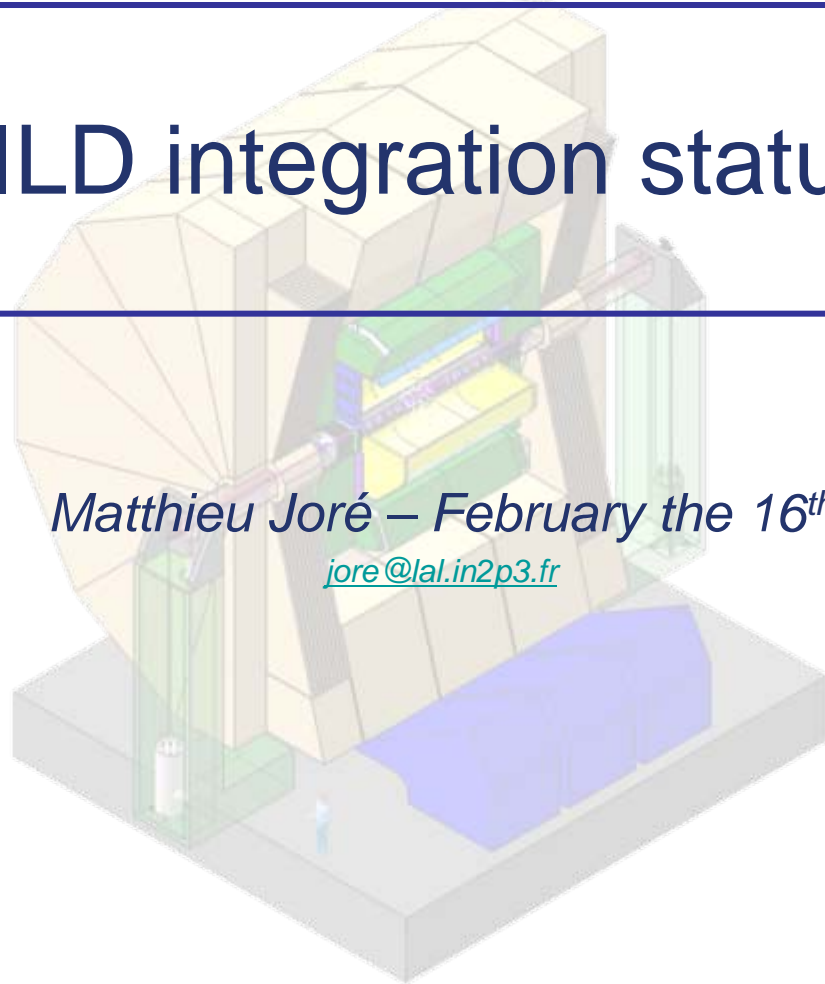


# ILD integration status



*Matthieu Joré – February the 16<sup>th</sup>*

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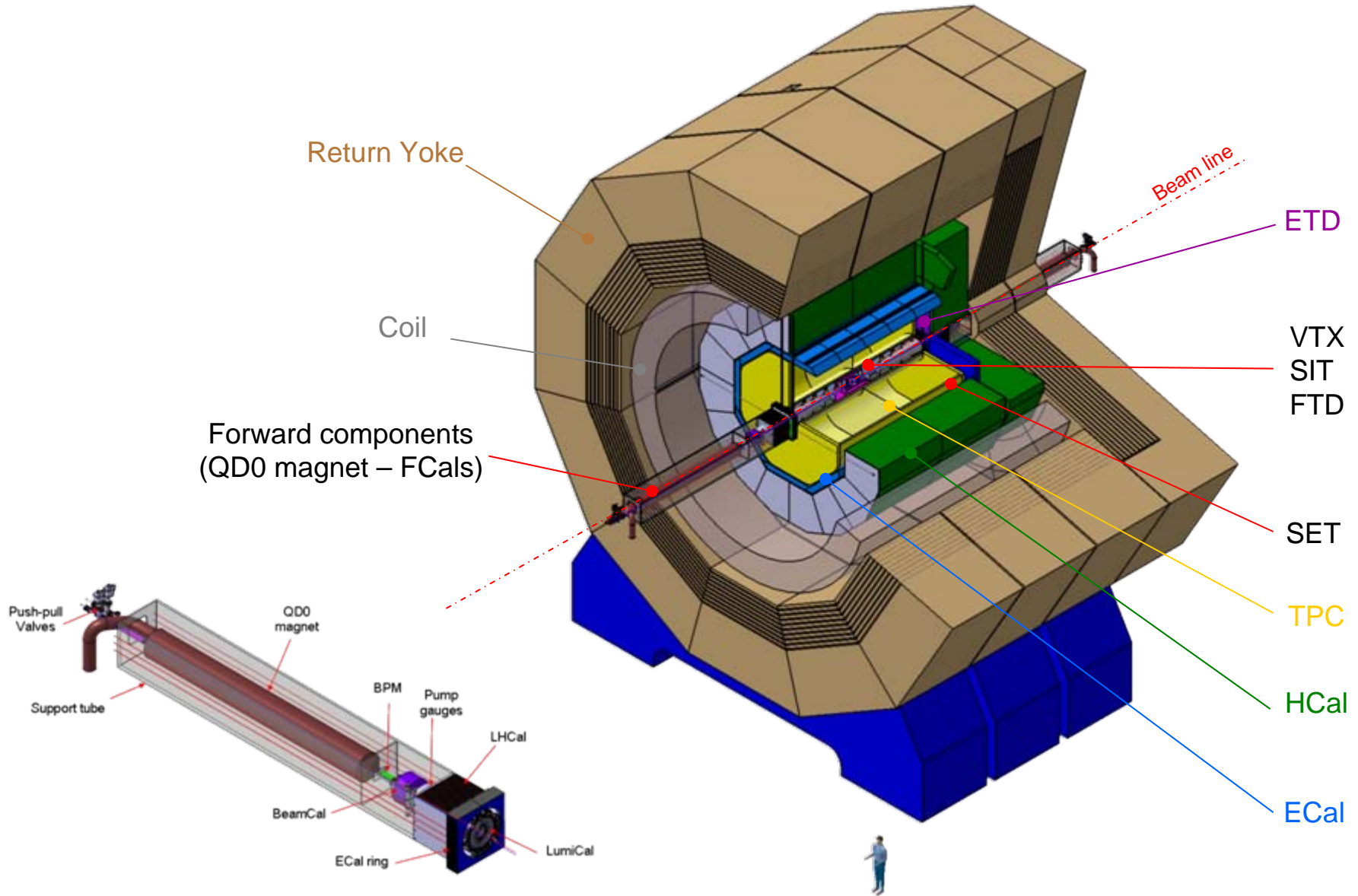


# Outline

- Inner region
  - **Integration principle**
  - **Assembly & maintenance**
- Forward region
  - **Description**
  - **Support tube**
  - **Forward Calorimeters**
    - LHCAL design
    - ECal ring design
    - LumiCal and integration
- TPC
- Calorimeters
  - **Barrel**
  - **EndCap**
- Cabling
- Conclusion and next steps



# ILD0 overview





# Inner region : principle

- The beam pipe :
  - **Supports the VTX detector**
  - **Is hanged from a support structure**
  - **Could be adjusted to the beam axis**
- The inner support structure :
  - **Made by 2 half shells**
  - **Supports {beam pipe + VTX} and all the silicon disks**
  - **Is supported by TPC Endplate or inner diameter**
- That way, {BP+VTX} and silicon disks are independents from QD0 support tubes
  - **Less risky than a 15m fixed structure**
  - **Adjustment possible**

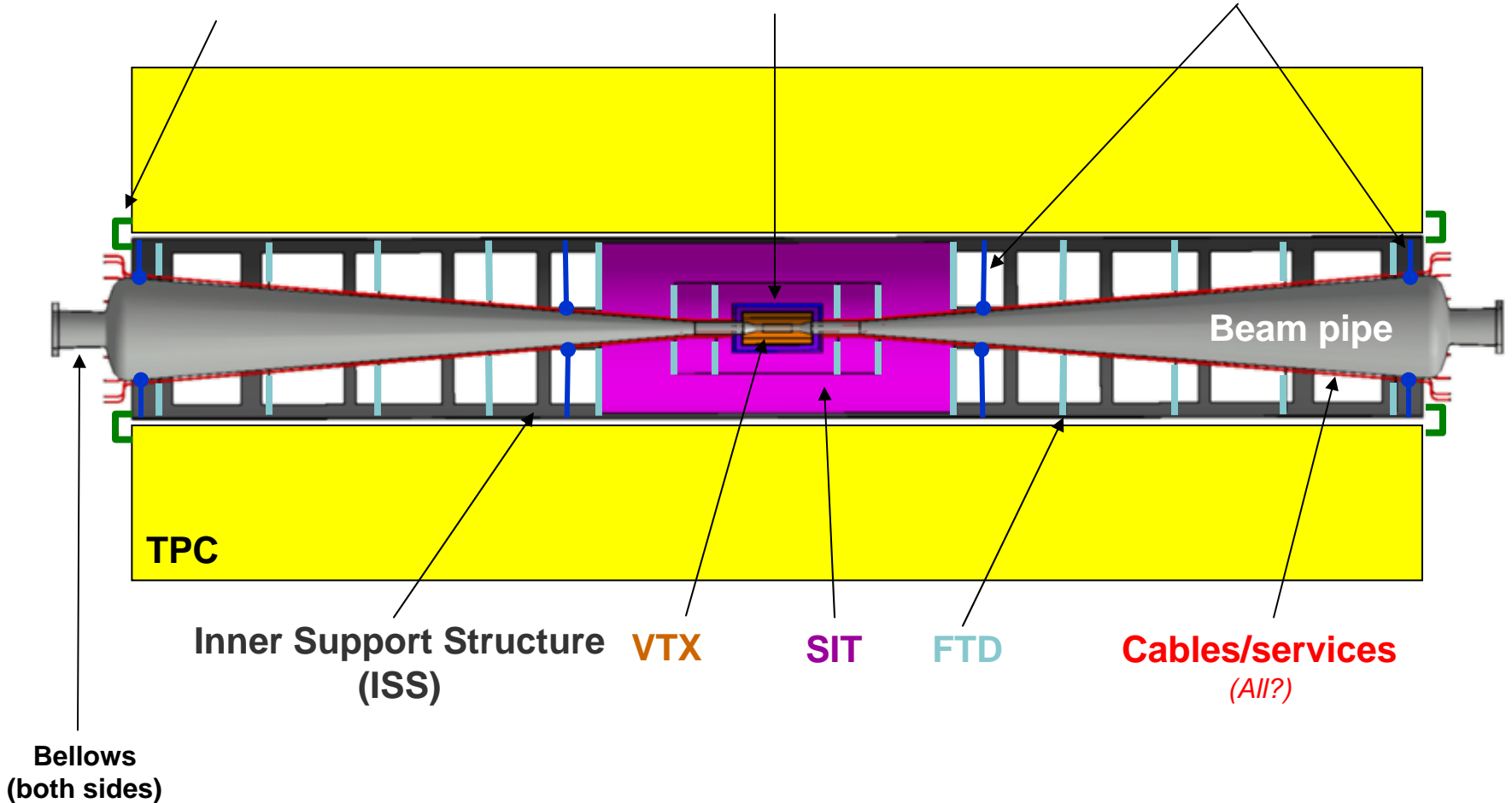


# Mechanical integration proposal

Fixation of ISS on TPC endplates or inner diameter

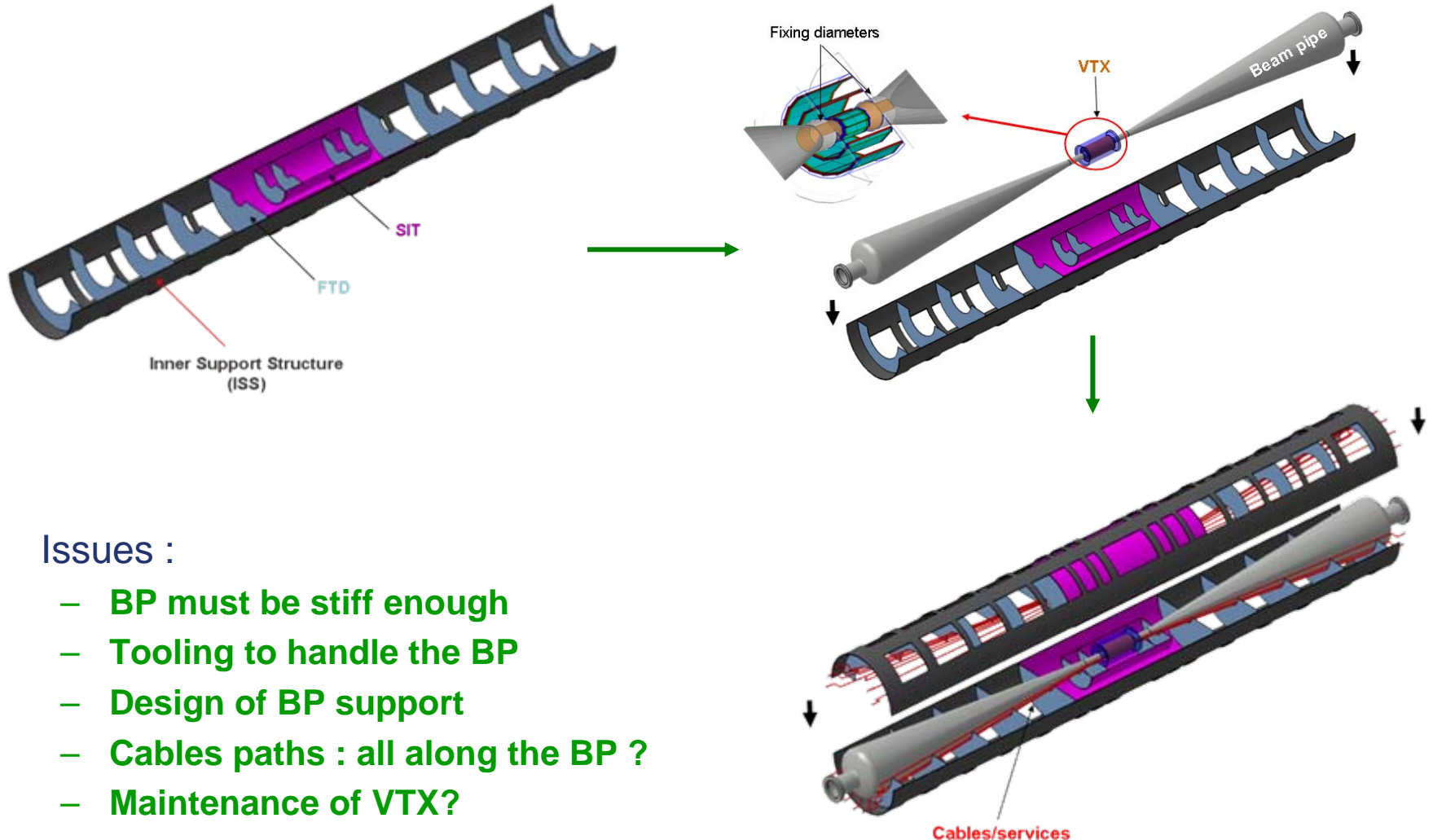
VTX fixed on beam tube

BP hang by small cables. Could be adjusted to beam axis.





# Inner detectors assembly

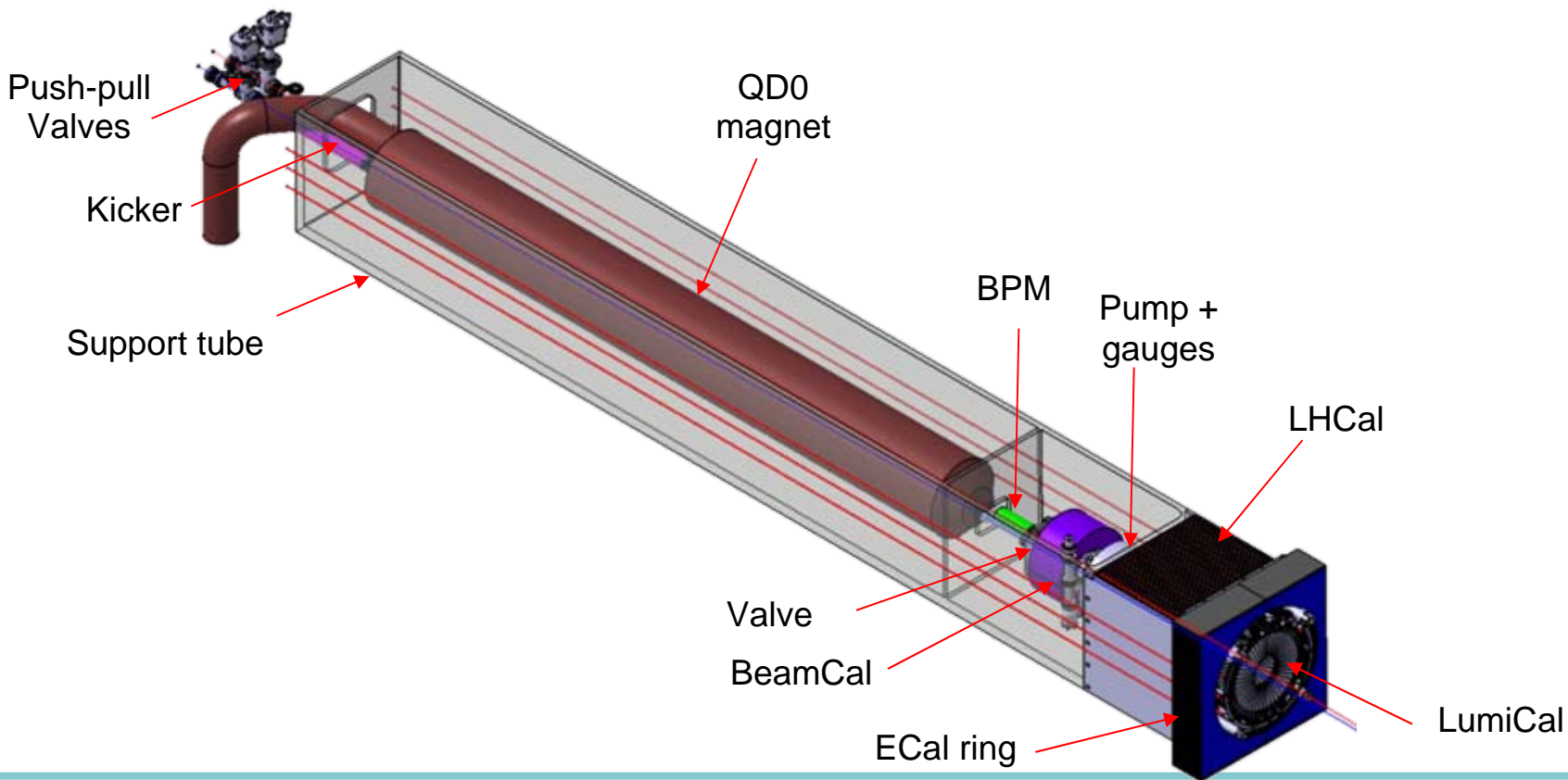


- Issues :
  - BP must be stiff enough
  - Tooling to handle the BP
  - Design of BP support
  - Cables paths : all along the BP ?
  - Maintenance of VTX?



# Forward region

- Support tube which supports all these components
  - **Forward Calos : LumiCal, ECal ring, LHCal, BeamCal**
  - **Vacuum components and beam diagnostics**
  - **Final focus magnet (big challenge!)**





# Support tube design

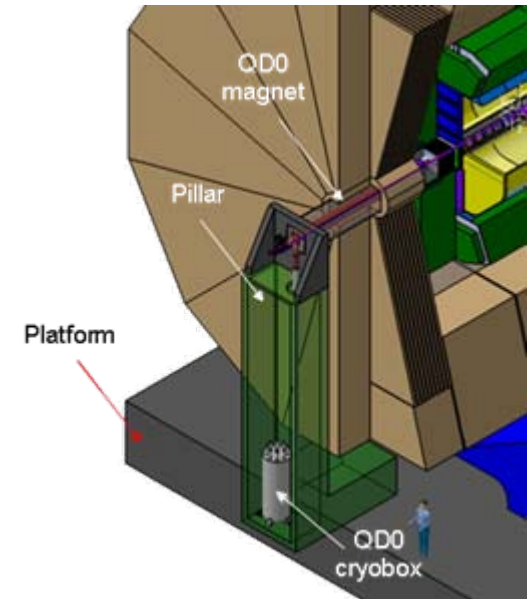
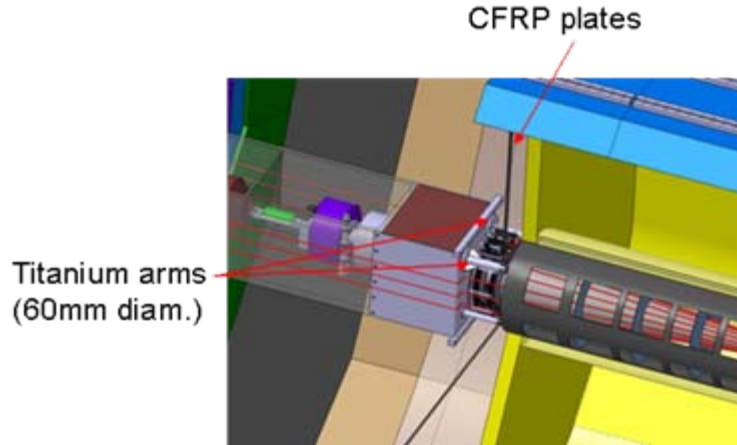
- High requirements on support tube
  - **Good vibration performance (QD0 stability)**
  - **Allowable amplitude**
    - Few mm in static load
    - About 50nm for ground motion (IR interface document)
  - **Alignment system is needed (in a mm range)**
- Solution : support tube fixed on a pillar and tension rods
  - **Better stability behavior than cantilever solution**
  - **Alignment performed with tension rods length (H/V + tilt) + link to pillar**
  - **Independent of EndCaps' position (e.g. powering up the coil)**
  - **Rods are made of CFRP plates**
    - Lowest material budget (<1%X0 in 2 small areas – 2,6 mm thick)
    - Best thermal stability : support tube position is stable
    - Deformation is corrected





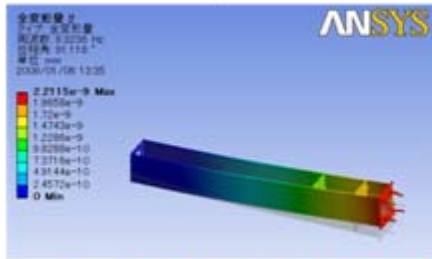
# Support tube

- Layout

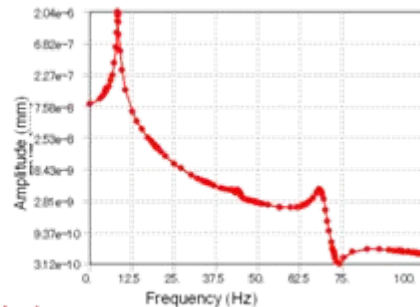


- Ground motion calculations (*from Yamaoka san*)

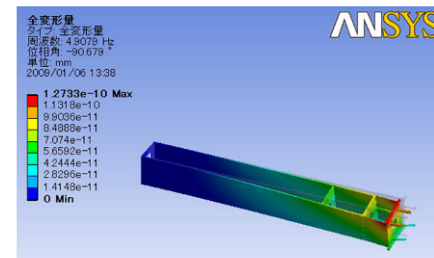
(Vertical direction)



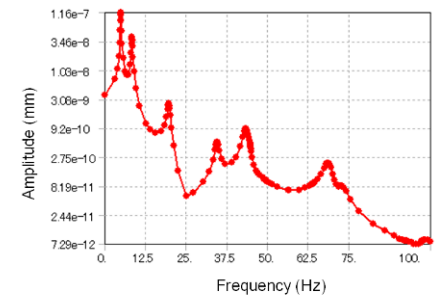
→ Amplitude: 2nm @8.3Hz (Vertical direction)



(Horizontal direction)



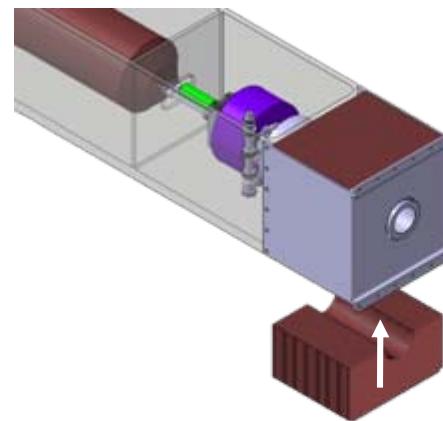
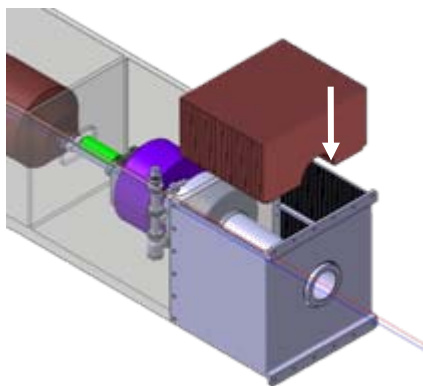
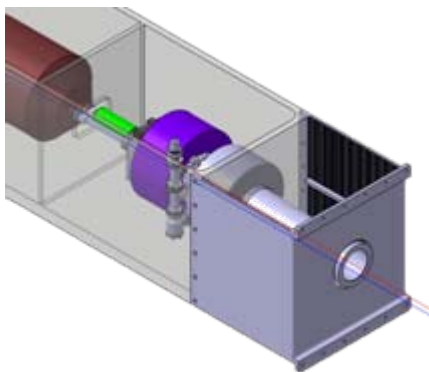
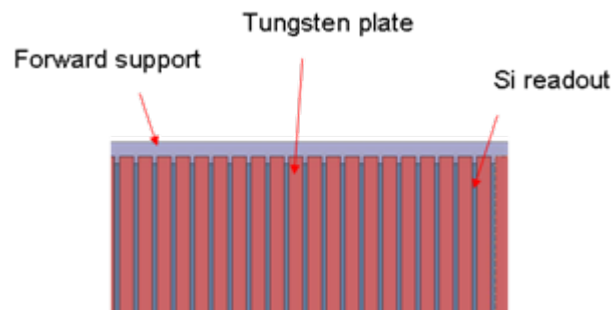
→ Amplitude: 0.1nm @4.9Hz (Horizontal direction)



– **Fulfills the BDS requirements (50nm)**



- LHCaI main characteristics :
  - **40 layers of Tungsten (10mm thick –  $4,17\lambda$ )**
  - **Silicon readout (3mm thick)**
- Construction :
  - **Split in 2 parts (top & bottom – ab. 1,3ton each)**
  - **Supported by 2 vertical plates (closer to BP & stiffer)**
  - **Tungsten plates guided by forward support**
  - **Silicon layers inserted between Tungsten plates**



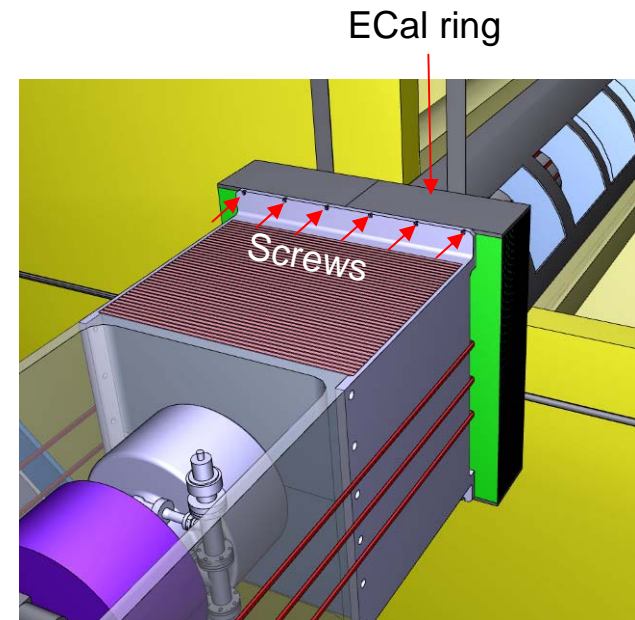
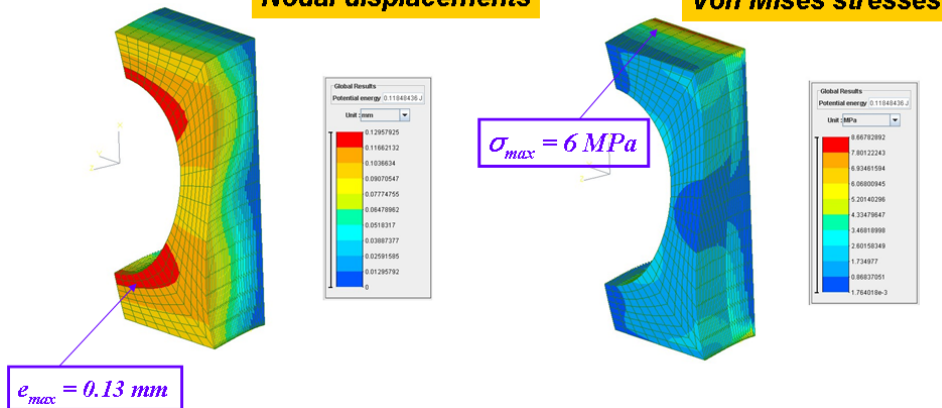


# Ecal ring

- ECal physical characteristics
  - Same absorbers sampling than barrel and Endcaps ECAL
    - 20 W layers of 2.1 mm thick + 10 W layers of 4.2 mm thick
  - Gap of detection layer (silicon) : 3 mm
- Construction (from Marc Anduze)
  - Made of 2 parts (350Kg each)
  - Assembled using top & bottom stainless steel plates (10 mm thick)
  - Fastened on forward support plate

Nodal displacements

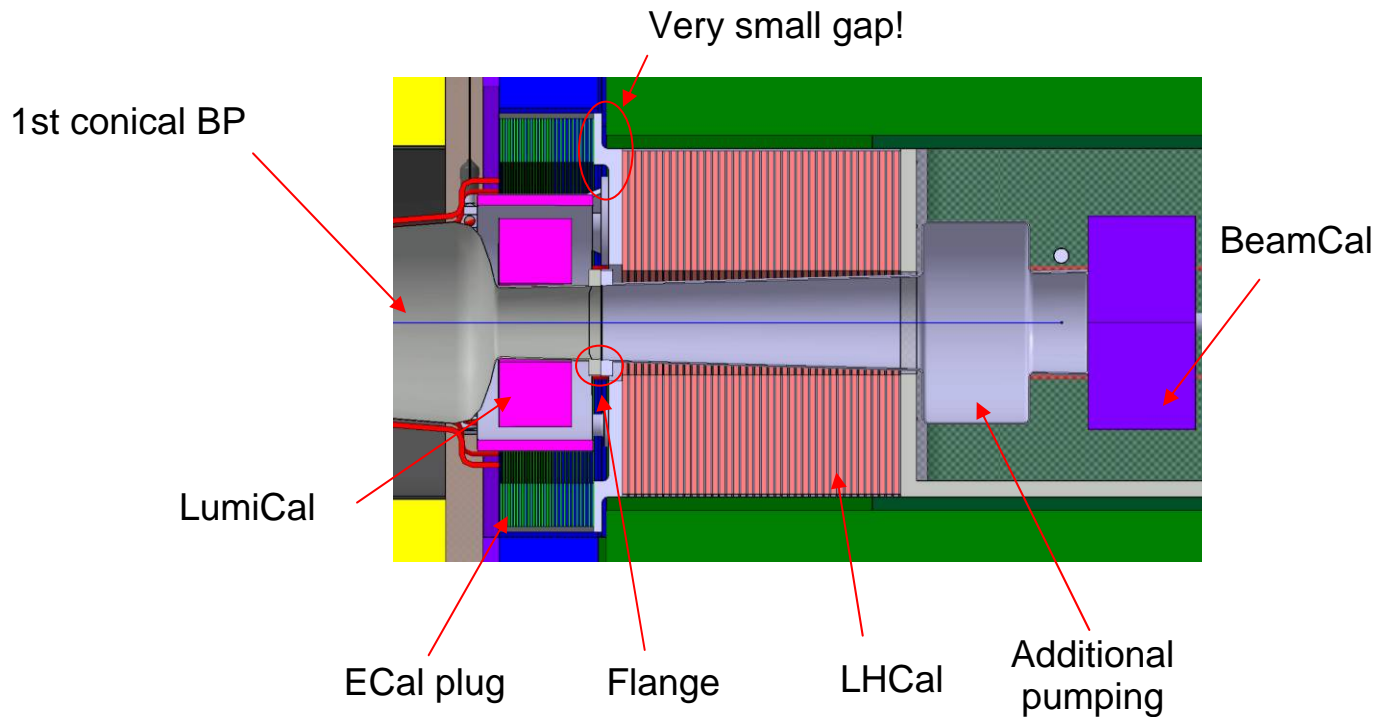
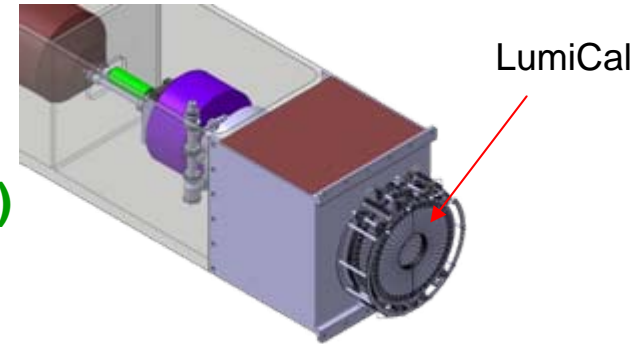
Von Mises stresses





# LumiCal and FCals integration

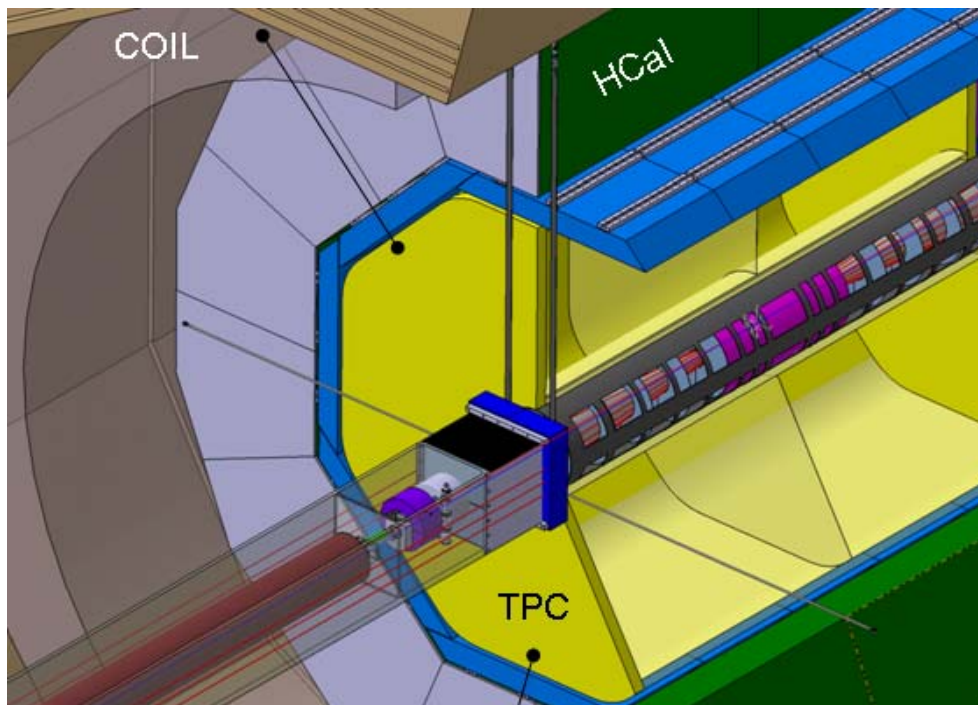
- Construction
  - **Made of 2 parts**
  - **Supported by intermediate support fastened on Forward tube (under design)**
- FCals integration





# TPC

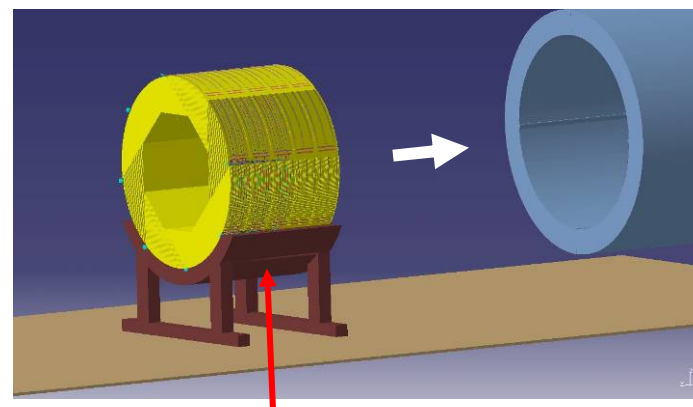
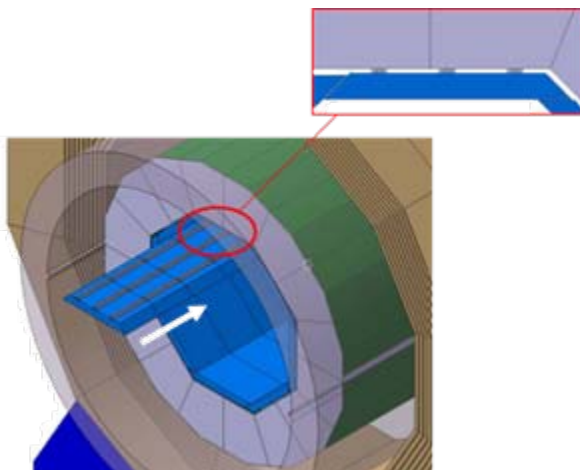
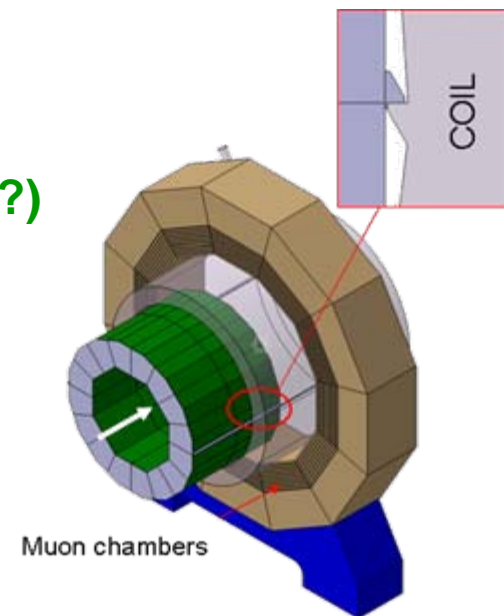
- TPC hanged from coil or barrel HCal
  - **Need to be designed in 10cm gap (isostatic system?)**
  - **Adjustments needed**
  - **Better stability with fixing on HCal (= smaller rods)**
    - Possible in SDHCal
    - Also in AHCal ?





# Barrel calorimeters

- HCal :
  - Split in 2 rings for AHCal – in 5 for SDHCal
  - Supported by rails on coil cryostat (at 3-9 O'clock?)
  - Common insertion scenario for both
- ECal :
  - Segmented in 8 staves of 5 modules
  - Slit with rails screwed on HCal

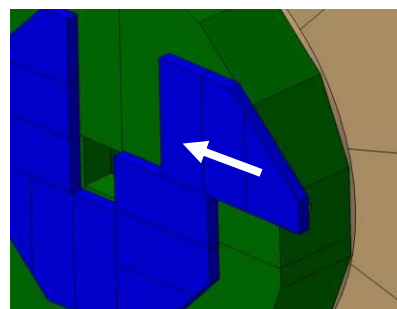
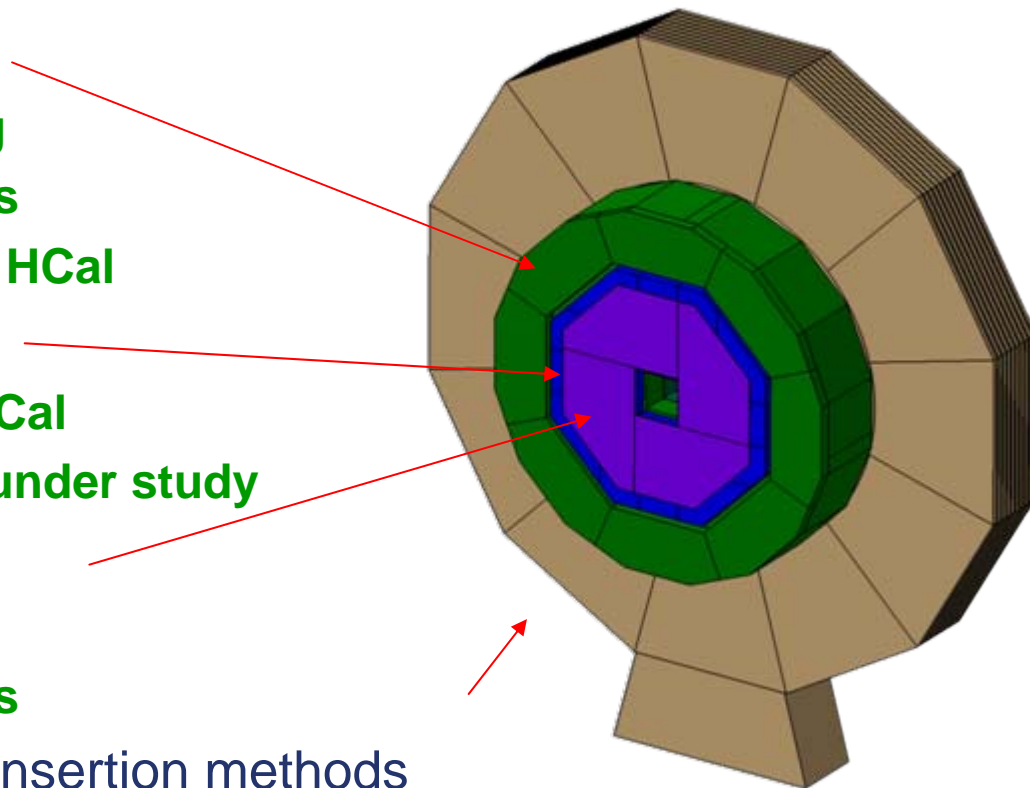


Insertion tooling



# EndCap Calorimeters

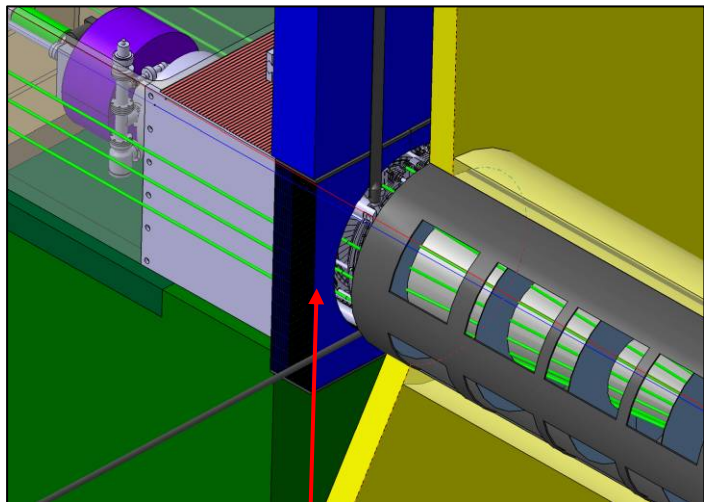
- HCal
  - attached to FSP via ring
  - segmented in 4 modules
  - HCal Rings screwed on HCal
- ECal
  - supported via rails to HCal
  - several configurations under study
- ETD
  - screwed on ECal
  - segmented in 4 modules
- Different muon chambers insertion methods
  - Horizontally
  - Radially



*ECal insertion*



# Reminder of cabling scheme

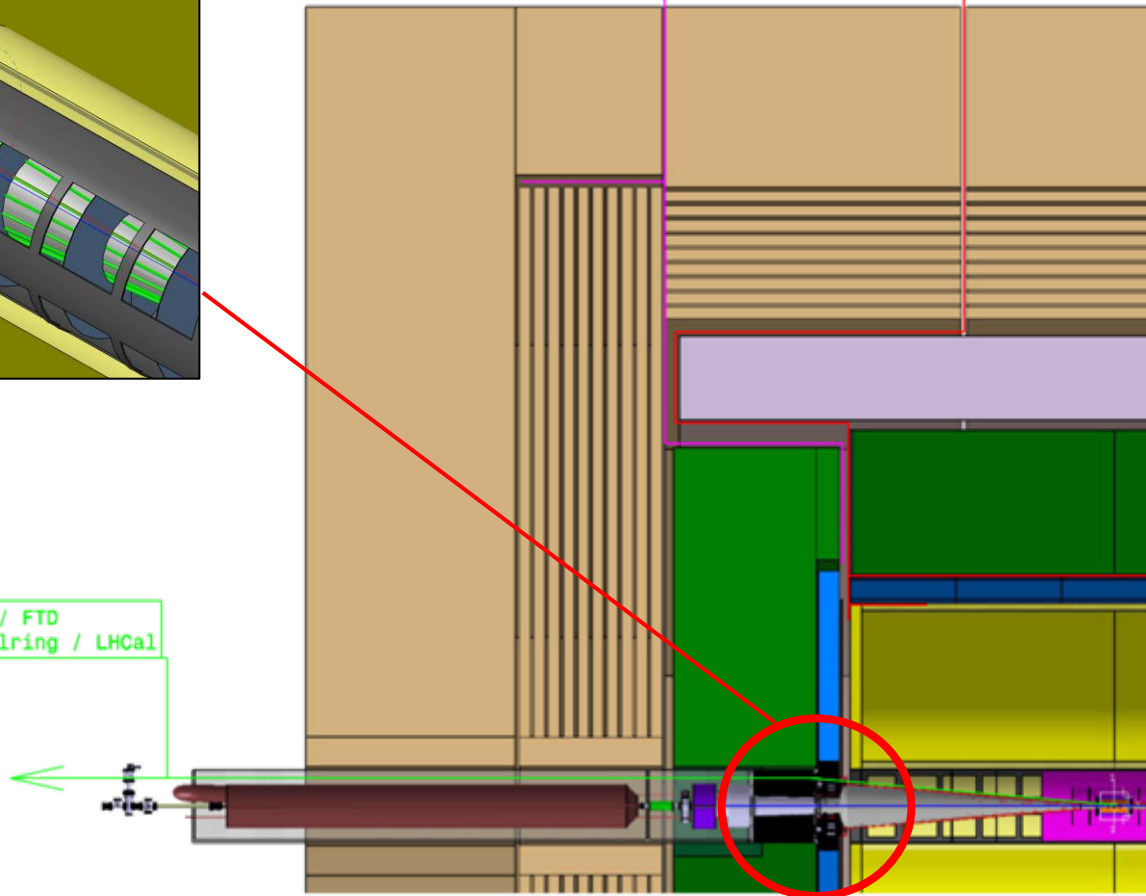


Inner cables/supplies behind the ECal ring

EndCap Calorimeters  
ETD  
EndCap muon chambers

TPC  
Barrel calorimeters  
Central ring muon chambers  
SET

Vertex / SIT / FTD  
LumiCal / ECalring / LHCAL

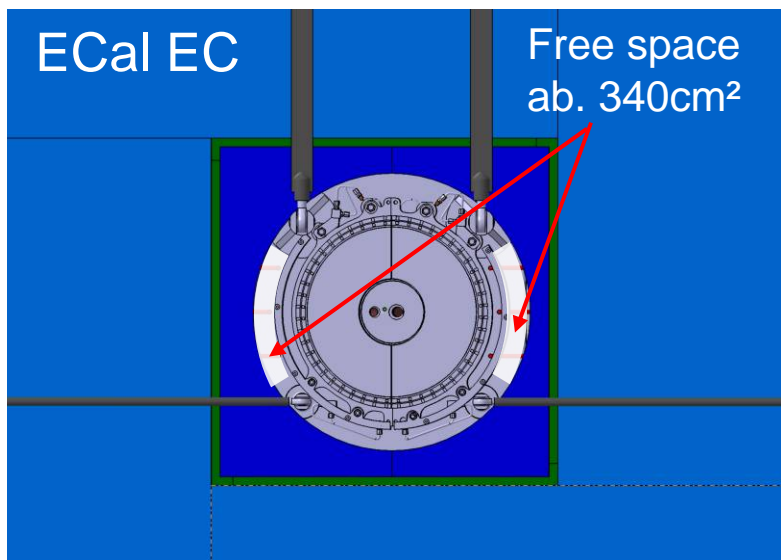






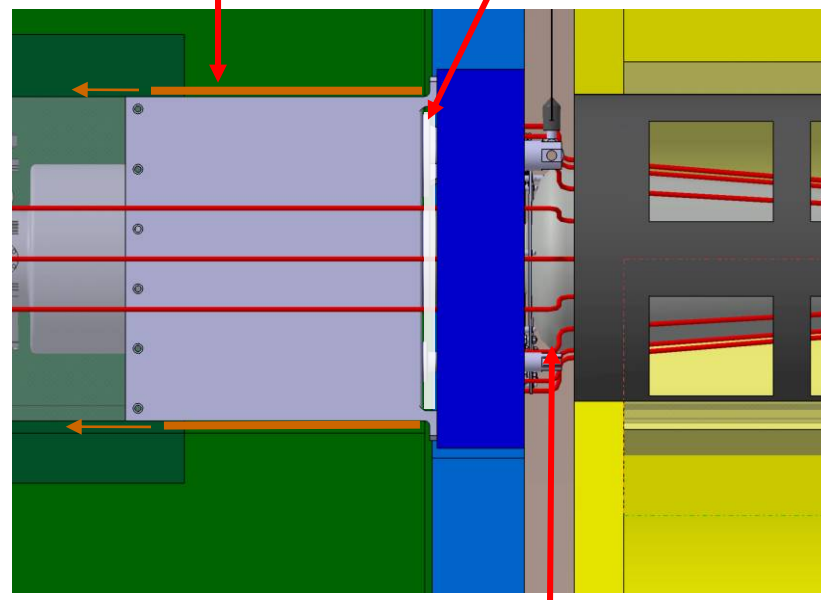
# Forward/inner region cabling

- Inner cables/services between Lumi and ECal plug



- Issues
  - Sufficient space for cables?
  - Patch panel for disconnecting inner cables/services

LHCal electronics boards and cables  
2x30x600mm (360cm<sup>2</sup>) available behind ECal plug



Cables/services disconnection



# Conclusions and next steps

- Inner and forward integration status seems sufficient for the Lol :
  - **Proposal for inner integration : agreement?**
  - **Forward tube fits the IR interface document requirements**
  - **FCals are integrated to the forward structure**
  - **Solutions for Calorimeters integration**
  - **Solution for cabling**
- But still many things to do toward a technical design :
  - **Detailed design of inner structure**
  - **LumiCal support**
  - **Evaluate precisely the number of cables and services**
  - **Detailed design of TPC support**
  - **Detail design of ST adjustment system (especially on pillar)**
  - **Etc...**

Thanks for your attention.