

Muon Forward Tracker

MFT Collaboration



ALICE

QGP France 2013

Introduction

Summary of what «physically» MFT looks like:

- Silicon detector
- Data flow
- Mechanical aspects
- Power supplies
- Cooling
- Insertion/Extraction procedure in ALICE

What is presently in the Letter Of Intent of MFT
(Project still under development)



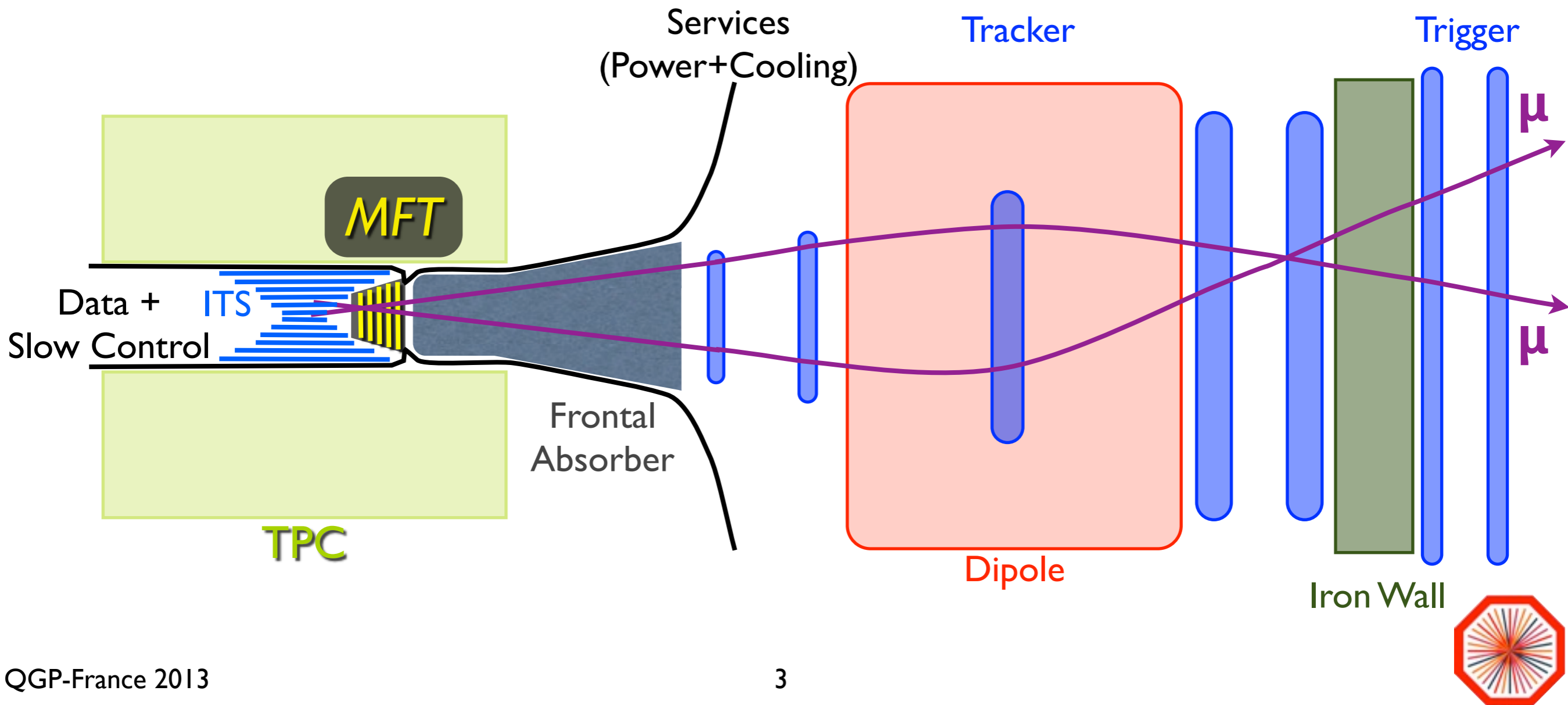
Constraints

High resolution tracker \Rightarrow low material budget (goal: 0.4% of X_0 per plane)

Low impact on surrounding:

- heat extraction + hermetically closed
- minimum of services passing along ITS with low material budget
 - \Rightarrow optical fibers for data+slow control only

Support of the beam pipe



Pixel CMOS

MAPS technology (Monolithic Active Pixel Sensor), common with ITS

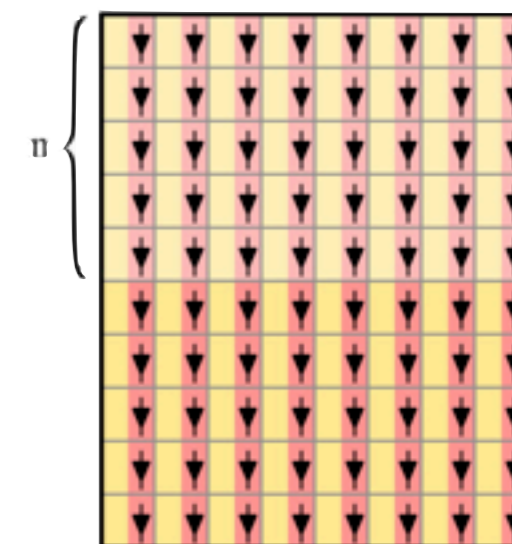
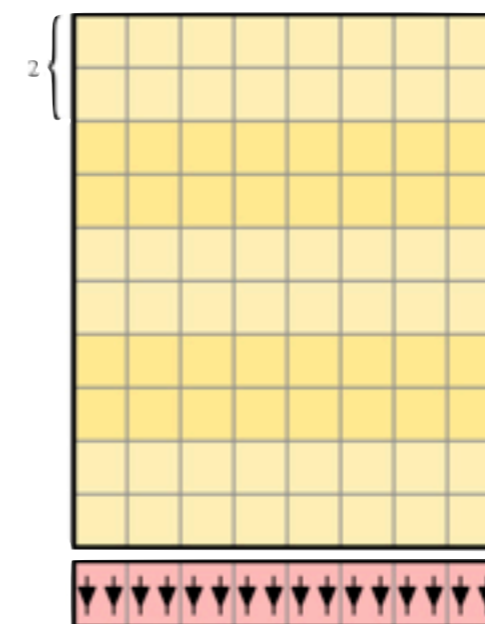
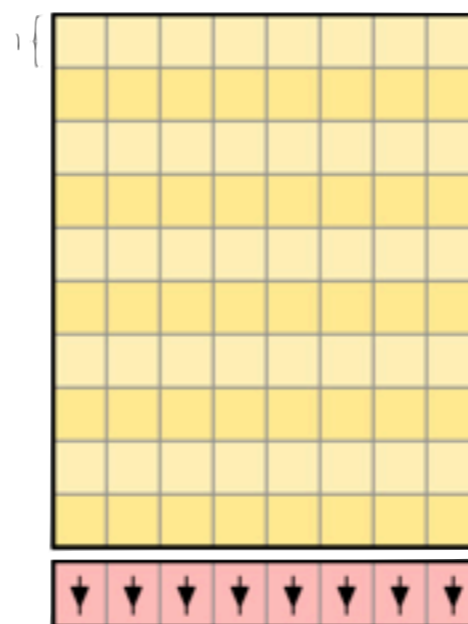
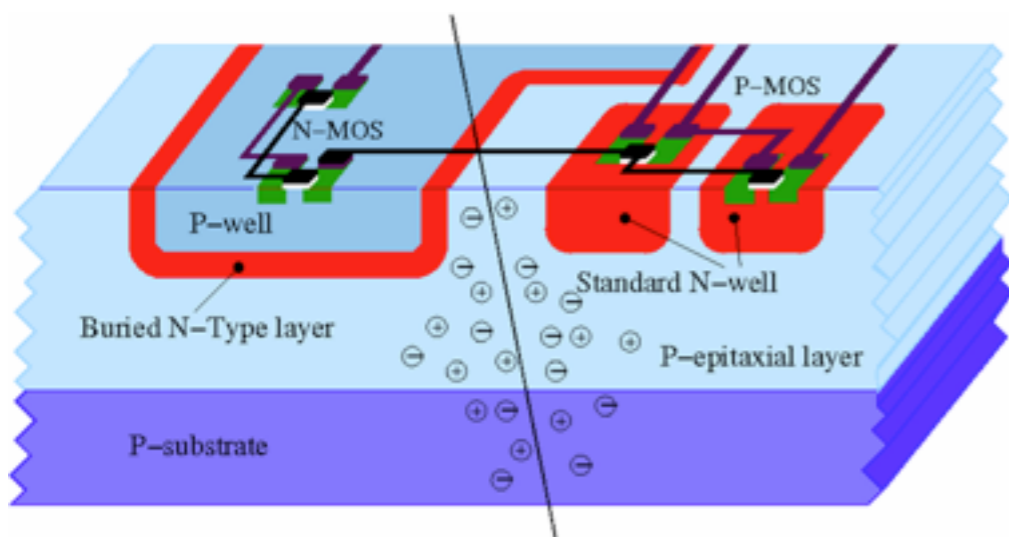
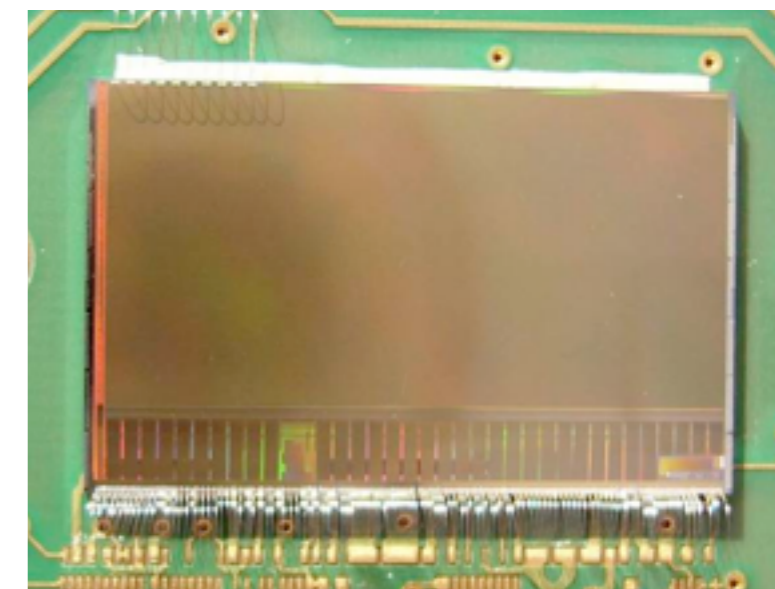
Active zone and read-out on the same substrate

Pixel size : 25 μ m

Thinning down to 50 μ m (low material budget)

Reduced cost compared to hybrid silicon pixels

Read-out time < 30 μ s (rolling shutter technics)



R&D to optimize:

- Read-out
- Power consumption

Power consumption

Integration time

Surface

$$P$$

$$nb_{rows} \times T_R$$

$$S$$

T_R : Time to readout a row

(a)

$$P \times 2$$

$$\frac{nb_{rows} \times T_R}{2}$$

$$S$$

nb_{rows} : Total number of rows

(b)

$$\frac{P \times n}{2}$$

$$\frac{nb_{rows} \times T_R}{n}$$

$$S \quad S_{discris}$$

n : number of rows readout simultaneously

(c)



Data Flow

hit density ≈ 1 cluster/mm²

Collision rate = 100kHz

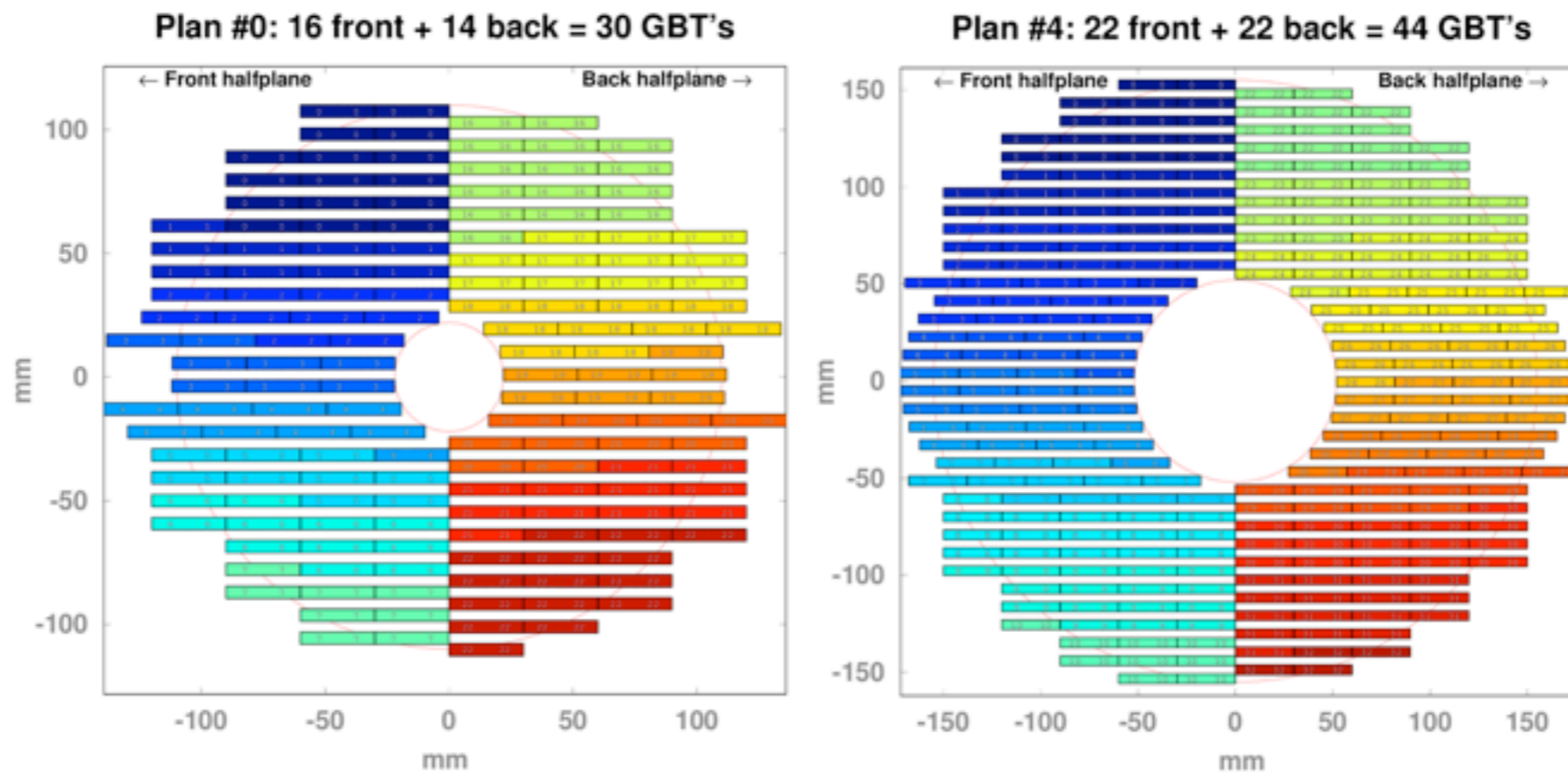
10⁻⁴ noisy pixel rate (pessimistic)

⇒ 144Gb/s after zero suppression

184 GBTs (concentrator+optical transceiver)

Table 3.3: Number of GBT links per plane for each detection side.

Plane	0	1	2	3	4
Front side	16	18	18	20	22
Back side	14	16	18	20	22

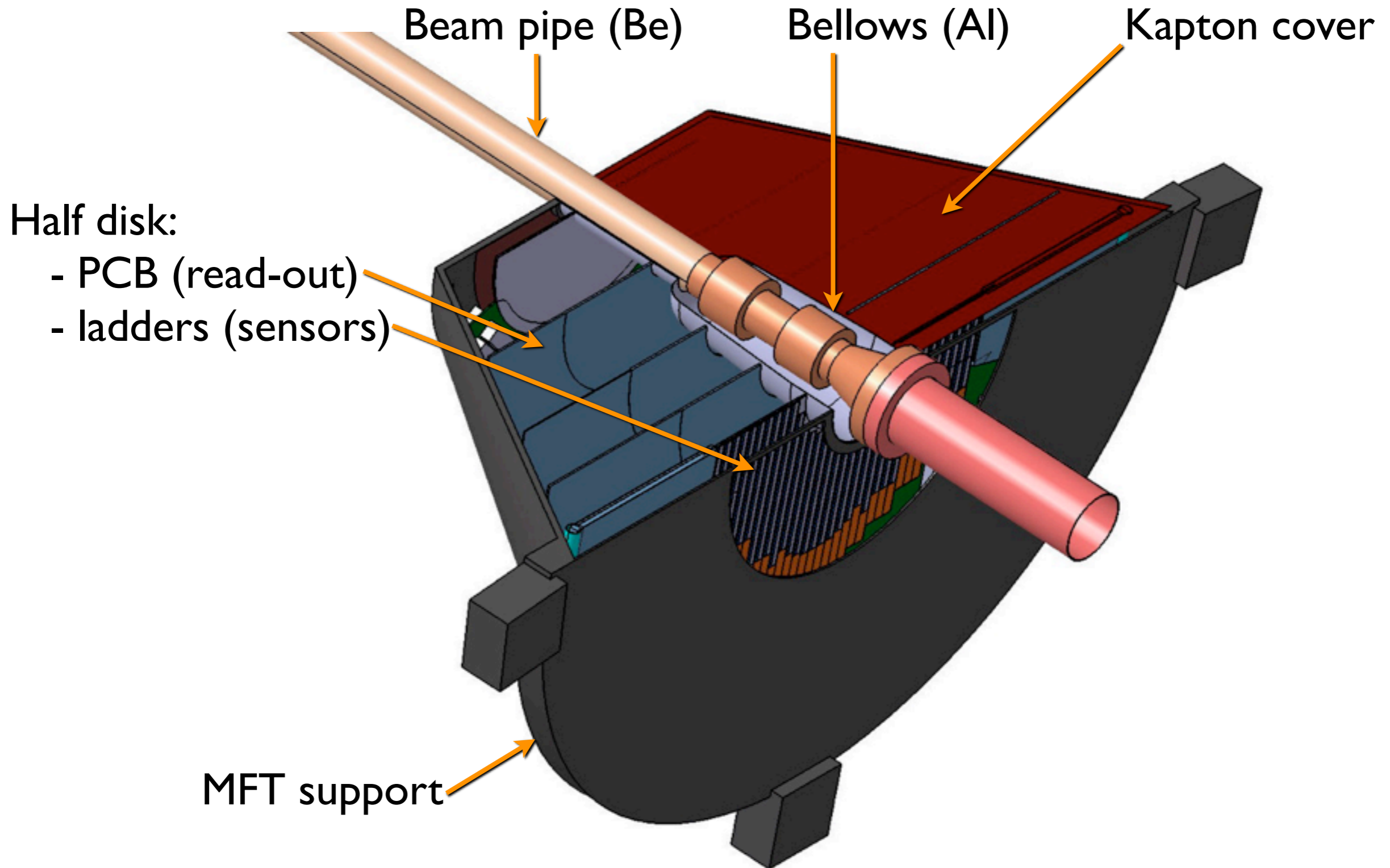


same colour = same GBT

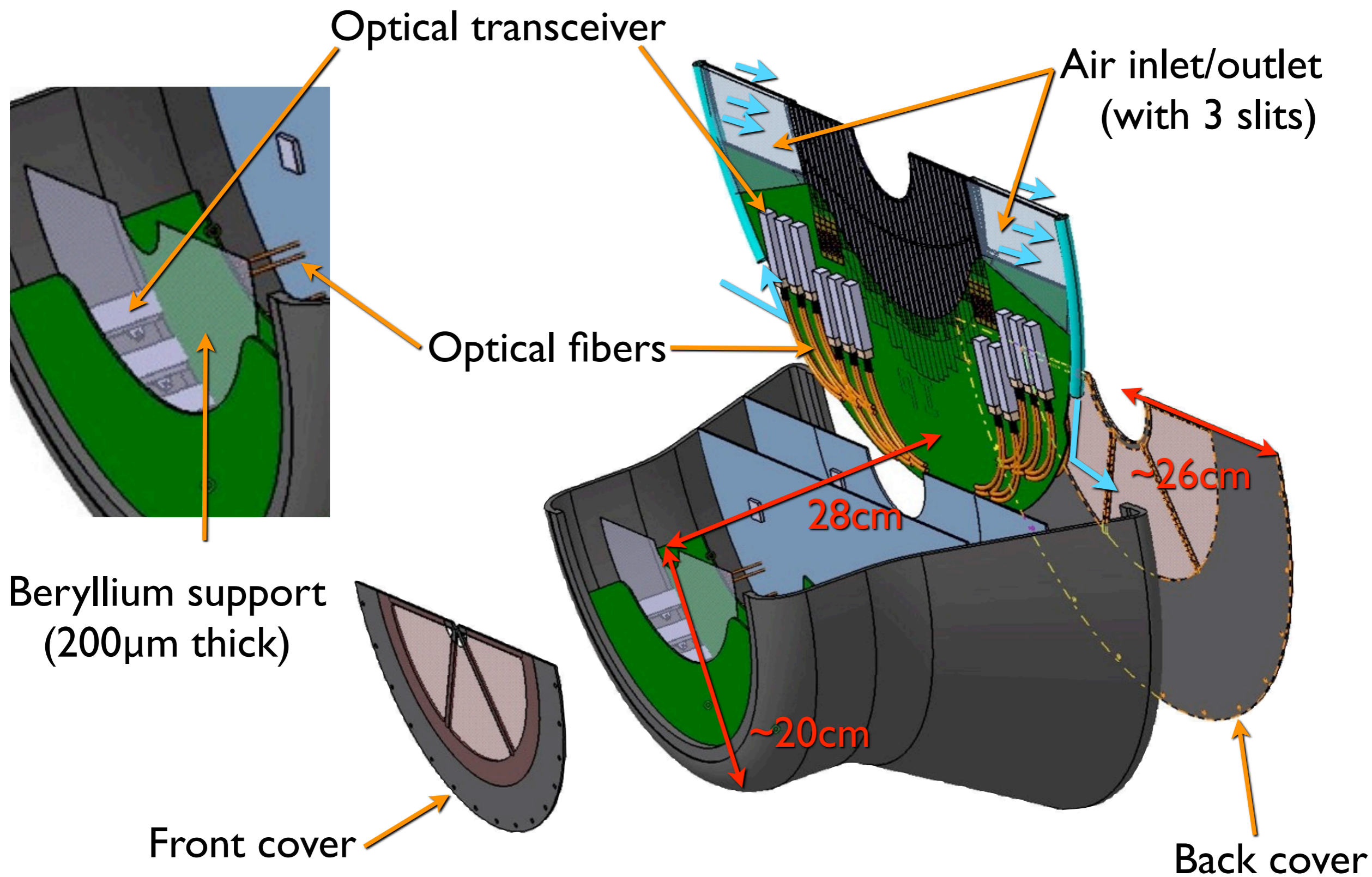


Overview of the MFT

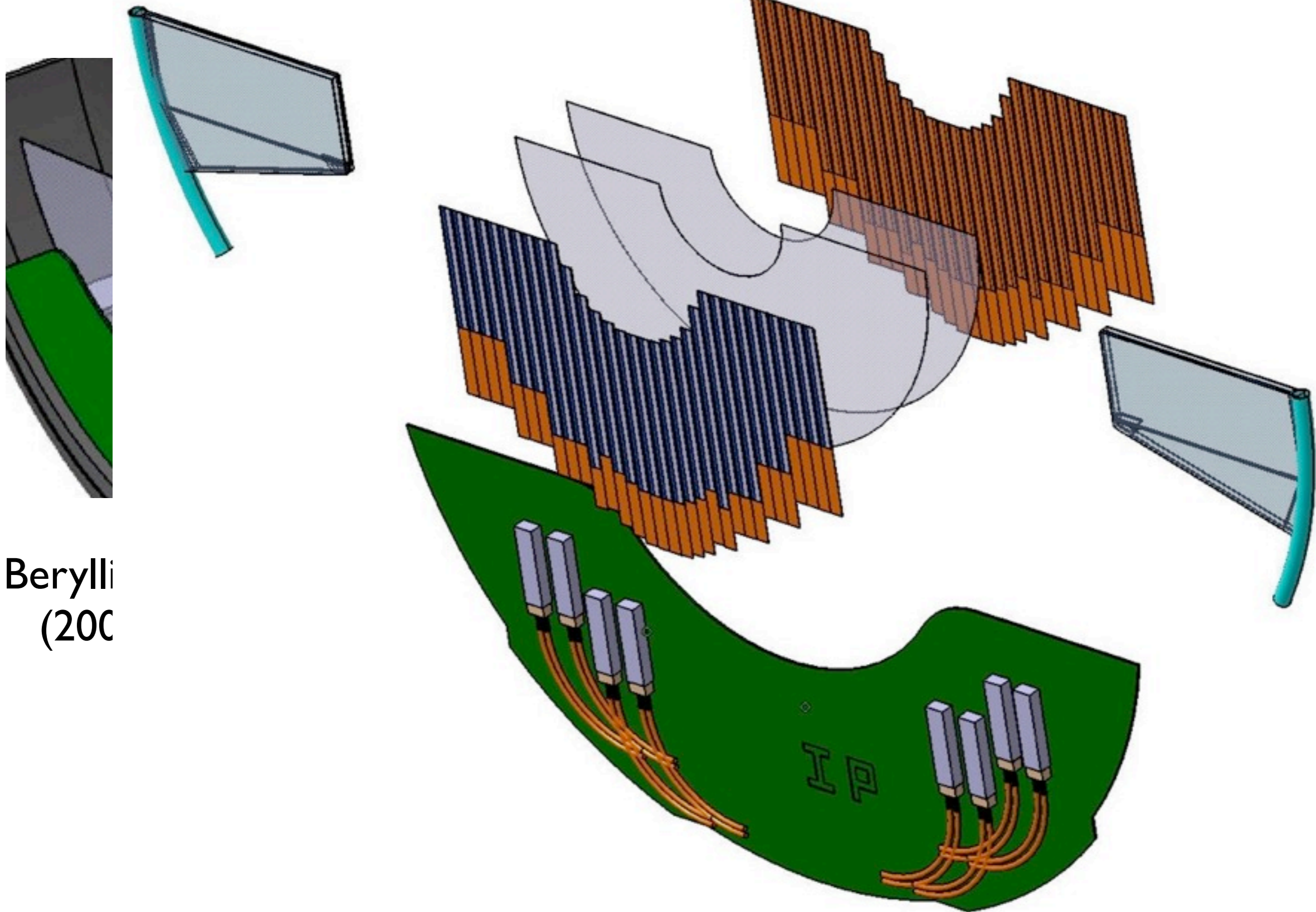
Disclaimer: not the up-to-date version but quite close enough (wait for next slide)



Overview of the MFT



Overview of the MFT

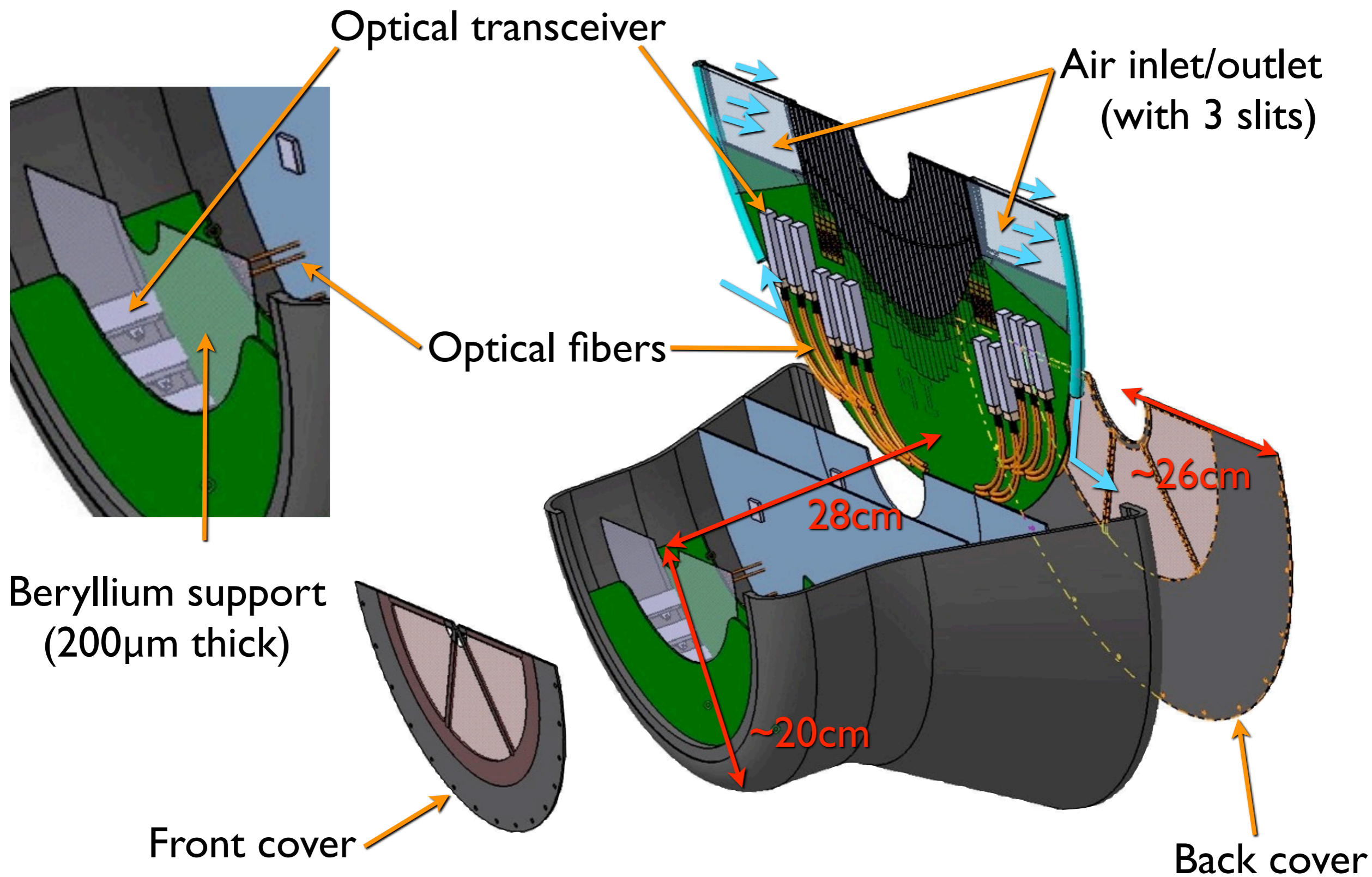


Beryllium
(200

er



Overview of the MFT



Power Supplies

Table 3.4: Estimation of power consumption of the MFT sensors.

Disk	Silicon Area (cm ²)	Nb of Sensors	Heat (W)	Current (A)
0	364.9	318	159	88.3
1	460.1	386	193	107.2
2	520.3	454	227	126.1
3	584.7	502	251	139.4
4	669.8	552	276	153.3
Total	2599.8	2212	1106	614.4

Table 3.5: Estimation of power consumption of the GBTs.

Disk	Nb of GBT	Heat (W)	Current (A)
0	30	75	23
1	34	85	26
2	36	90	27
3	40	100	30
4	44	110	33
Total	184	460	139

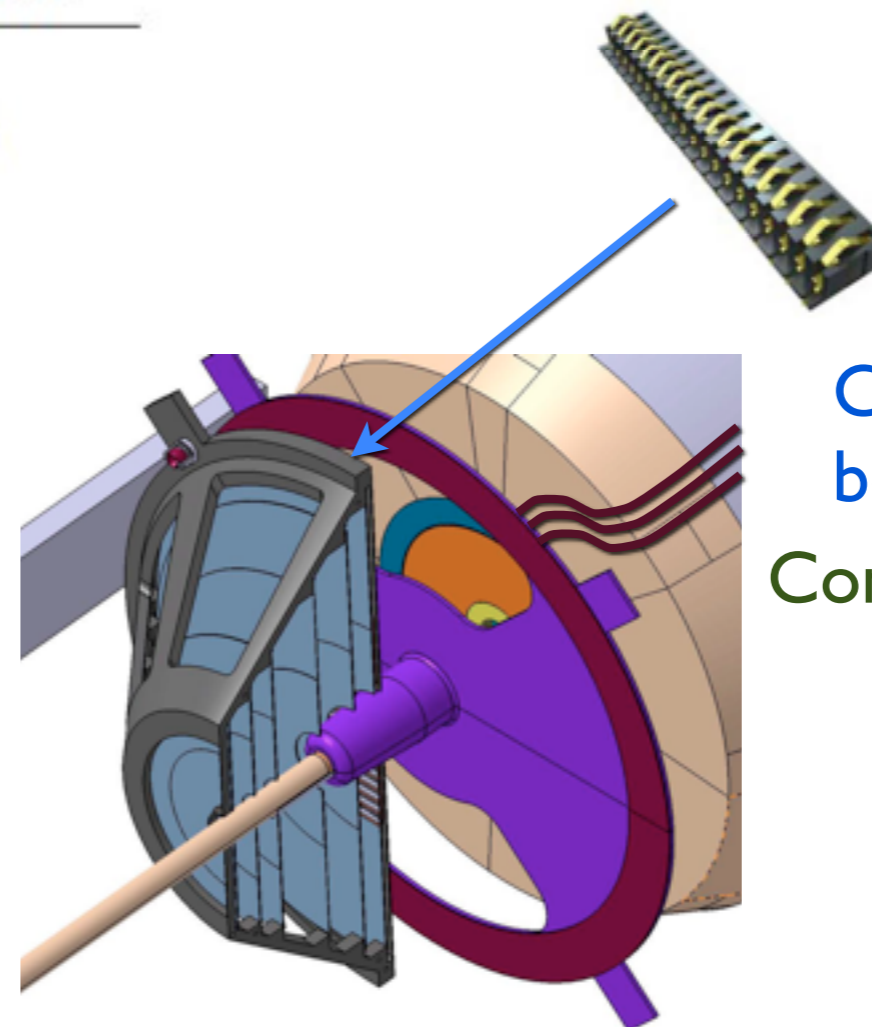
MAPS chips: 1.8V

GBTs: 3.3V

⇒ ~ 800 A to provide

⇒ 40cm² cross-section of copper cables
(3 cable trays)

Zero Insertion Force connectors:



Copper plates on
beam pipe support

Connexion by pressure
125kg ⇒ feasible



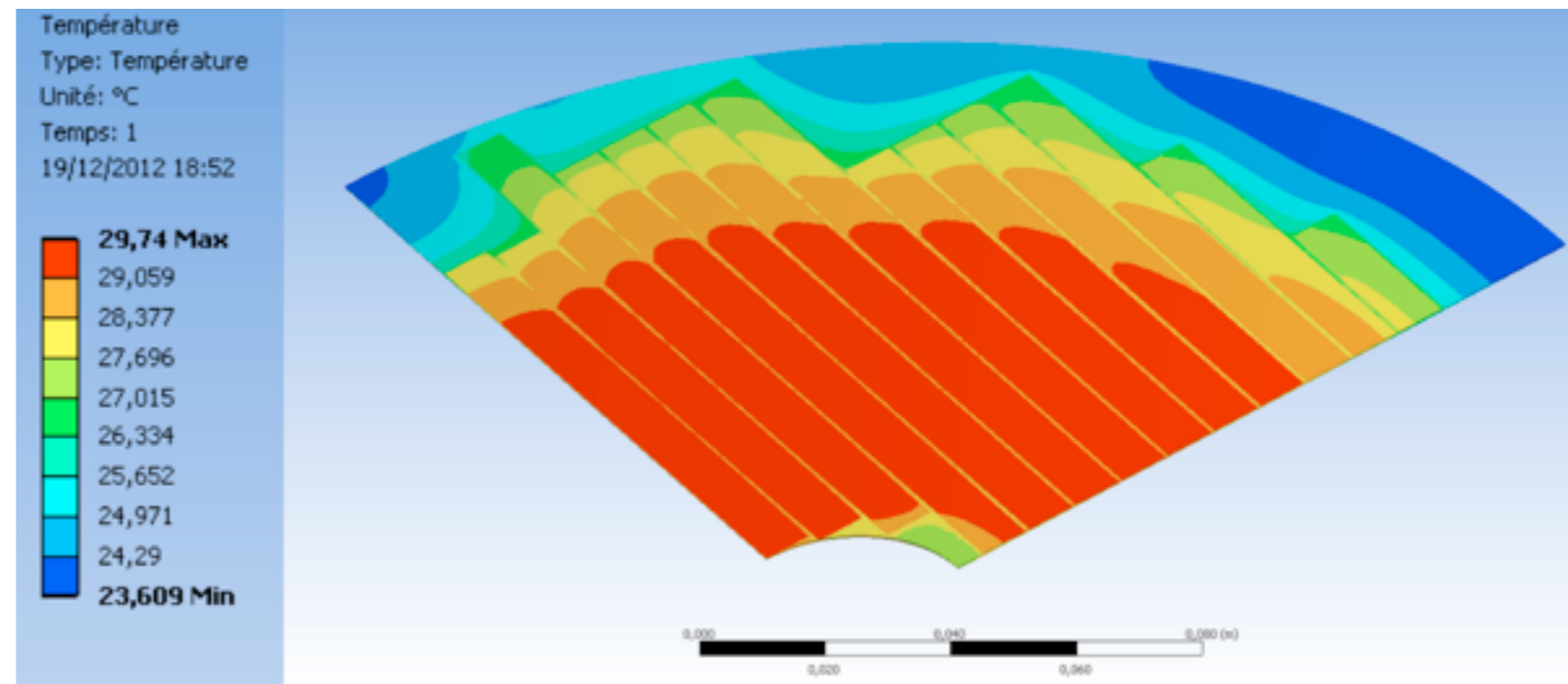
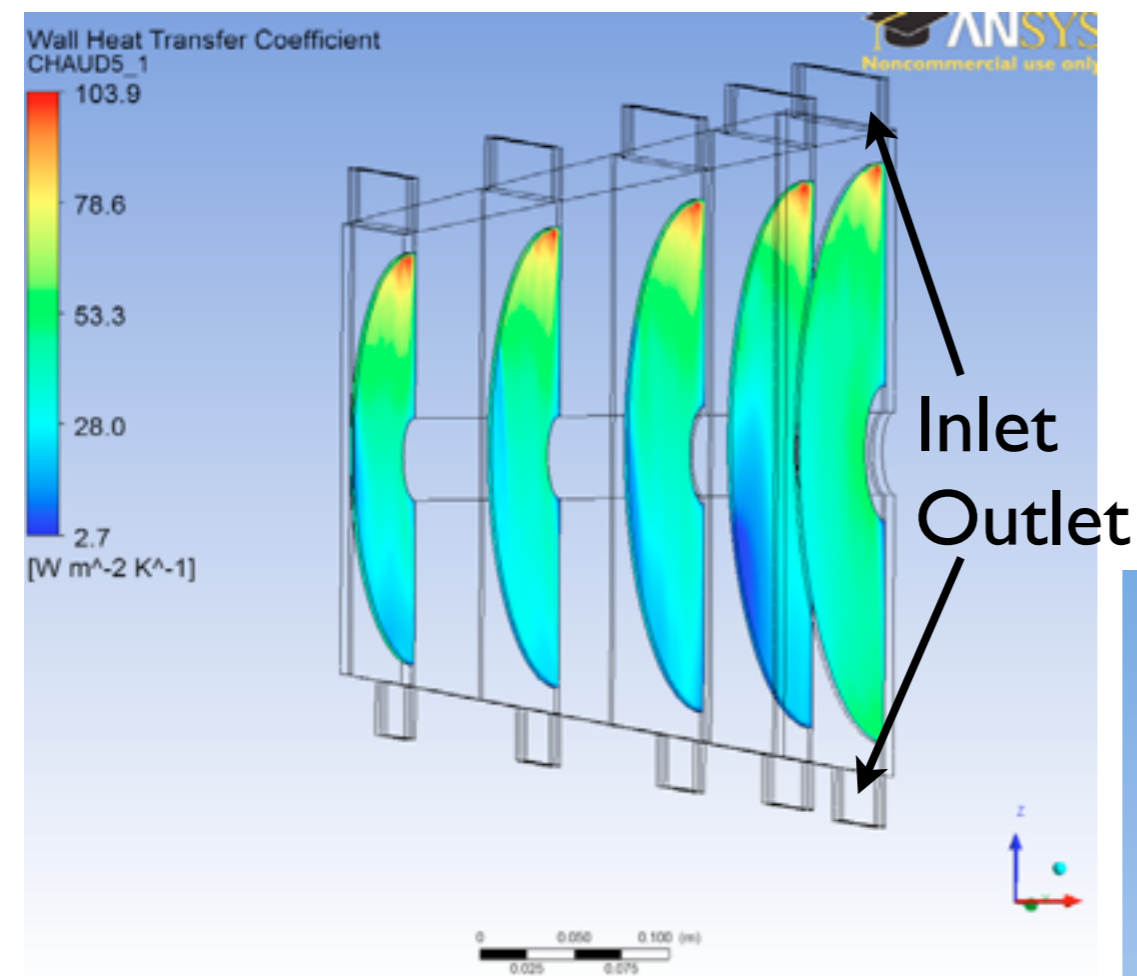
Cooling

Heat to extract (sensors + read-out): $\sim 2\text{kW}$

Maximal temperature on sensors: 30°C

Material thickness too small ($200\mu\text{m}$) for heat extraction by conduction

\Rightarrow Air cooling (22°C) above and within planes
flow : $3000\text{ L}\cdot\text{mn}^{-1} \Rightarrow$ speed $\sim 10\text{m}\cdot\text{s}^{-1}$
sufficient a priori
require more simulations and optimization

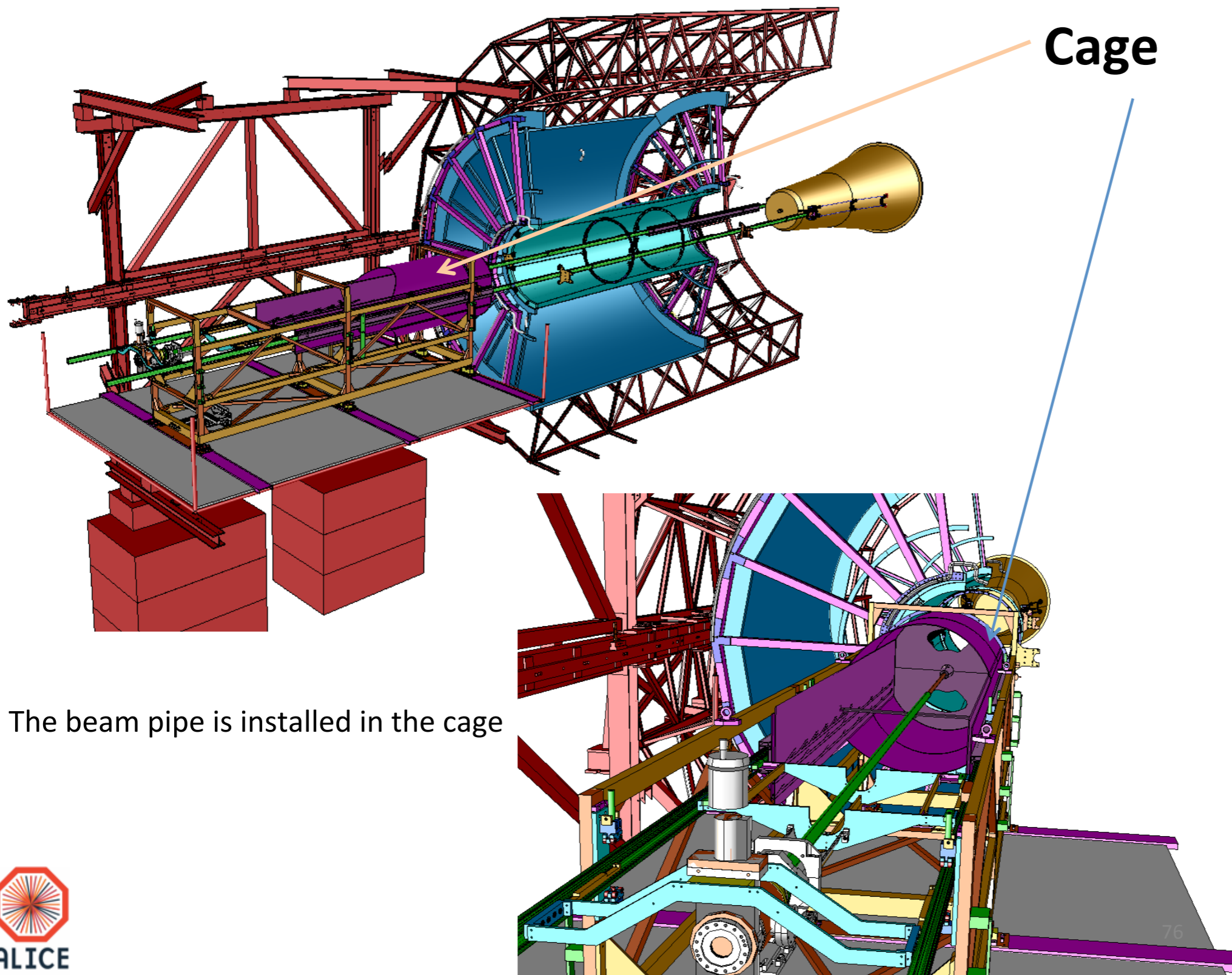


Cooling with liquid on periphery
not excluded



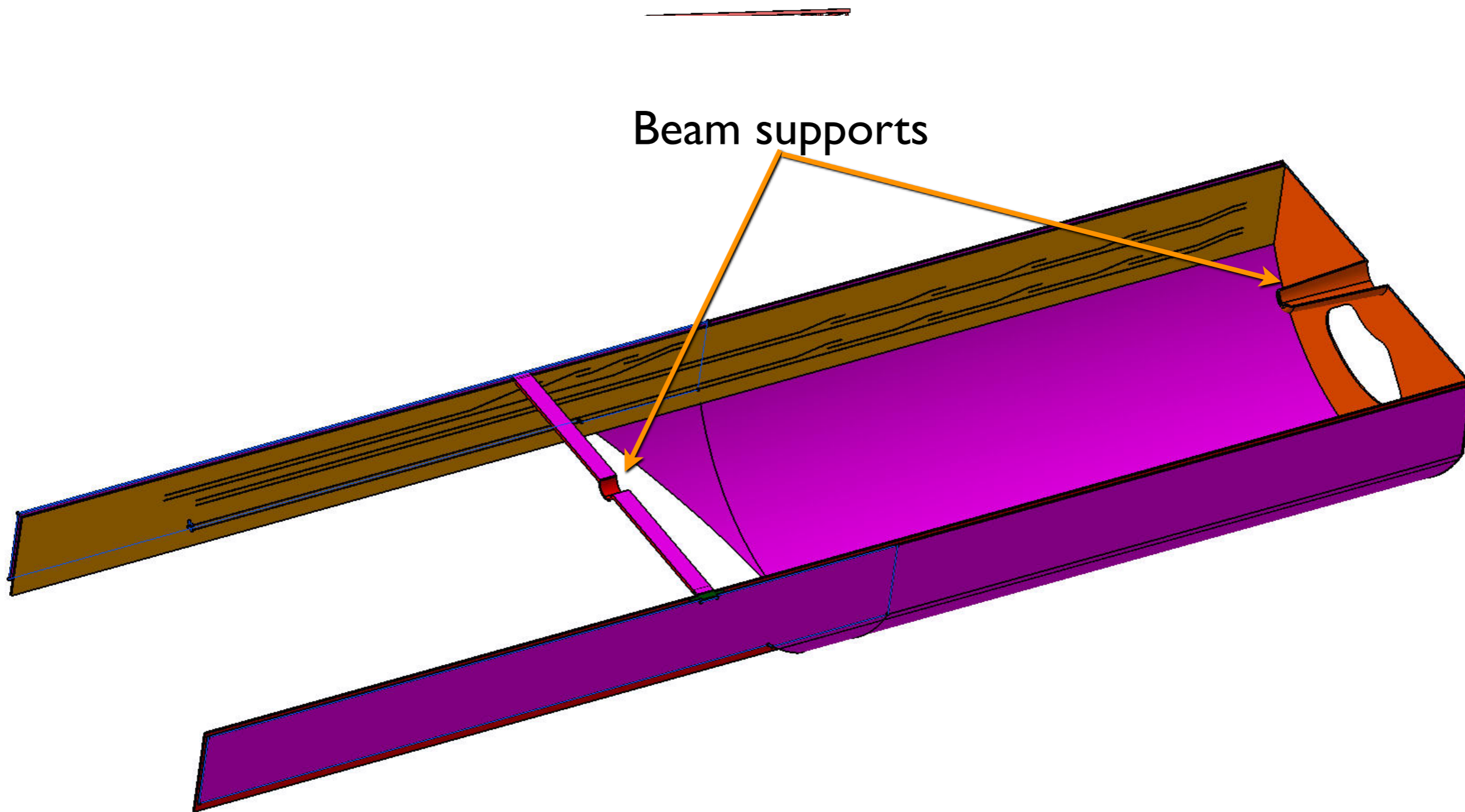
Insertion Story Board

Slides from Corrado Gargiulo (dec. 17th 2012)

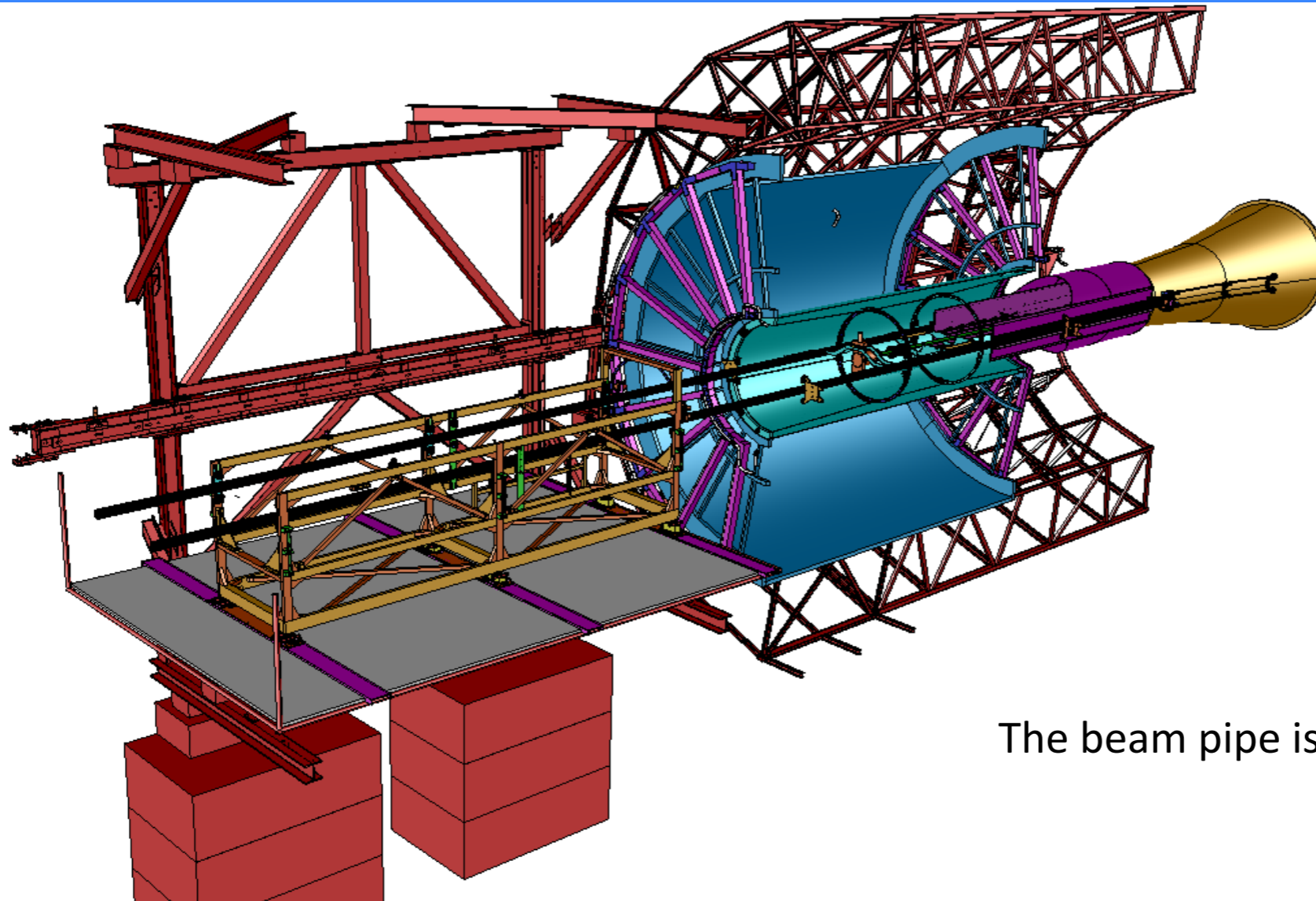


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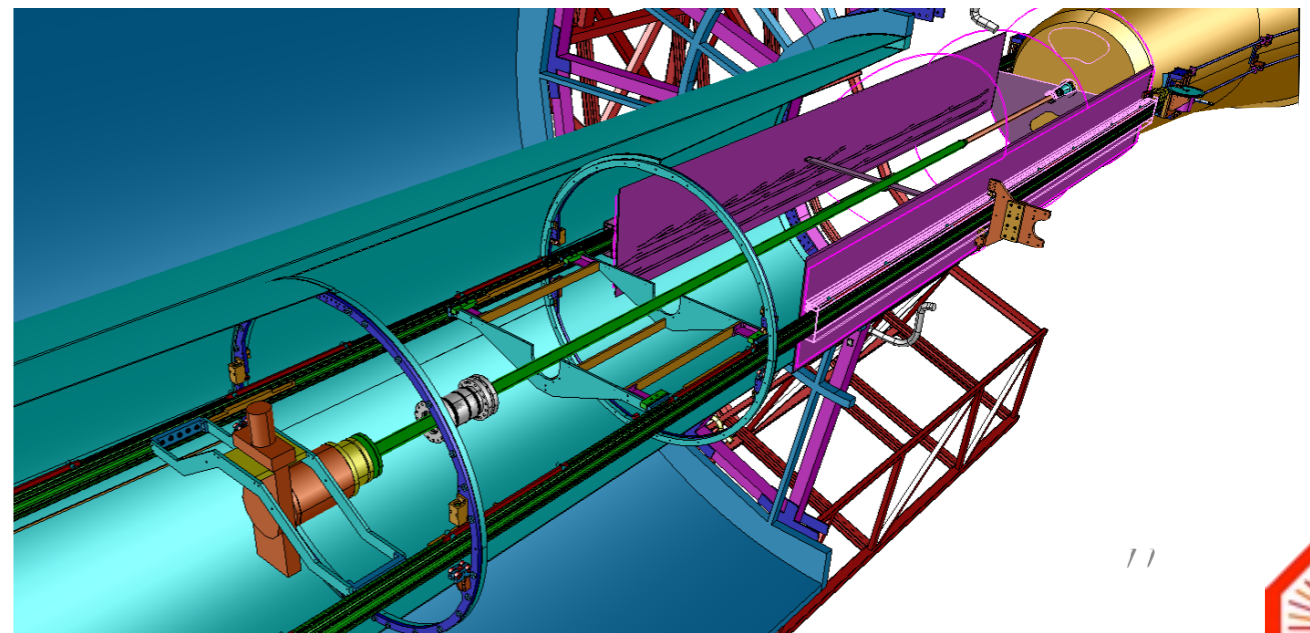
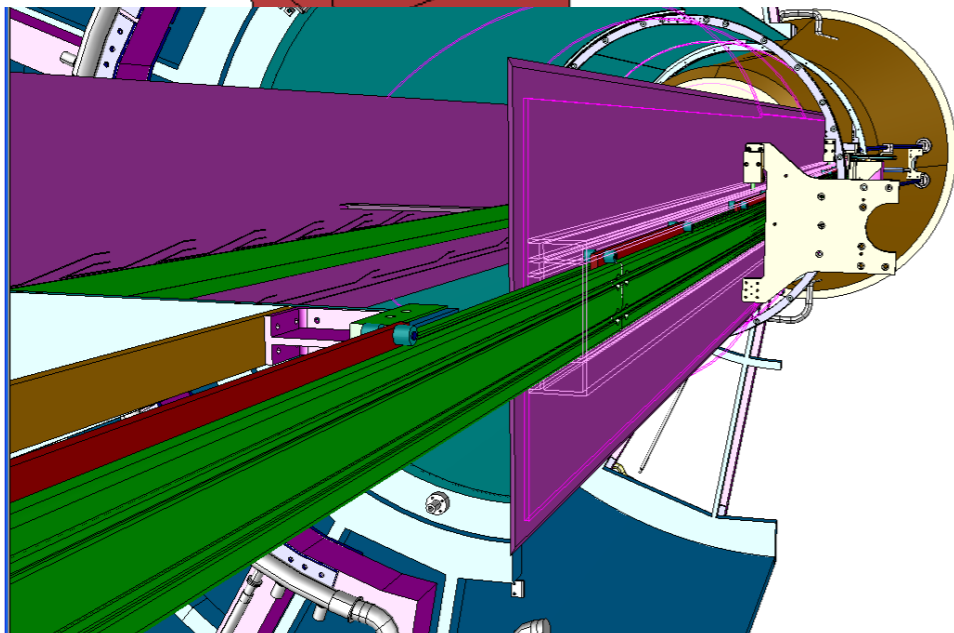


Insertion Story Board



Cage installation

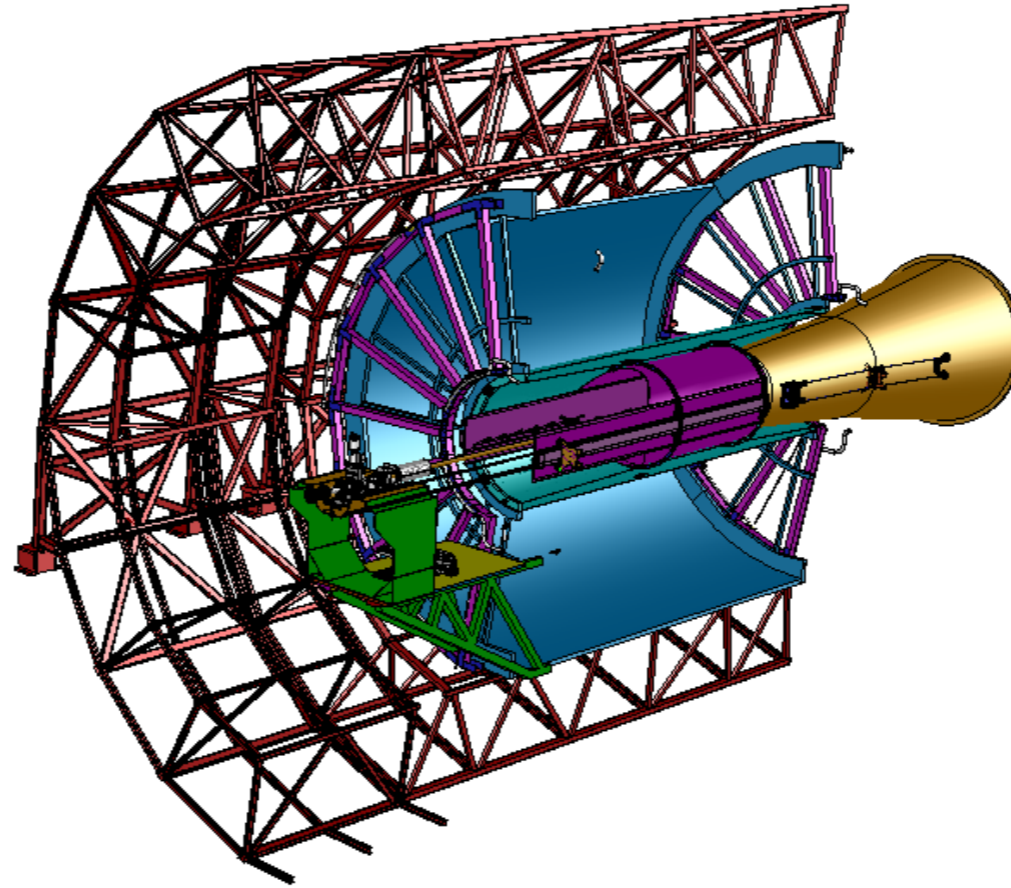
The beam pipe is installed in the cage



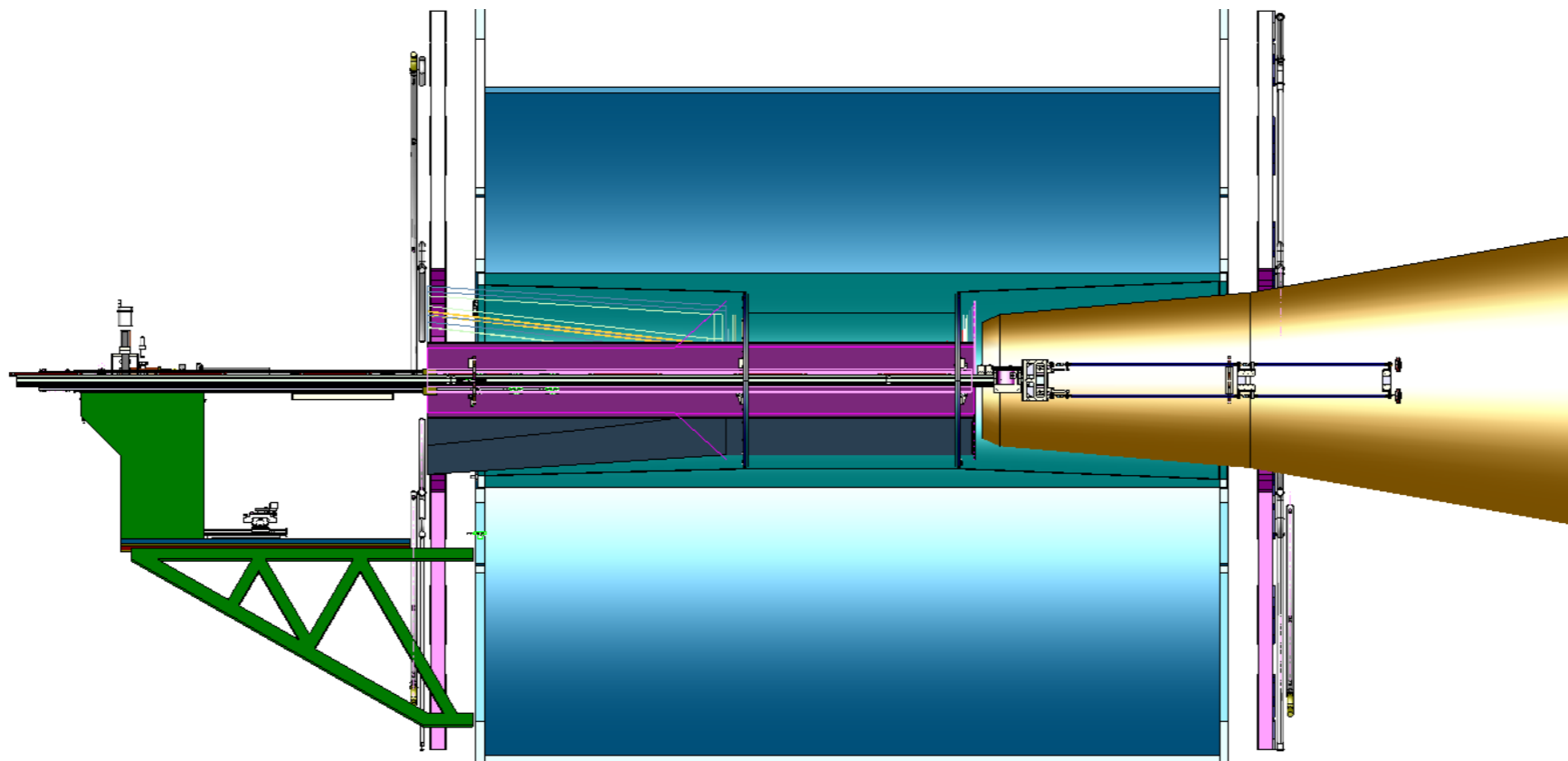
11



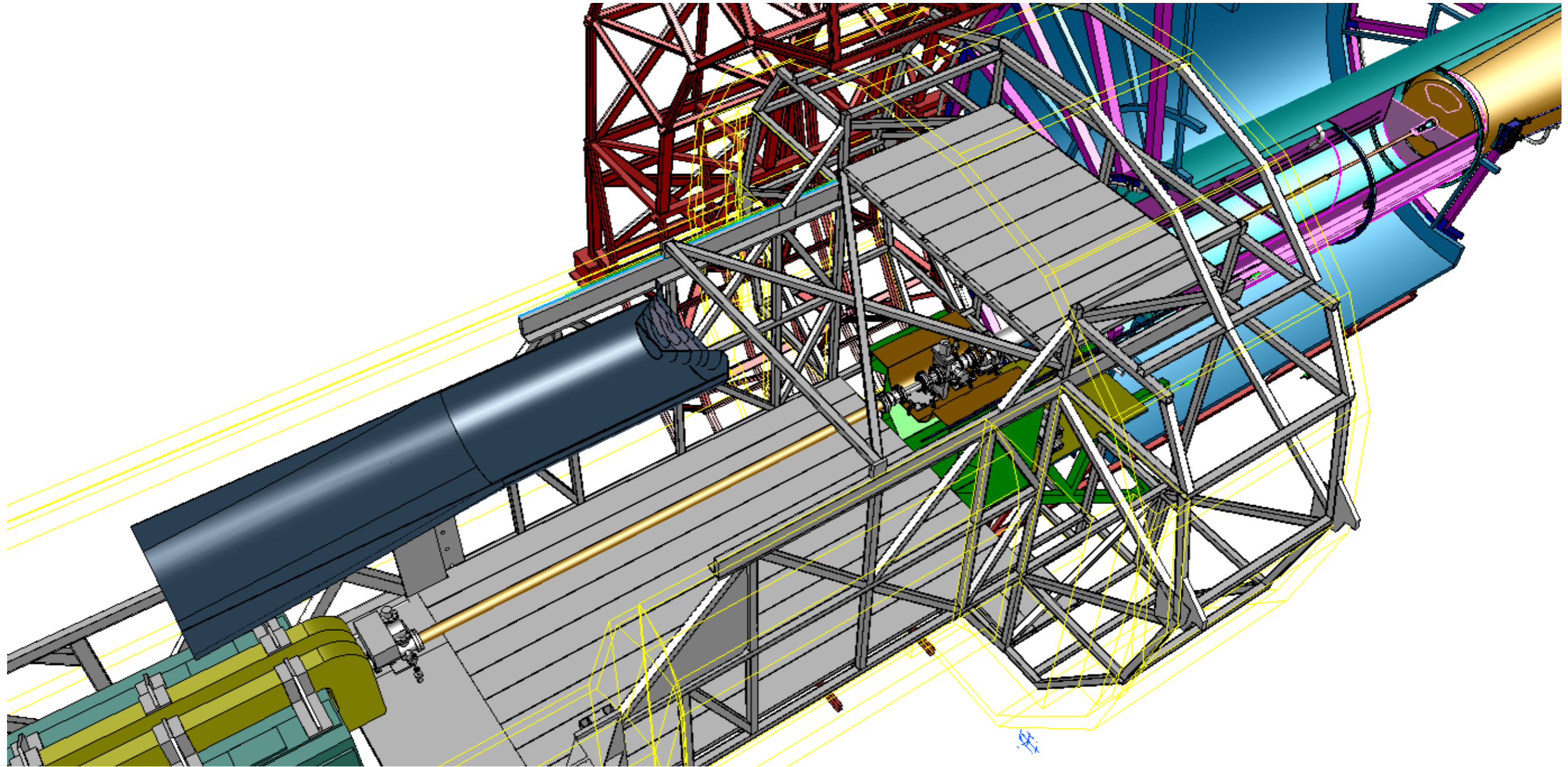
Insertion Story Board



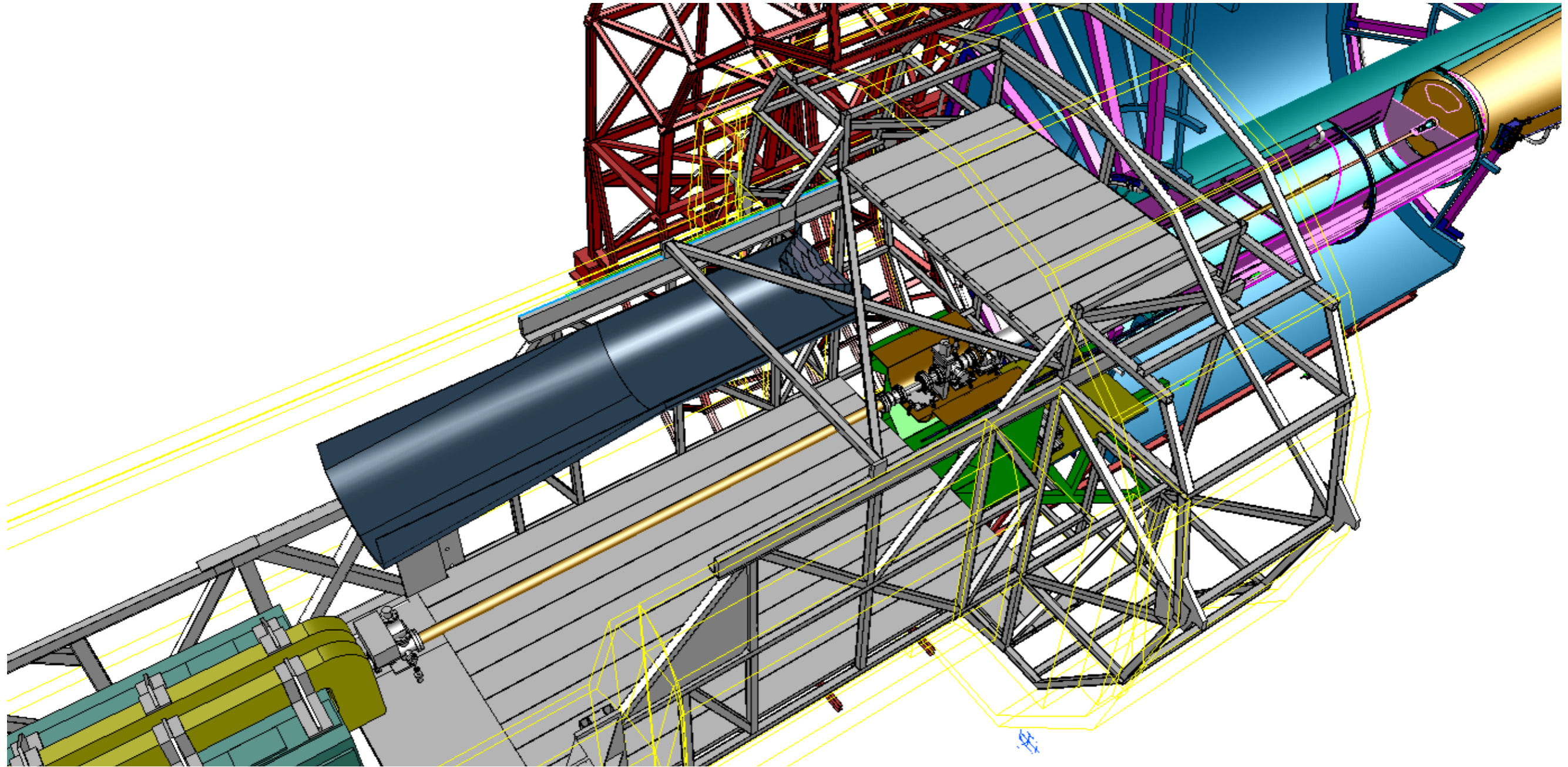
Remove Delfi frame



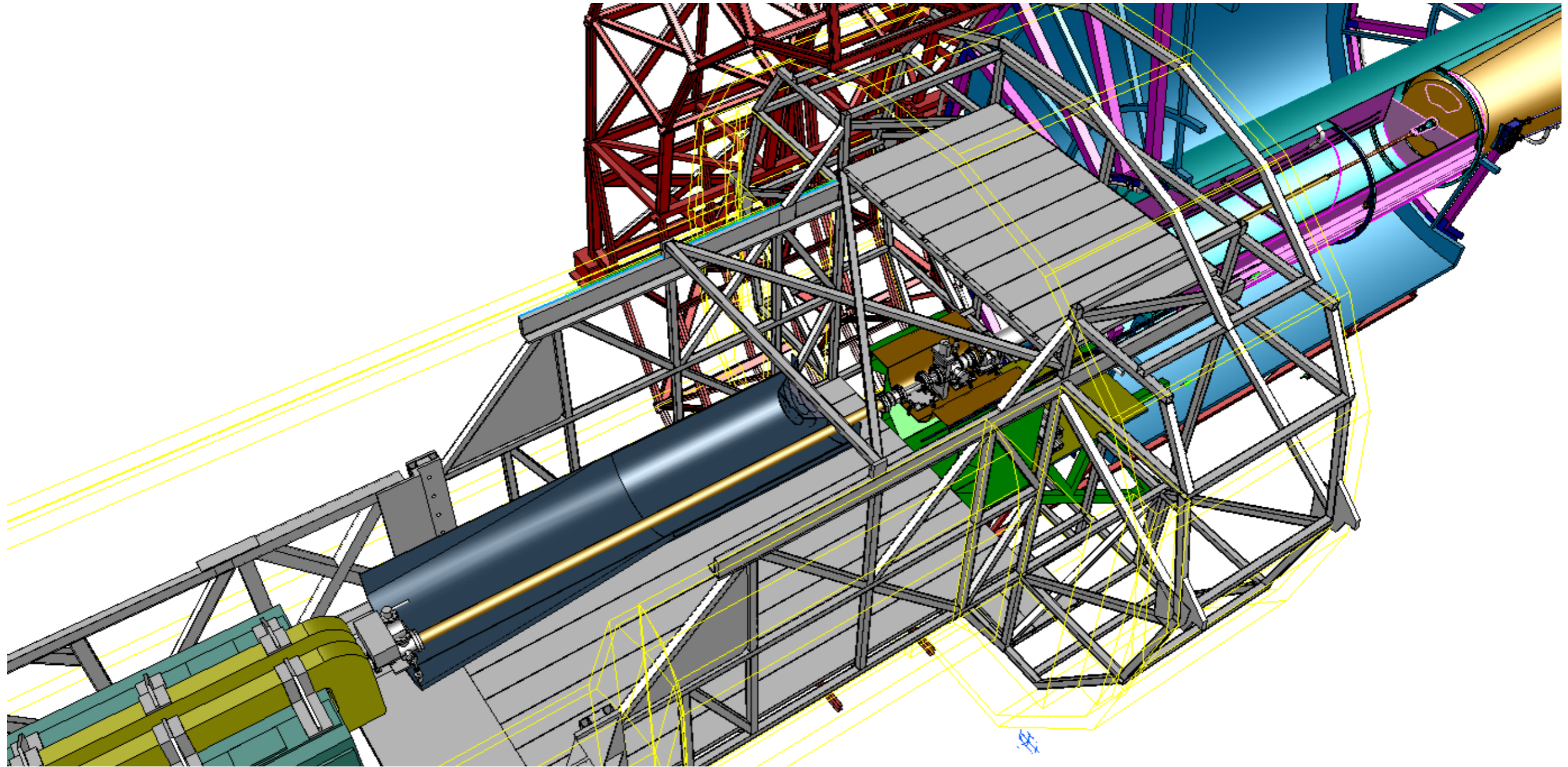
Insertion Story Board



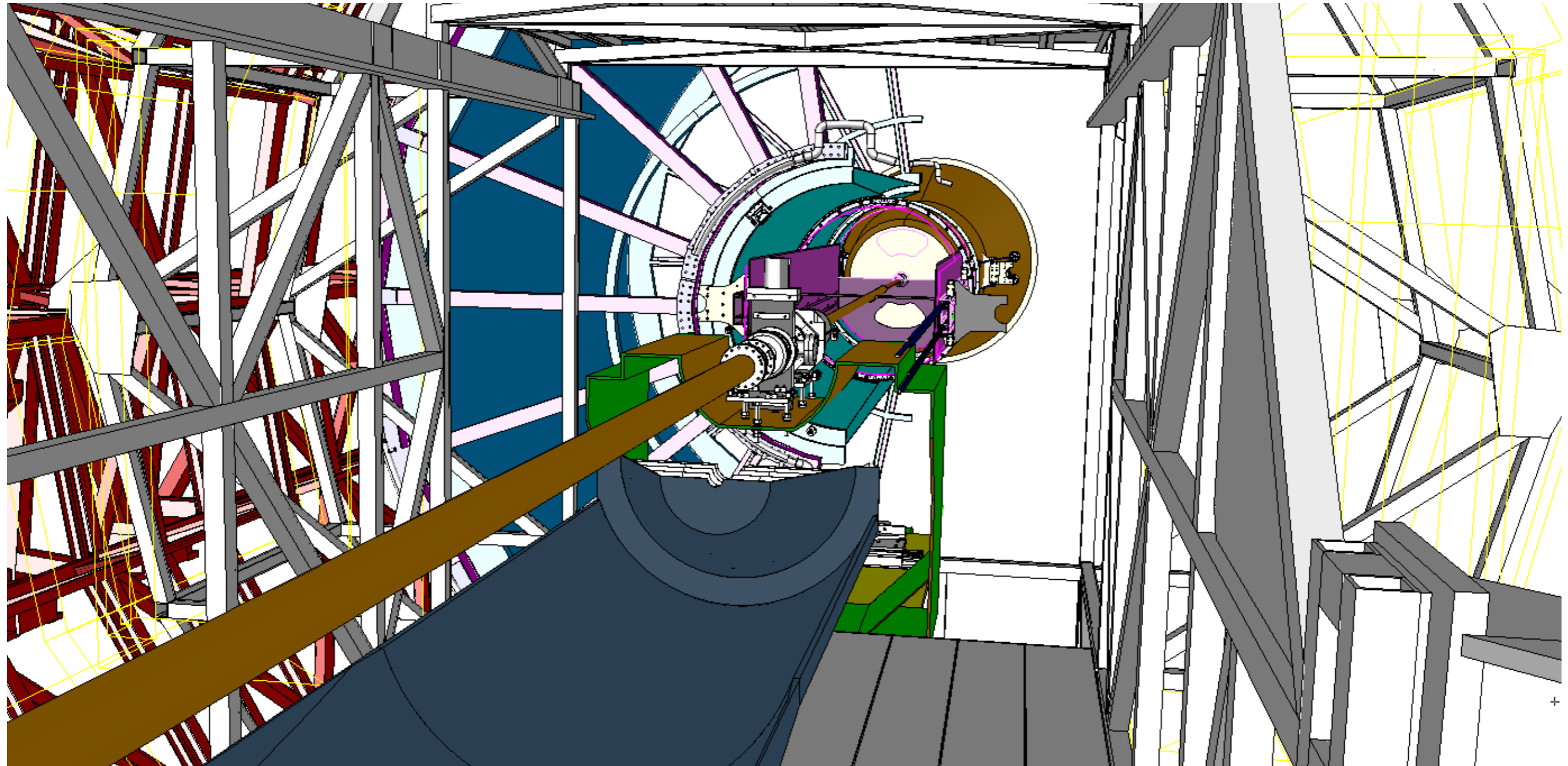
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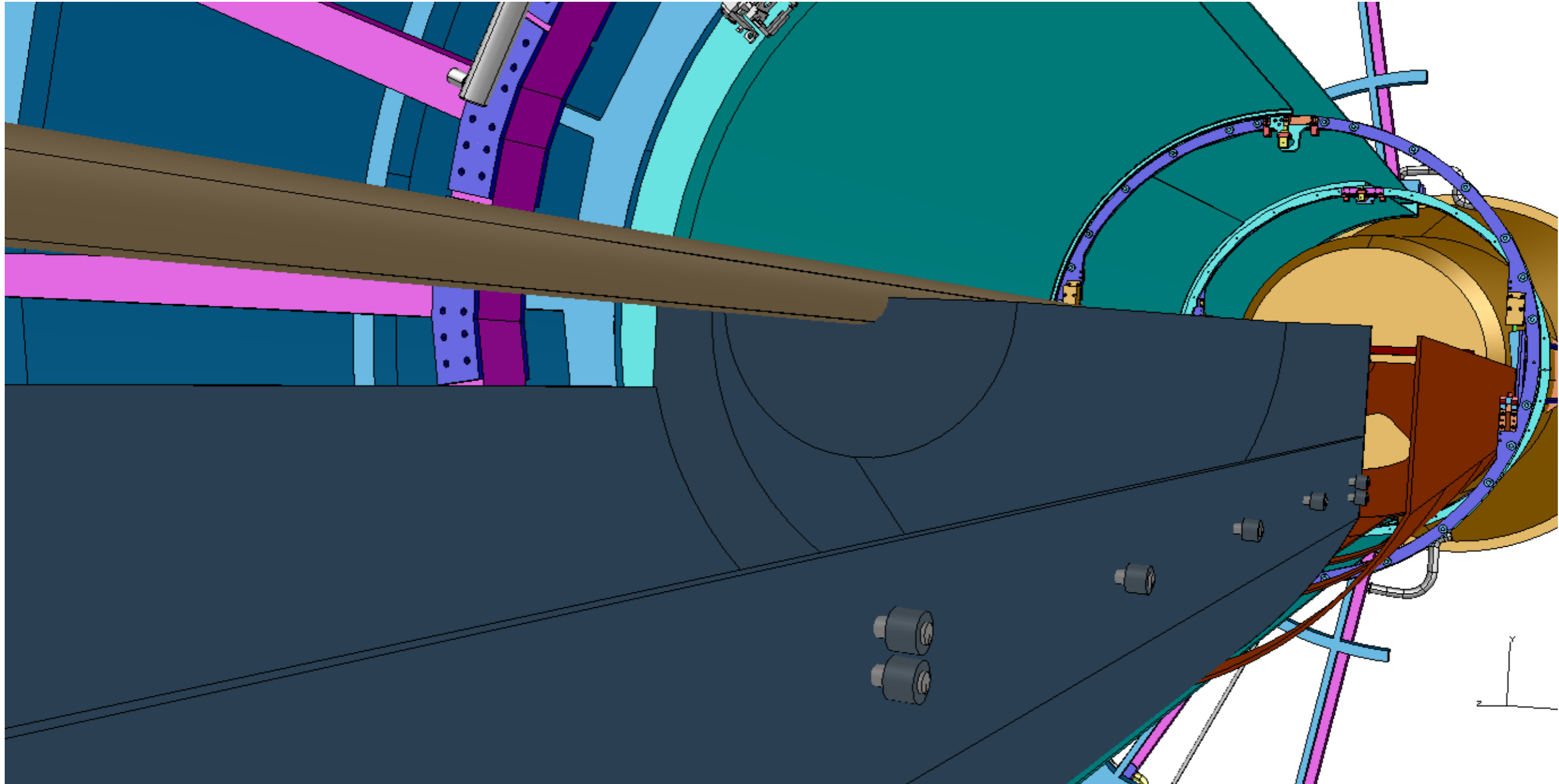
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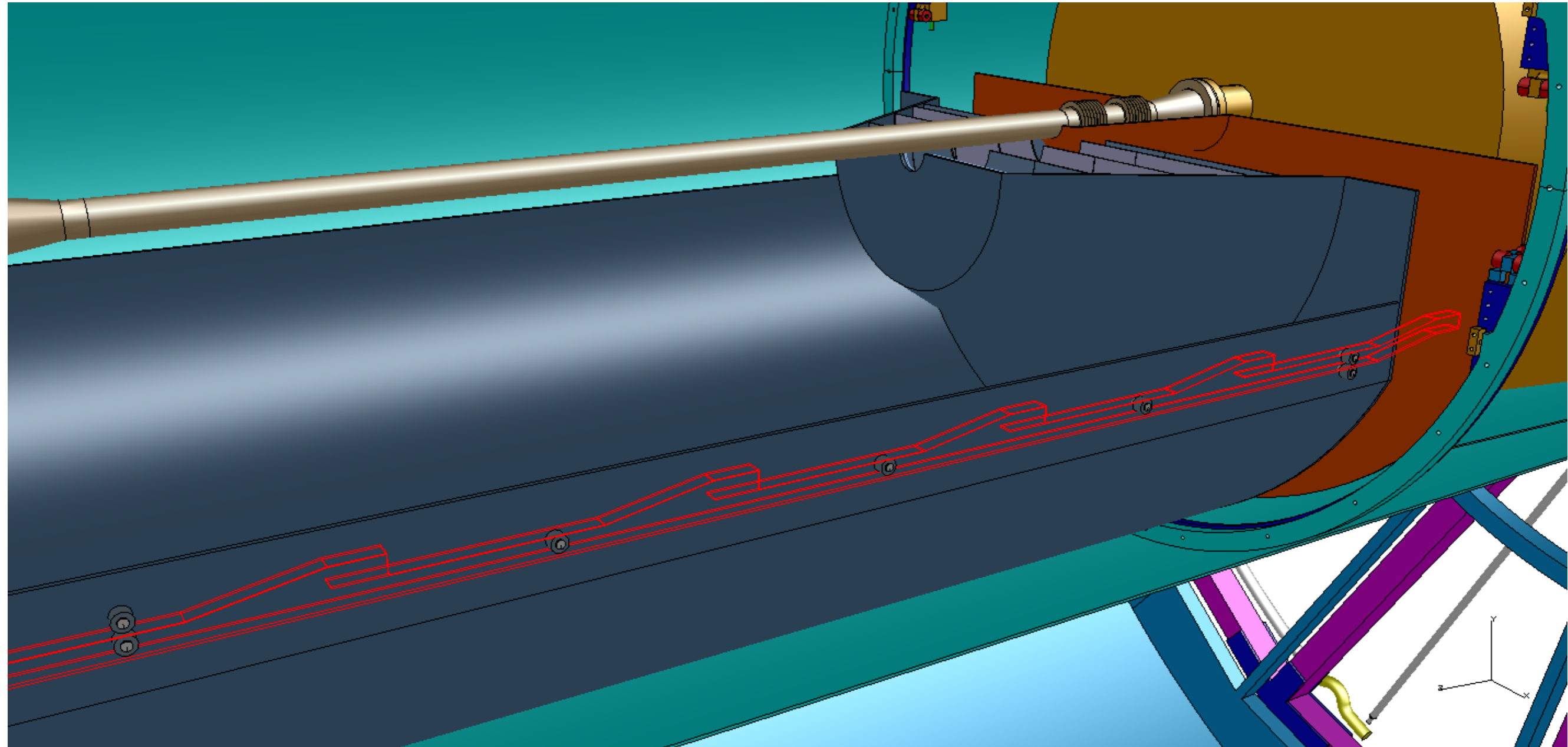
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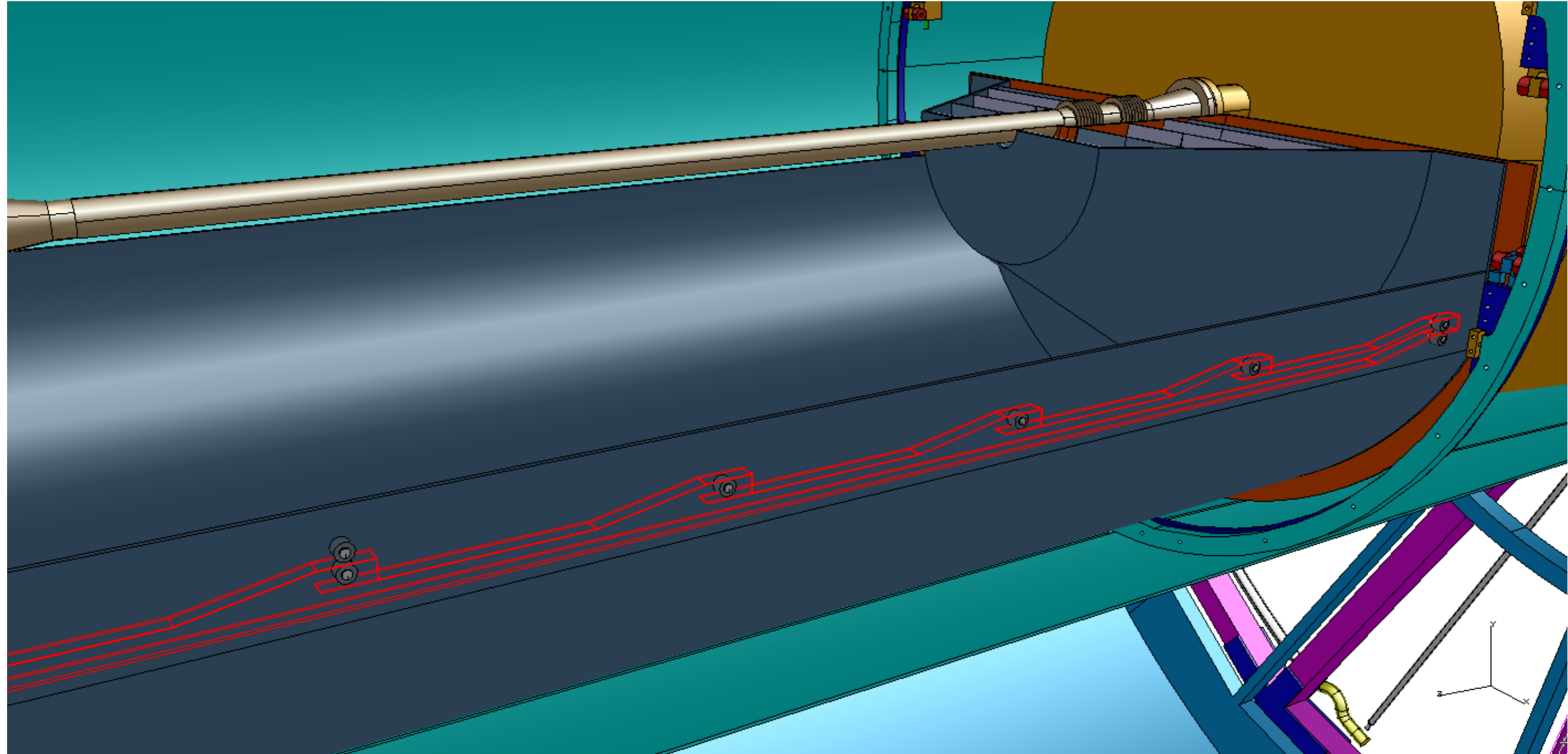
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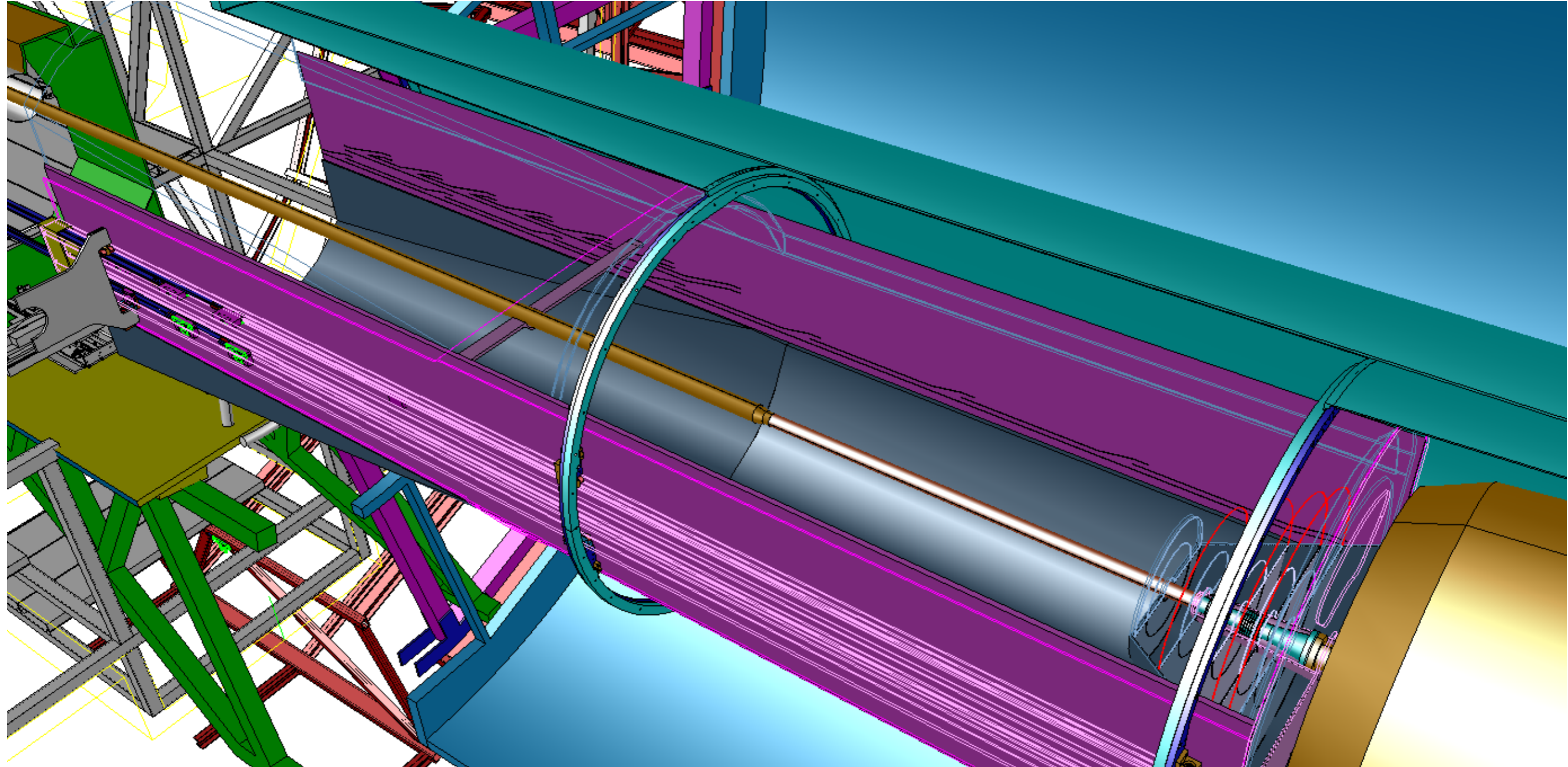
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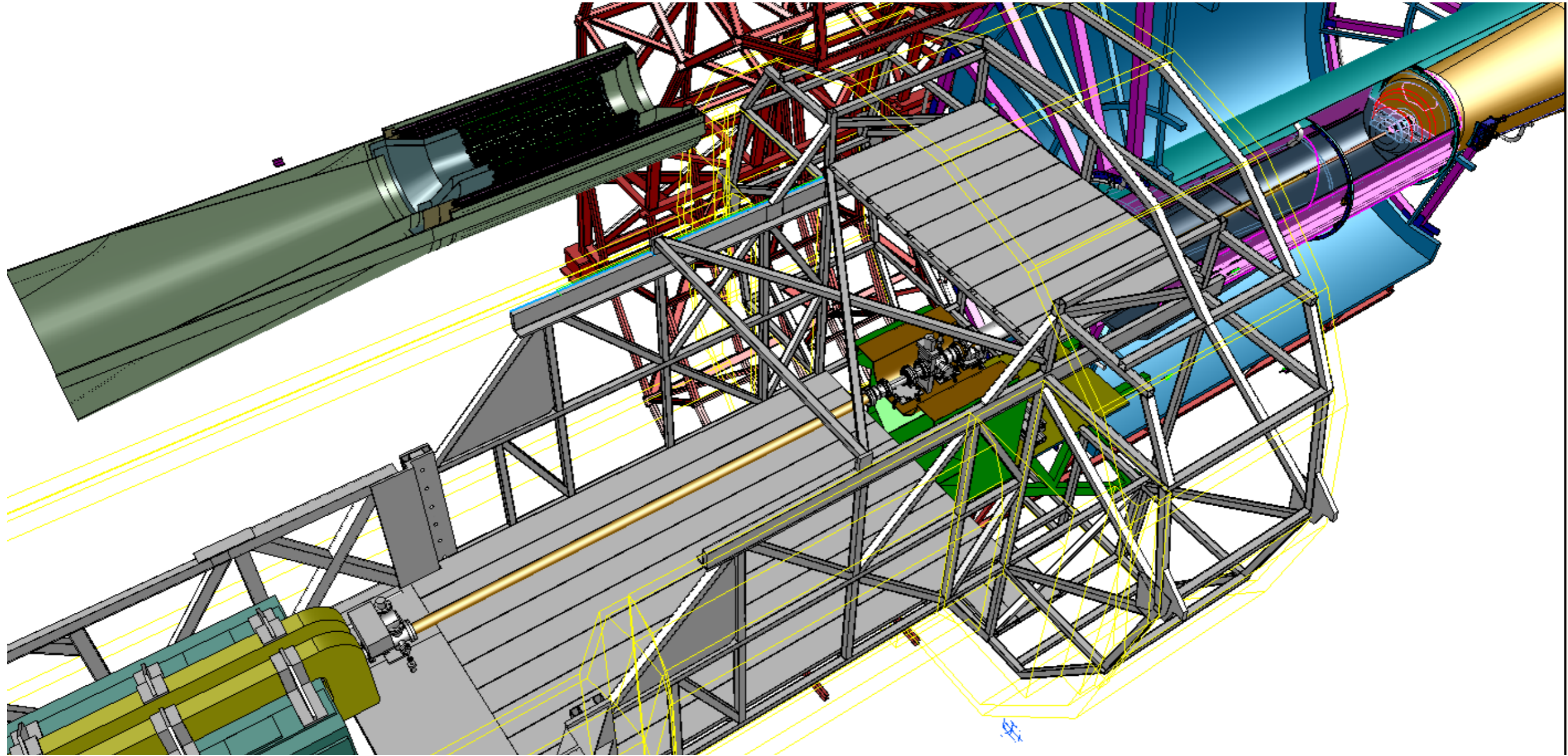
Insertion Story Board



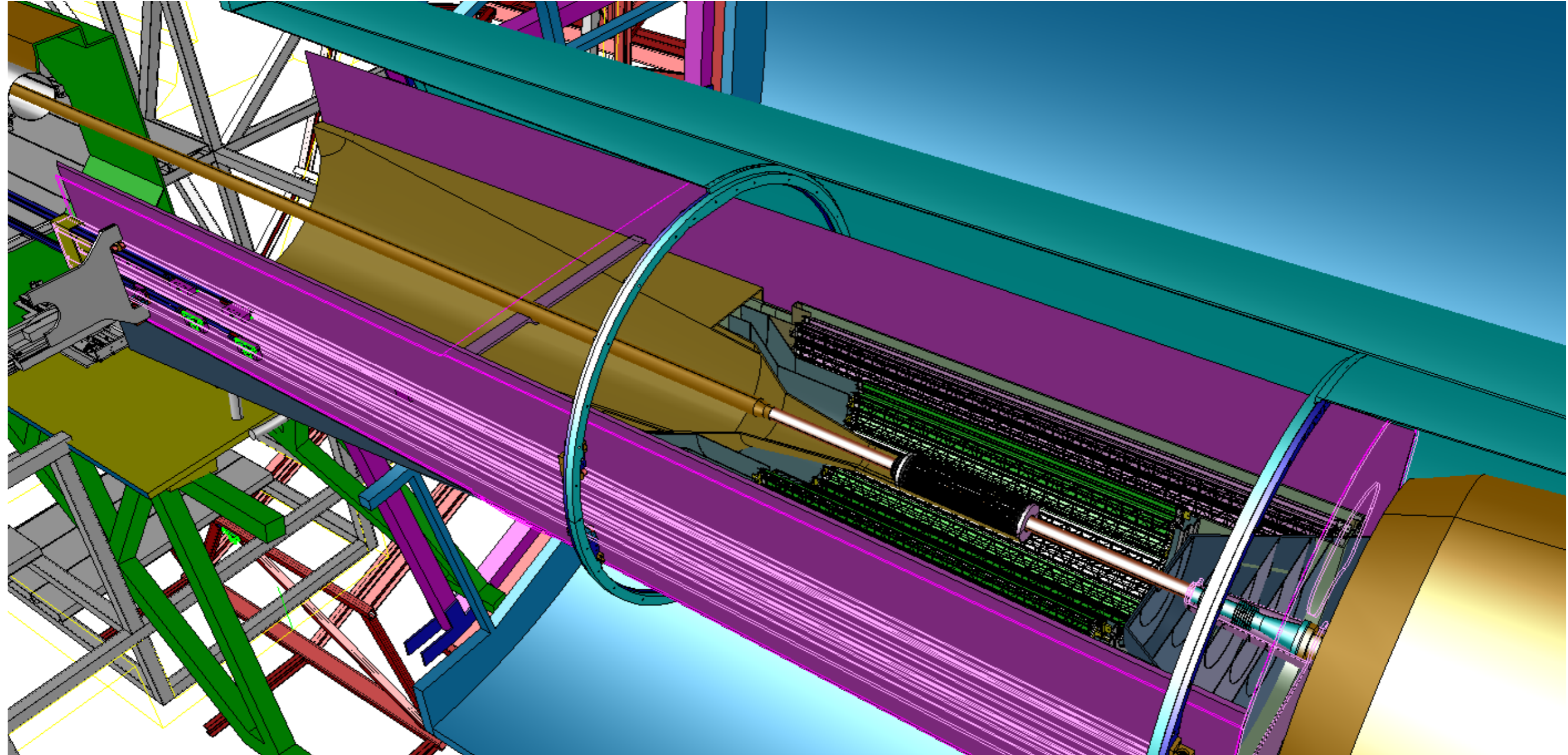
Insertion Story Board



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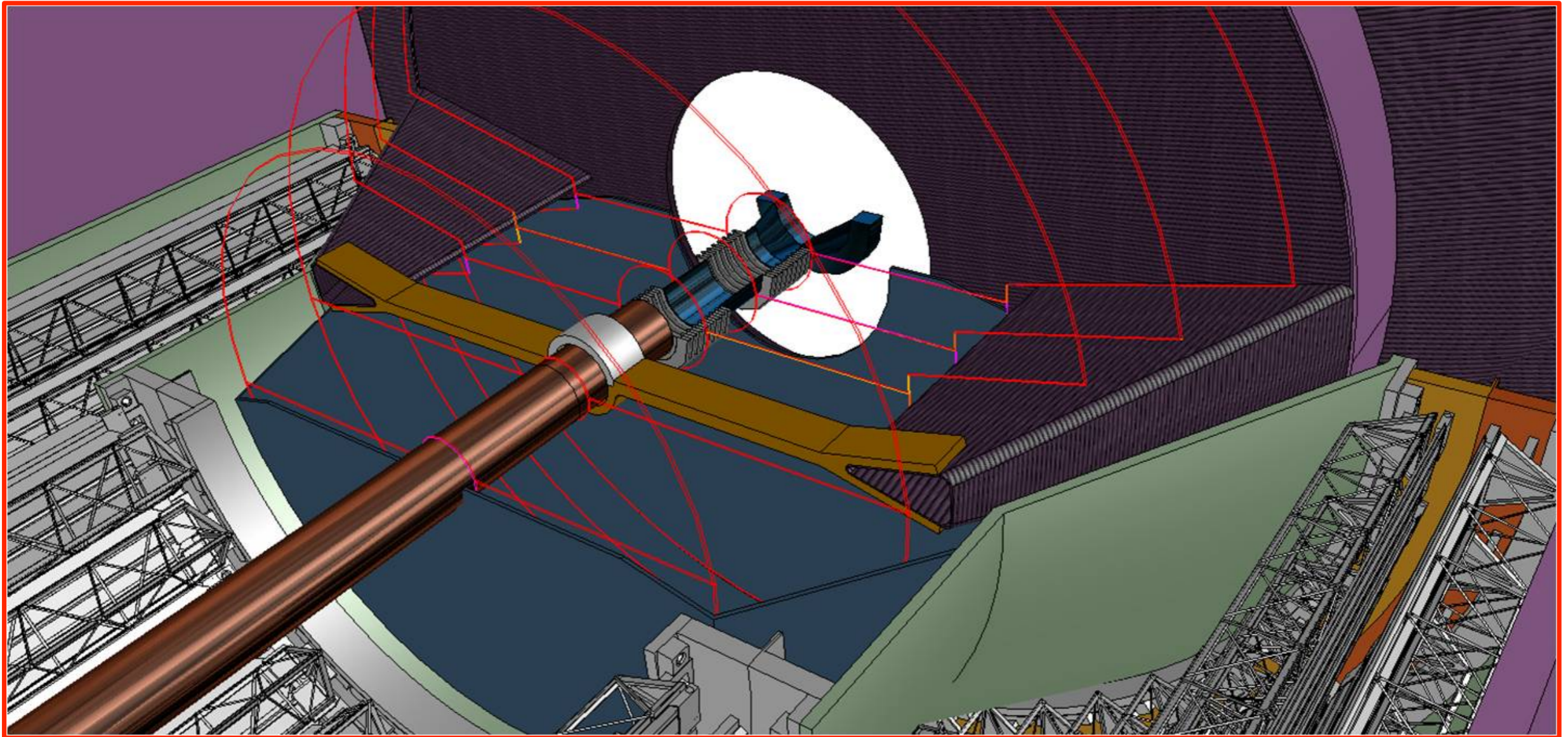


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Beam pipe support

Proposition from the ALICE Technical Coordination



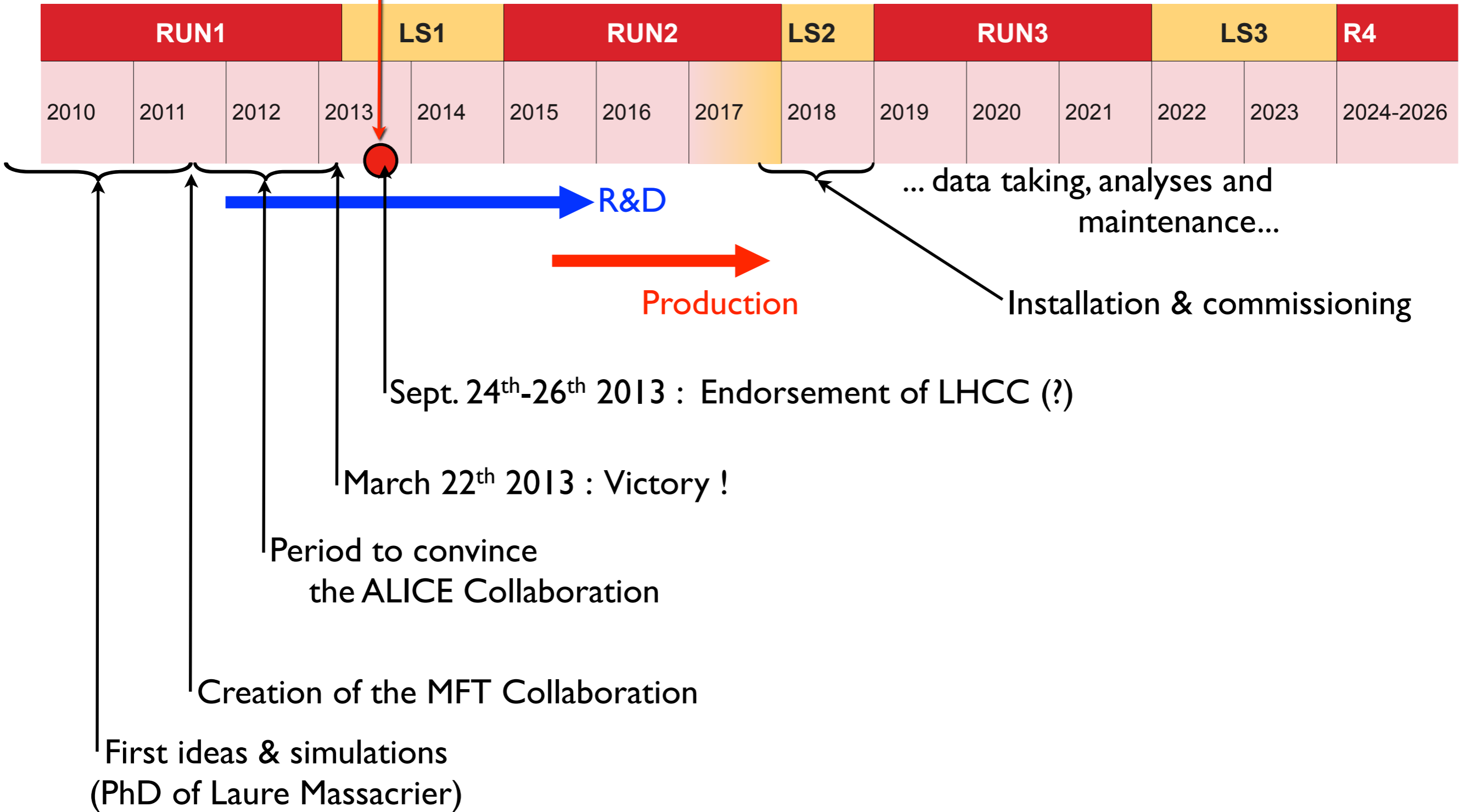
First design; has to be optimized



Calendar

You are here

LS = «Long» Shutdown (i.e. no collisions)



Calendar

You are here

LS = «Long» Shutdown (i.e. no collisions)



R&D

Production

... data taking, analyses and maintenance...

Installation & commissioning

Sept. 24th-26th 2013 : Endorsement of LHCC (?)

March 22th 2013 : Victory !

Period to convince the ALICE Collaboration

Creation of the MFT Collaboration

First ideas & simulations (PhD of Laure Massacrier)



Conclusion

MFT: challenging but feasible
makes the physics of Muon Spectrometer
richer.

Synergies with ITS (same technology)

**Presentation at LHCC (sept. 24th-26th)
for endorsement**

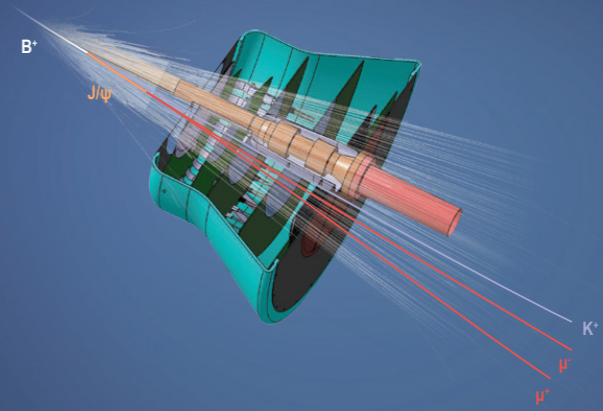
Designs and prototypes of flexes underway
Design of assembly procedure in progress

ALICE
Addendum to the Letter of Intent

CERN-LHCC-2013-014
LHCC-I-022-ADD-1
ALICE-UG-003
September 25, 2013

ALICE

Upgrade of the
ALICE Experiment
Addendum to the Letter of Intent
The **Muon Forward Tracker**



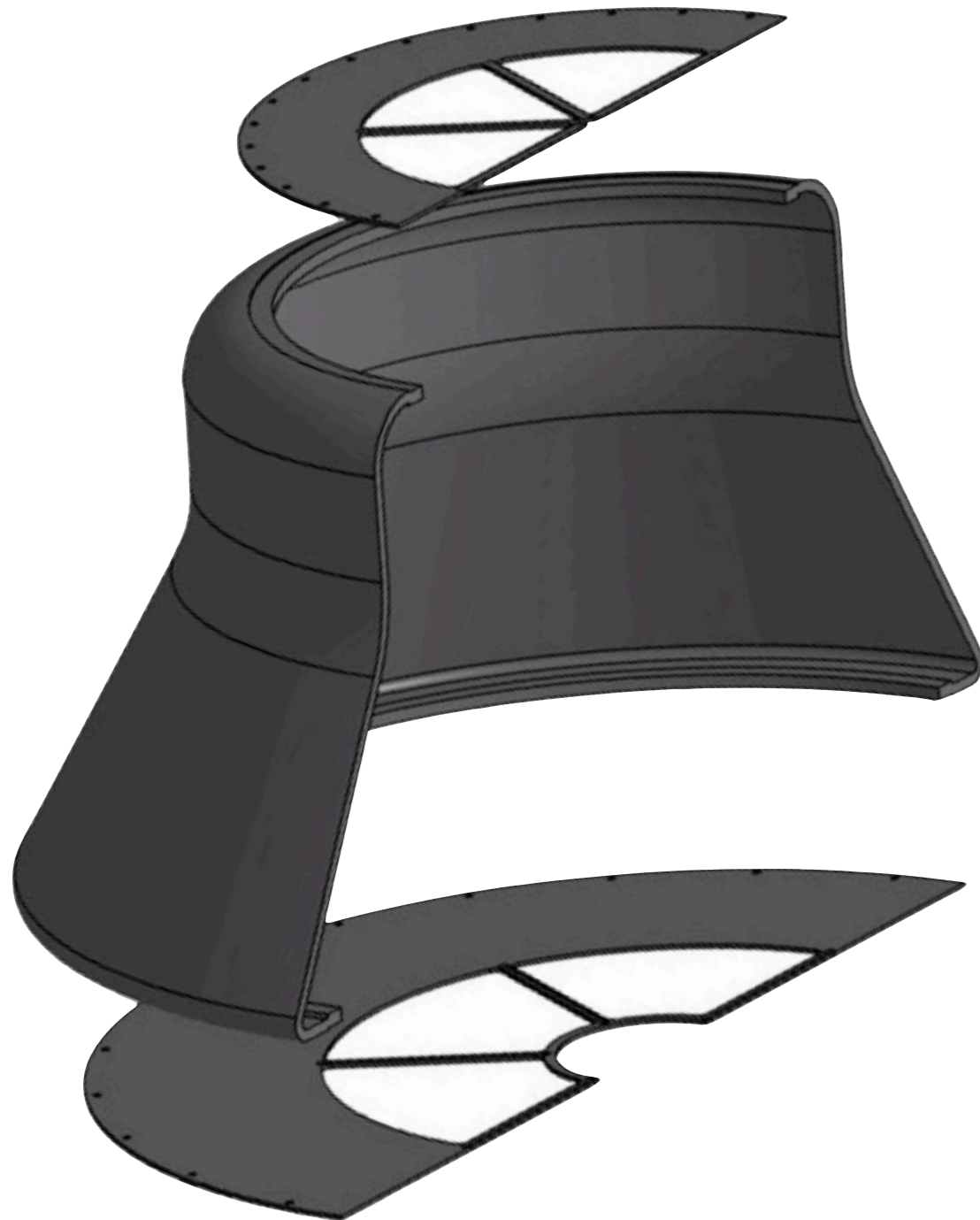
Addendum to the Letter of Intent for the Upgrade of the ALICE Experiment | The Muon Forward Tracker | CERN-LHCC-2013-014 (LHCC-I-022-ADD-1)



One last thing...



One last thing...



MAY THE FORCE BE WITH US!

