Cooling
 - Lorentz angle
- Ongoing work

Additional barrel layer?

- Relatively large distance between outer vertex (R=60mm) layer and first tracker layer (R=230mm)

- Can an additional barrel layer 0 be placed closer to the vertex detector?

- Is it needed? Pixels: l=O(25μm) or strips: l=O(1mm)?
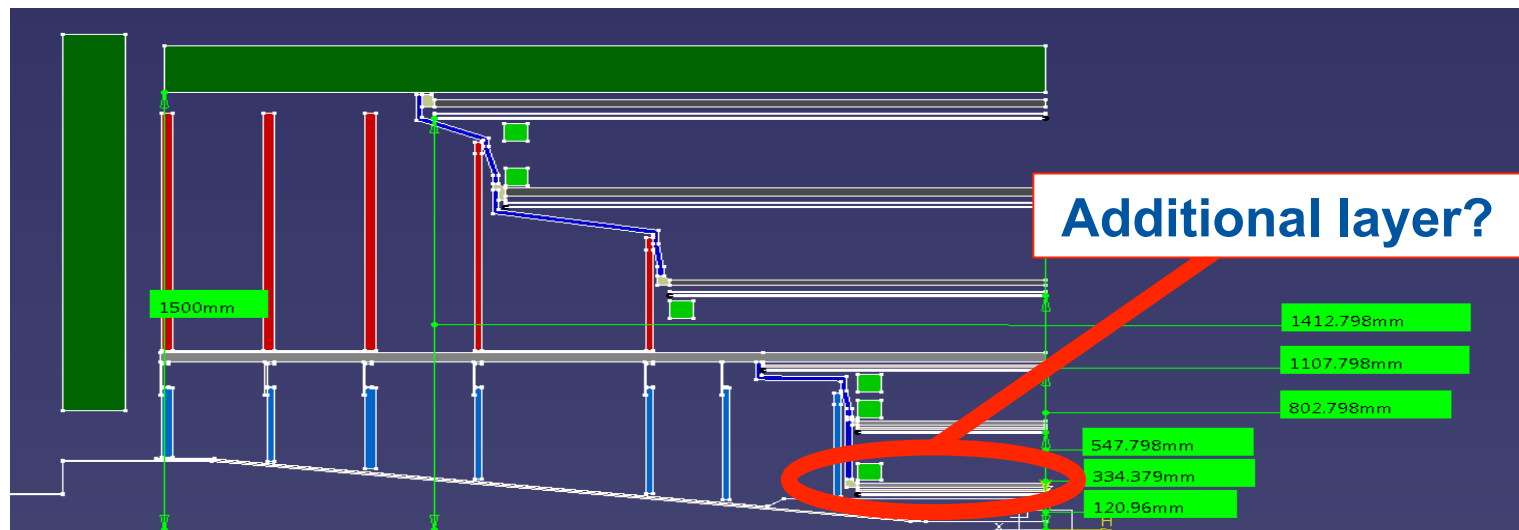
Barrel length

- Variation of barrel length / angle between barrel and endcap region in fast simulation

- Shorter barrel, worse pt-resolution
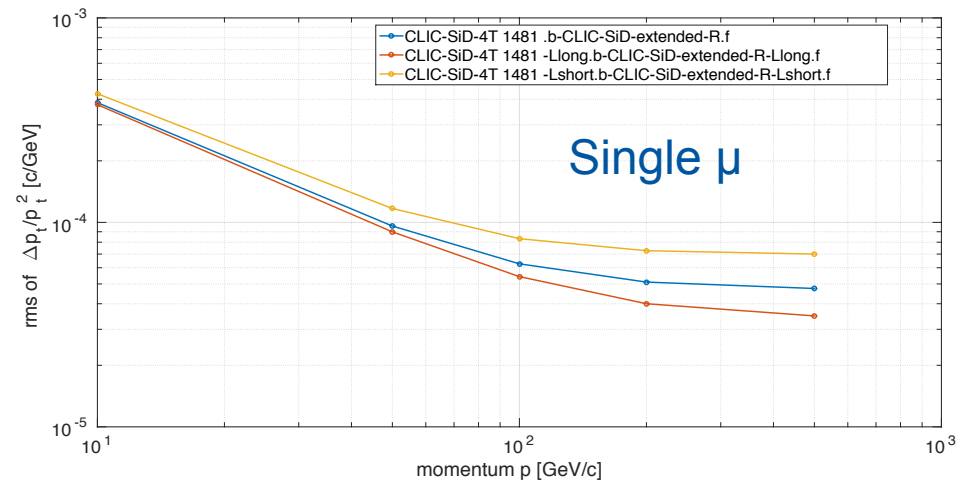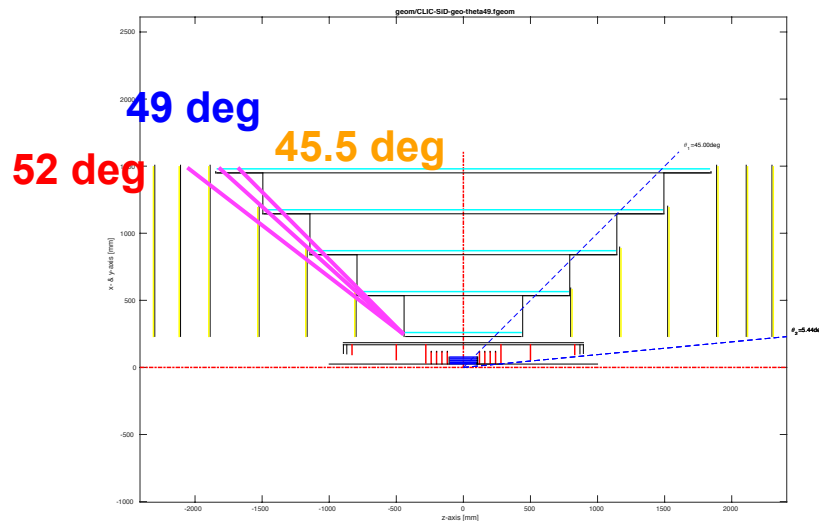
Barrel to Endcap transition?

- Each barrel layer has different length
- Services routed along barrel to endcap transition
- Large material contribution in small angular range
- Not pointing to IP
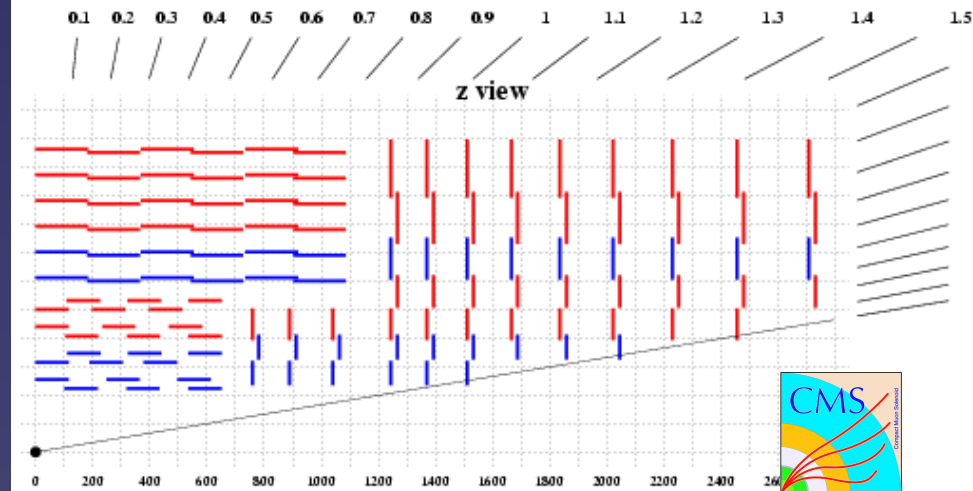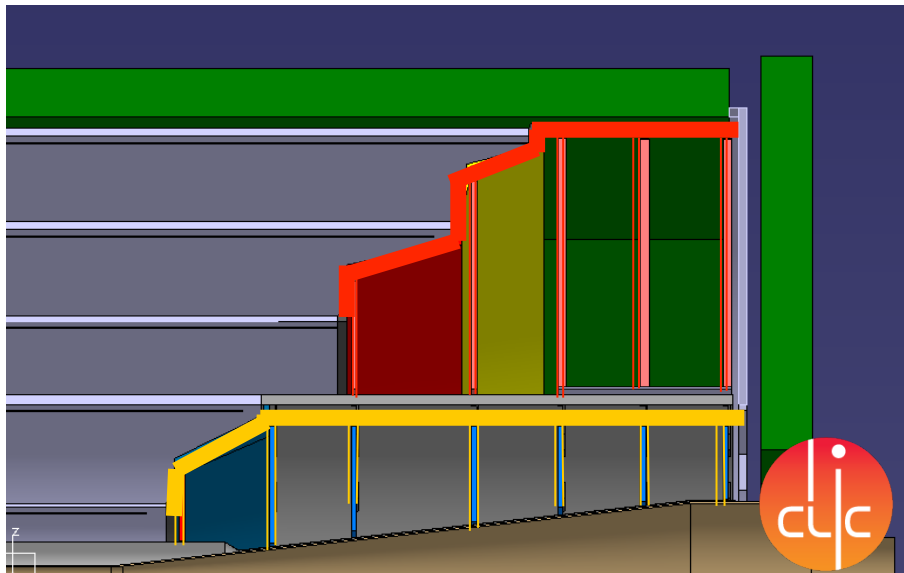
Summary

- Simulation on deformation of barrel support structures (CF skin + Honeycomb structure) resulted in estimation of material budget for supports
  - Input to simulations
- Started to look into possible alternatives, e.g. 3d space frame
- Module placement, staggered vs. windmill
- Additional barrel layer 0 seems feasible
  - Is it needed?
- Barrel to endcap transition?