FCC-HH EXPERIMENT

INTEGRATION PROCEDURE

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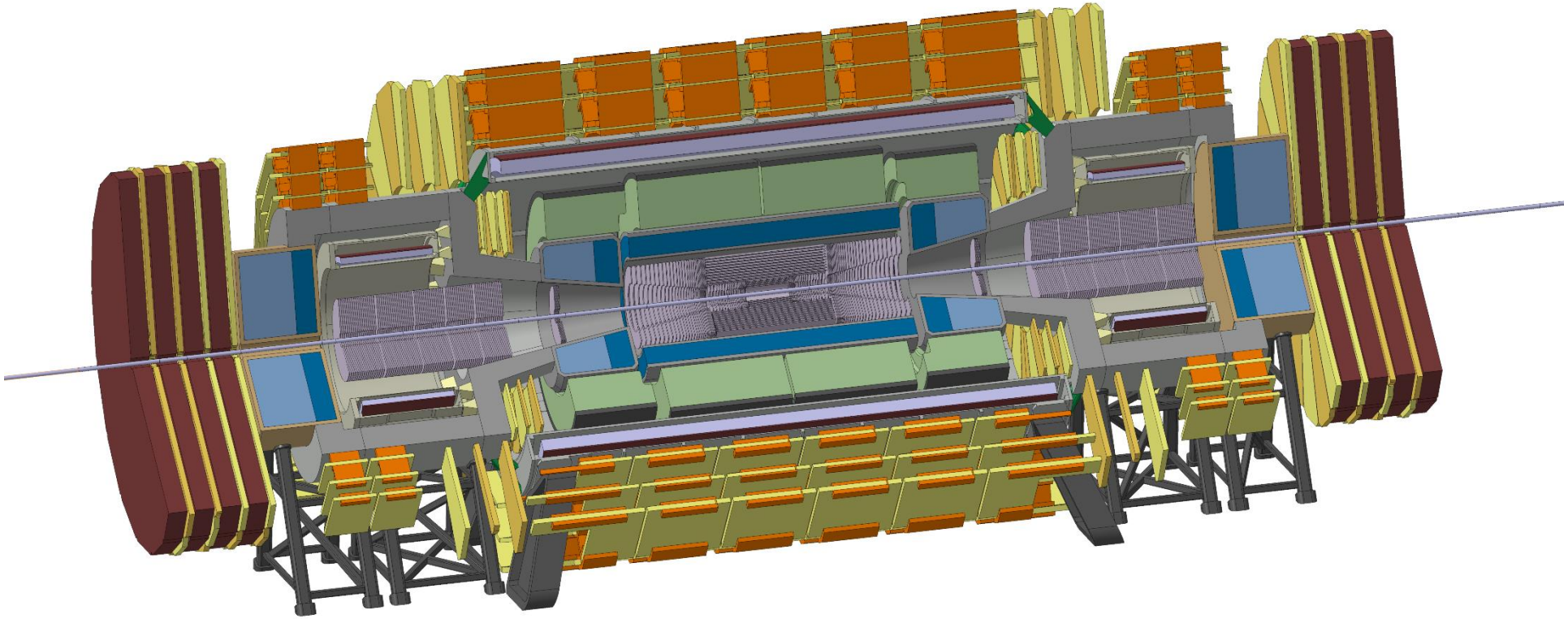
FCC collaboration

FCC WEEK

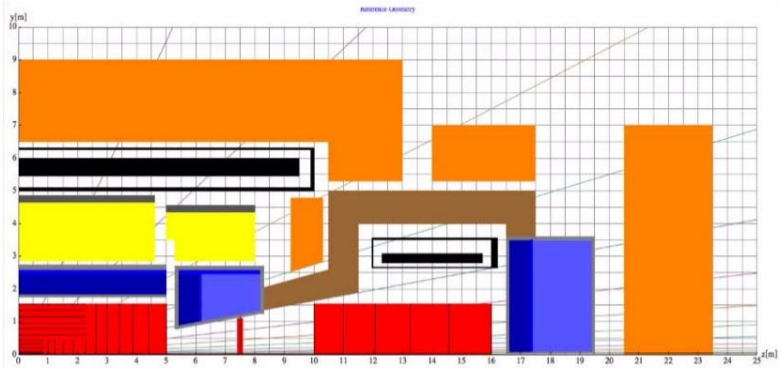
BERLIN 2017

DETECTOR OVERVIEW

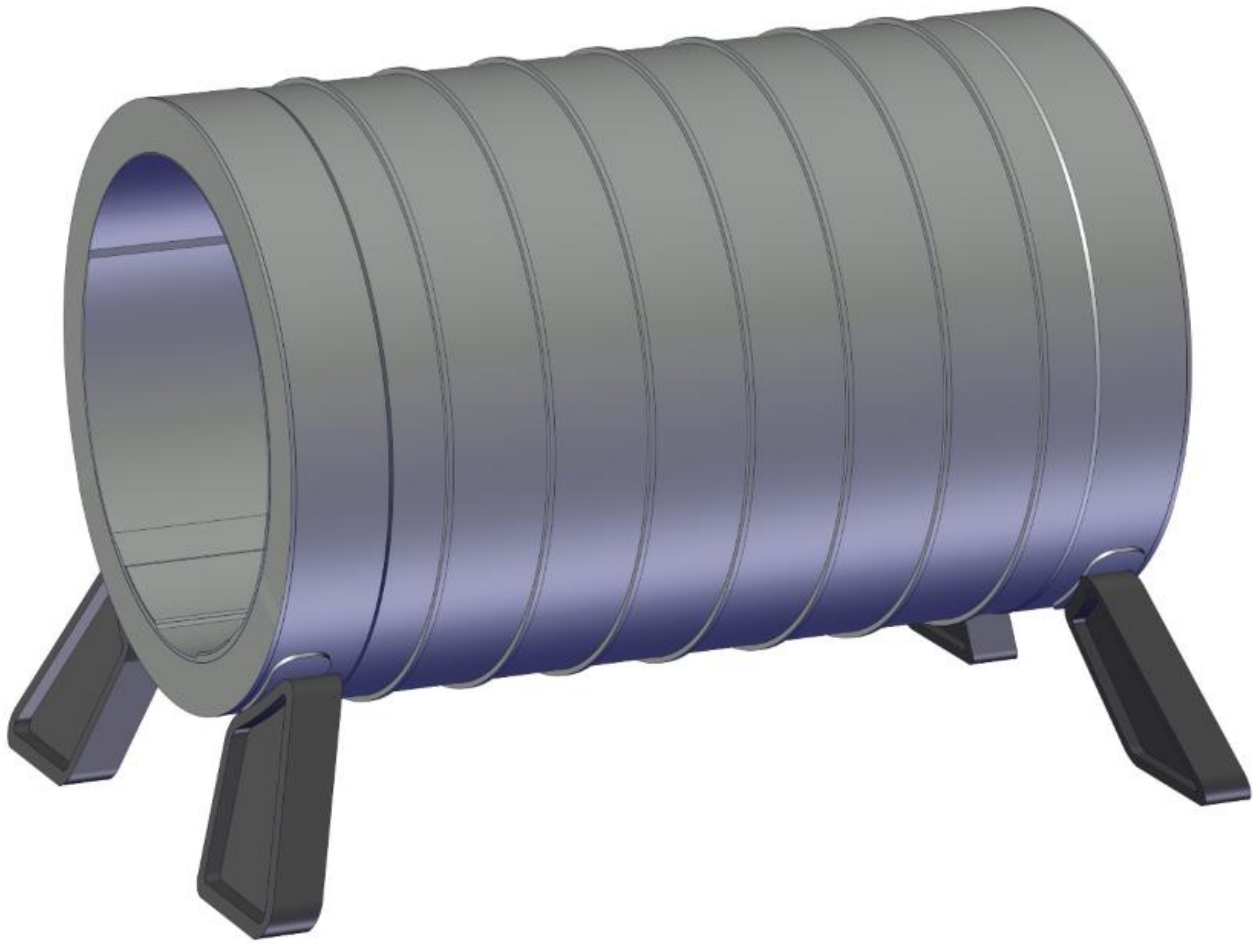


Base Line Design

- Exception was made in the forward Muon Chambers
- The use of iron in between the muon chambers is a possibility

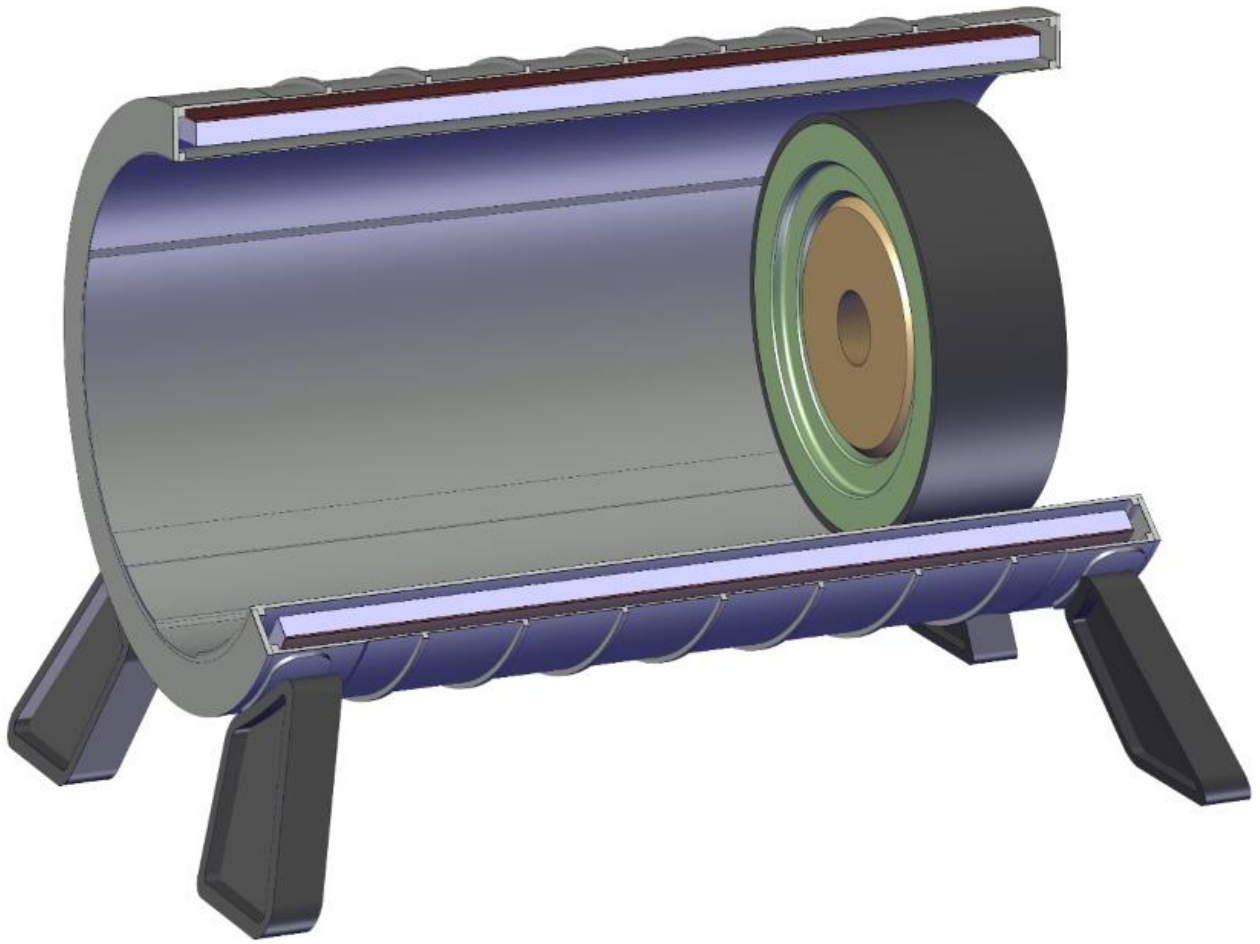


EXPERIMENT INTEGRATION



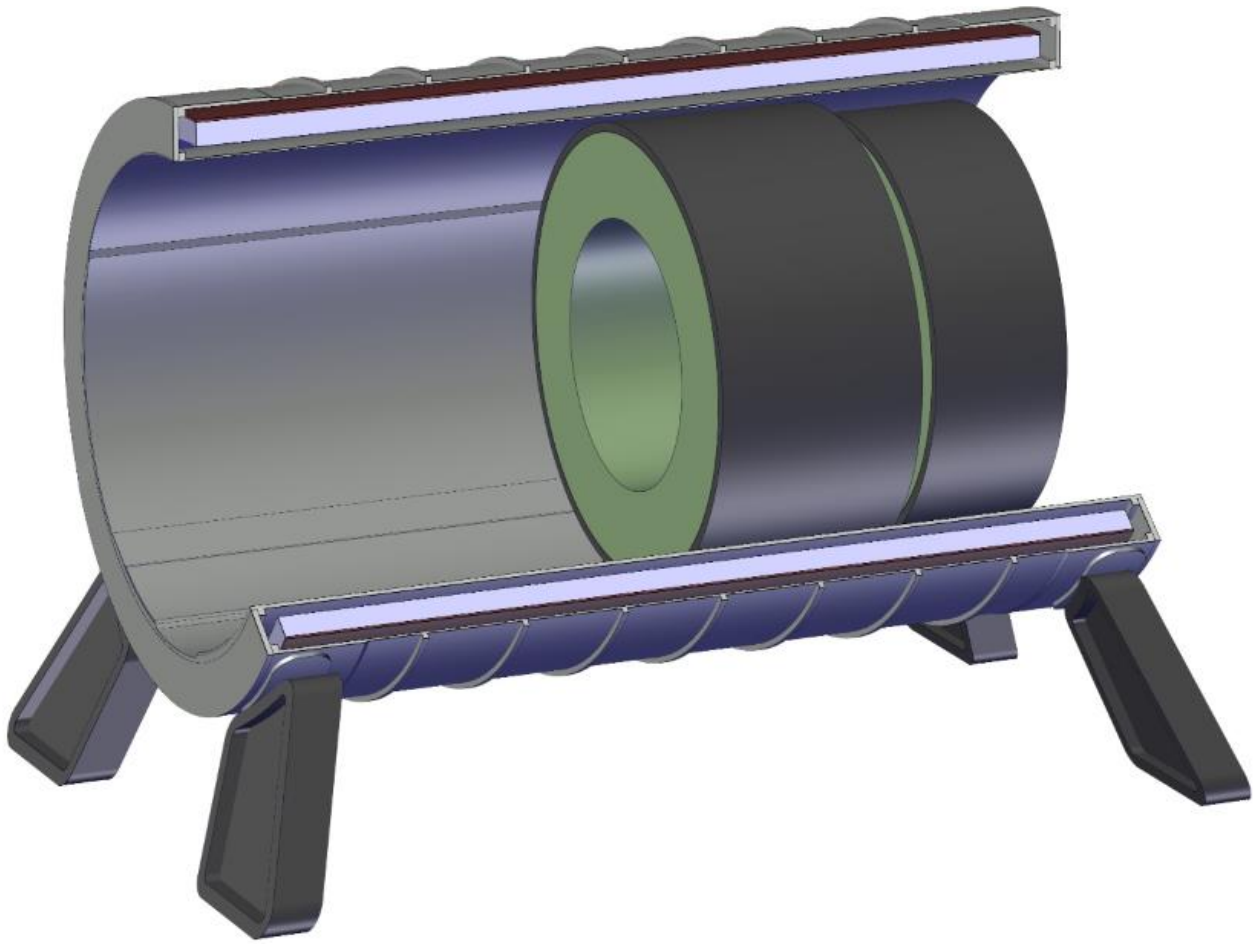
1 - Install Central Solenoid

EXPERIMENT INTEGRATION



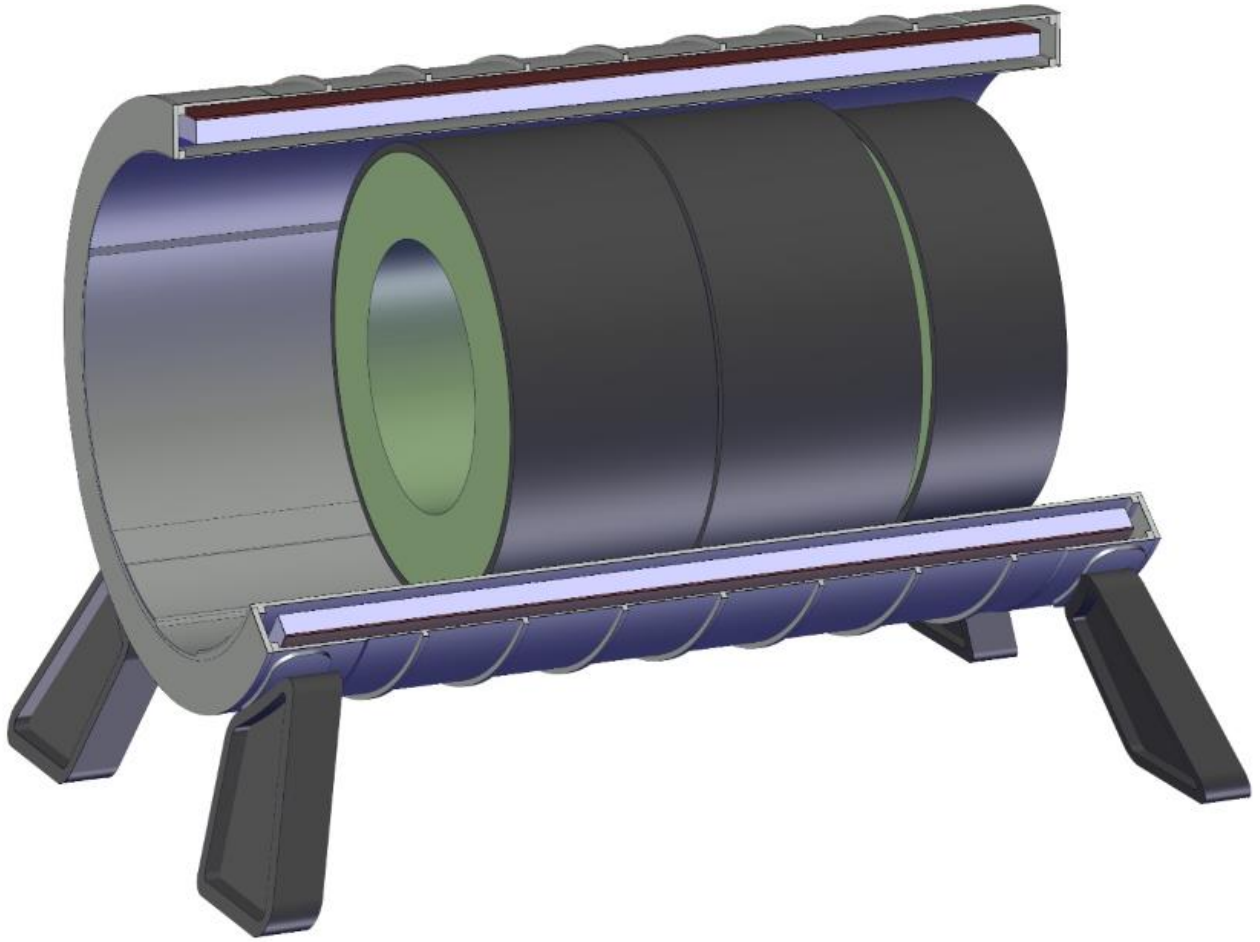
2 - Install 1st HCal module with 1st Ecal Module

EXPERIMENT INTEGRATION



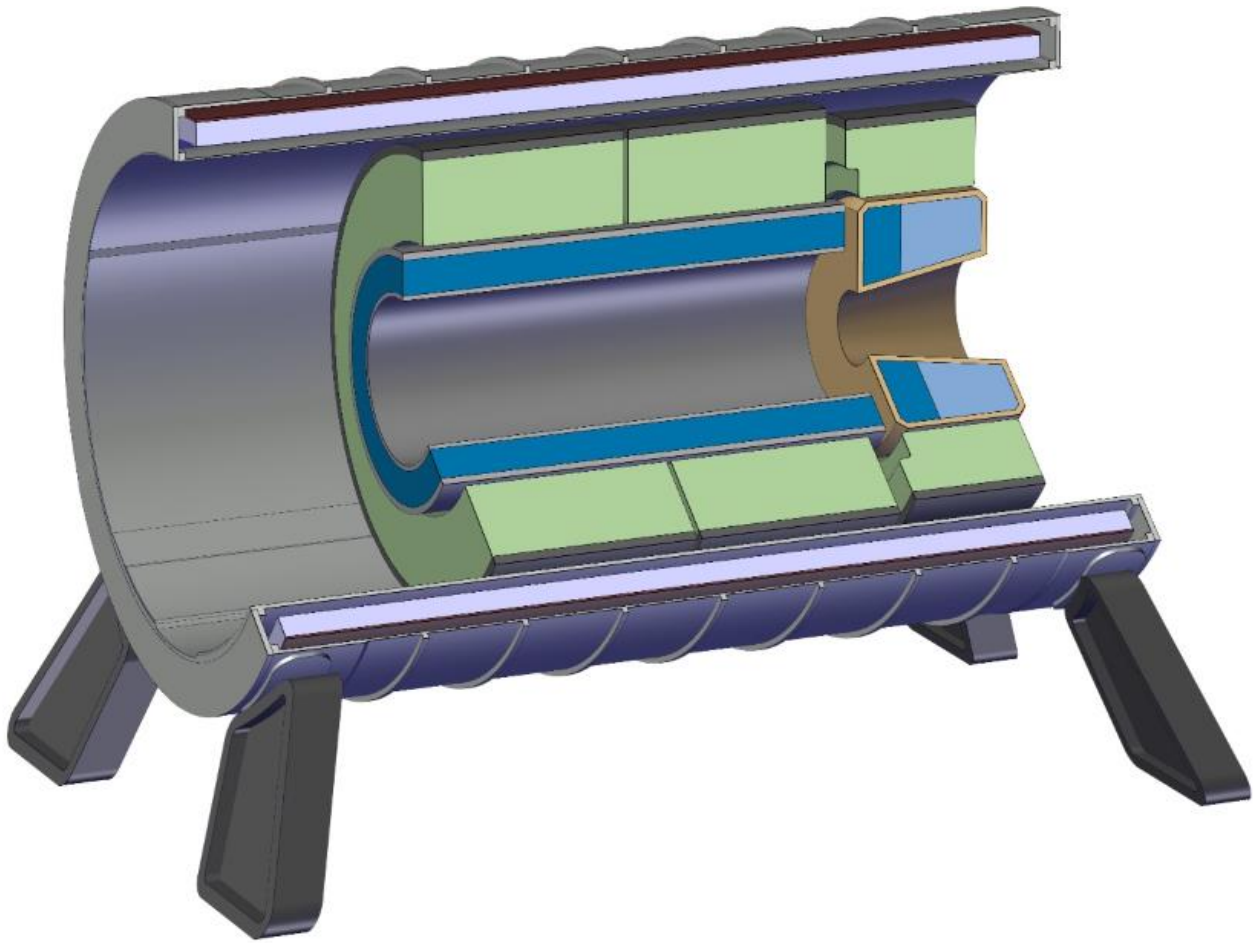
3 - Install 2nd HCal module

EXPERIMENT INTEGRATION



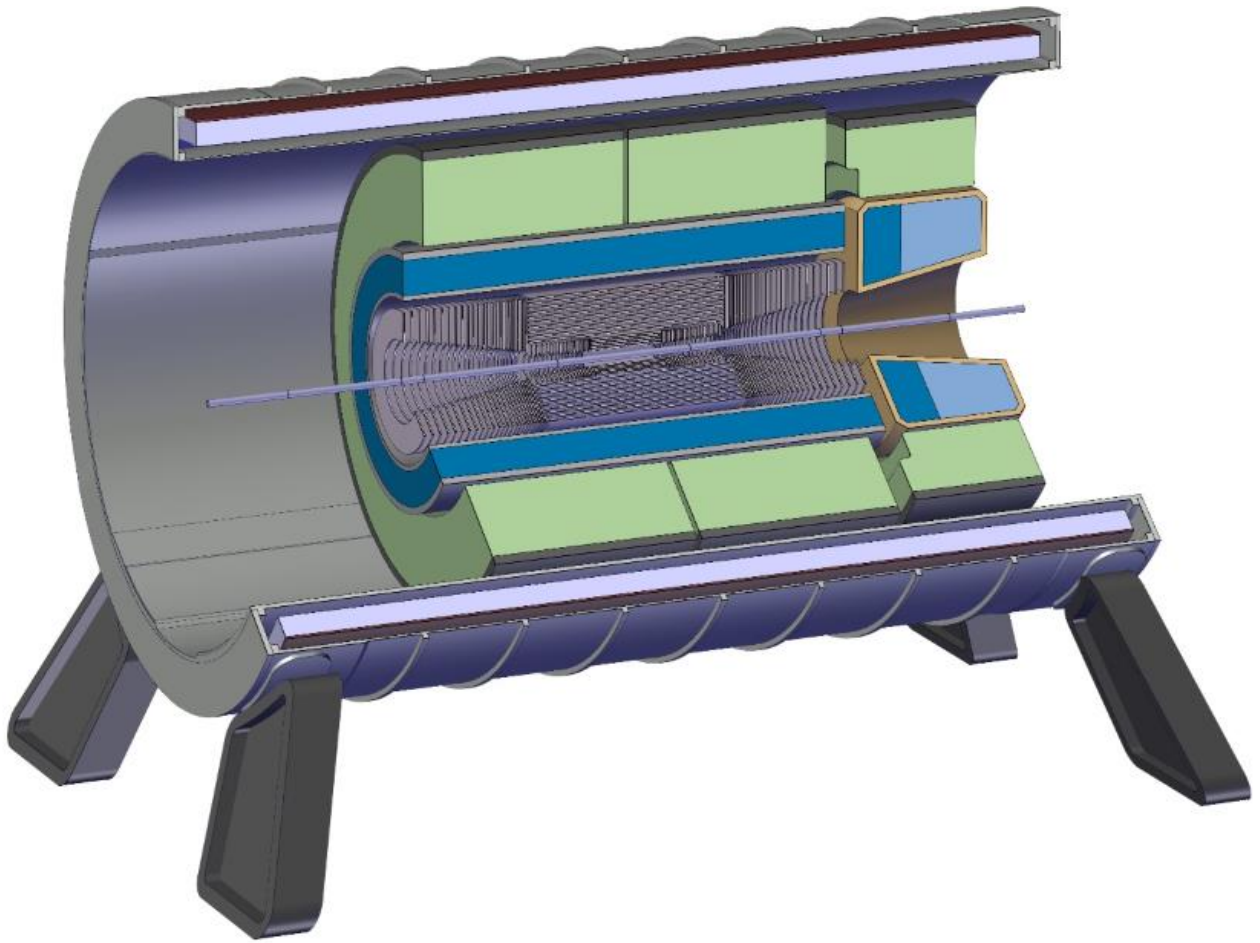
4 - Install 3rd HCal module

EXPERIMENT INTEGRATION



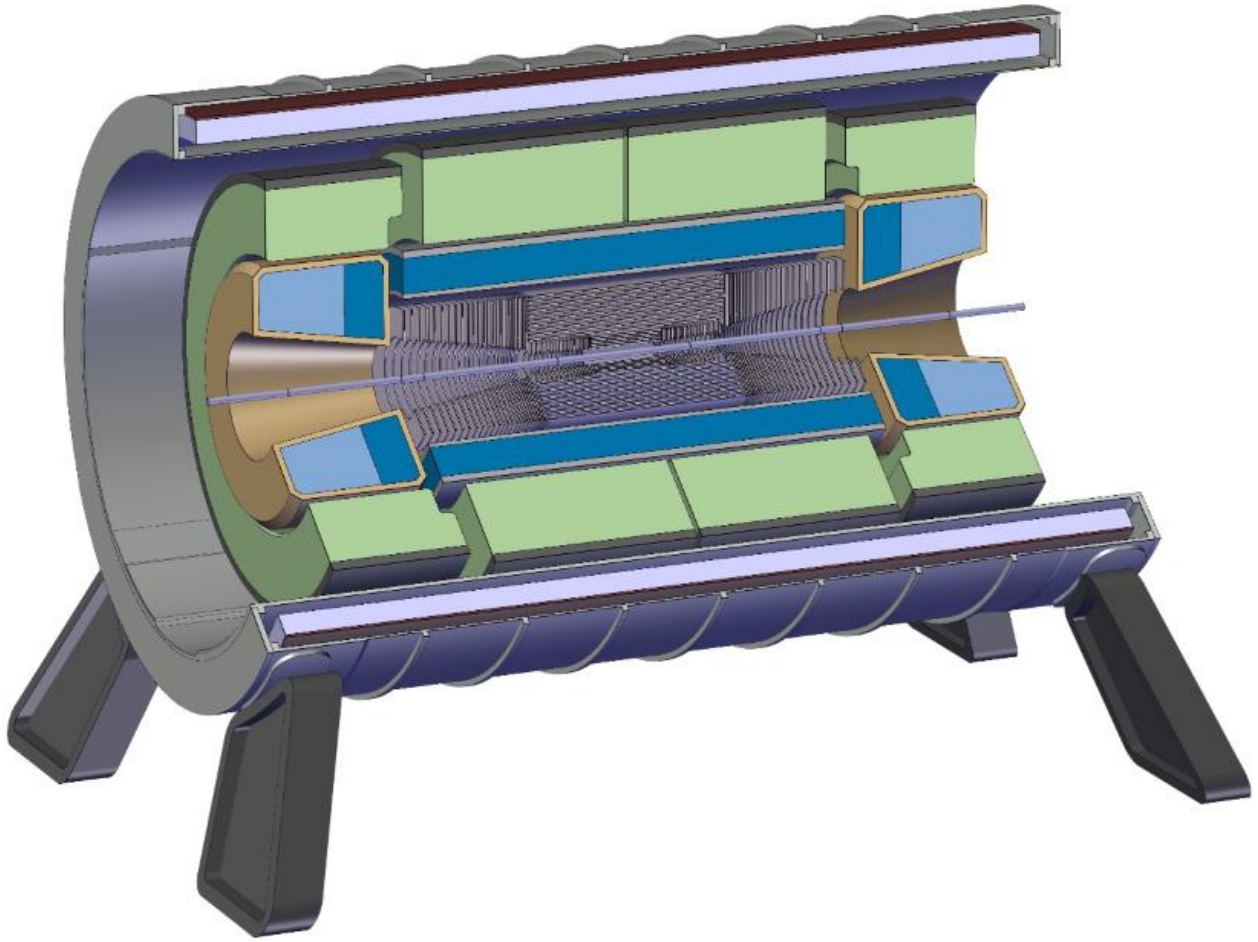
5 - Install 2nd ECal module

EXPERIMENT INTEGRATION



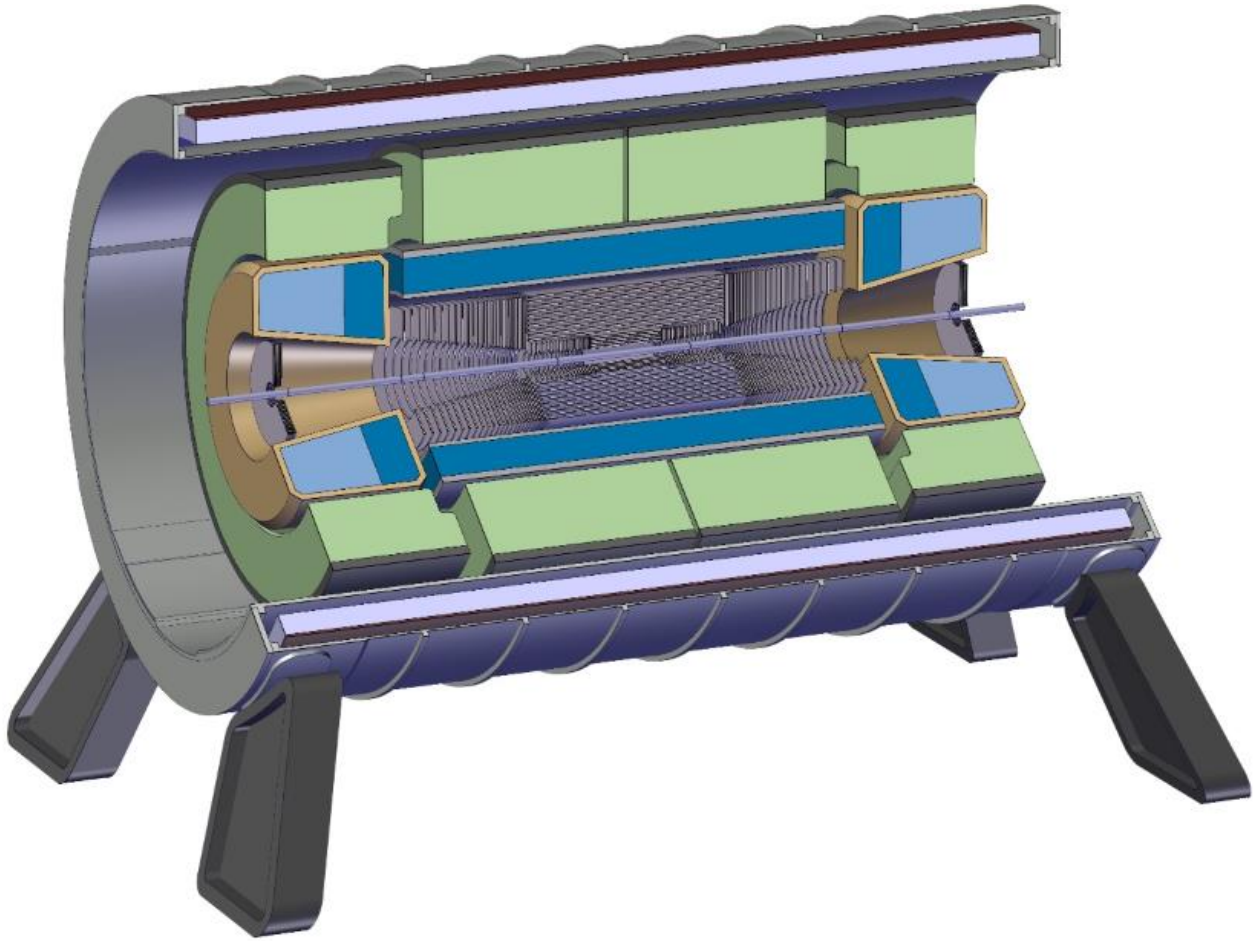
6 - Install Inner Tracker

EXPERIMENT INTEGRATION



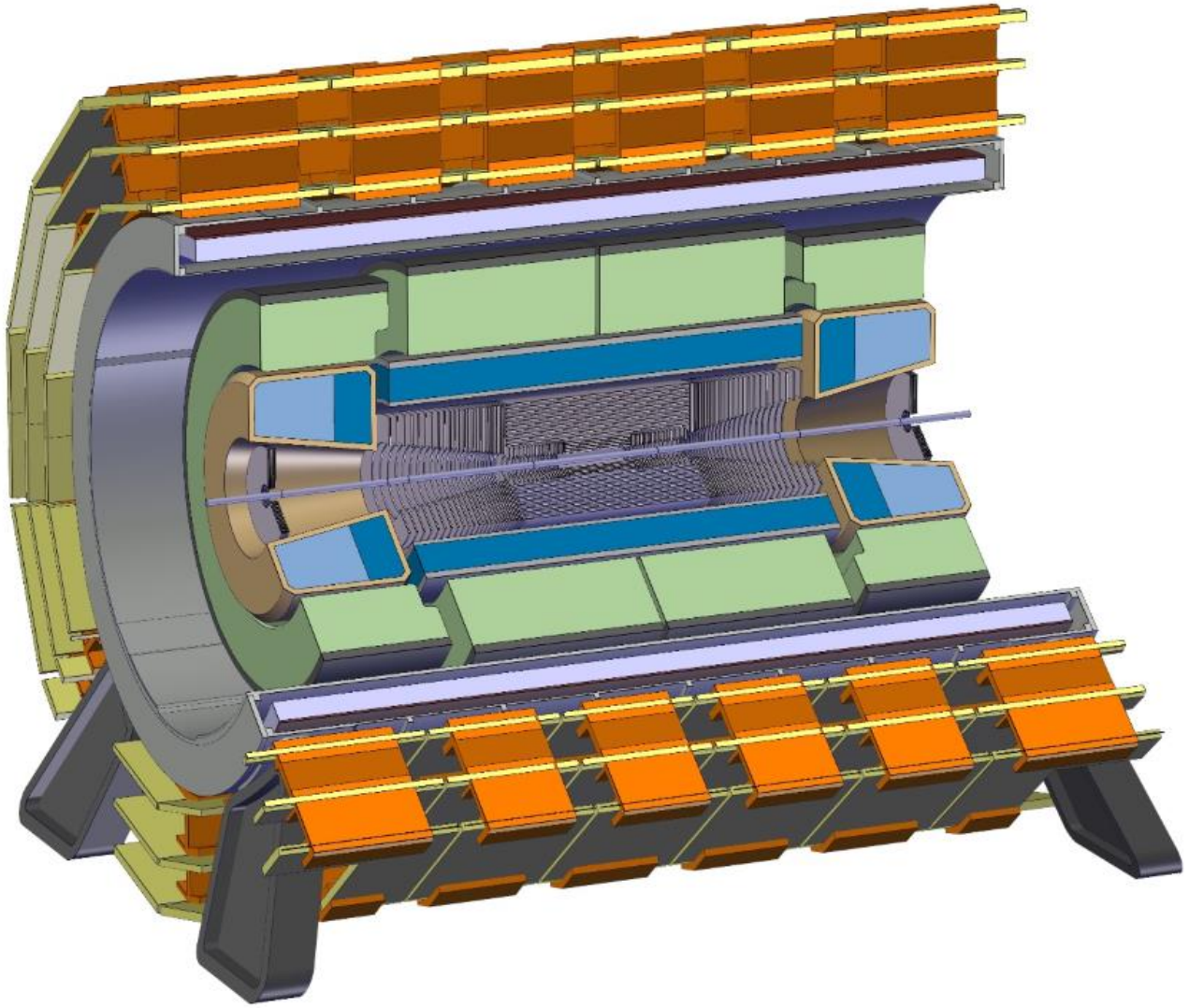
7 - Install the last Ecal and HCal module

EXPERIMENT INTEGRATION



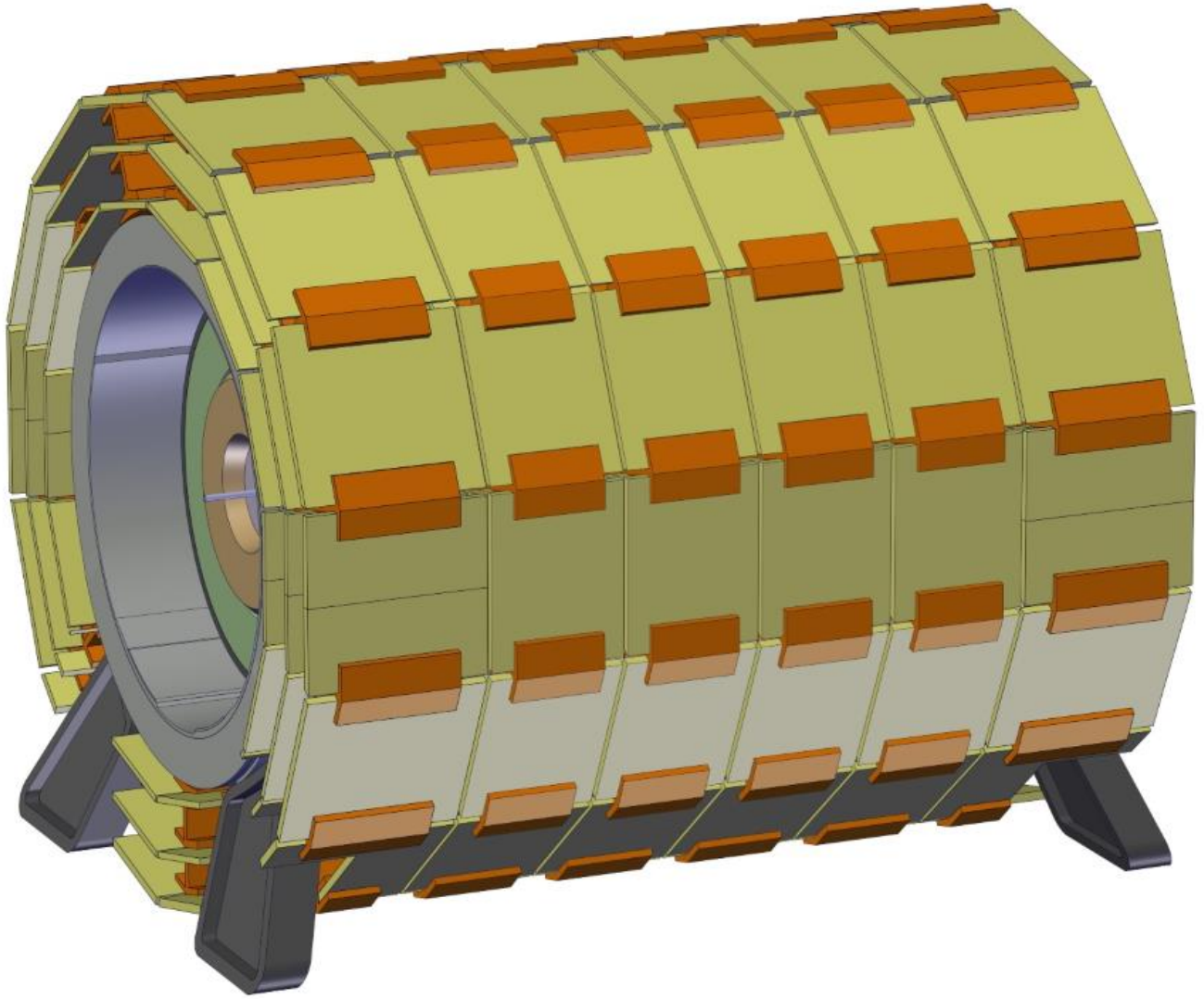
8 - Install Forward Tracker module

EXPERIMENT INTEGRATION



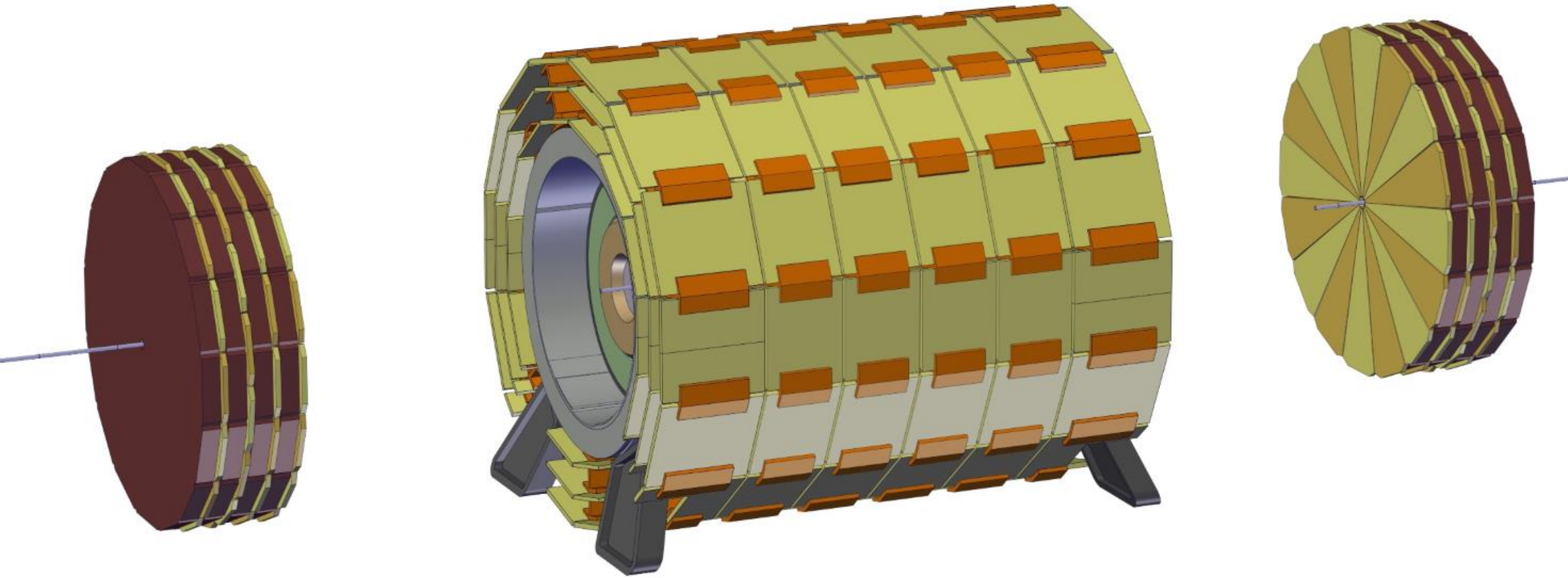
9 - Install Muon Chambers onto the solenoid

EXPERIMENT INTEGRATION



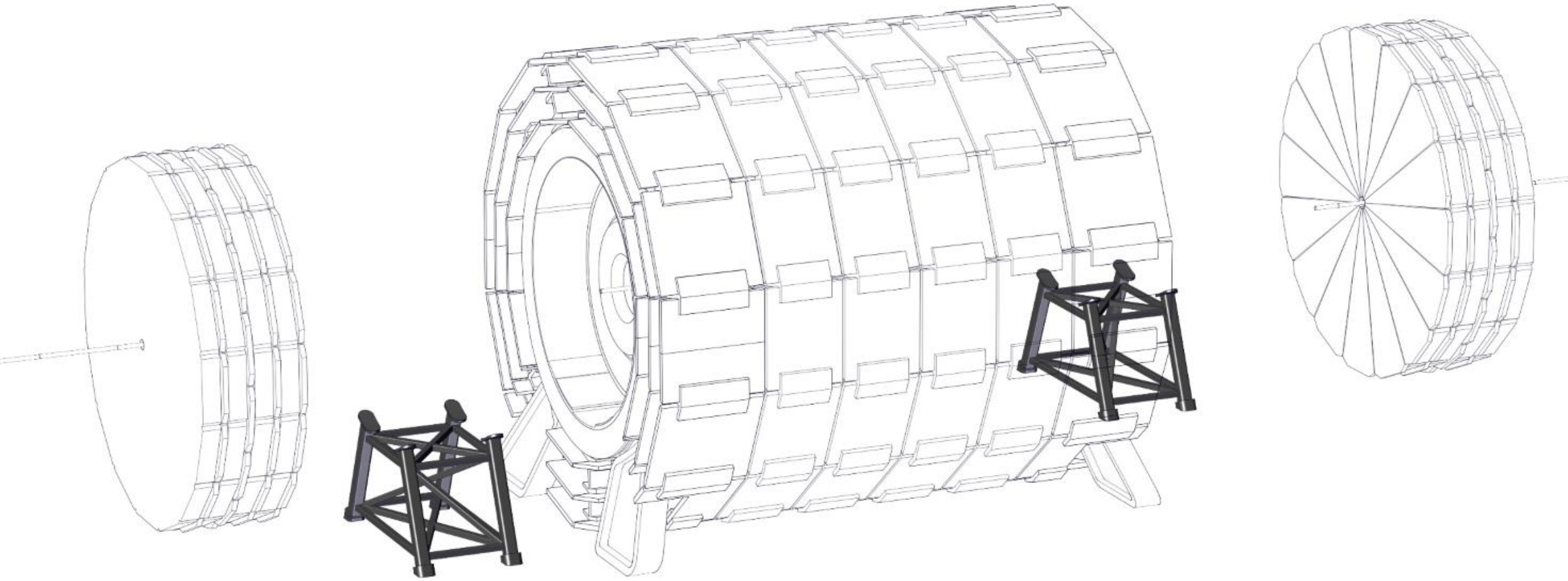
9 - Install Muon Chambers onto the solenoid

EXPERIMENT INTEGRATION



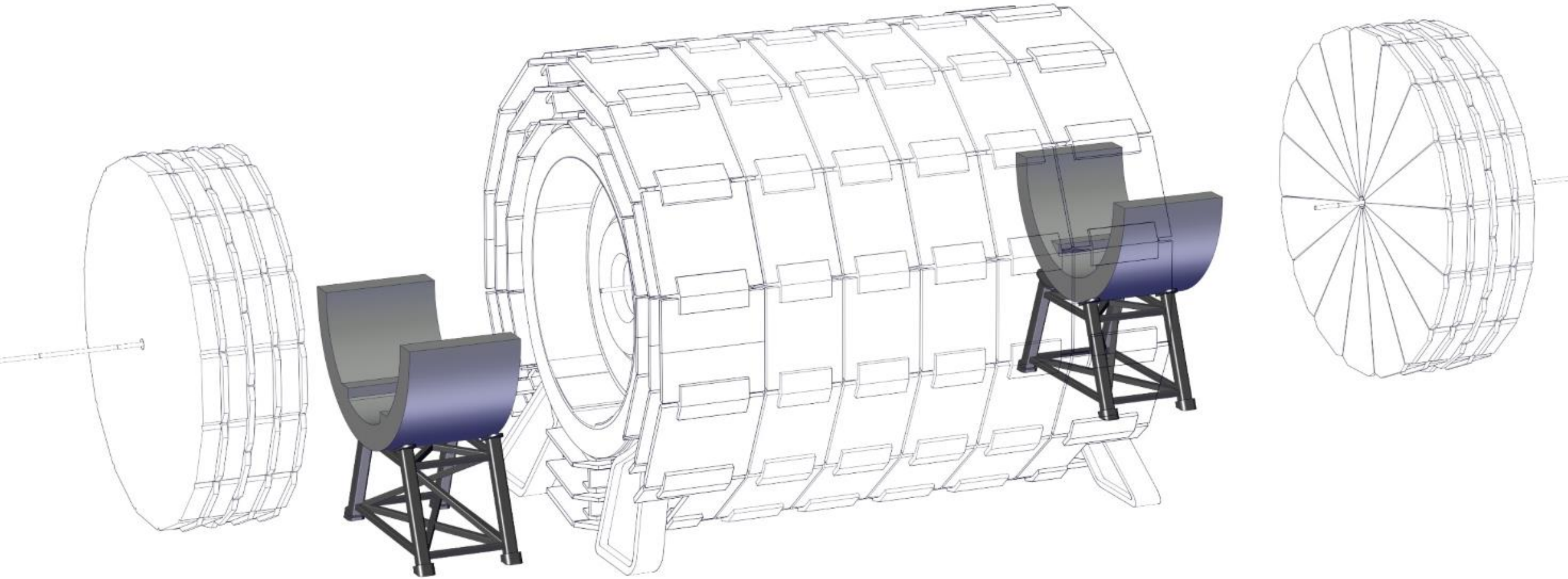
10 – Install Forward Muon Chambers

EXPERIMENT INTEGRATION



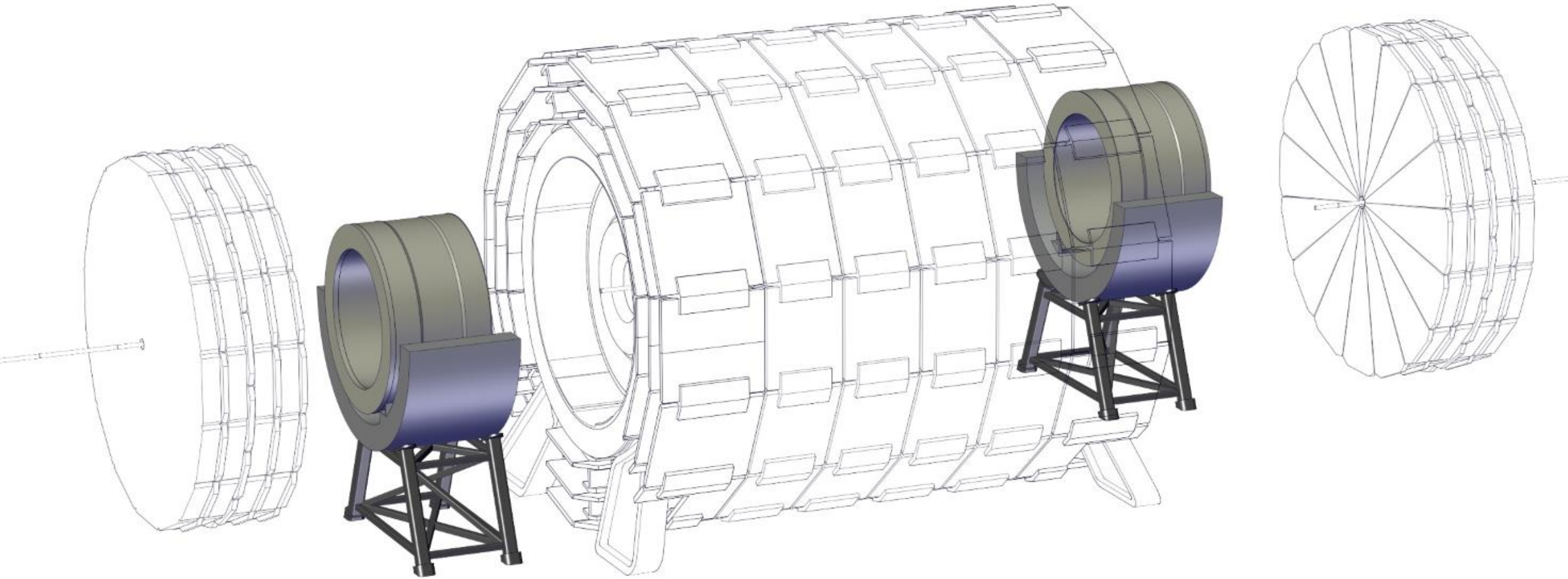
11 – Install the Forward Solenoid support structure

EXPERIMENT INTEGRATION



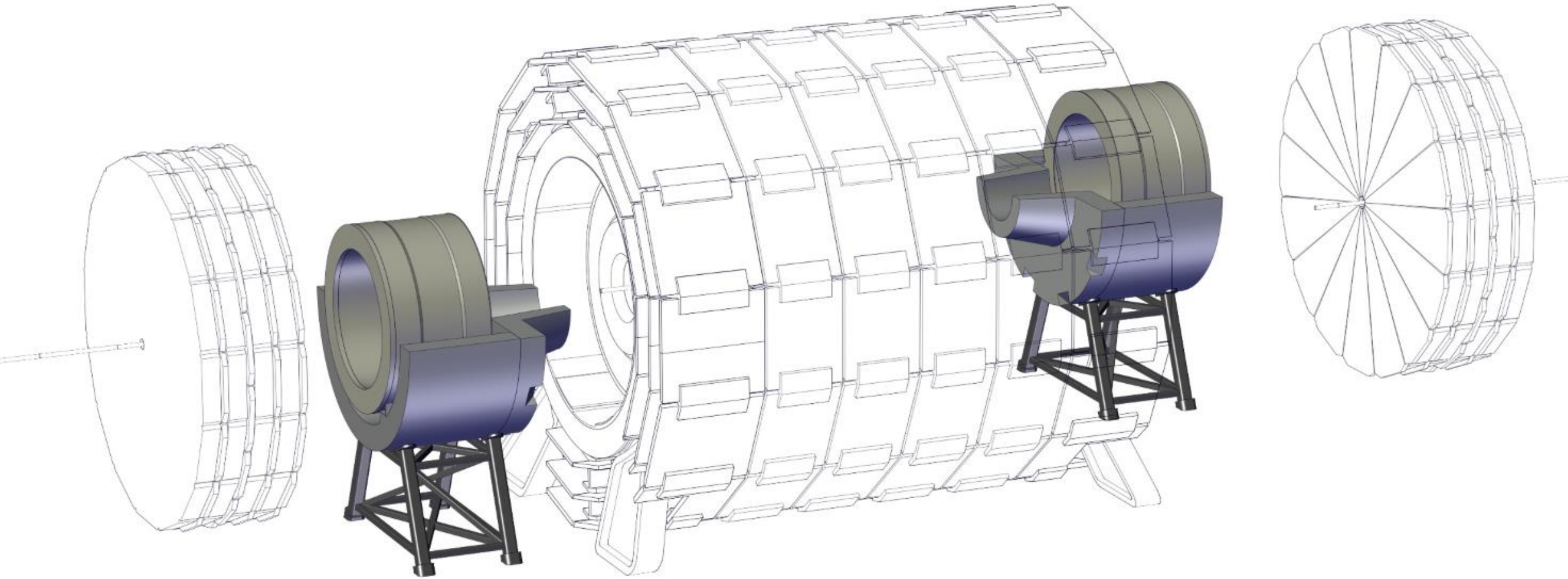
12 – Install bottom half of the Radiation Shield

EXPERIMENT INTEGRATION



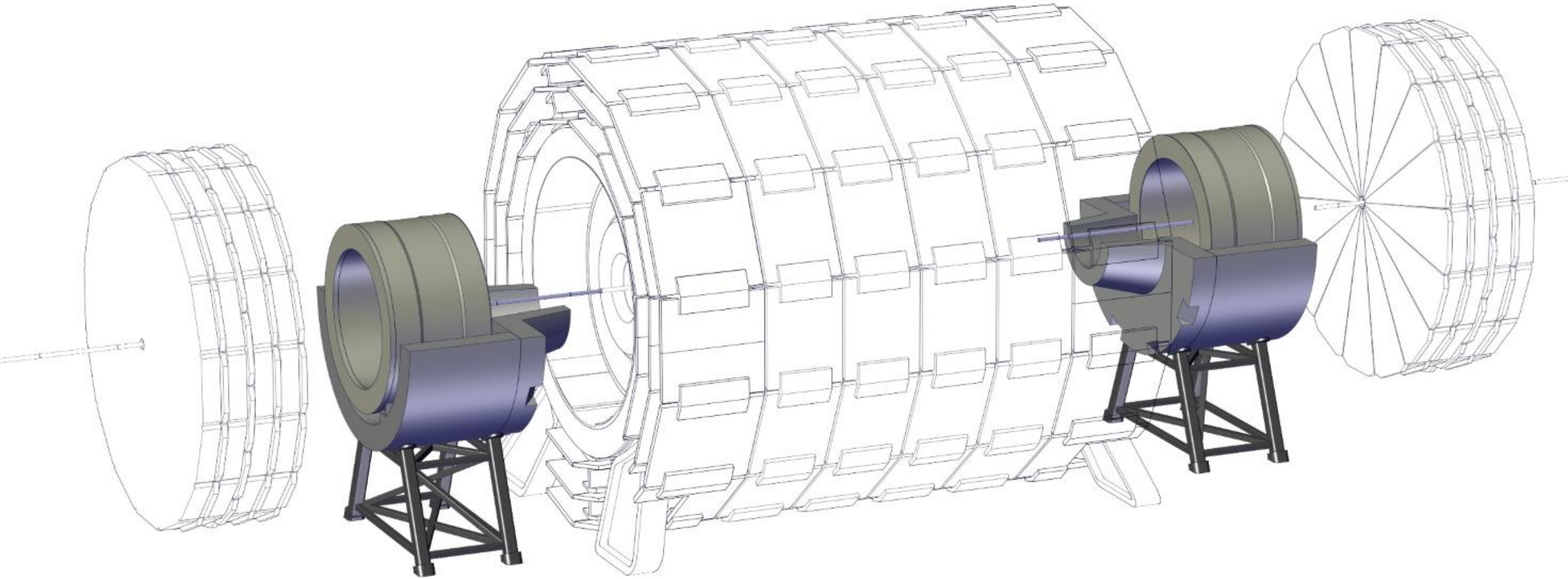
13 – Install Forward Solenoids

EXPERIMENT INTEGRATION



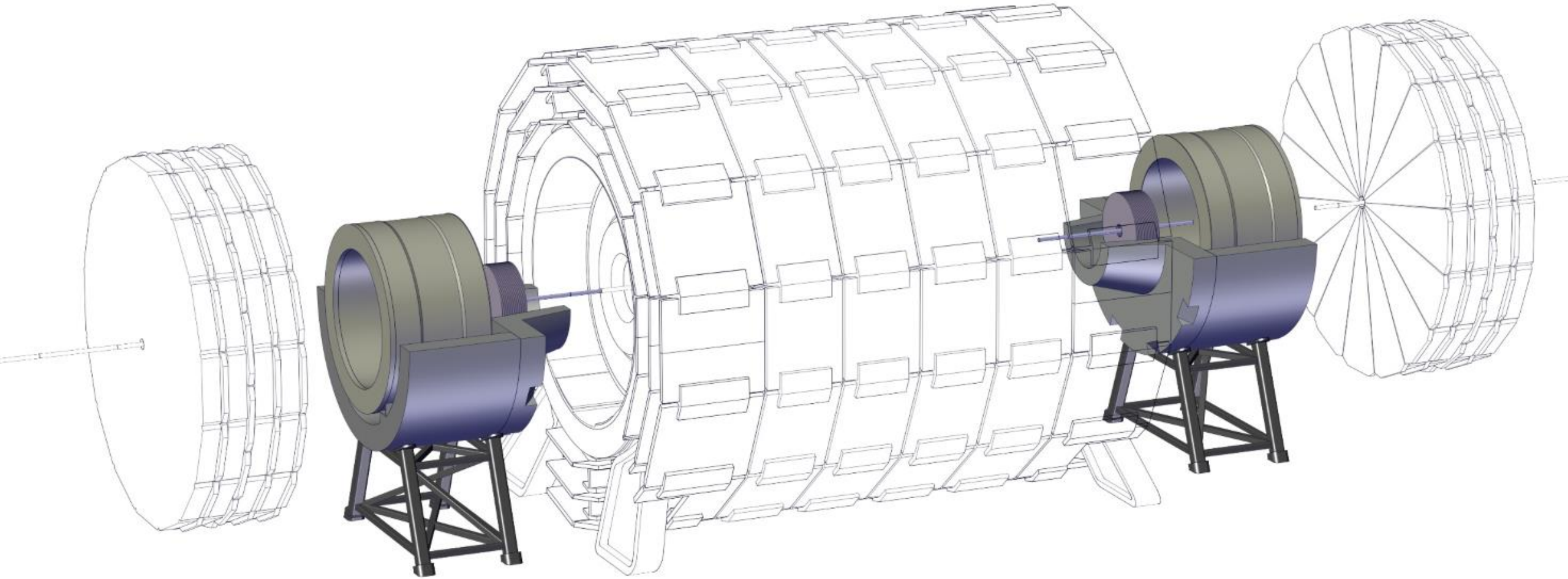
14 – Install bottom half of the radiation shield nose

EXPERIMENT INTEGRATION



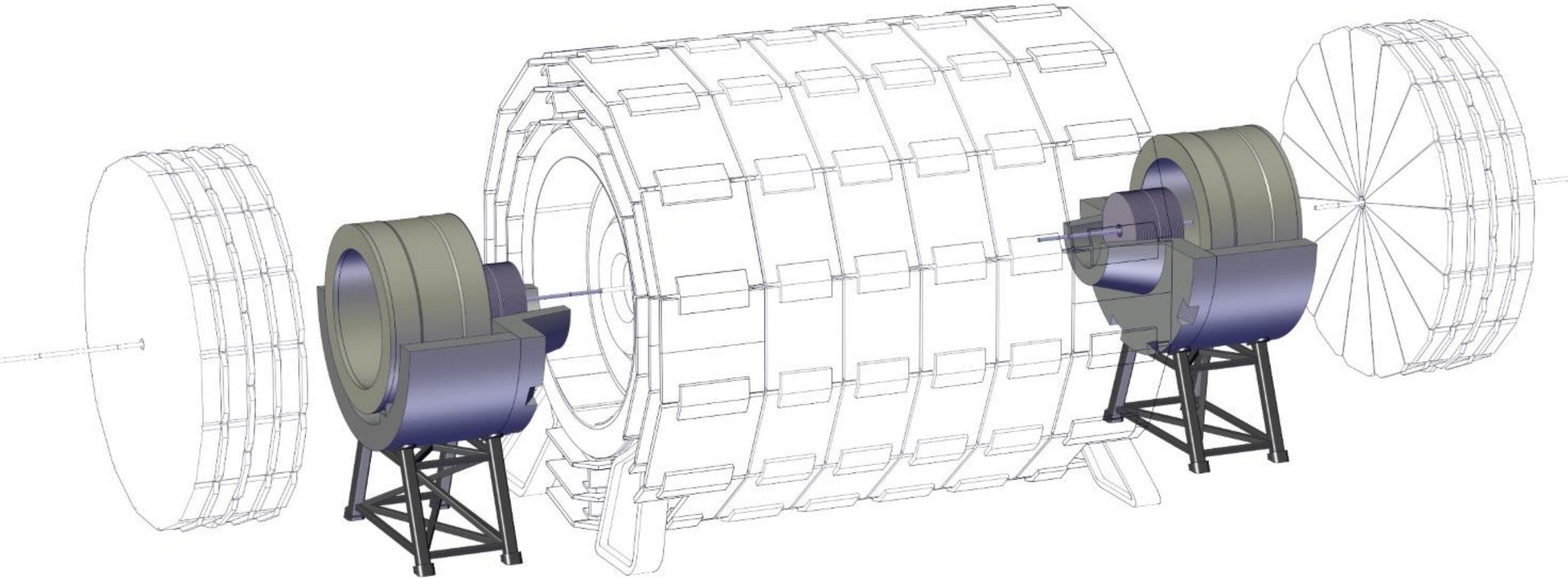
15 – Align forward solenoid with the experiment and install part of the beam pipe

EXPERIMENT INTEGRATION



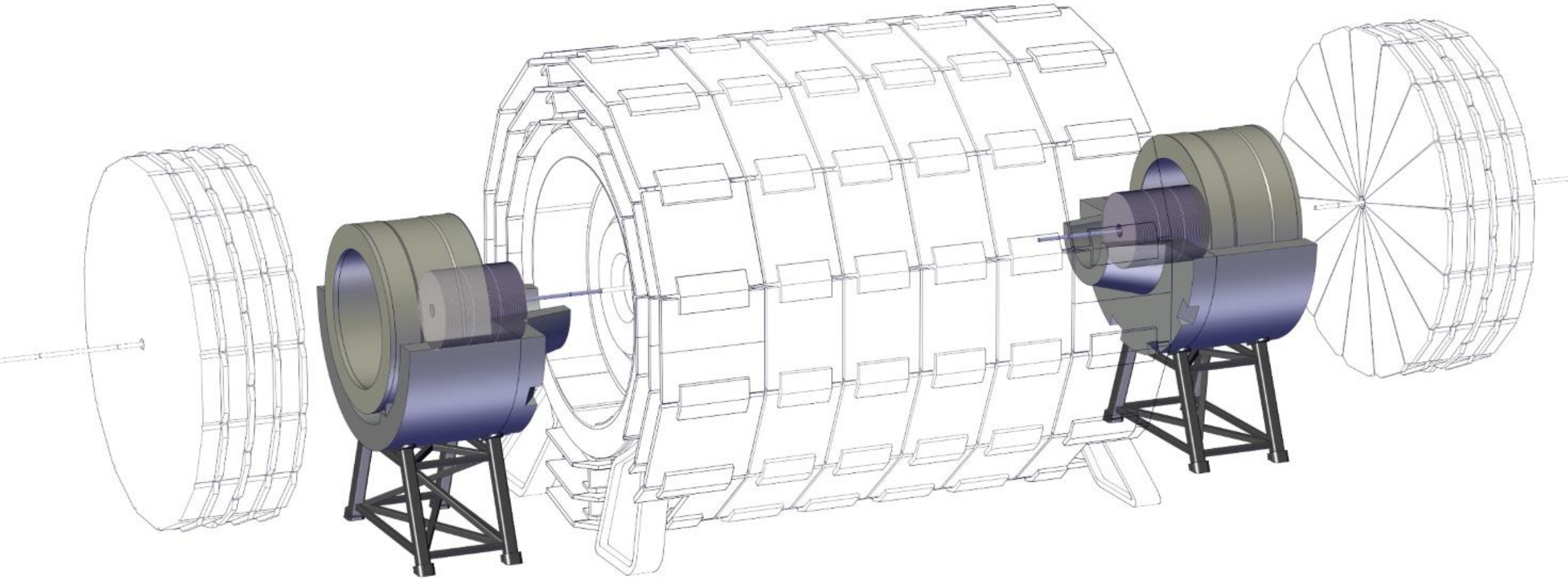
16 – Install Forward Trackers

EXPERIMENT INTEGRATION



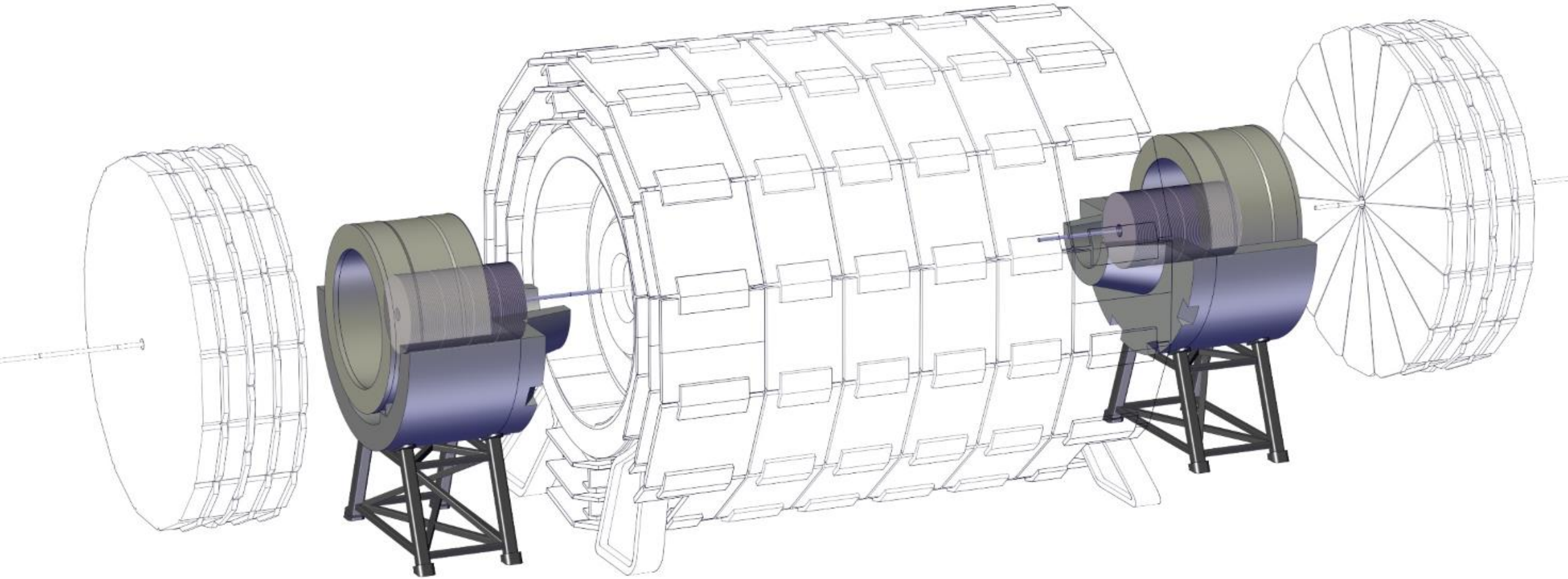
16 – Install Forward Trackers

EXPERIMENT INTEGRATION



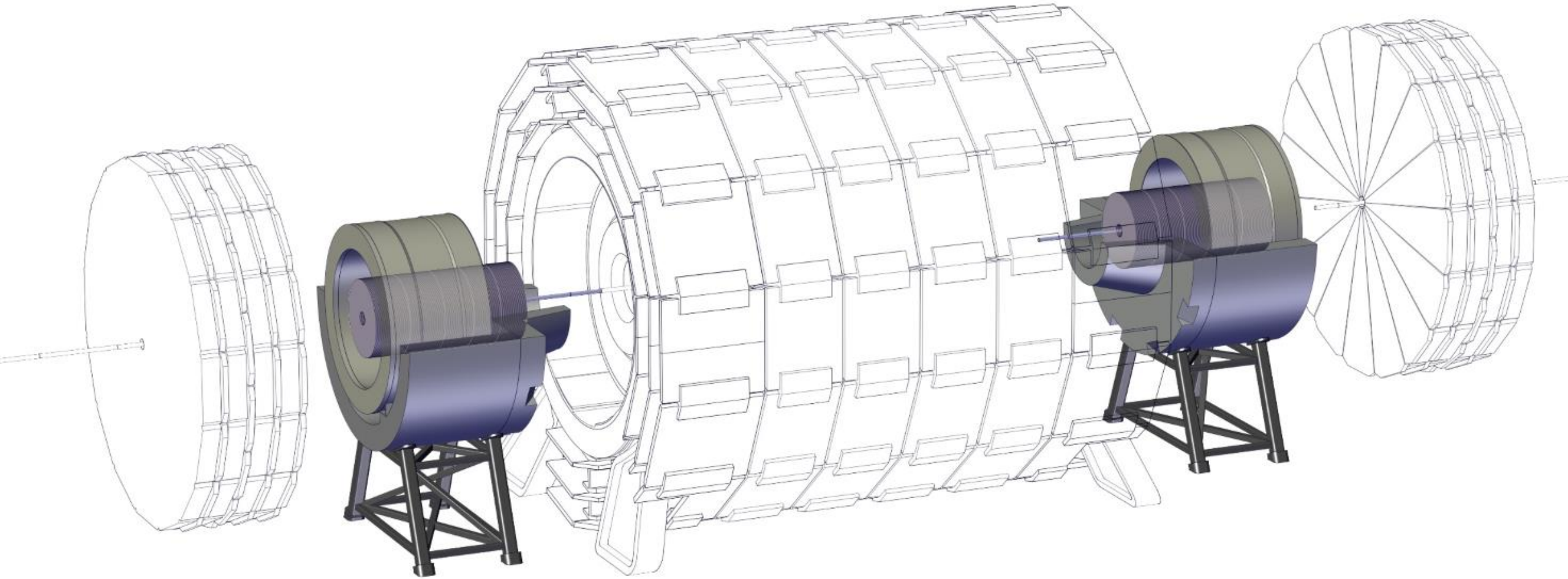
16 – Install Forward Trackers

EXPERIMENT INTEGRATION



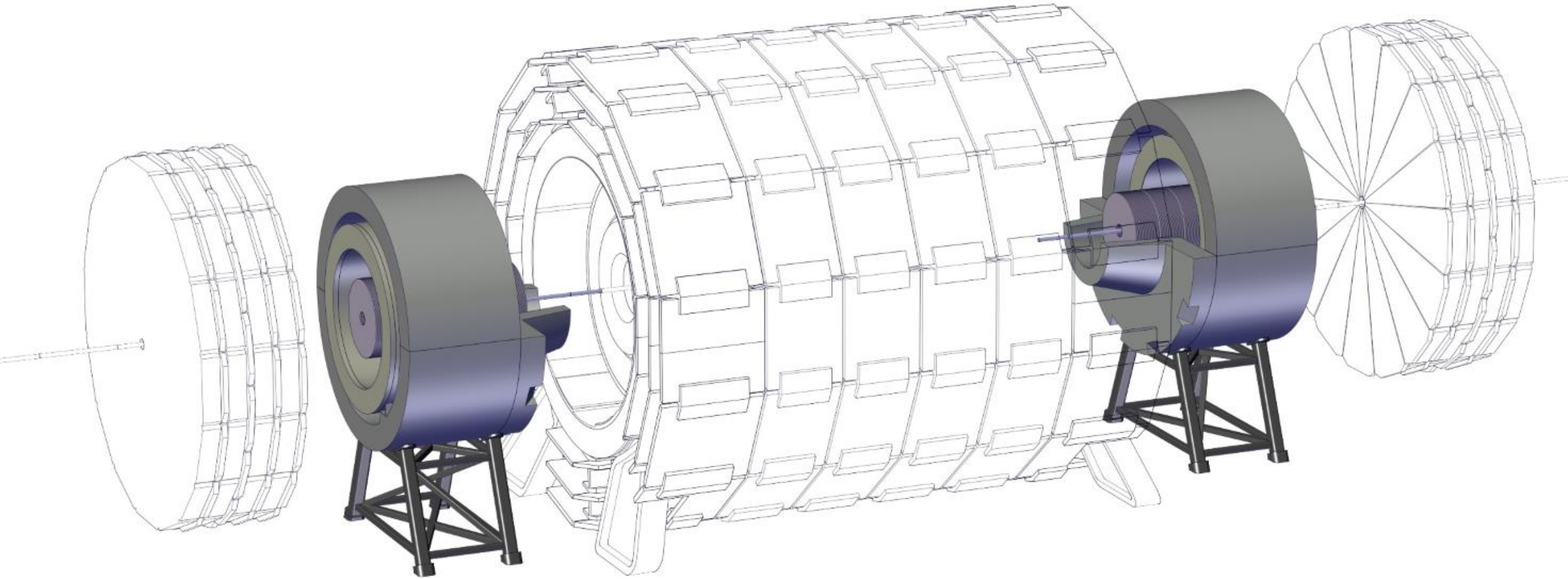
16 – Install Forward Trackers

EXPERIMENT INTEGRATION



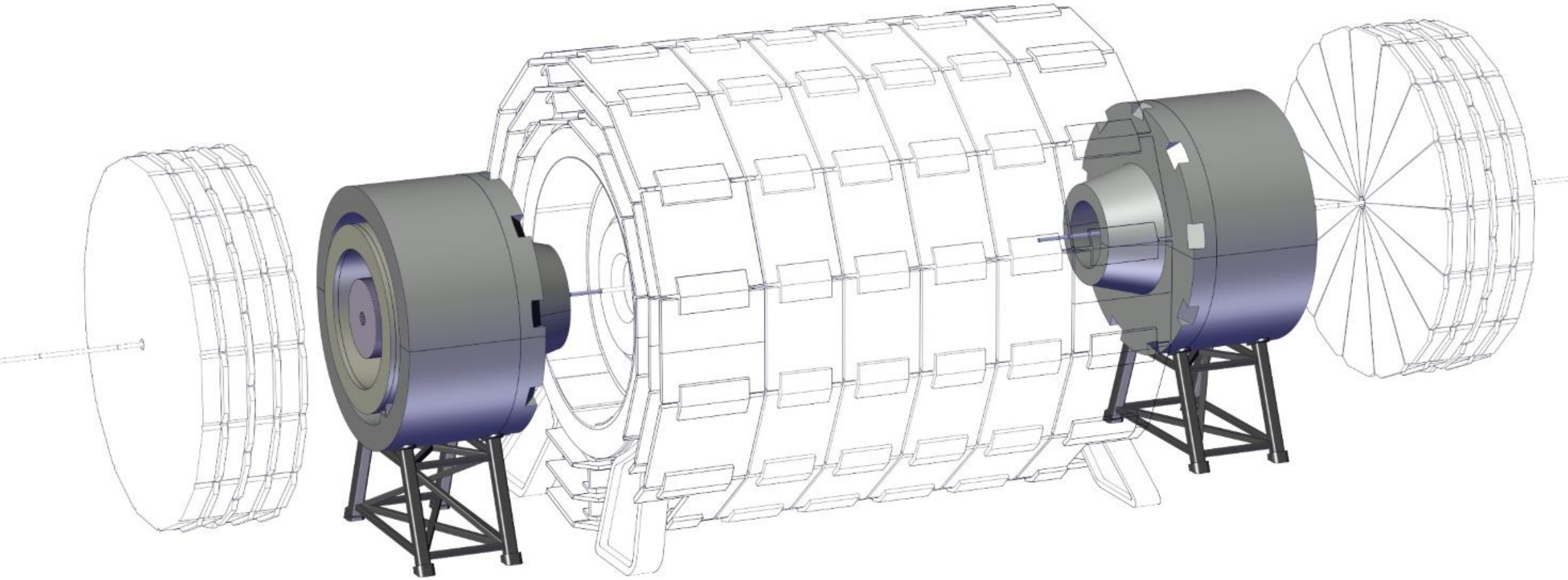
16 – Install Forward Trackers

EXPERIMENT INTEGRATION



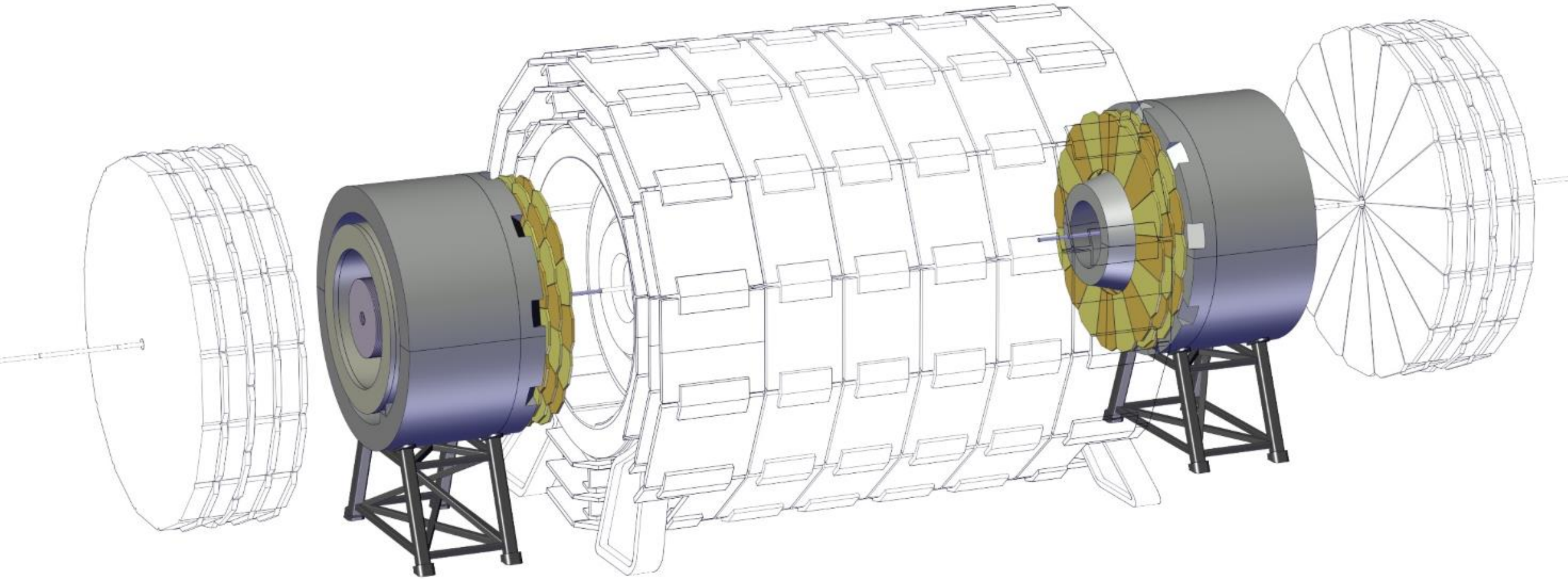
17 – Install top half of the Radiation Shield

EXPERIMENT INTEGRATION



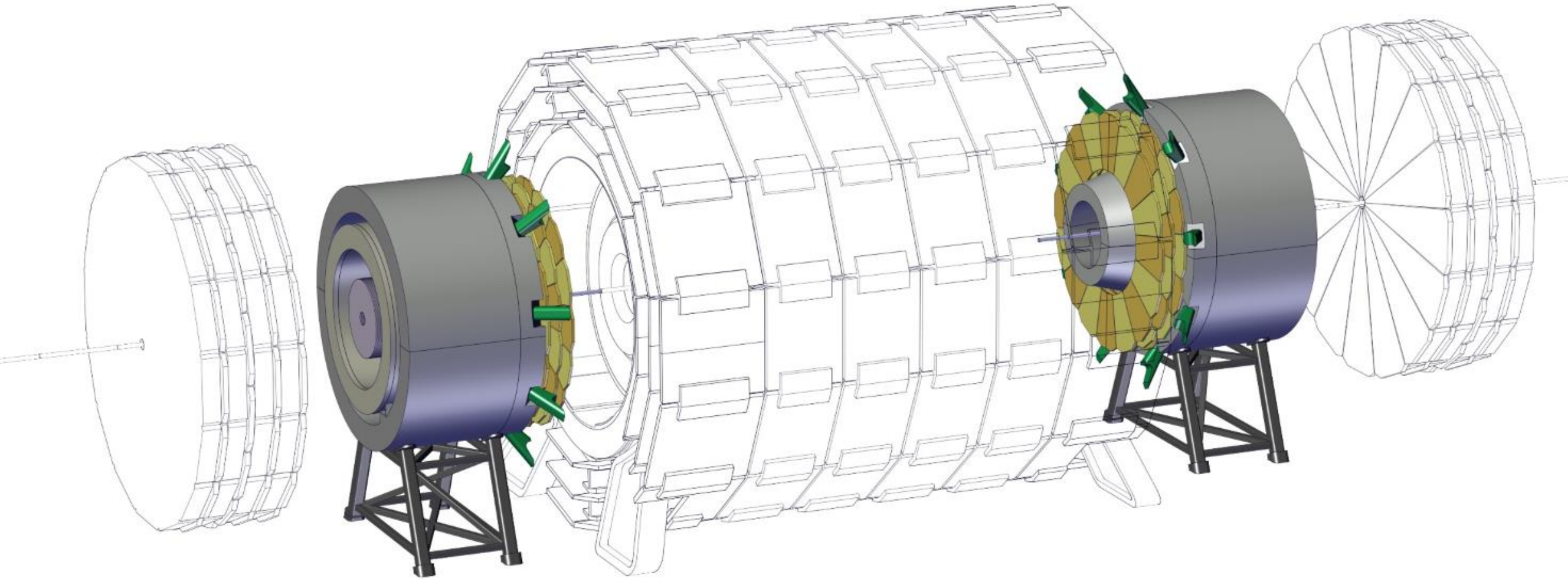
18 – Install top half of the Radiation Shield nose

EXPERIMENT INTEGRATION



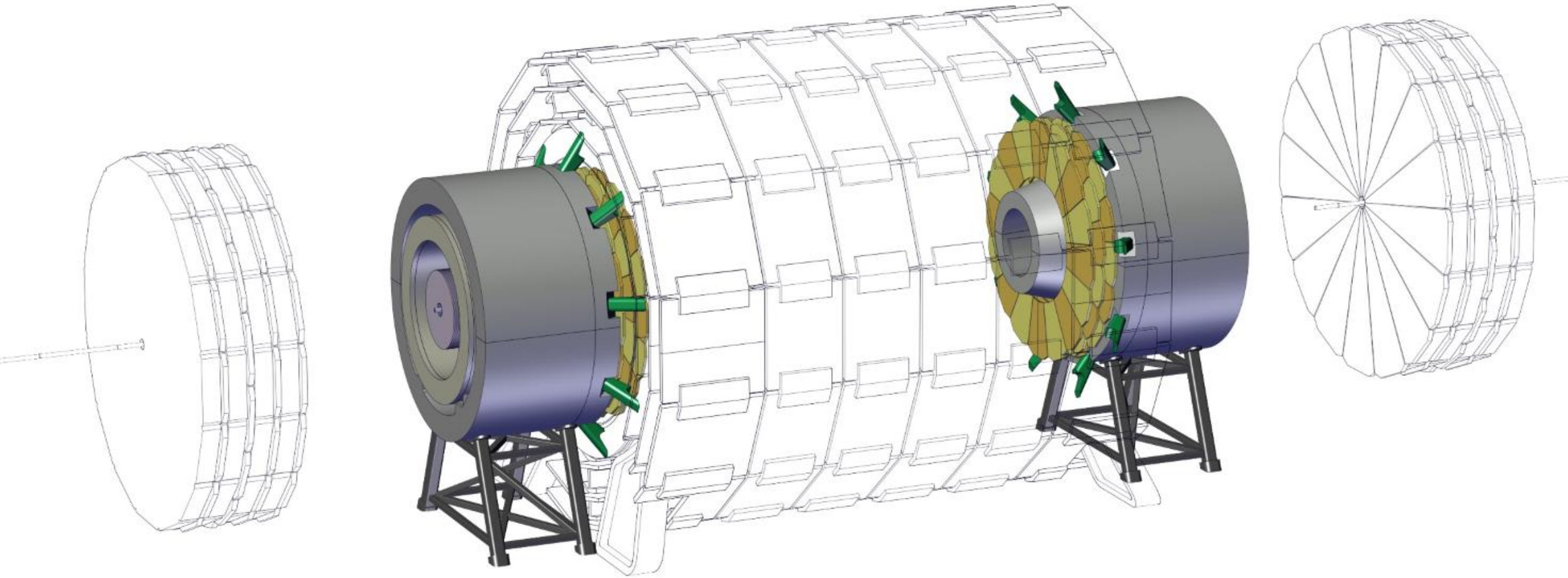
19 – Install Muon Chambers

EXPERIMENT INTEGRATION



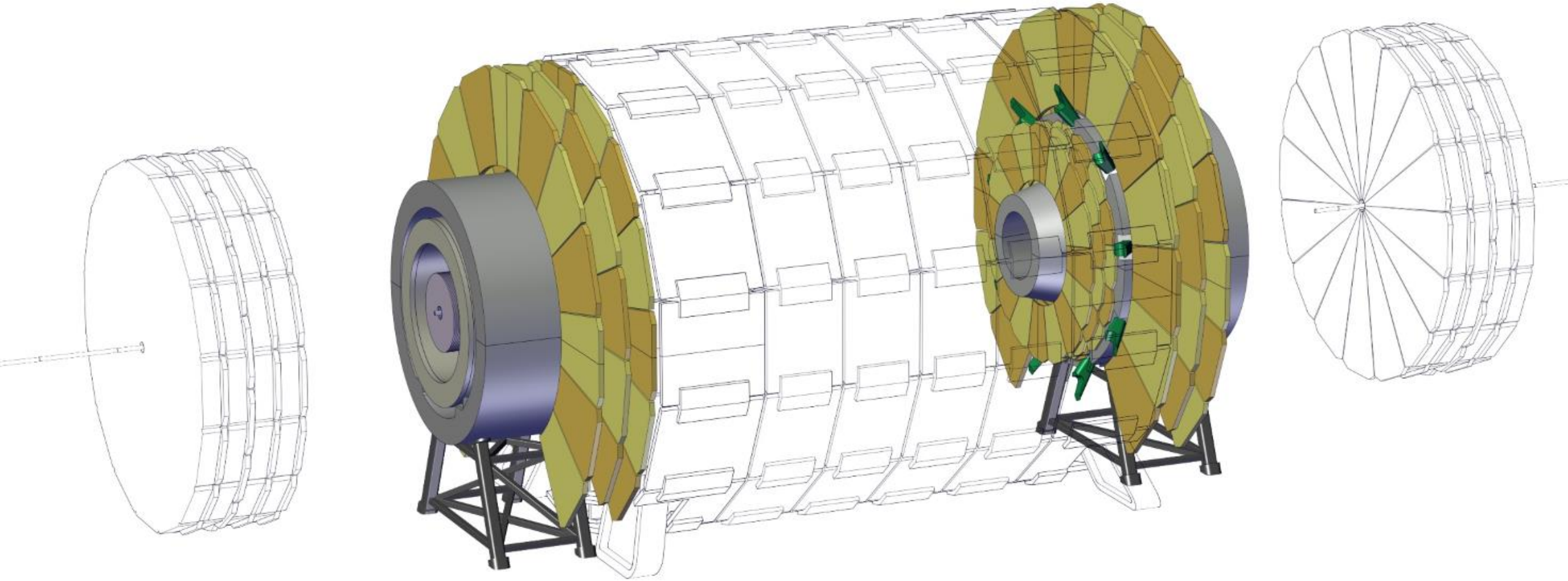
20 – Install Spokes

EXPERIMENT INTEGRATION



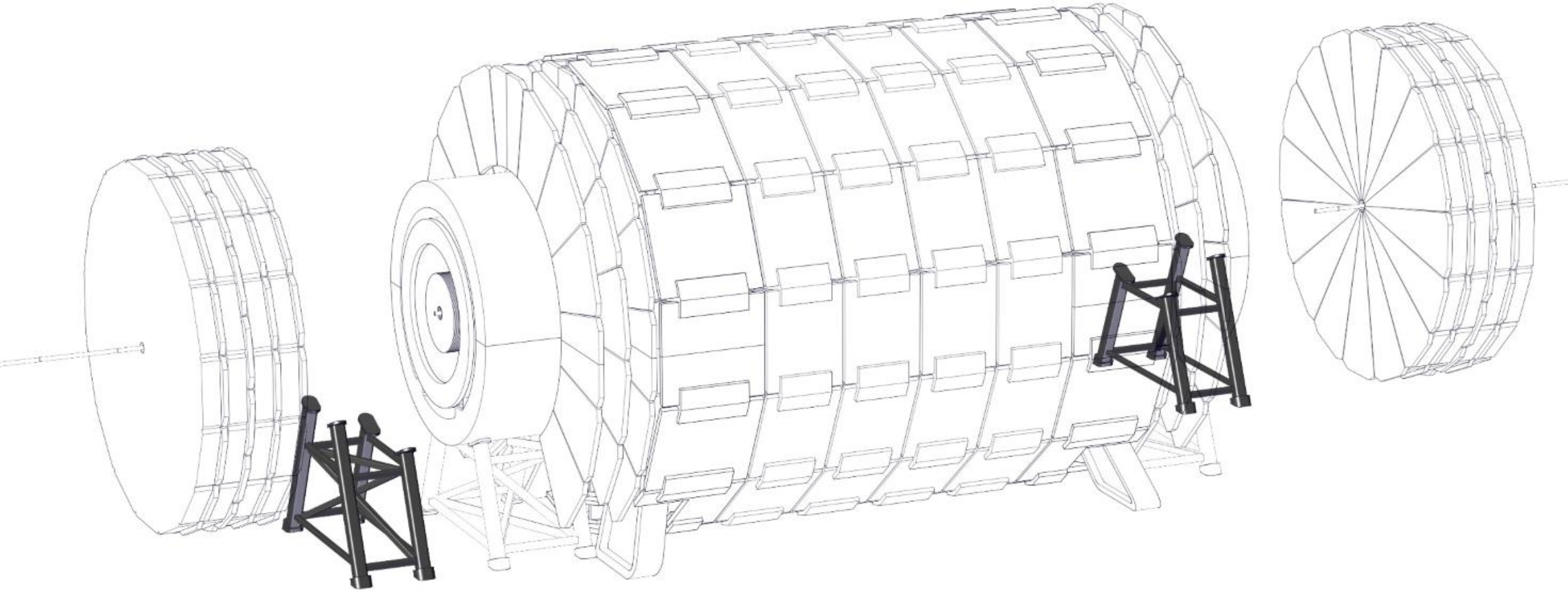
21 – Connect Spokes to main cryostat

EXPERIMENT INTEGRATION



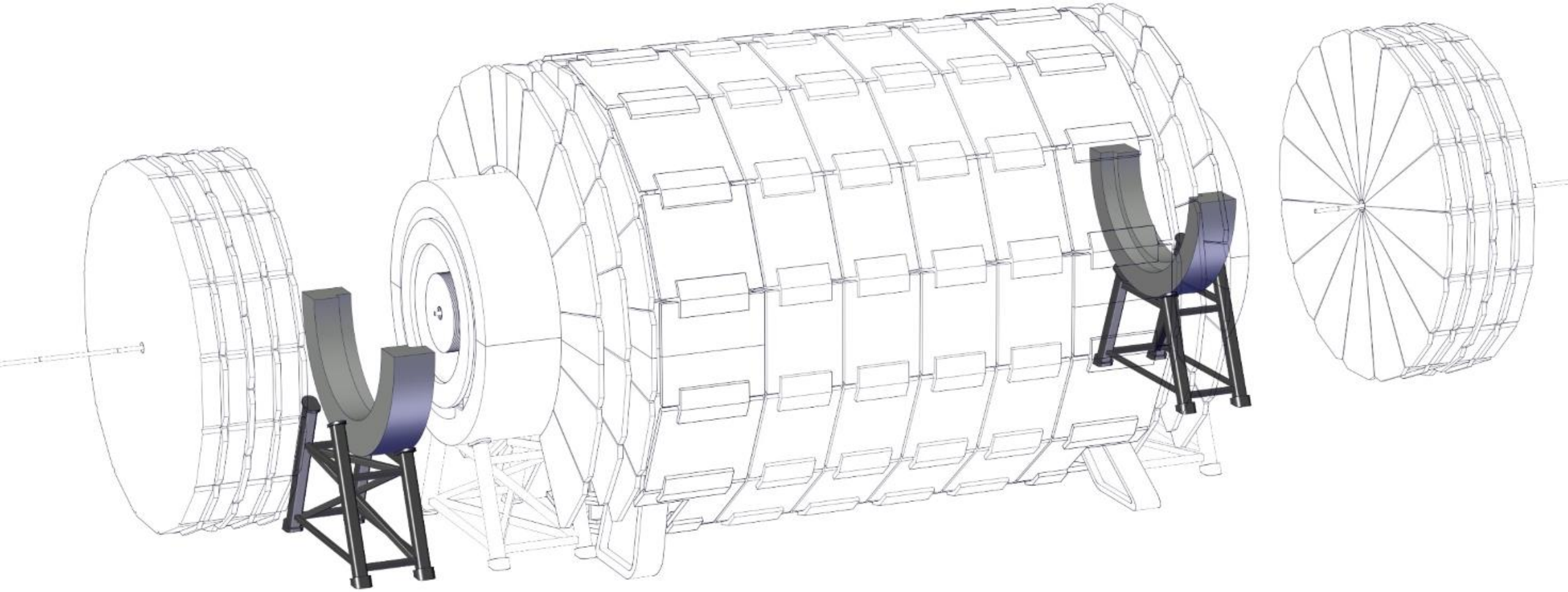
22 – Install Muon Chambers

EXPERIMENT INTEGRATION



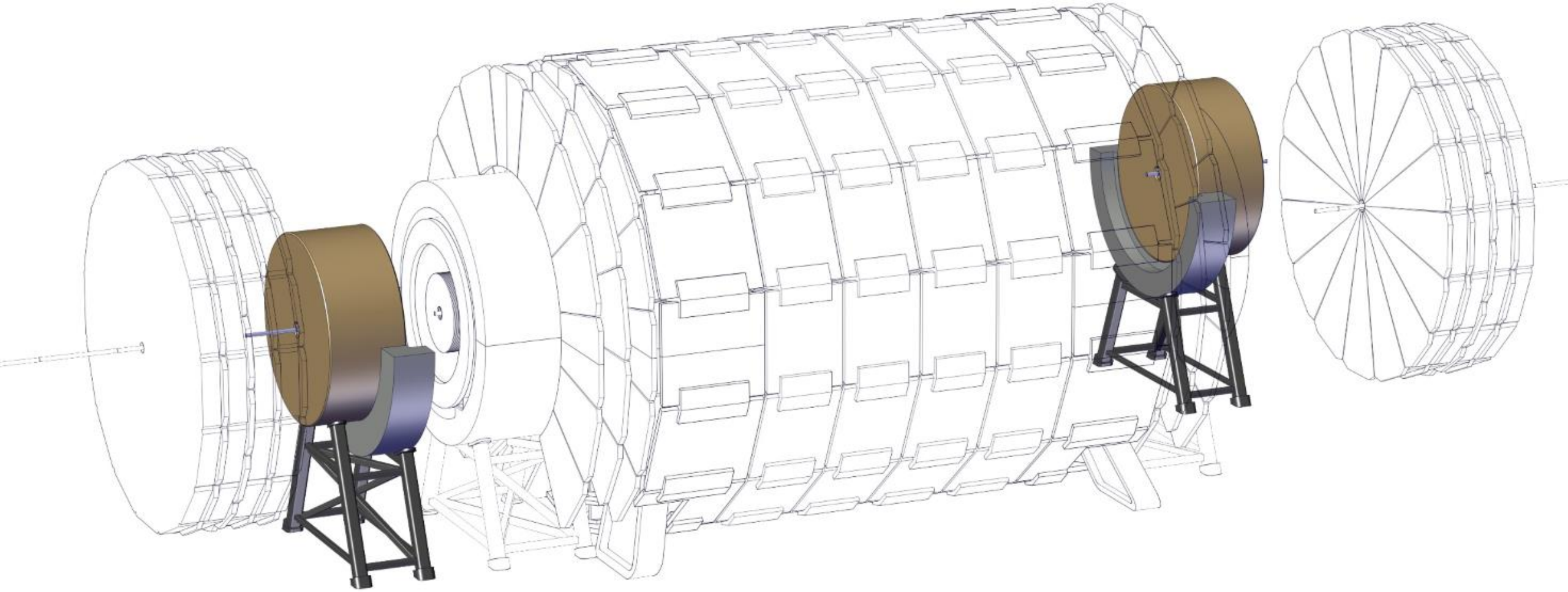
23 - Install Forward ECal support structure

EXPERIMENT INTEGRATION



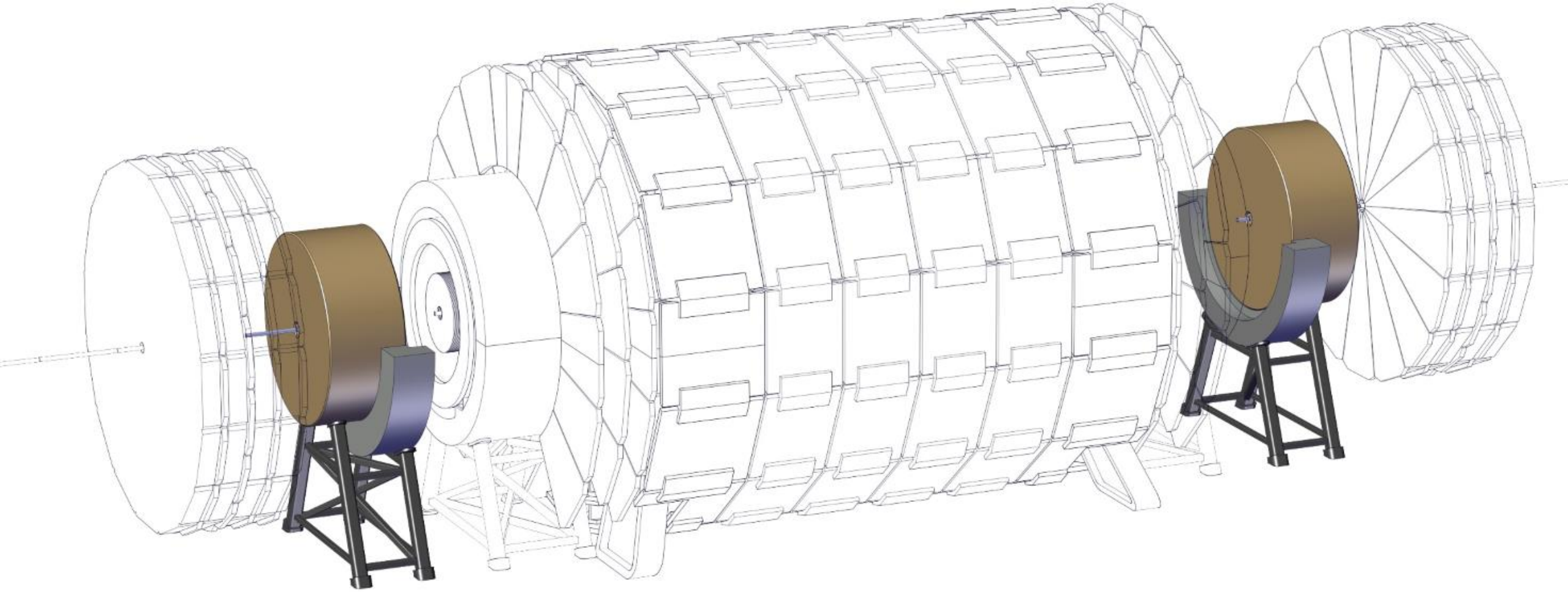
24 - Install bottom half of the ECal Radiation Shield

EXPERIMENT INTEGRATION



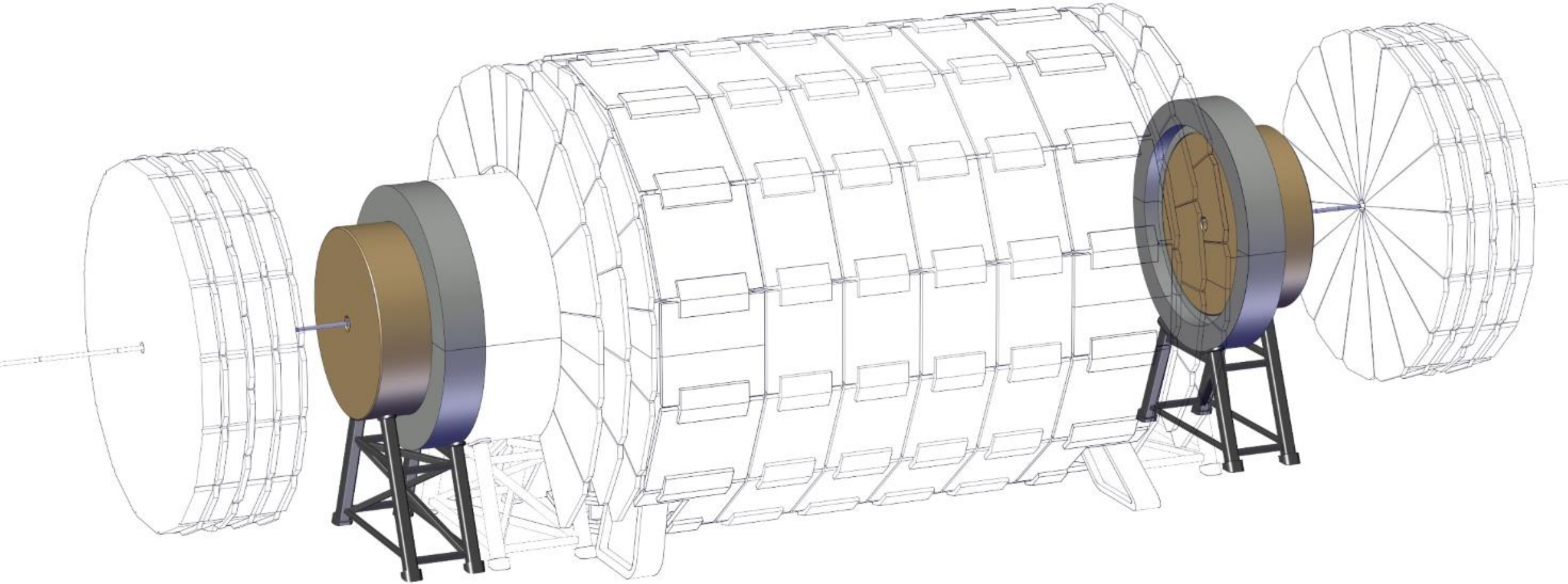
25 - Install Forward ECal

EXPERIMENT INTEGRATION



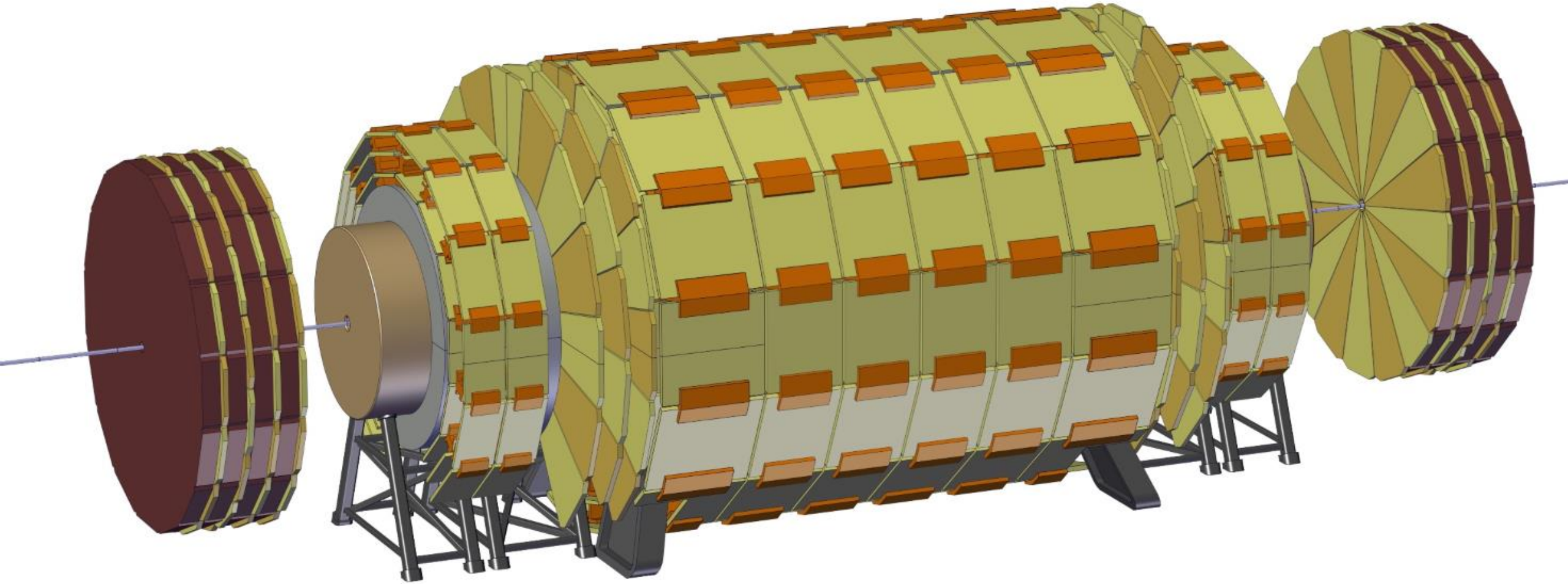
26 – Align the off-centered ECal with the experiment and close Beam Pipe

EXPERIMENT INTEGRATION



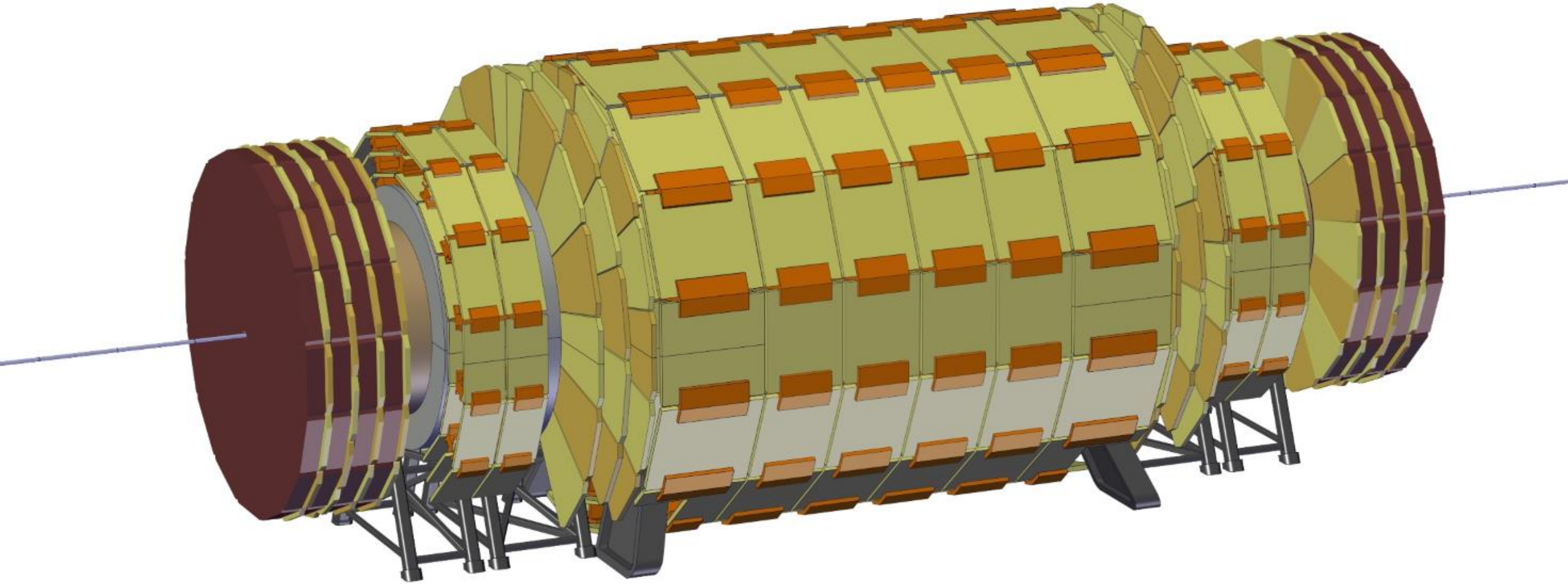
27 – Install the top half and close the radiation shield

EXPERIMENT INTEGRATION



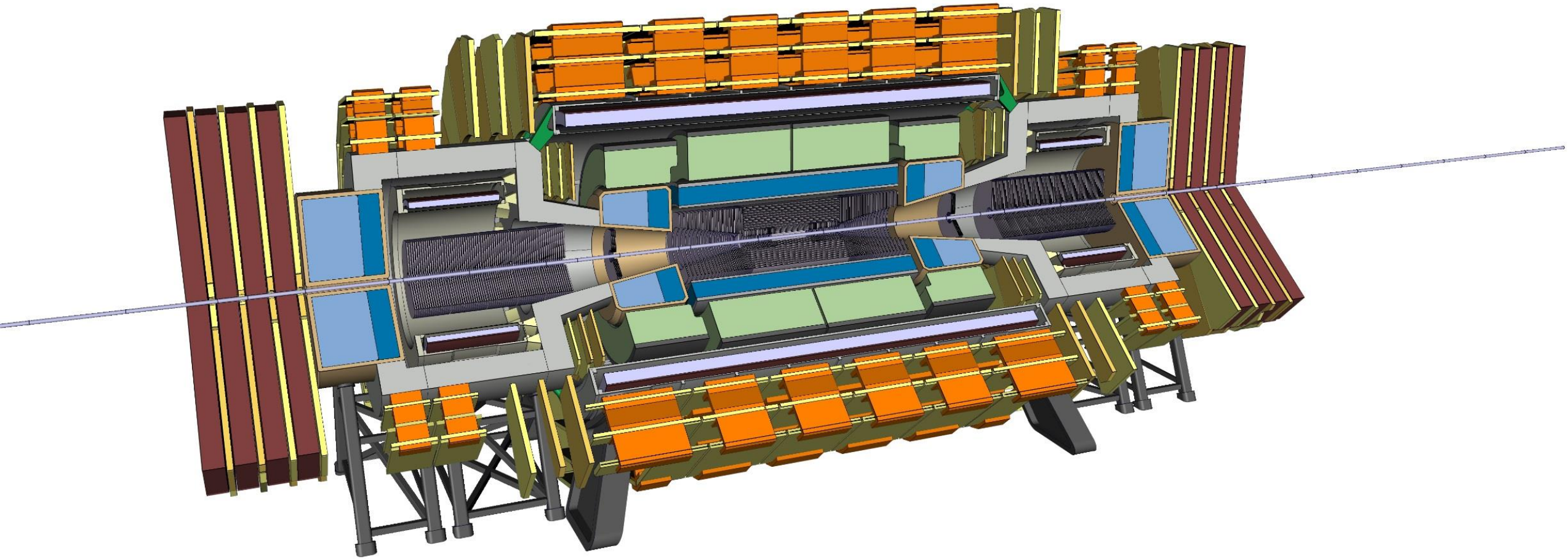
28 – Install remaining Muon Chambers

EXPERIMENT INTEGRATION



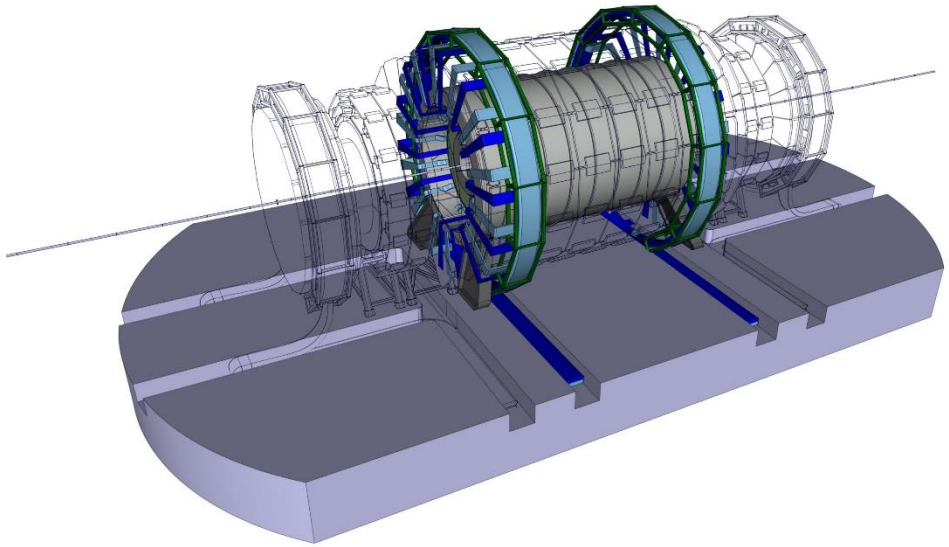
29 – Move Forward Muon Wheels to their final position

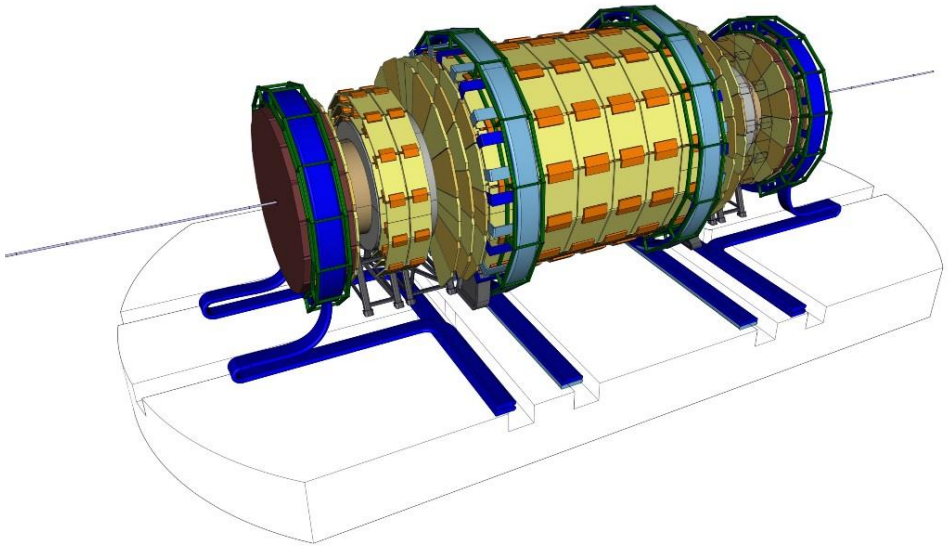
EXPERIMENT INTEGRATION



COMPLETE ASSEMBLY

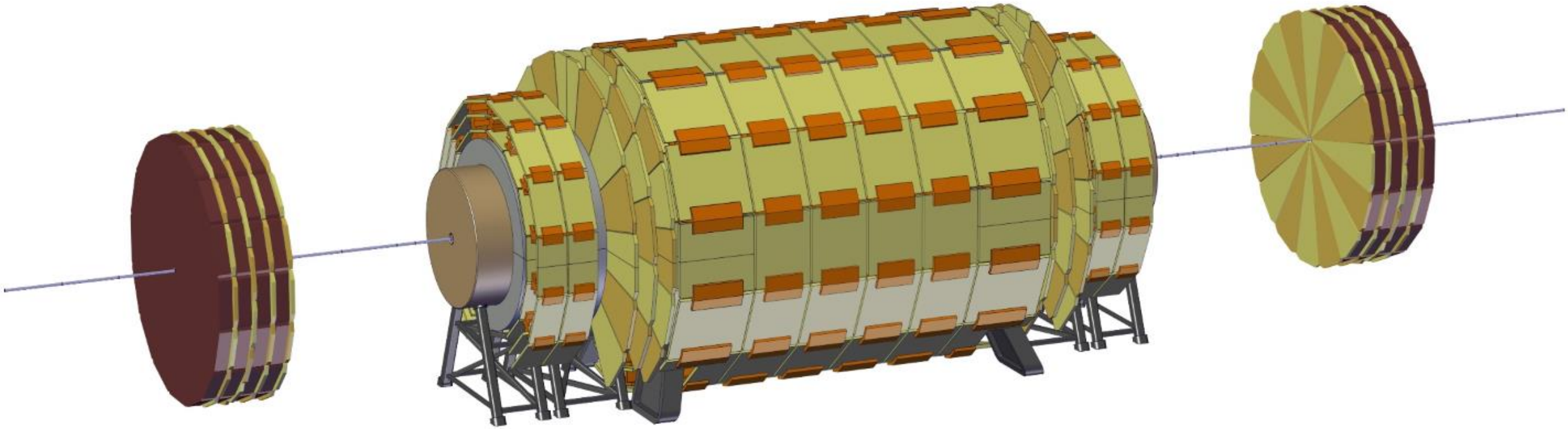
SERVICES ROUTING





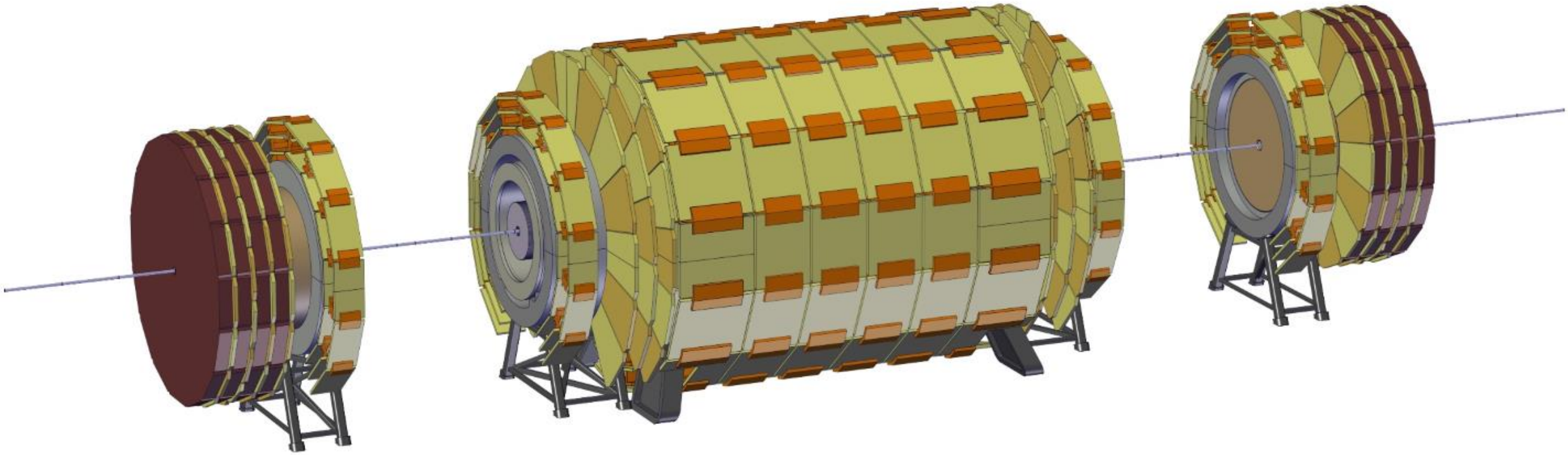
- Inner detectors cables and services are routed to the exterior of the detector and then to a side cavern.
- Forward detectors will make use of flexible chains that will be placed on trenches allowing only for longitudinal movements.
- For simplicity, only the services routing of the muon chambers in the forward direction are shown in the pictures above.

SHORT OPENING SCENARIO



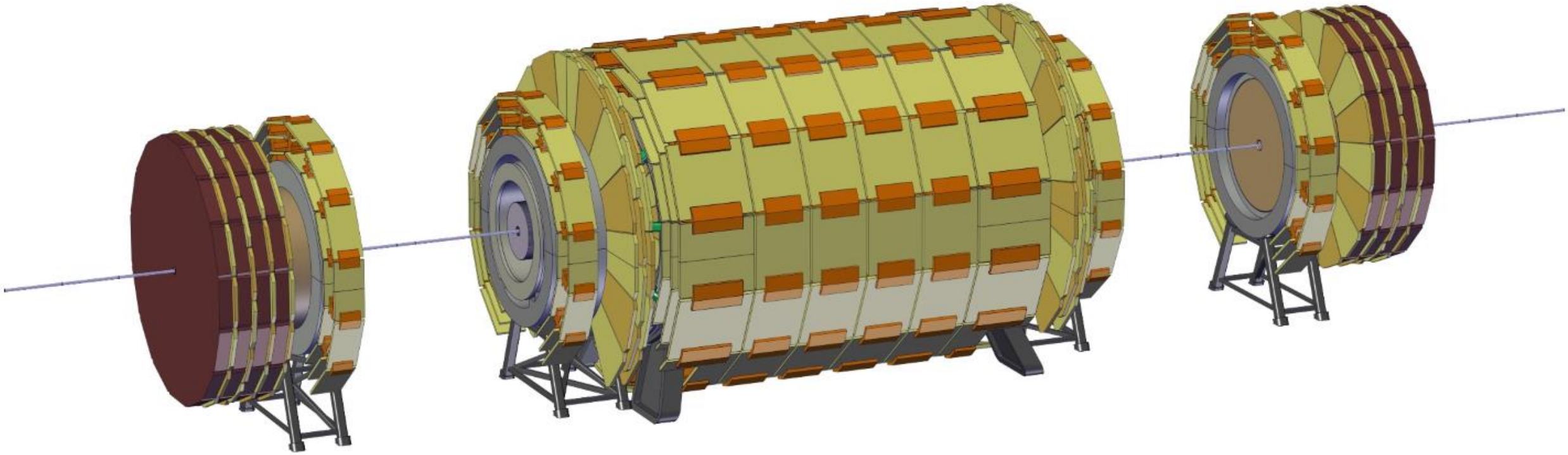
1 – Slide the Forward Muon Chambers away from the experiment

SHORT OPENING SCENARIO



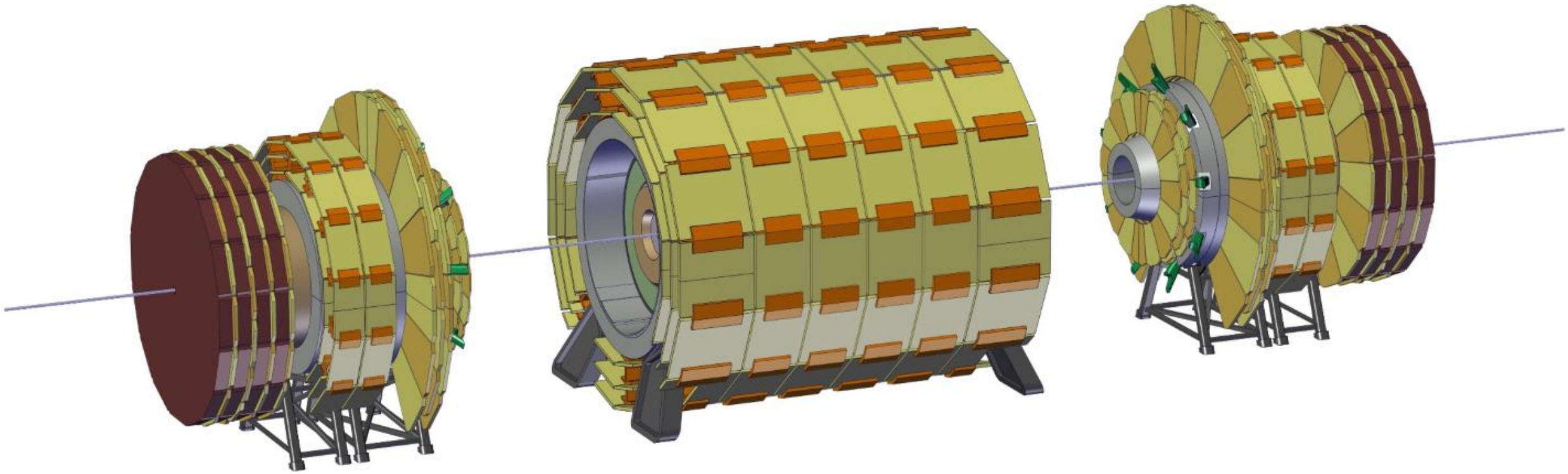
2 – Open Radiation Shield

SHORT OPENING SCENARIO



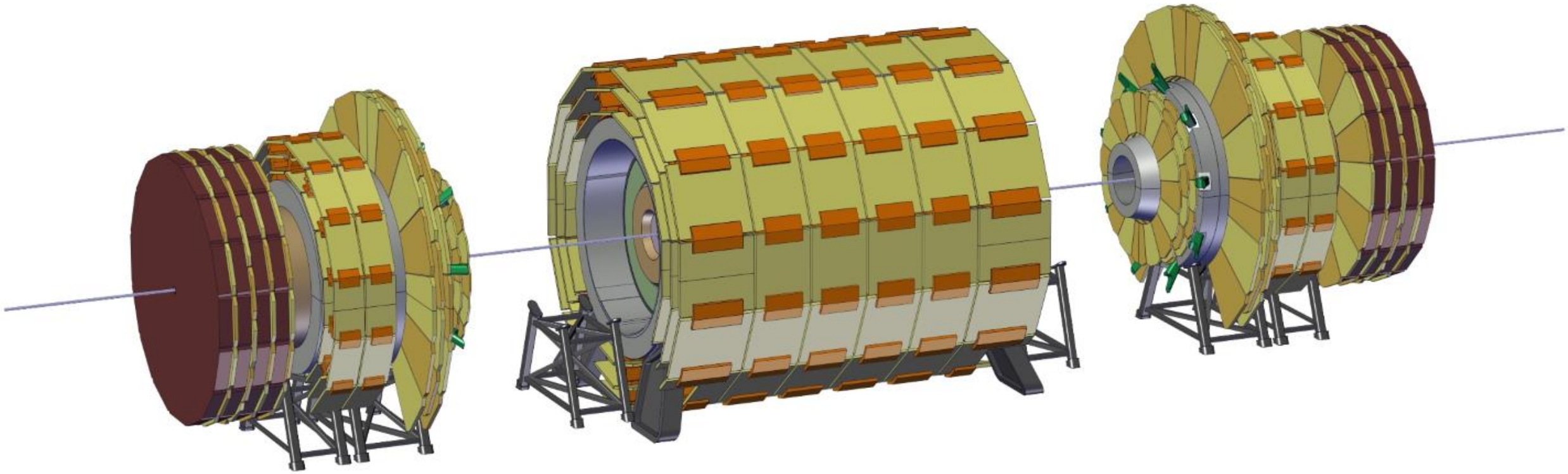
3 – Compact Muon Chambers and disconnect Spokes

SHORT OPENING SCENARIO



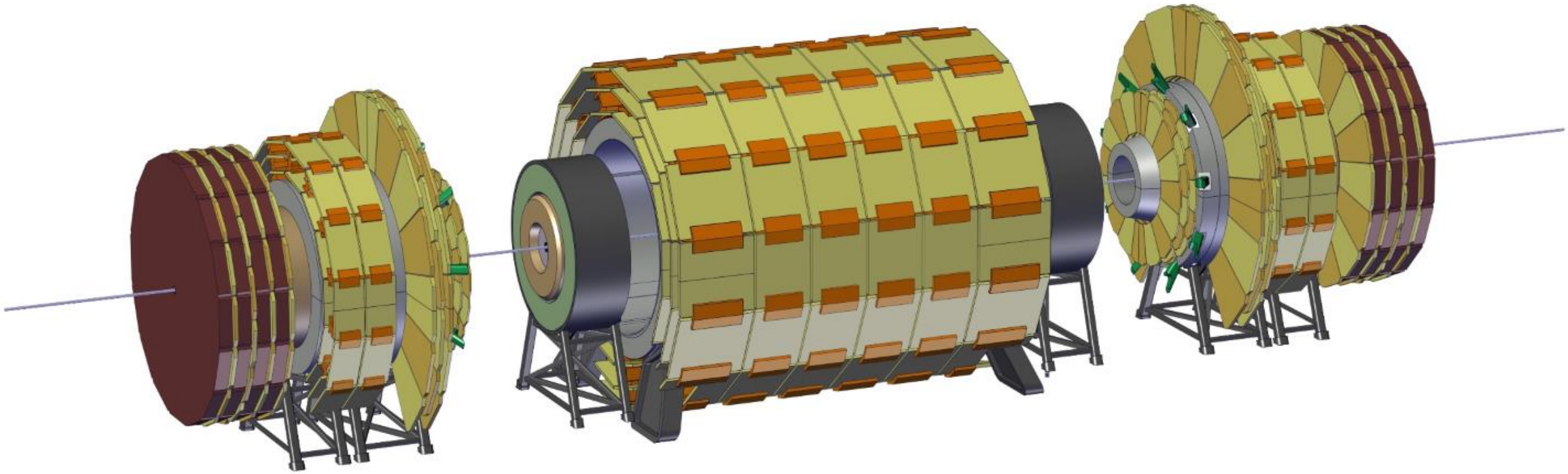
4 – Move Forward Solenoid close to Forward ECal

SHORT OPENING SCENARIO



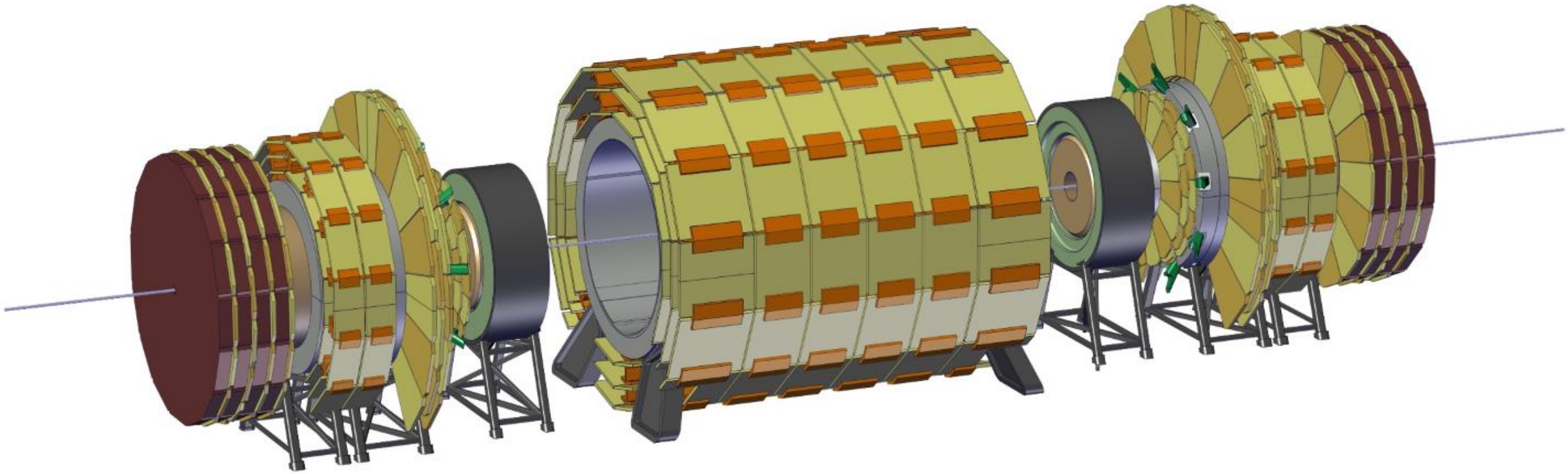
5 – Install support for HCal

SHORT OPENING SCENARIO



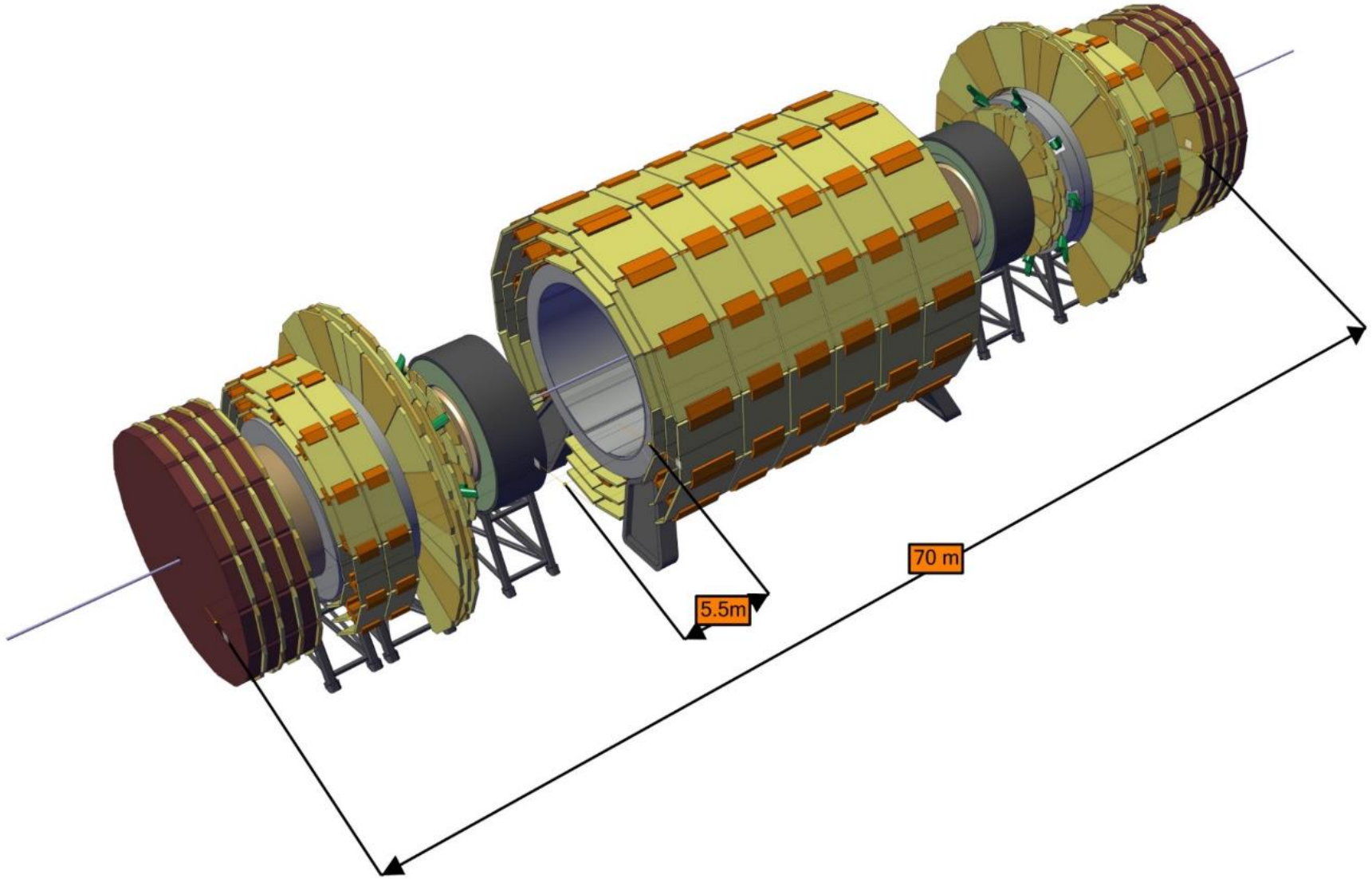
6 – Slide HCal outwards

SHORT OPENING SCENARIO



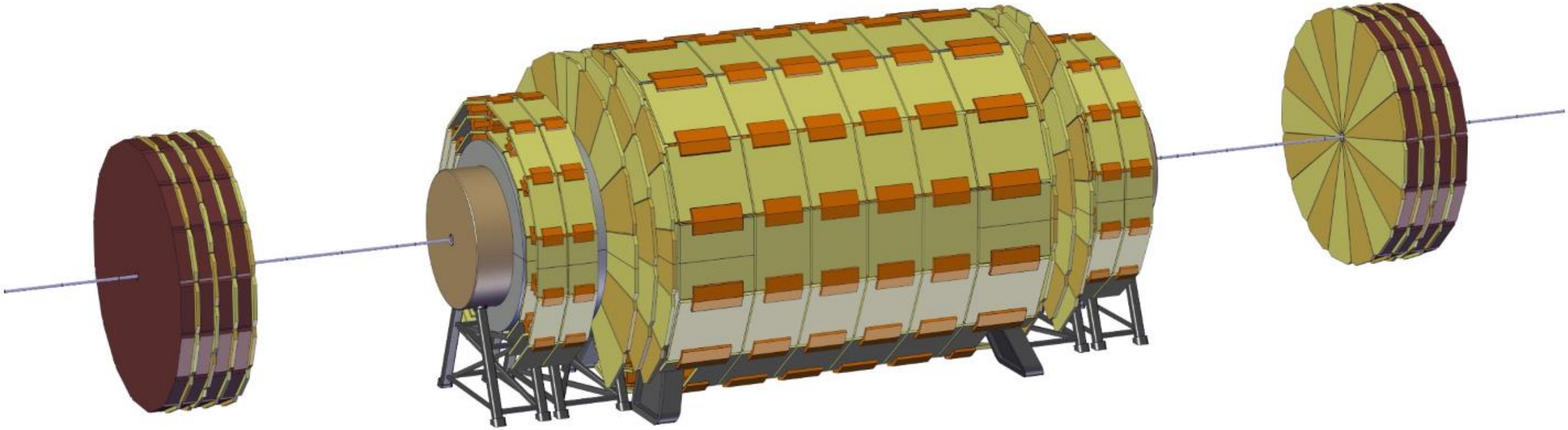
6 – Slide HCal outwards

SHORT OPENING SCENARIO



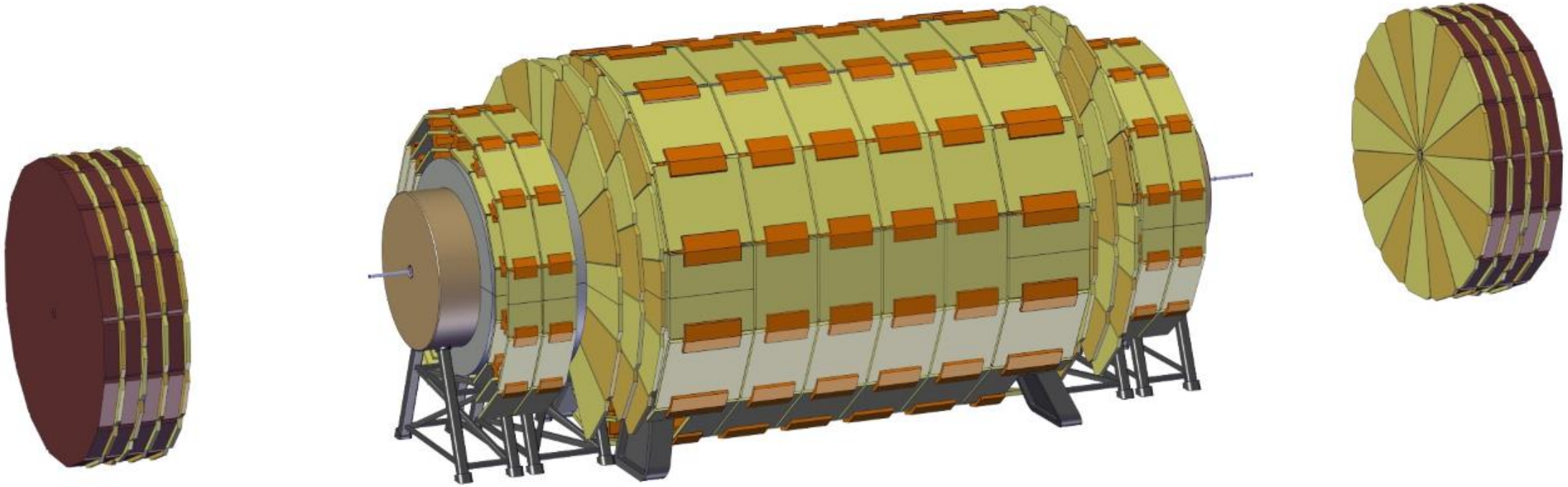
Short Opening final layout

LONG SHUTDOWN SCENARIO



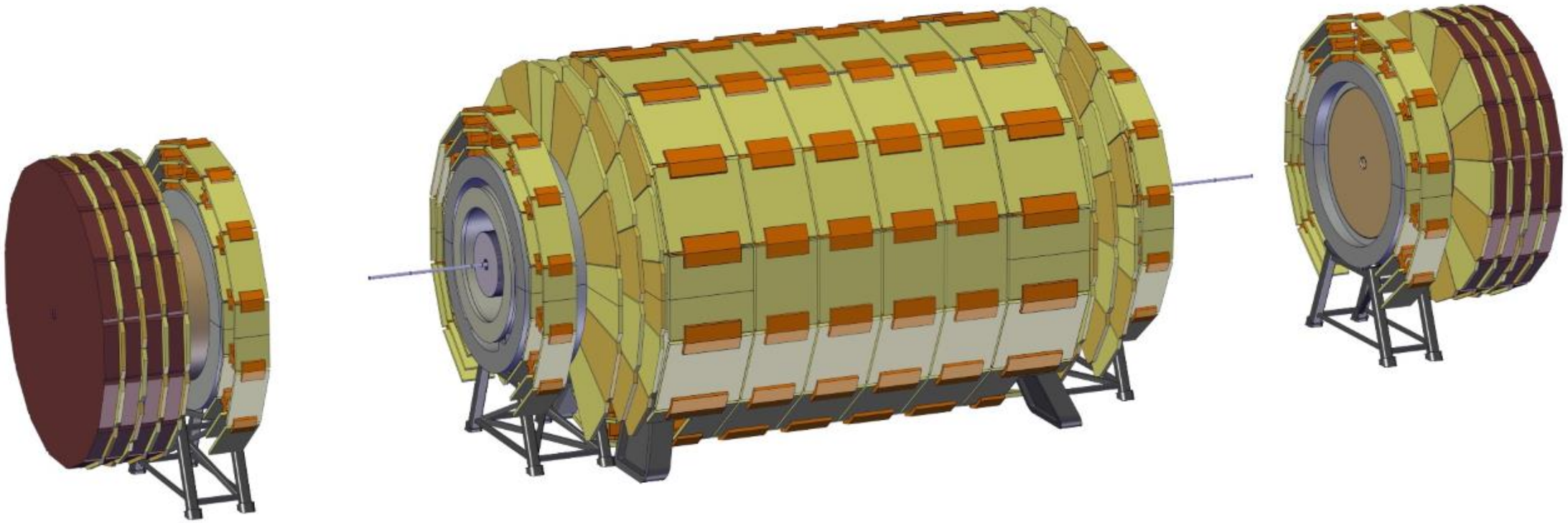
1 – Slide the Forward Muon Chambers 13.5 m away from the Forward ECal

LONG SHUTDOWN SCENARIO



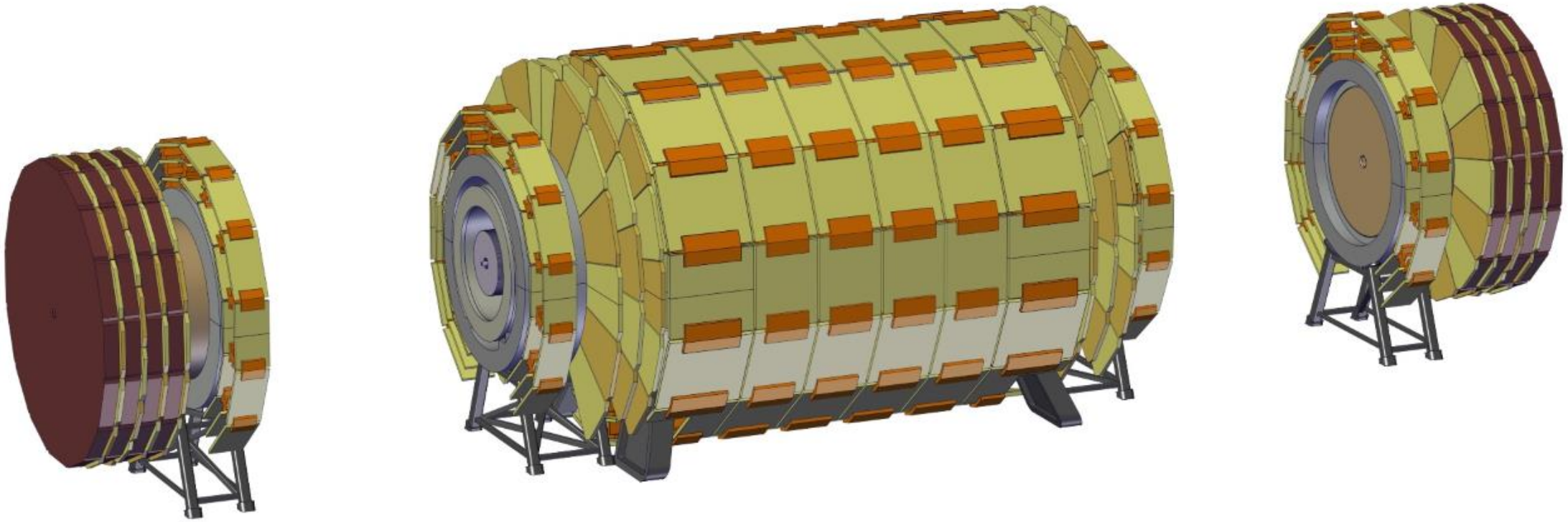
2 – Remove part of the Beam Pipe

LONG SHUTDOWN SCENARIO



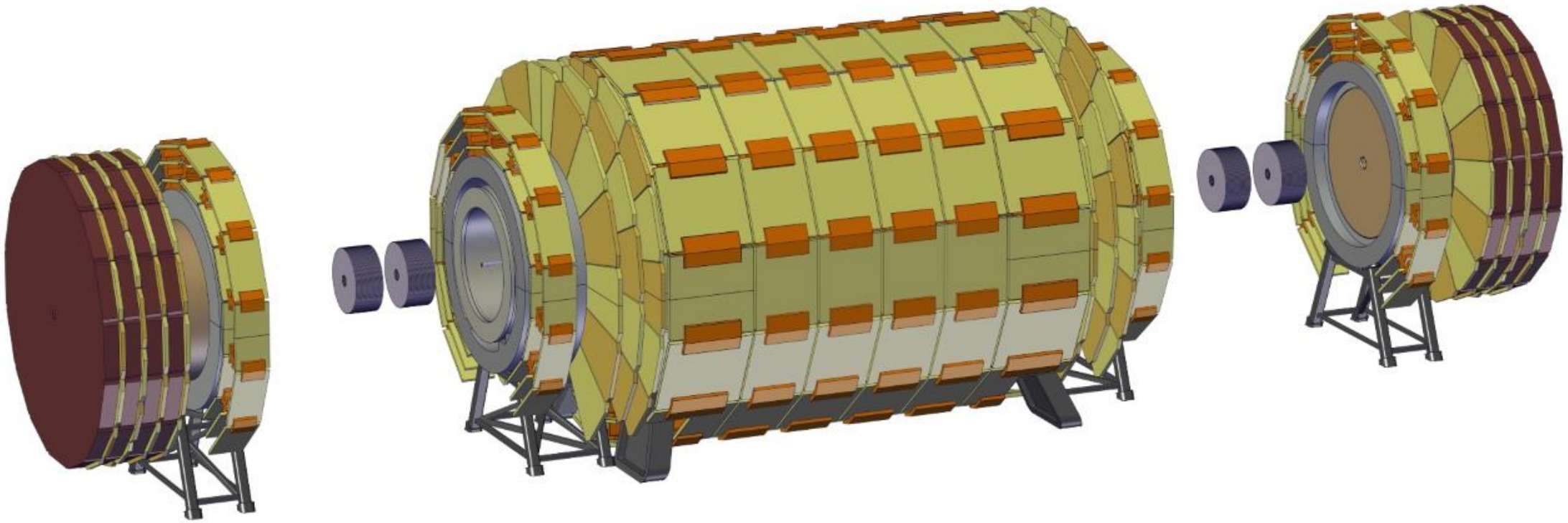
3 – Slide the Forward ECal Structure

LONG SHUTDOWN SCENARIO



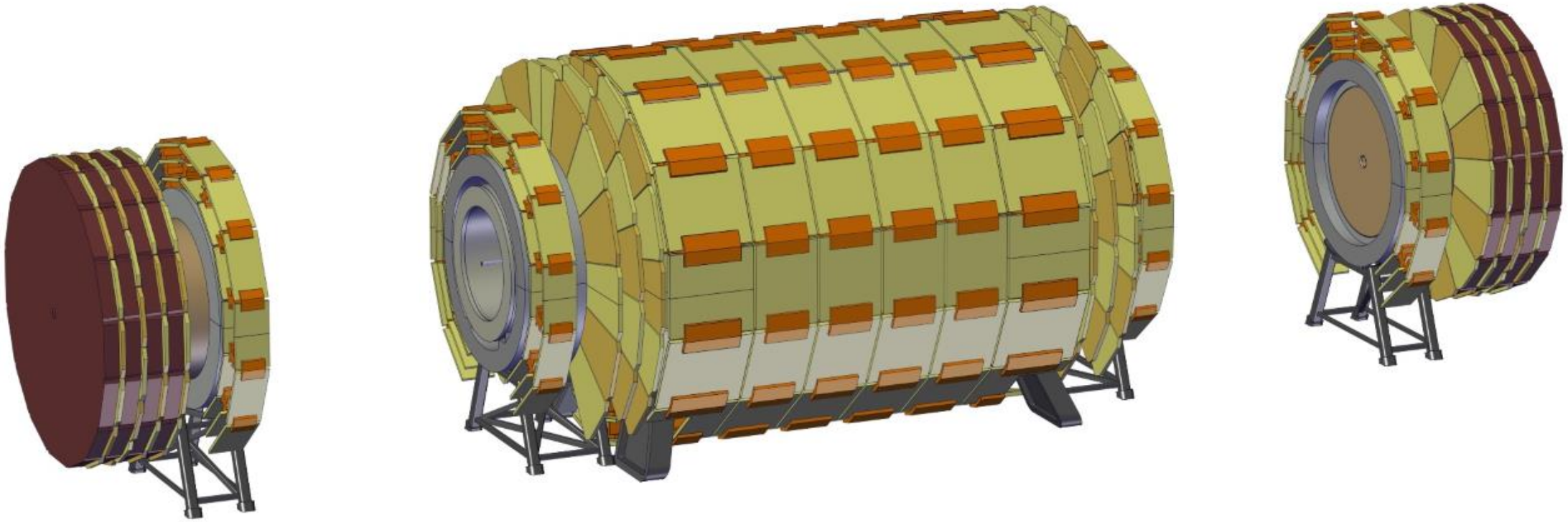
4 – Remove another portion of the beam pipe

LONG SHUTDOWN SCENARIO



5 – Remove forward trackers if necessary

LONG SHUTDOWN SCENARIO



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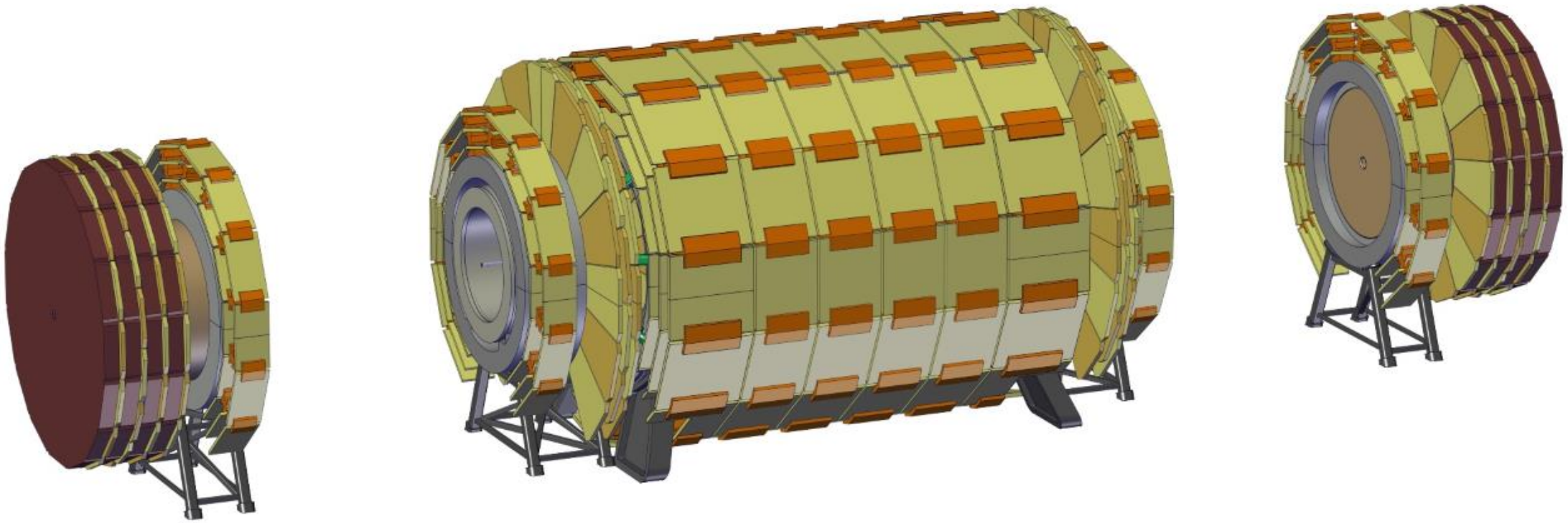
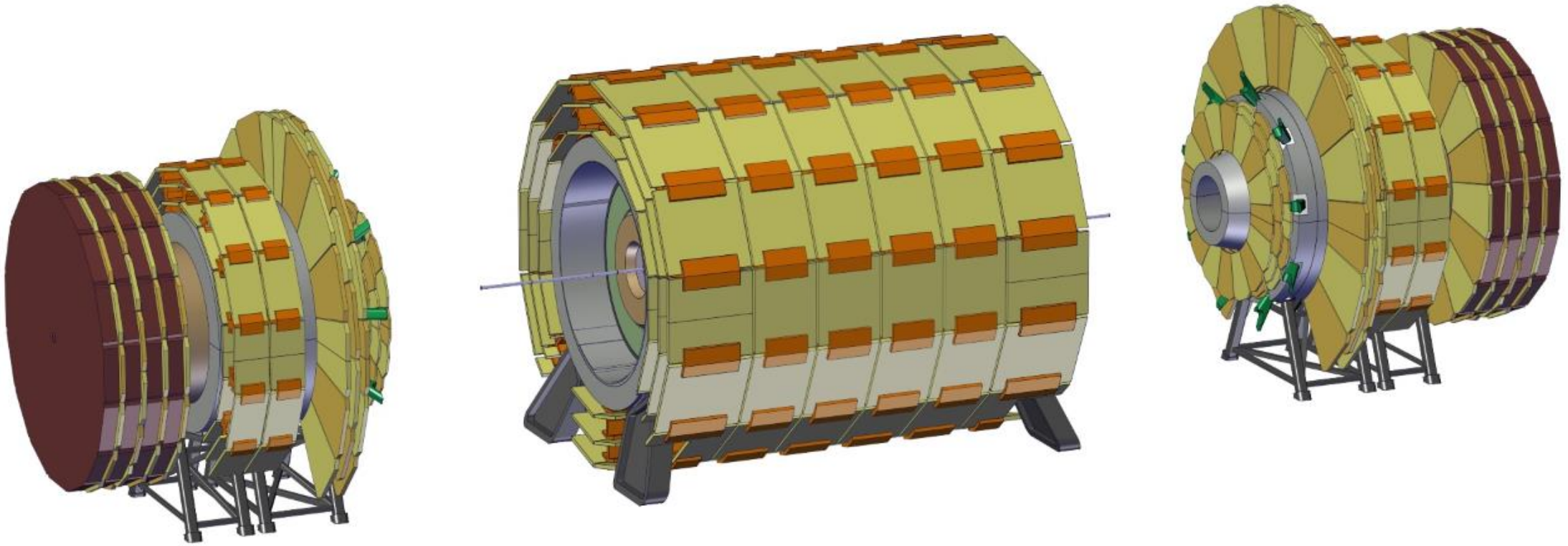
LONG SHUTDOWN SCENARIO



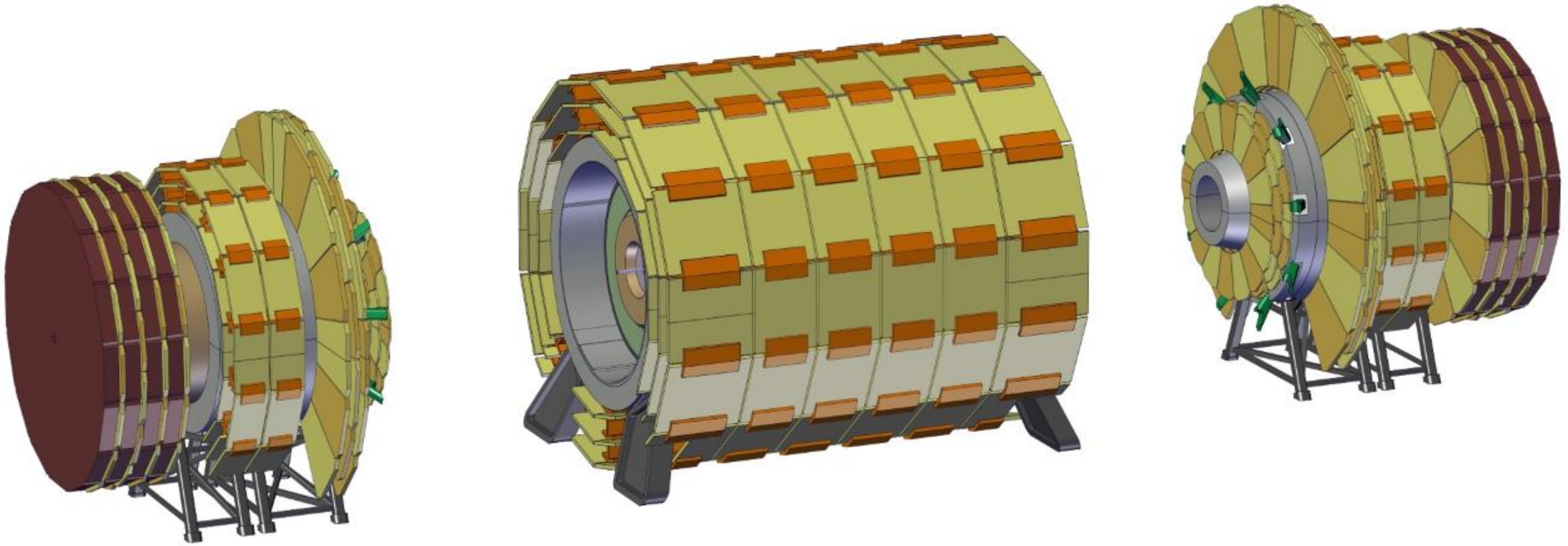
6 – Compact Muon Chambers and disconnect the spokes

LONG SHUTDOWN SCENARIO



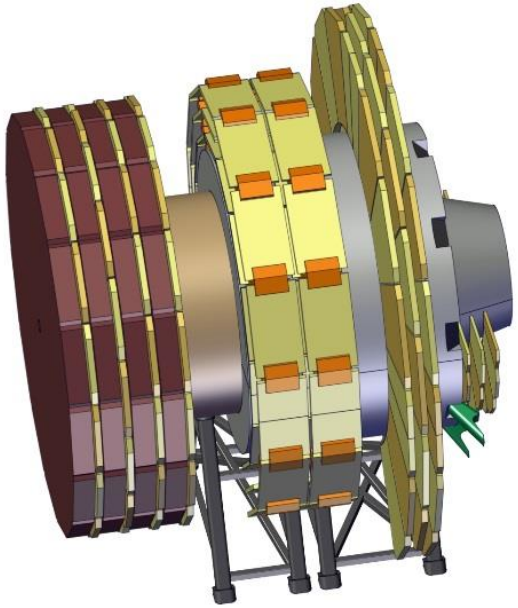
7 – Move Forward Solenoid towards the forward ECal

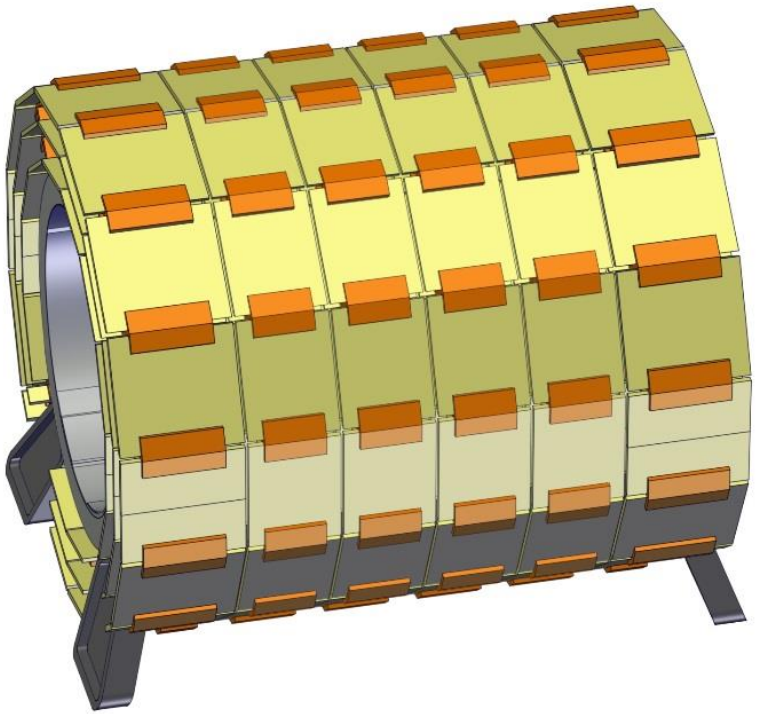
LONG SHUTDOWN SCENARIO

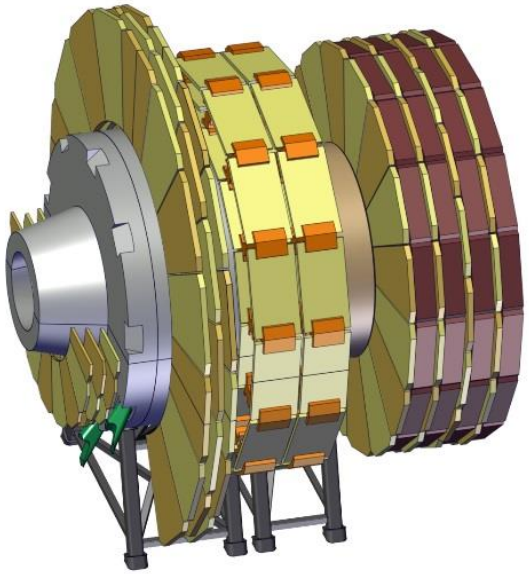


8 – Remove another portion of the beam pipe

LONG SHUTDOWN SCENARIO

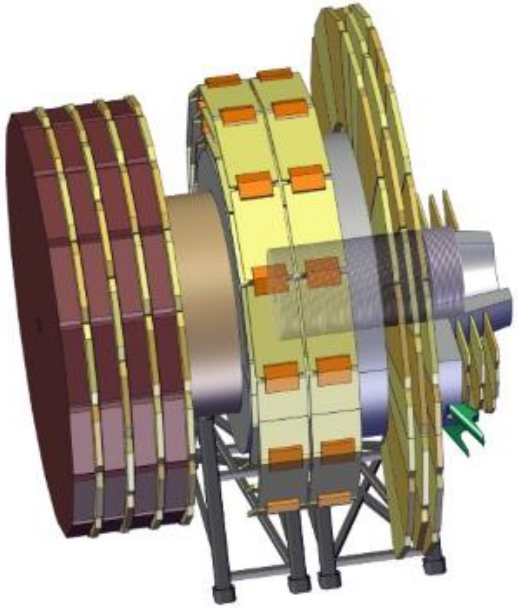


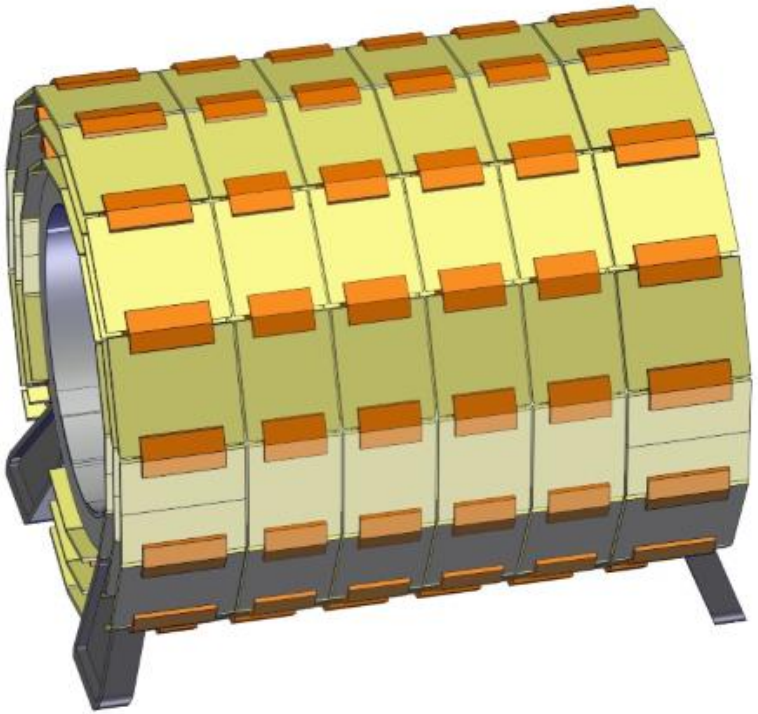


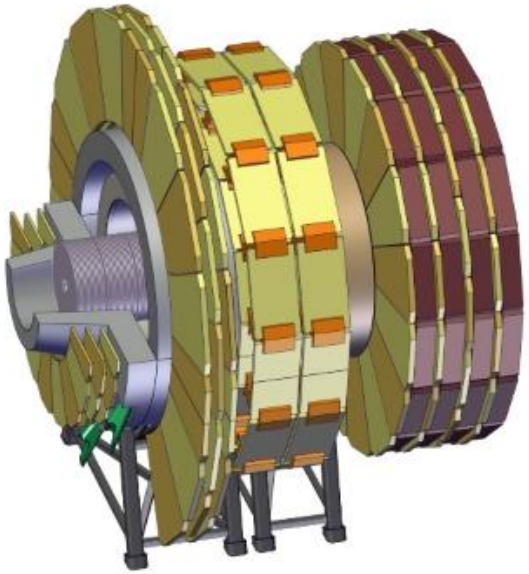


9 – Remove top Muon chambers on the radiation shield nose

LONG SHUTDOWN SCENARIO

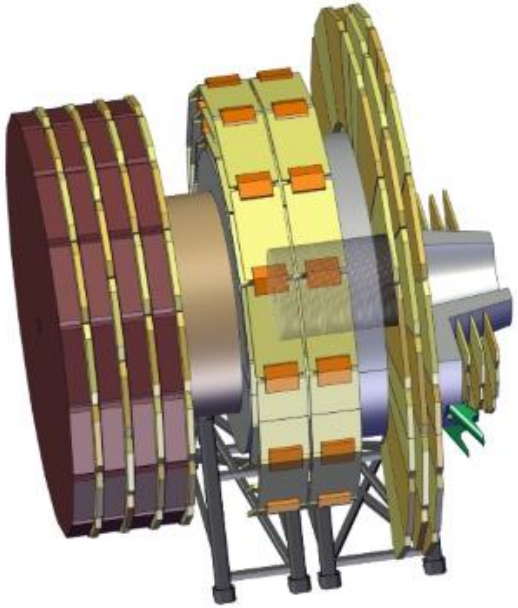


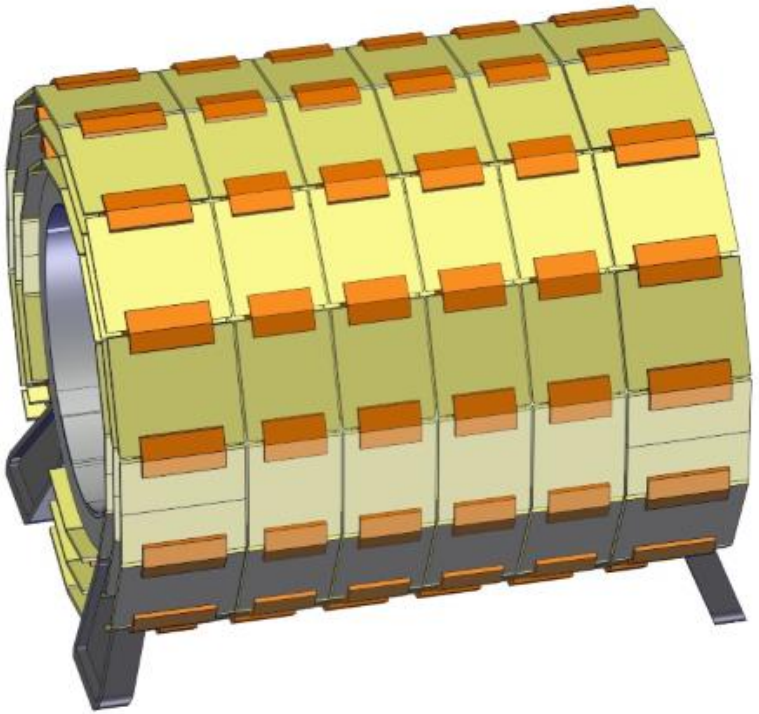


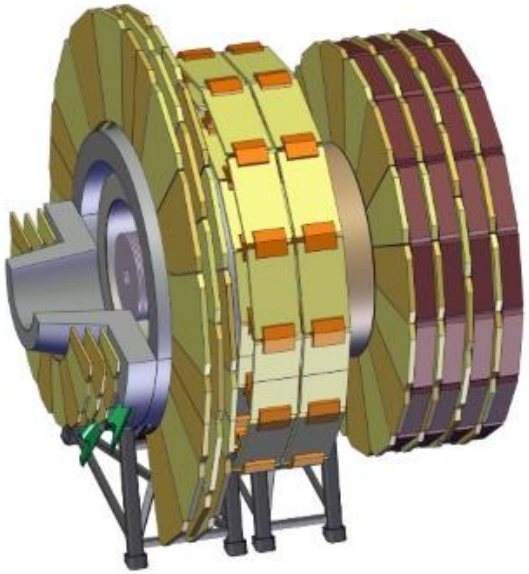


10 – Remove top part of radiation shield nose

LONG SHUTDOWN SCENARIO

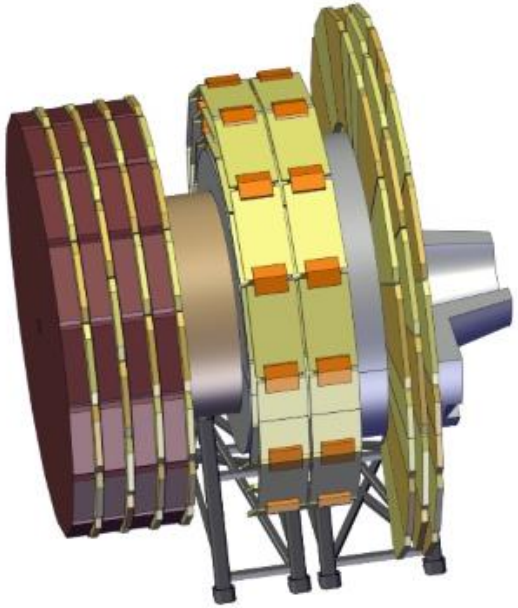


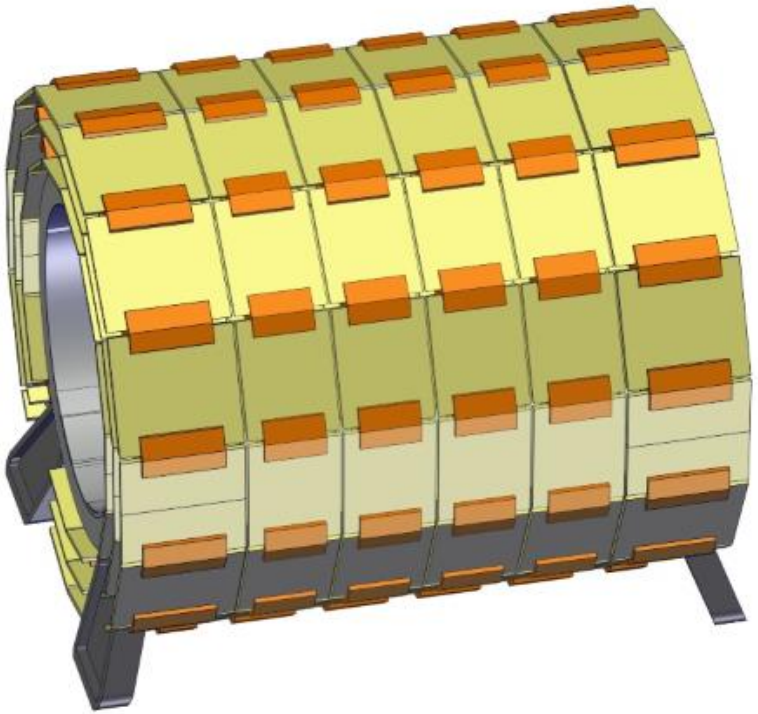


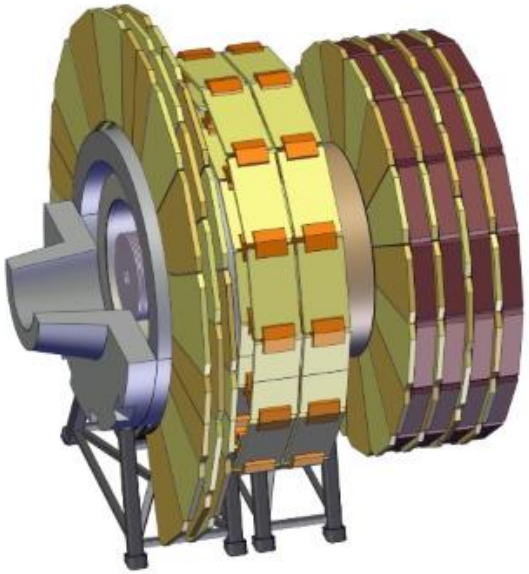


11– Remove two tracker modules in the forward direction

LONG SHUTDOWN SCENARIO

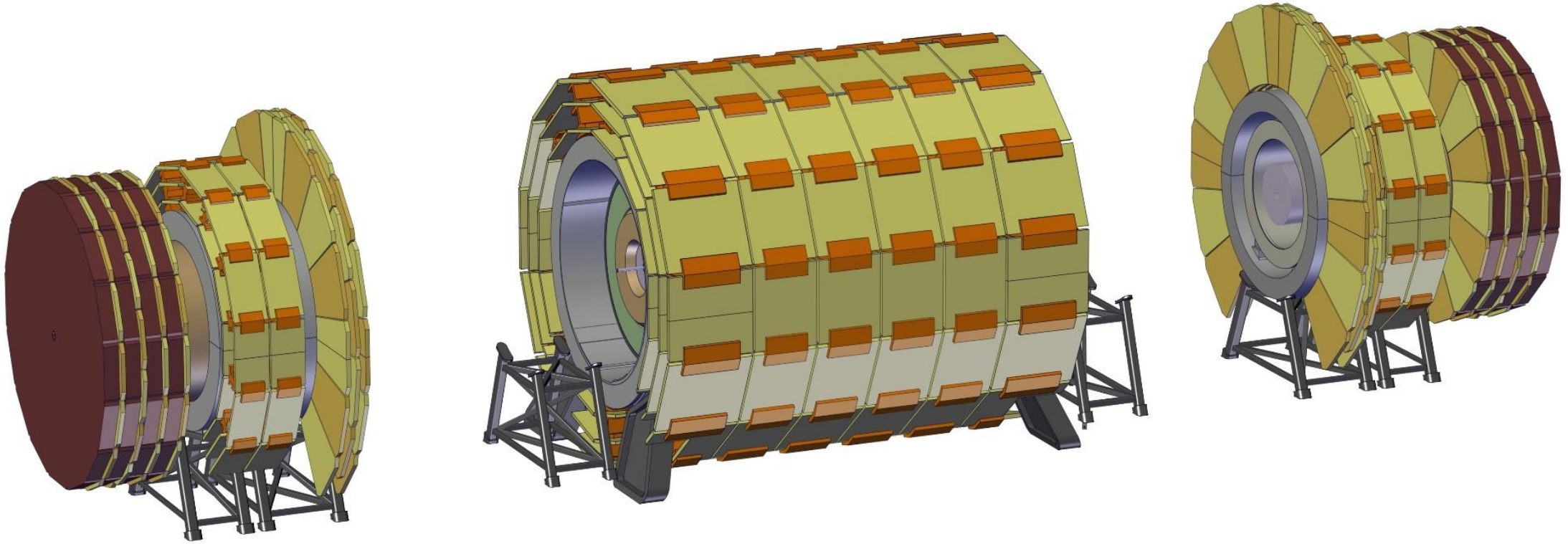






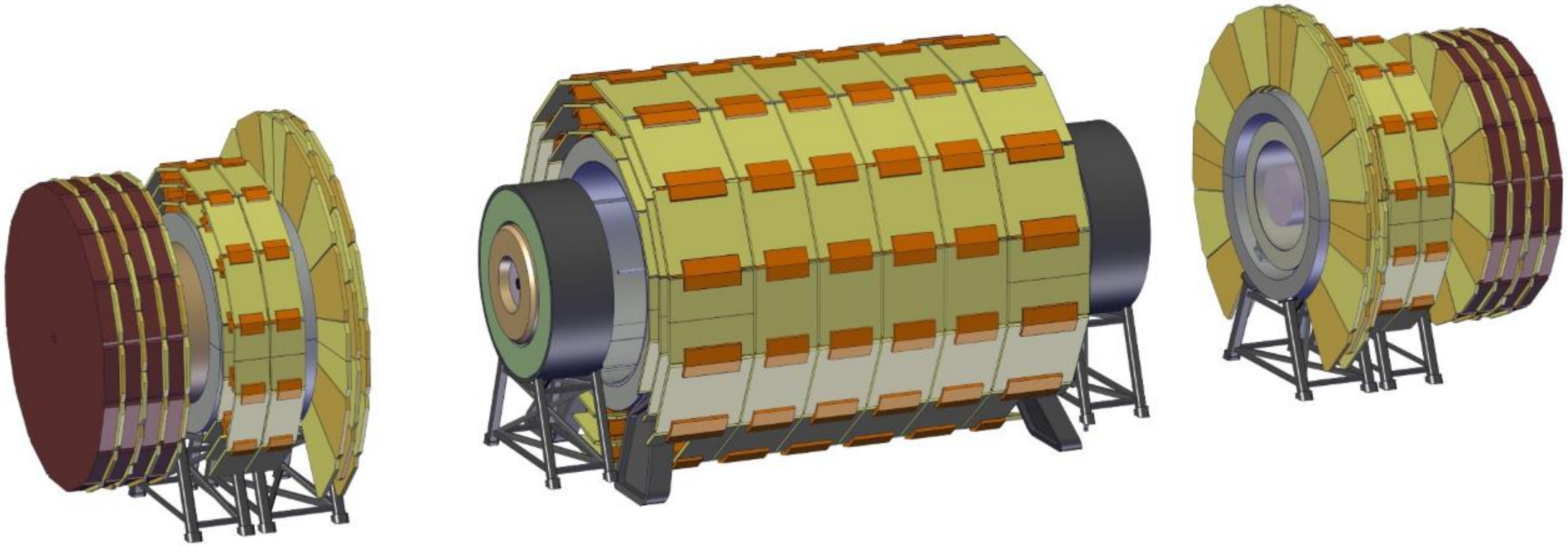
12 – Remove bottom Muon Chambers on the radiation shield nose

LONG SHUTDOWN SCENARIO



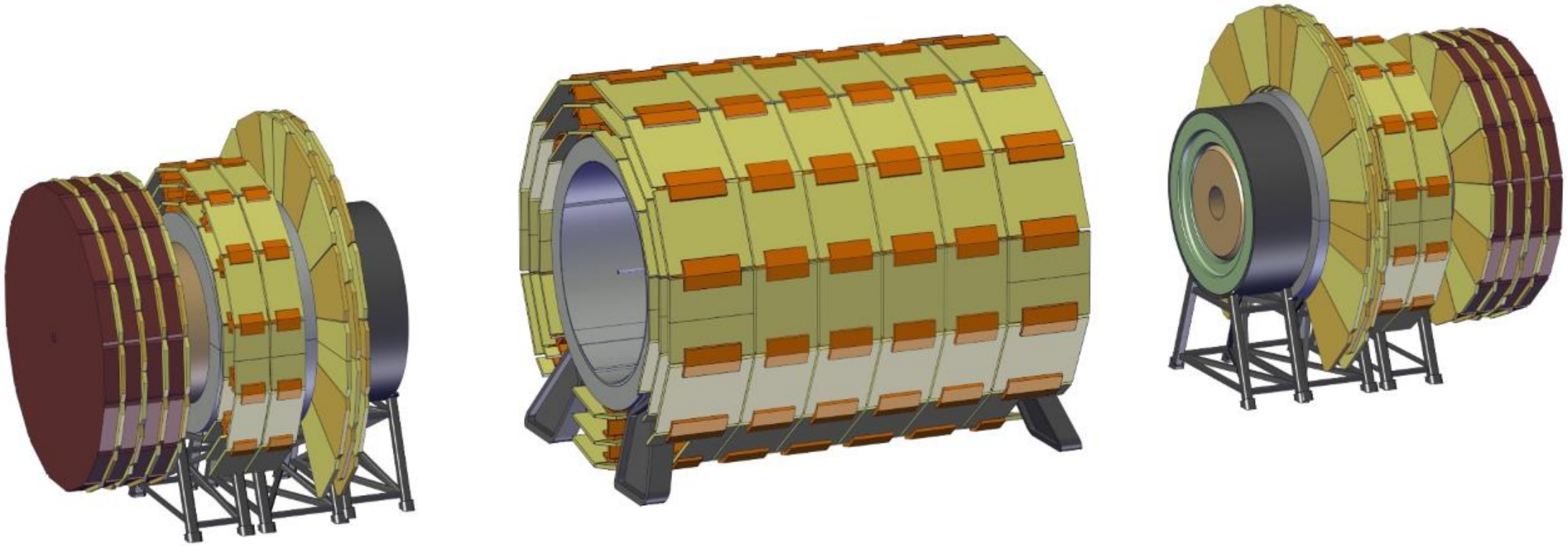
13 – Install temporary support for HCal and ECal Modules

LONG SHUTDOWN SCENARIO



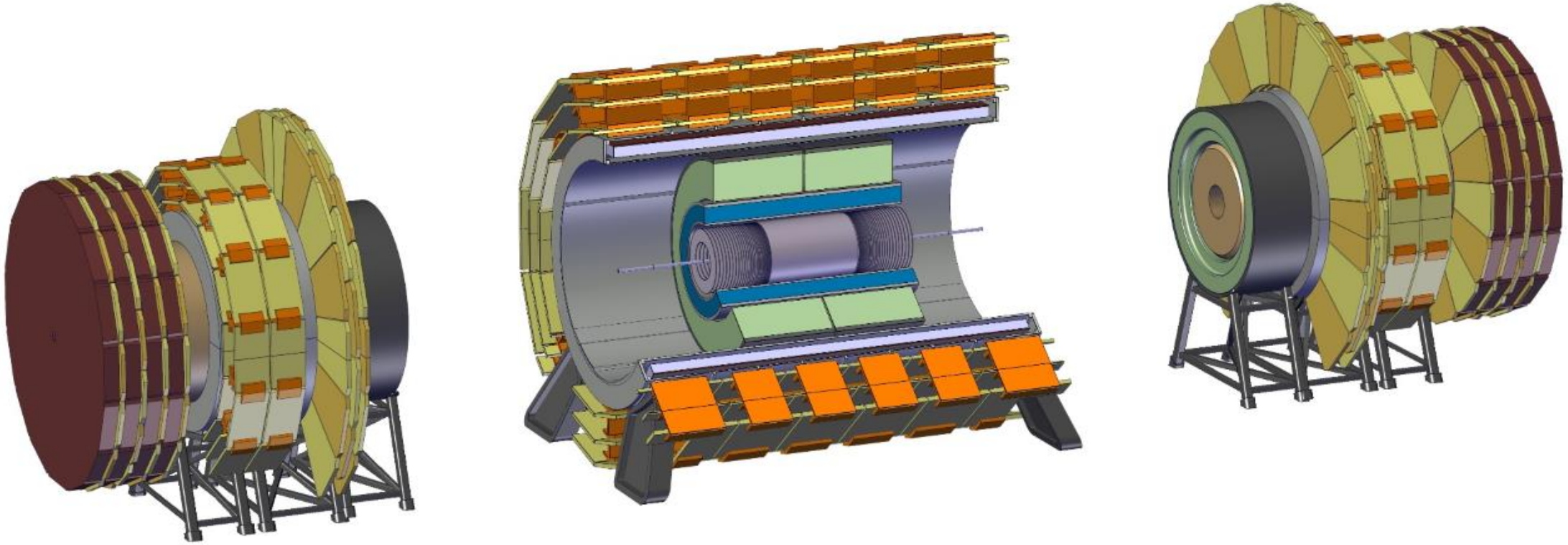
14 – Remove HCal and ECal module

LONG SHUTDOWN SCENARIO



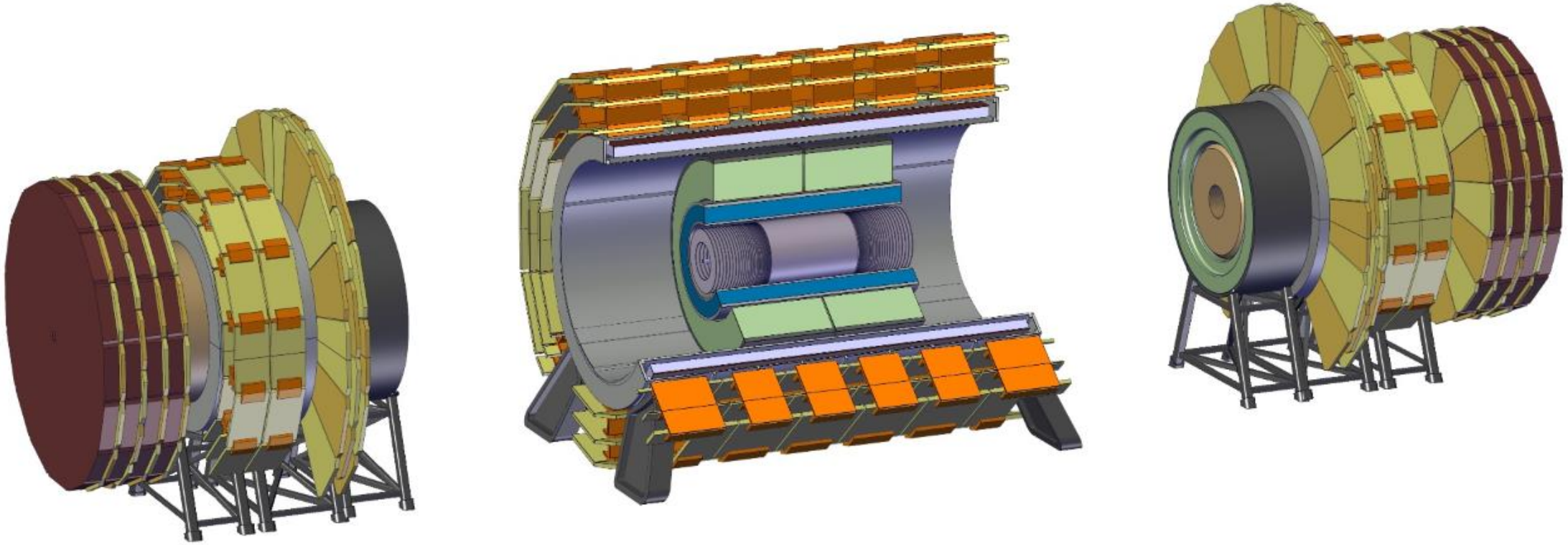
15 – Move HCal and ECal module next to the forward solenoid

LONG SHUTDOWN SCENARIO



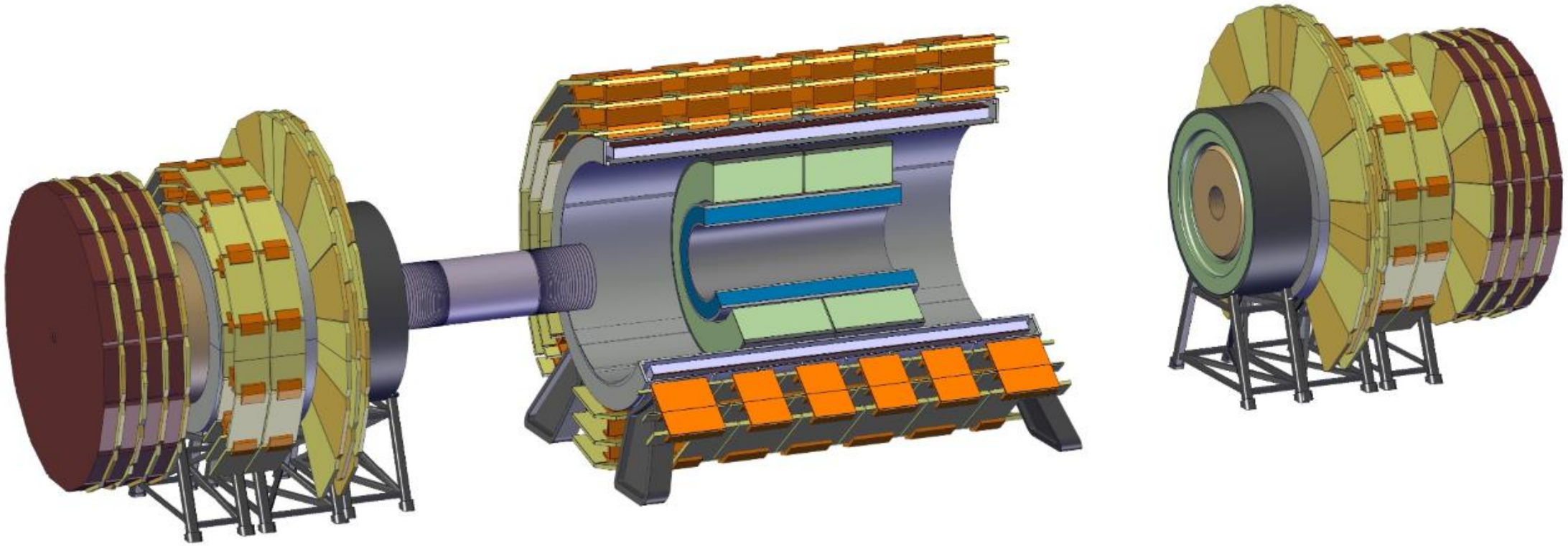
15 – Move HCal and ECal module next to the Forward Solenoid

LONG SHUTDOWN SCENARIO



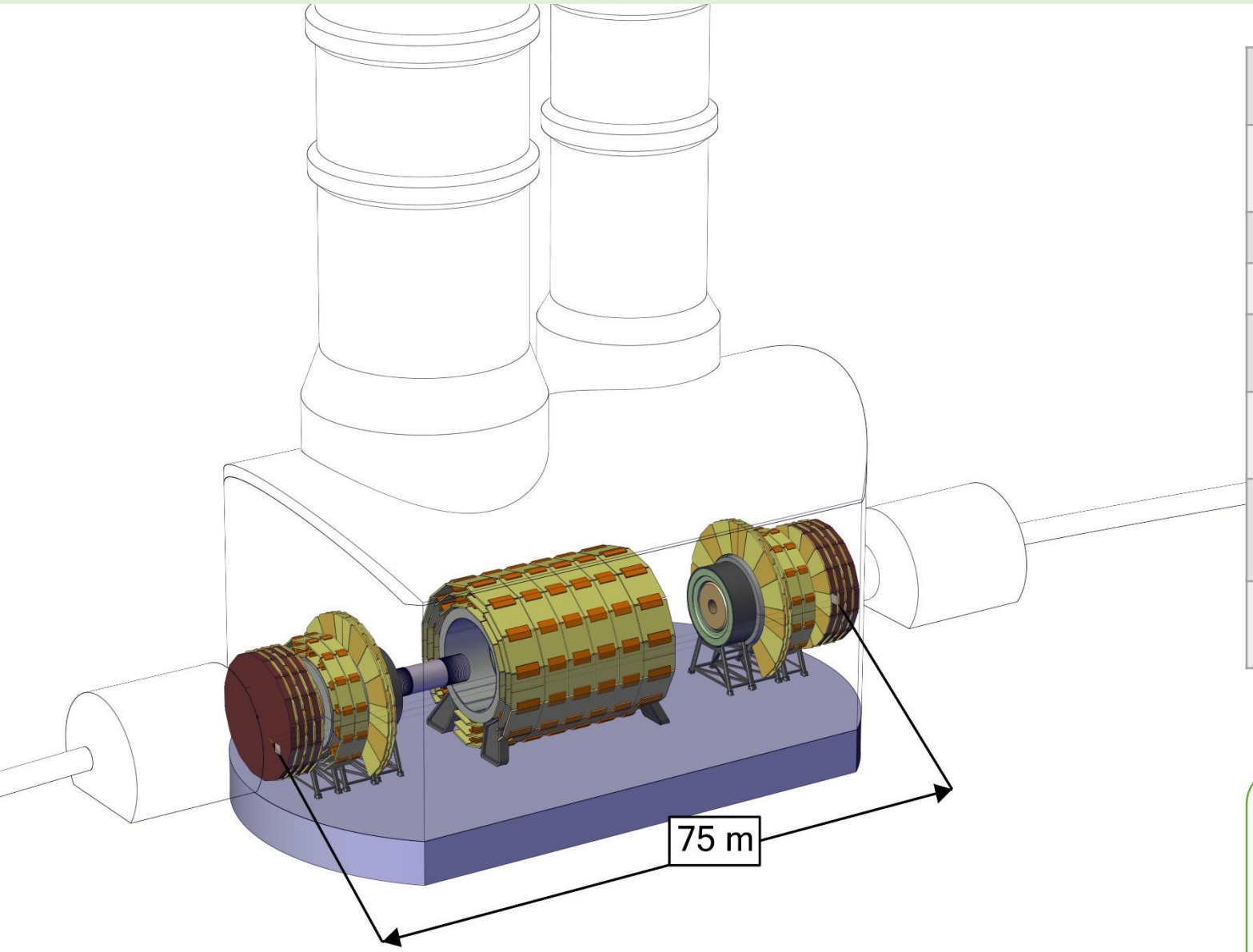
16 – Remove another portion of the beam pipe

LONG SHUTDOWN SCENARIO



17 – Extract inner trackers

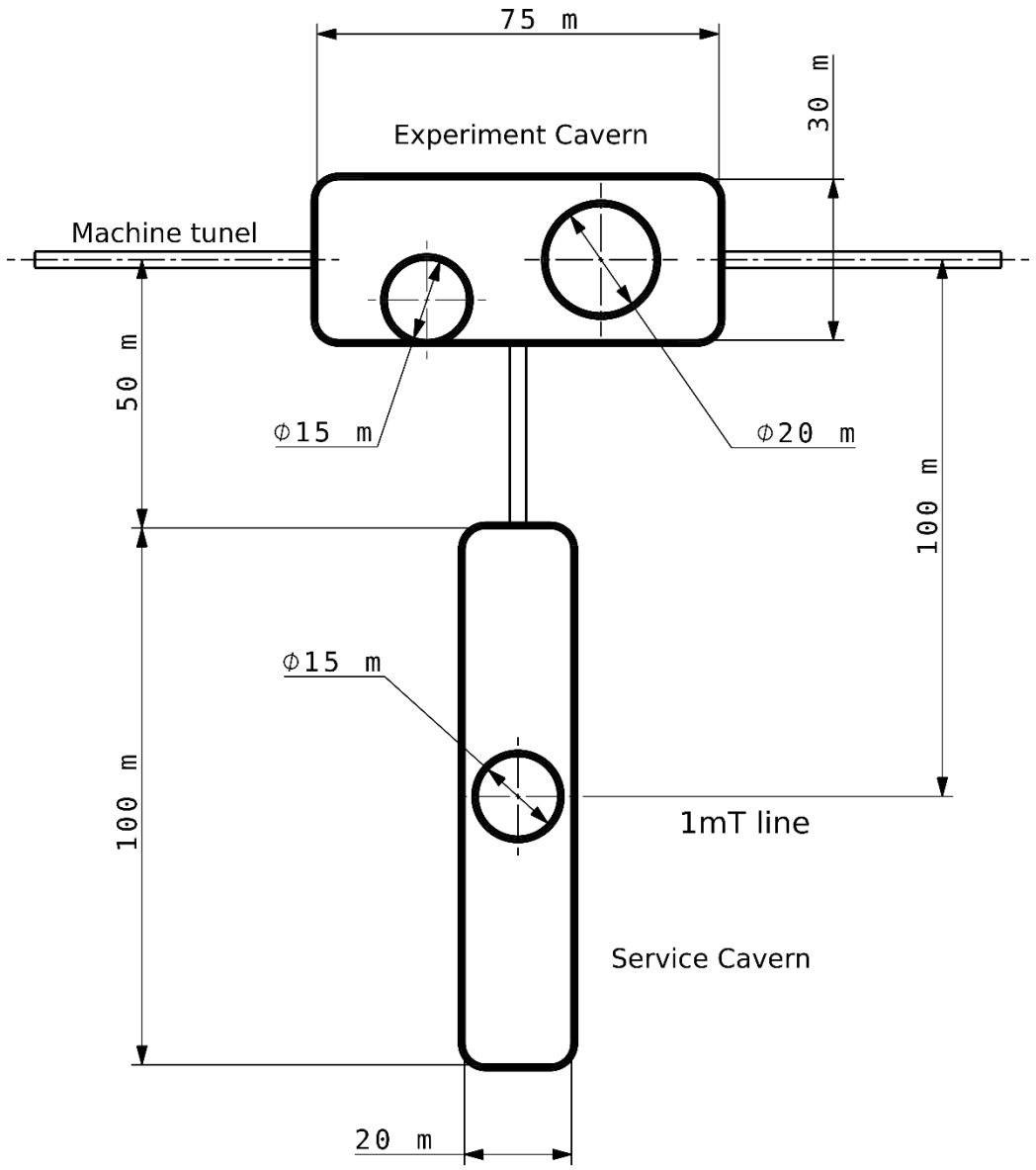
CAVERN



Maximum length experiment	*75m
Cavern Size (L x W x H) [m^3]	75 x 30 x 35
Main Shaft diameter [m]	20
Main Shaft usable space [m^2]	18x15
Secondary shaft diameter [m]	15
Secondary shaft usable space [m^2]	9x5
Main shaft crane requirement [kt]	2 or 3 (depends on Hcal modularity)
Secondary shaft crane requirement [kt]	0.6

* Depending on the compromises made, the open experiment length may vary from 70 m to 80m.

CAVERN



- Experiment cavern has two shafts
- Secondary shaft is off-center
- Service cavern is perpendicular to the experiment
- Service cavern dimensions are 15 x 20 x100 m^3 (HxWxL)
- 1mT line is at half length of the service cavern
- Most sensitive electronics can be placed further from the magnet system