SVT IB global mechanics

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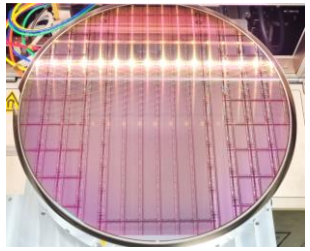
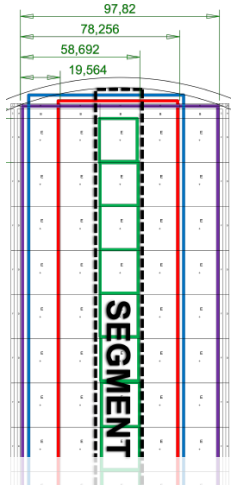
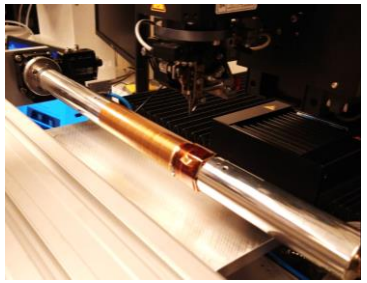
Generalities about SVT

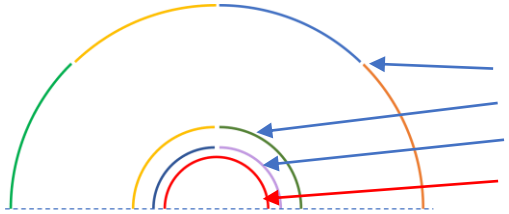
From DIS to exclusive process → high precision tracking hermeticity →
- high position resolution sensors
- low mass → low power

From ALICE/ITS3 development → 65 nm TPSCo technology with bent silicon sensors!



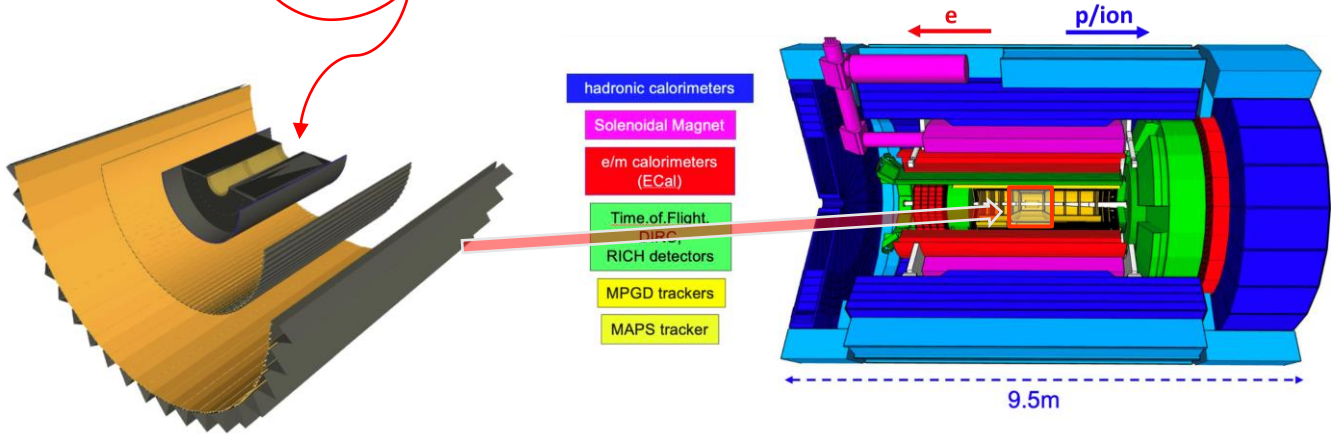






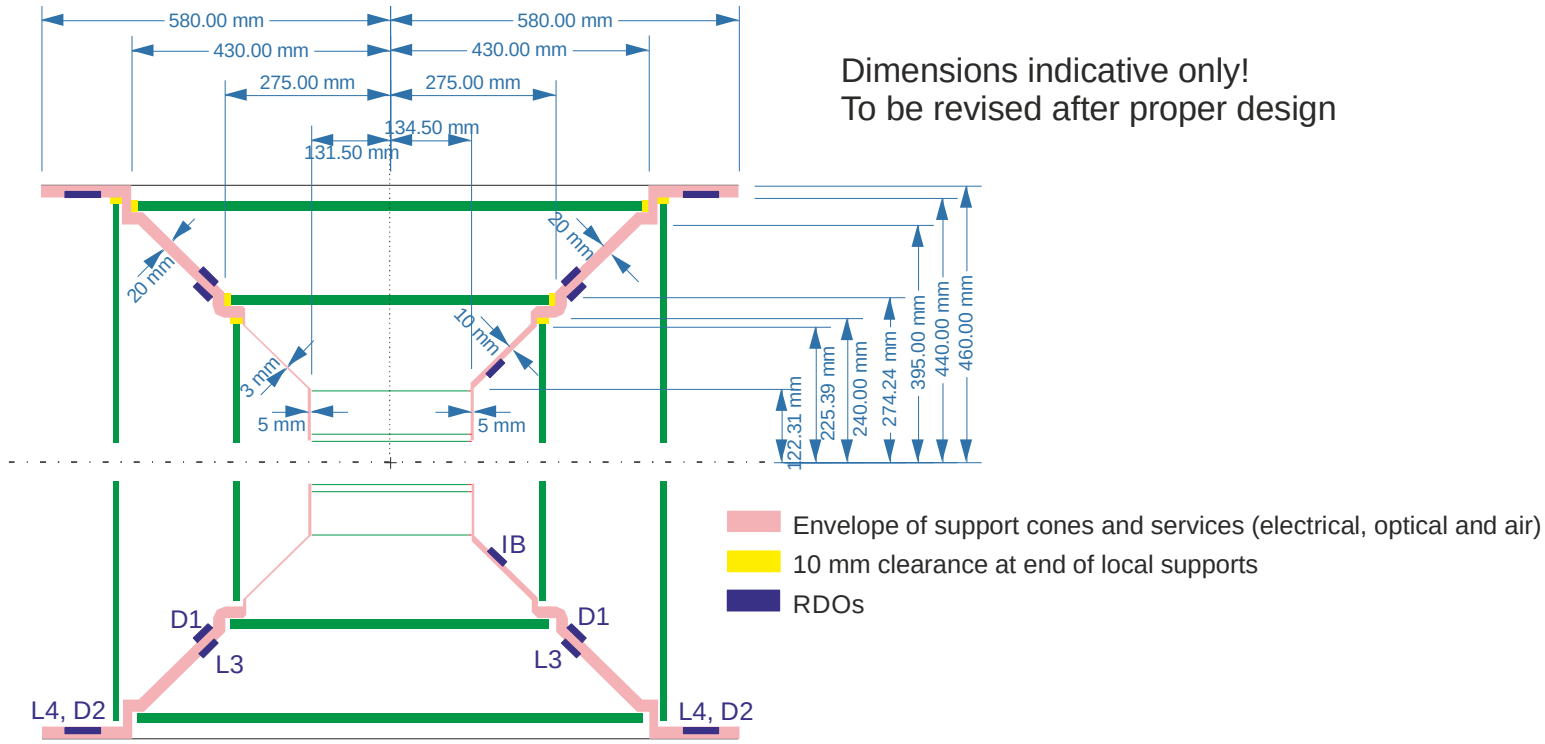
inner layers (3)

- Thinned down to 50 μm
- Pitch 21 × 23 μm
- 40 mW/cm^2 power dissipation (~800mW/ cm^2 in the LEC)
- 0.05% X /X_0 (just the sensor)
- ~ 3.3 g/sensor



General thoughts about global support

- Assembly procedure drives the design of the support
- Need to have as low as possible X, at least in the e-side
- Preliminary design with best-guess quotes (from G. Viehauser)
- OB/IB supports are two separated objects



Dimensions indicative only!
To be revised after proper design

- Just a reminder about properties one wants to find in the materials of the support/services (probably not exhaustive):
  - low X_0
  - hydrophobic
  - insulating
  - thermal and chemical stability
  - chemically not ‘‘dangerous’’ (e.g. no fluorine)
  - no flammability (and at least highly self-extinguishing)

- carbon fiber composites
- carbon foams
- kapton (and maybe other polymides)

not all properties are always satisfied…but can work on this
e.g. CF is hygroscopic…and conductive at high frequency!
but can be treated with parylene coating…

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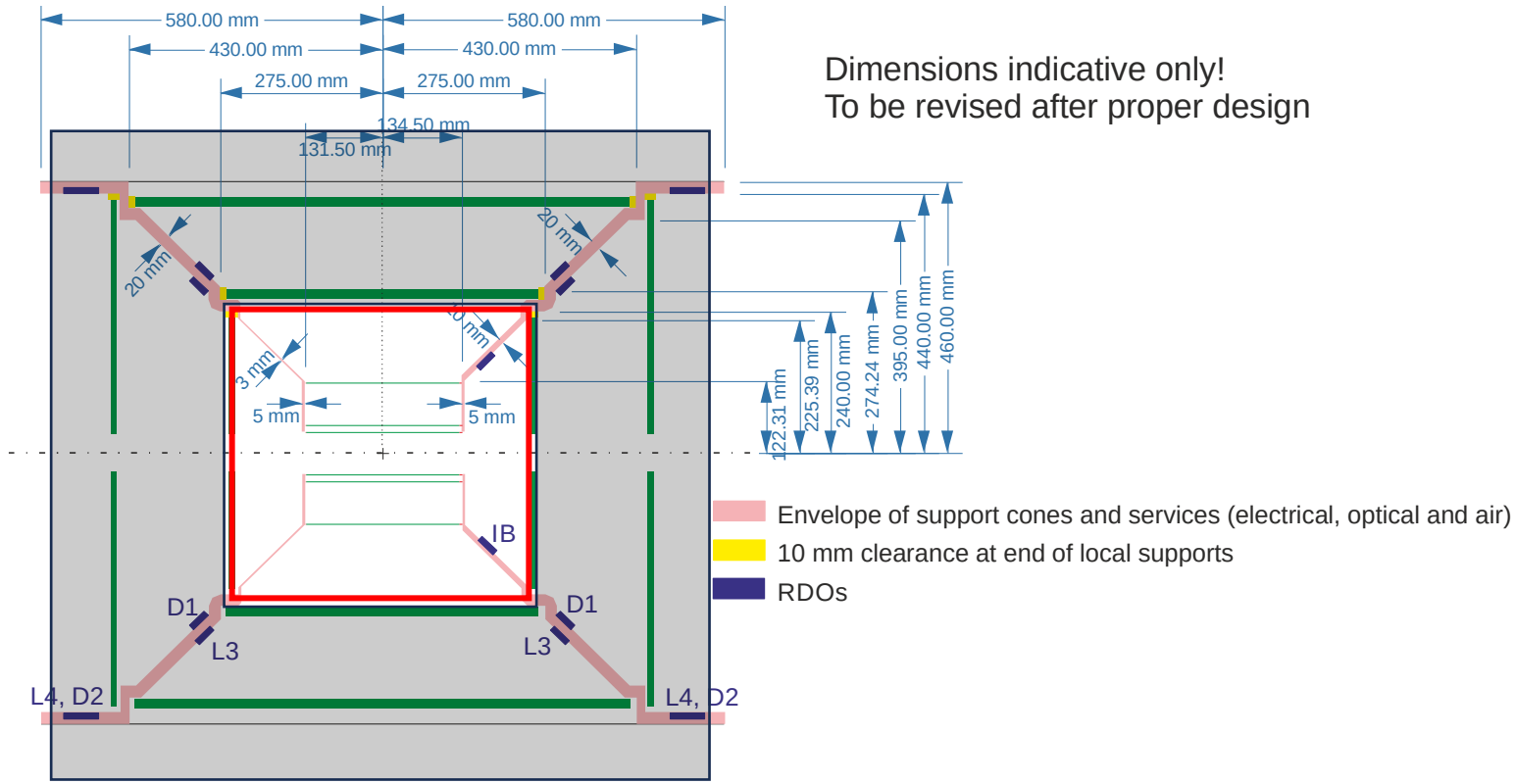

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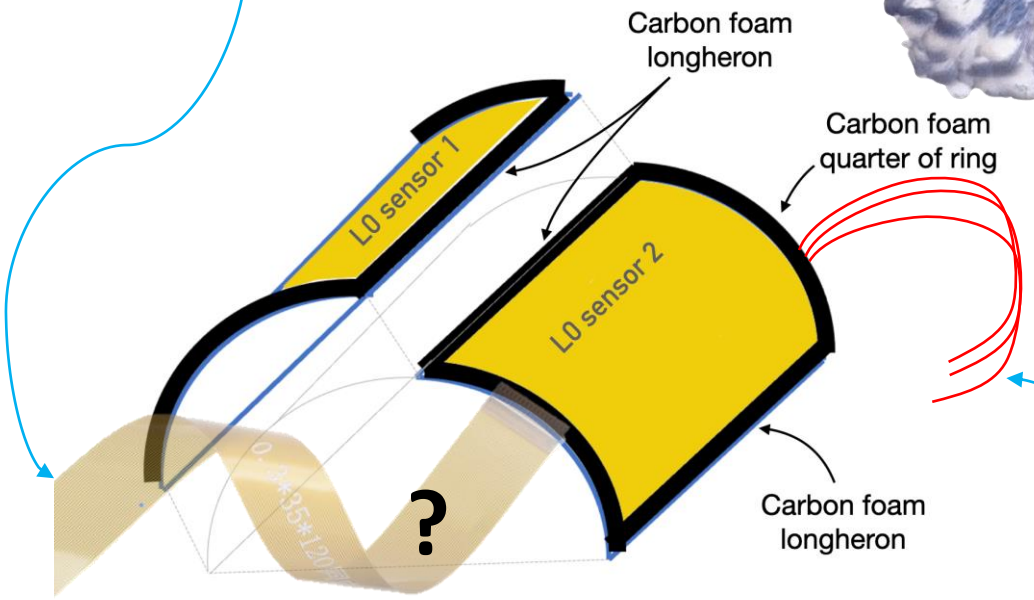
Starting points for services

FPC's ITS3-inspired, but with mandatory differences, to be updated along the way…

now 250*20*0.75 mm

Cooling: a first guess on air distribution on the layers



e-side

cables or FPC's?

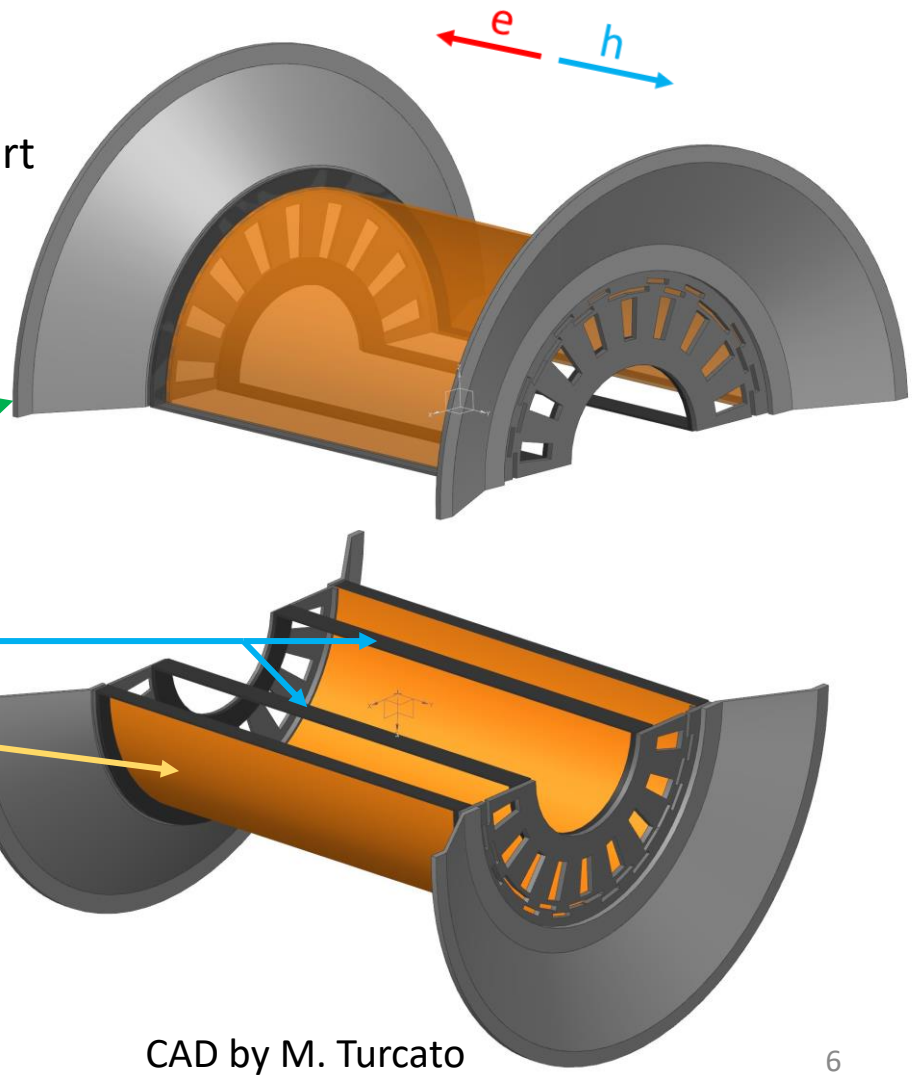
we tried with the first hypothesis as a placeholder, to figure out the possible routing – one cable per phase/ground, **1 mm** ∅

h-side

SVT IB global support design

Updated radii from ITS3 TDR sensor size
+ 0.5 mm spacing between sensors
L0 → r = 37.5 mm
L1 → r = 50 mm
L2 → r = 125 mm

IB half barrel support

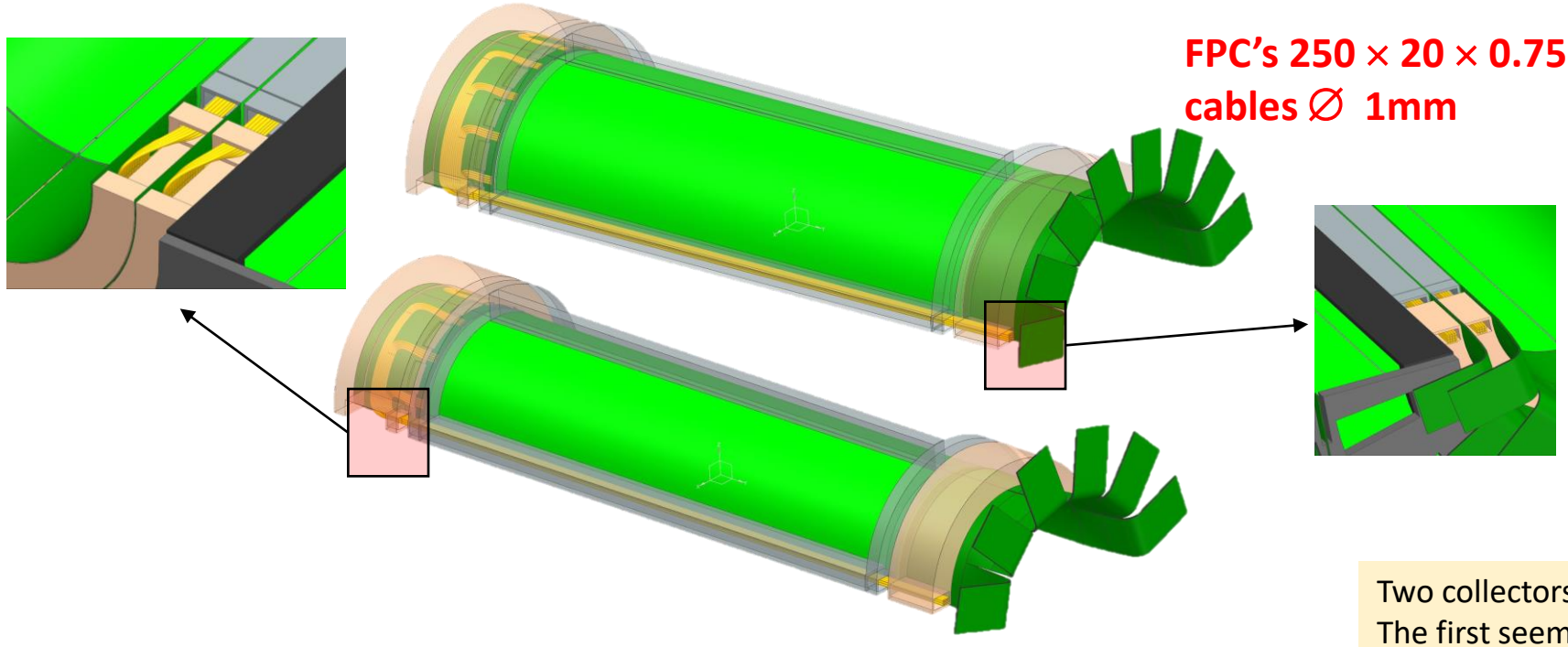


Material of the support: likely, carbon fiber composite (CFC)

- Symmetric design e-h side, but for cables routing
- Half-cones to support IB and connect to OB
- Frames to support the sensors (on their local mechanics)
- Light-material wall (kapton?) to protect L2 while minimizing X/X_0 in the sensitive area

CAD by M. Turcato

L0-L1 local mechanics

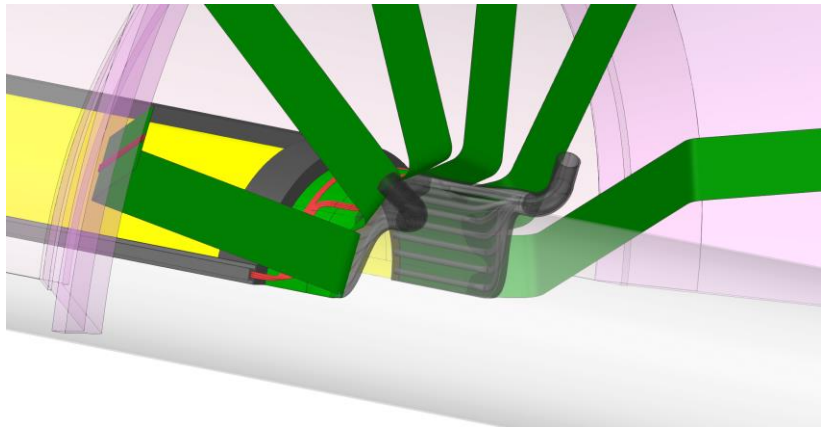


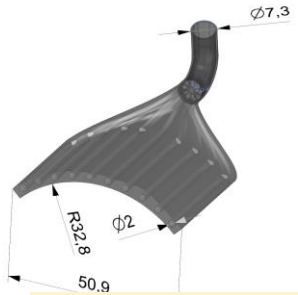
FPC's 250 × 20 × 0.75mm
cables ∅ 1mm

L0+L1 with local support structures in transparency to show e-side cables routing

WARNING: here cable trays are alternative to carbon foam → to be discussed!

Two collectors: with internal channels or single volume. The first seems to favor uniformity of air flow (test ''quick and dirty'')



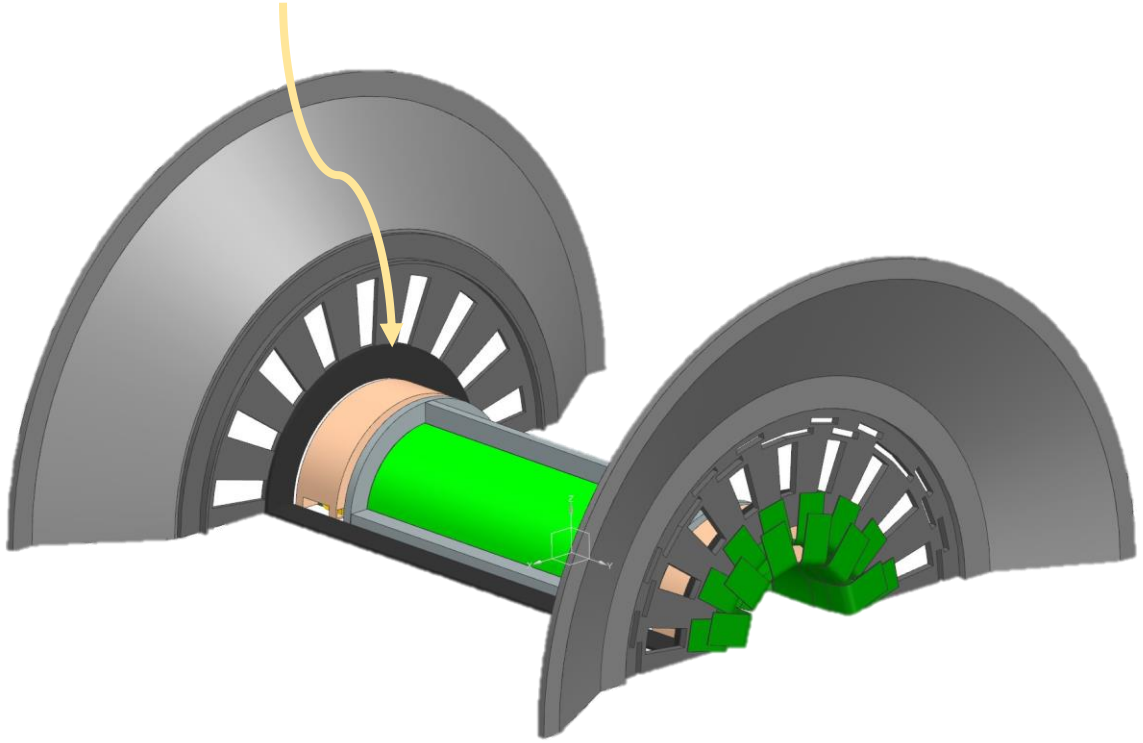


A first guess of air flow collector between L0 and L1
n.b. in this drawing the collector is *below* L0 – drawing being updated

SVT IB mechanical support

L0+L1 on global support

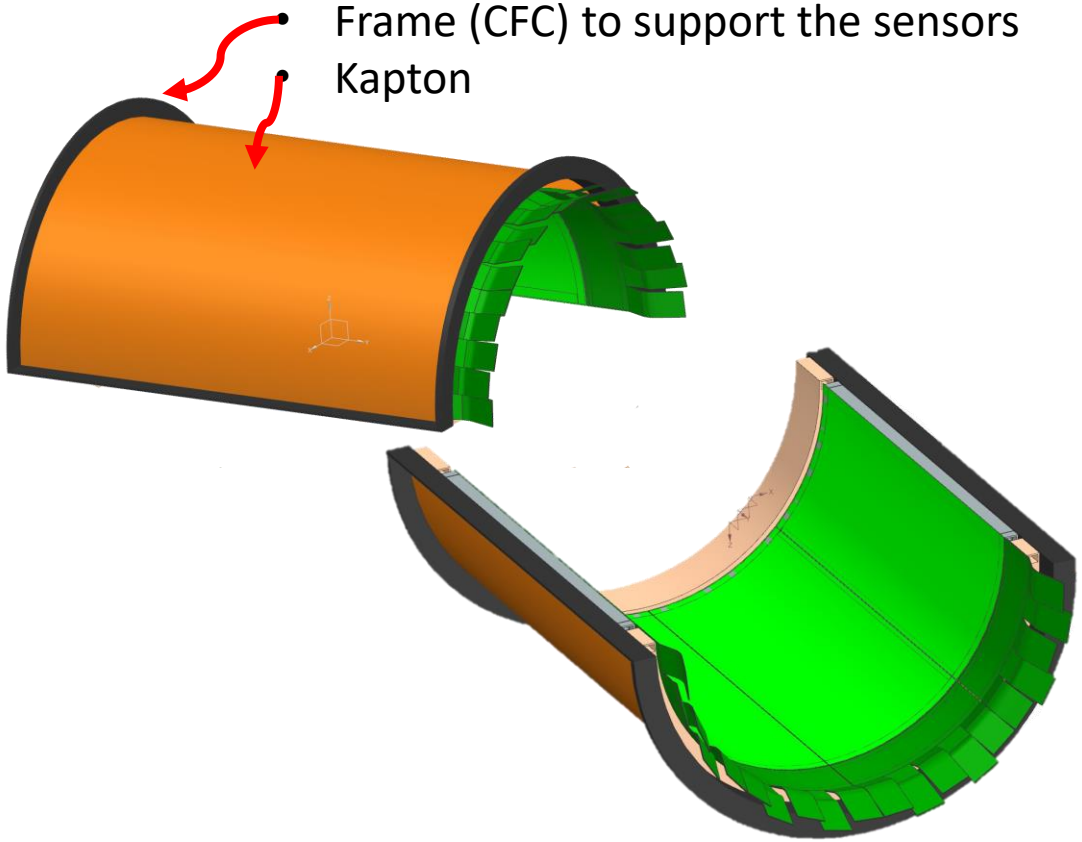
Frame to hold the half-rings and longerons supporting the sensors



L2 on its frame (current guess - working out details with MIT)

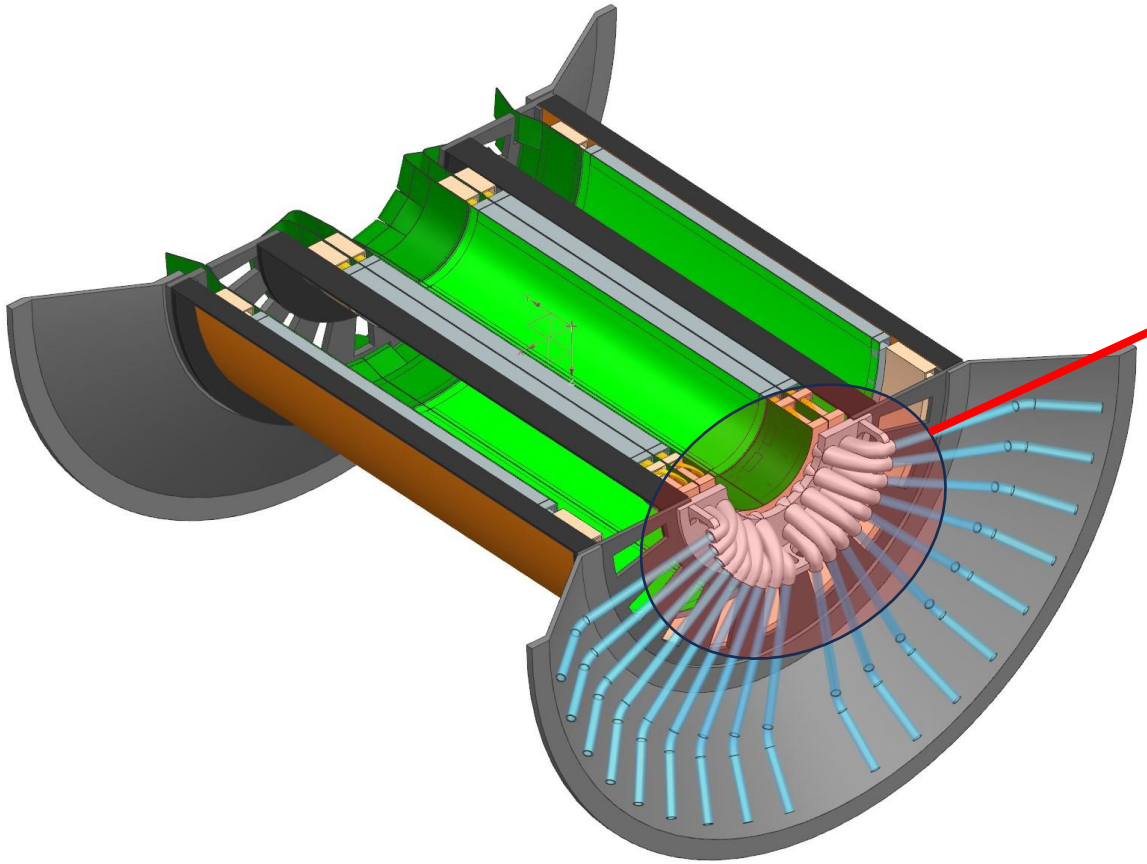
Frame (CFC) to support the sensors

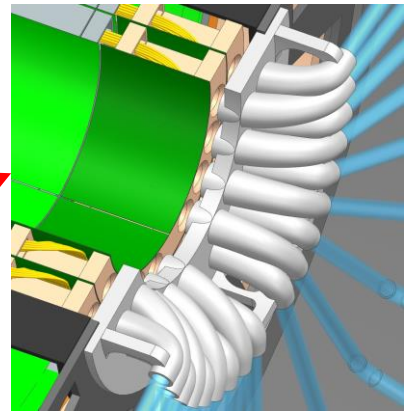
Kapton

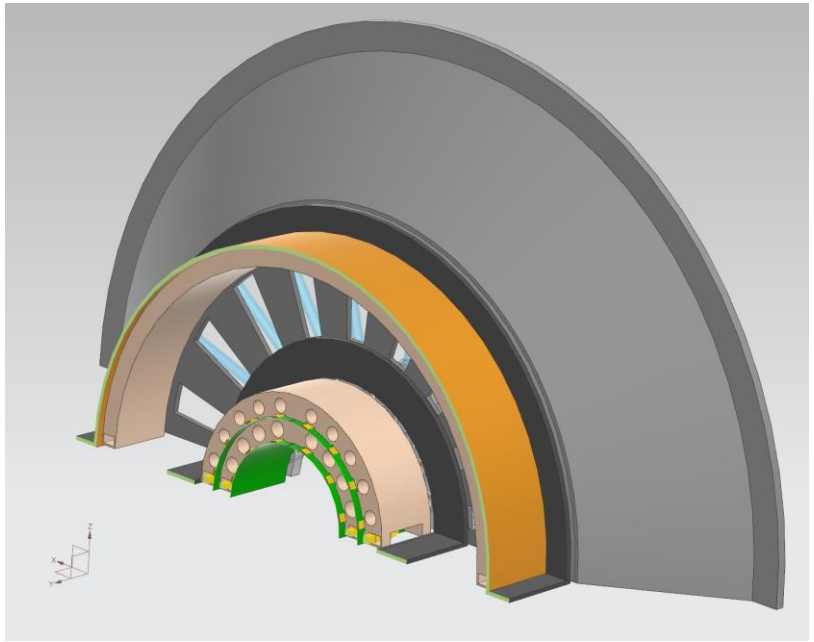


Alternative cooling routing

- Alternative to avoid overlap with FPC’s
- Material budget to be verified with GEANT4 simulation
- Assembly procedure to be studied on mock-ups







Test it

- Mock-ups at increasing level of detail will be produced
  - first is coming after the summer break, 3D printed with common PVC wire
  - test assembly procedure, alternatives for routing of services, etc.
  - updating the design as long as details come in: FPC not a big issue (should not be much different from what is around), cooling still under study

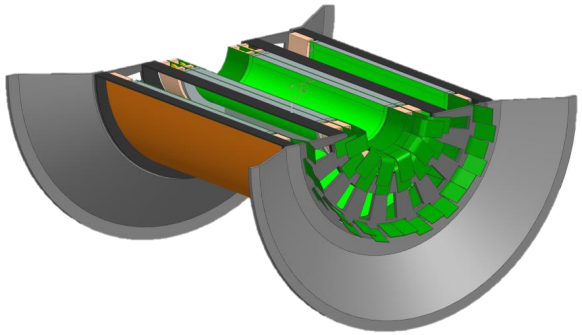
- Mechanical precision
  - Prototypes and final supports will undergo a quotes survey with Mitutoyo measuring machine
  - On the same bench (best mechanical stability) a vibrational test can be performed with a position measurement tool (confocal chromatic sensor), looking for air flow-induced vibrations, with air flow from air distributors and in wind tunnel

Mitutoyo Euro C-A7106
700 mm bore, 0.05 μm step

PVC-wire 3D printed air distributor

PRECITEC CHRocodile mini
confocal chromatic sensor, 4 kHz/10kHz sampling, axial resolution <=400 nm
(to be procured)

Summary - activities and plans



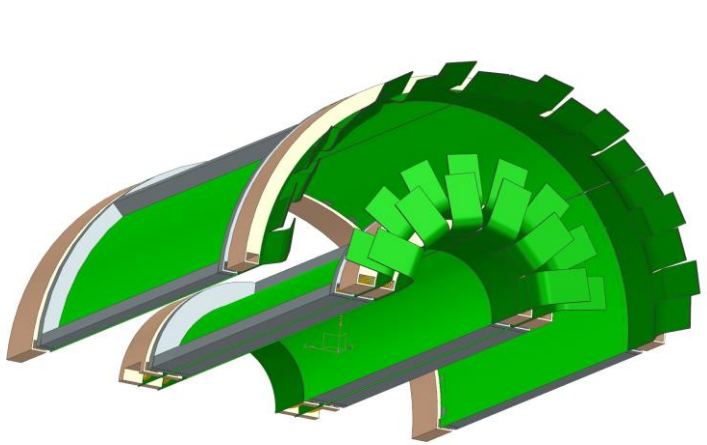
- CAD model of global IB support development
  - tight contact with MIT for L2 integration
- Production of mock-ups for various tests, mainly assembly and integration procedures
  - First 3D print after summer break, for a ''first-guess'' assembly test
- FEA thermal analysis started – reference for mechanical model refinement after verification on mock-up with heaters
- Procedure developed for CAD → GEANT4 translation (two PhD students) to cross-check material choices with thickness maps
- Full procedure from flat sensor to L0+L1 on final support to be implemented locally, as a second production center (with INFN-Bari)
  - Technical staff available
  - Main challenge: procurement of wire-bonder, but gathered interest from a few projects available to co-funding (under discussion)
- The team: M. Benettoni, P. Rebesan (Engineers), M. Turcato (CAD Designer), RT
  - work done in collaboration with INFN Bari

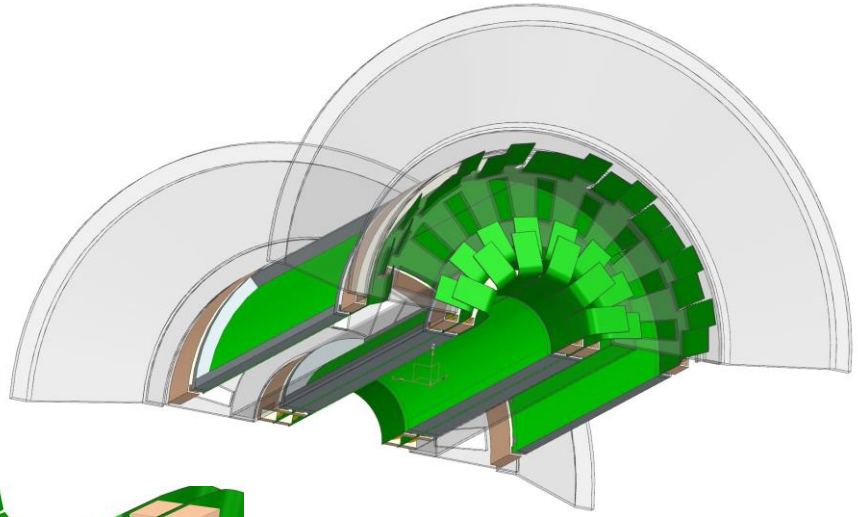

That's all Folks!

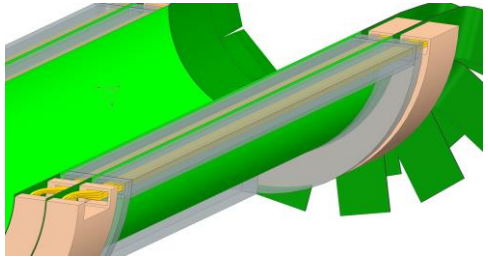
Backups

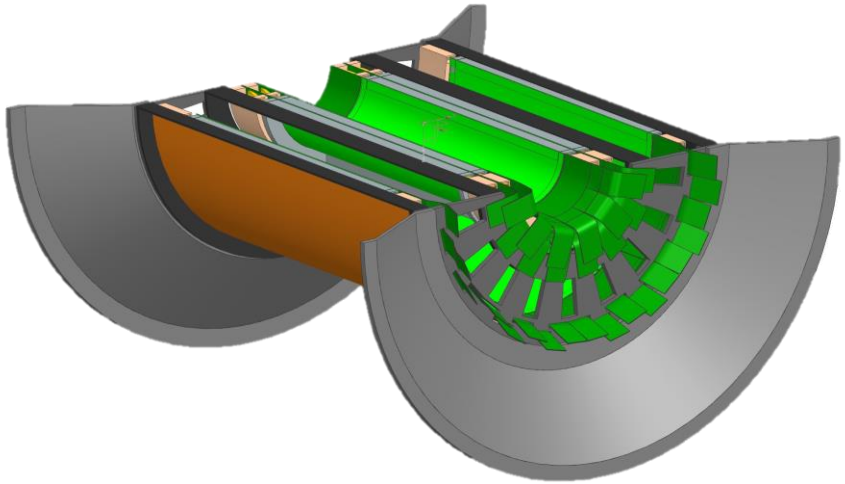
SVT IB half barrel assembled

Final mechanical assembly (cooling is missing):









CAD by M. Turcato

Chromatic Confocal Distance Measurement