

DT Contributions to ATLAS

ITk Pixel Outer Barrel

26th June 2024

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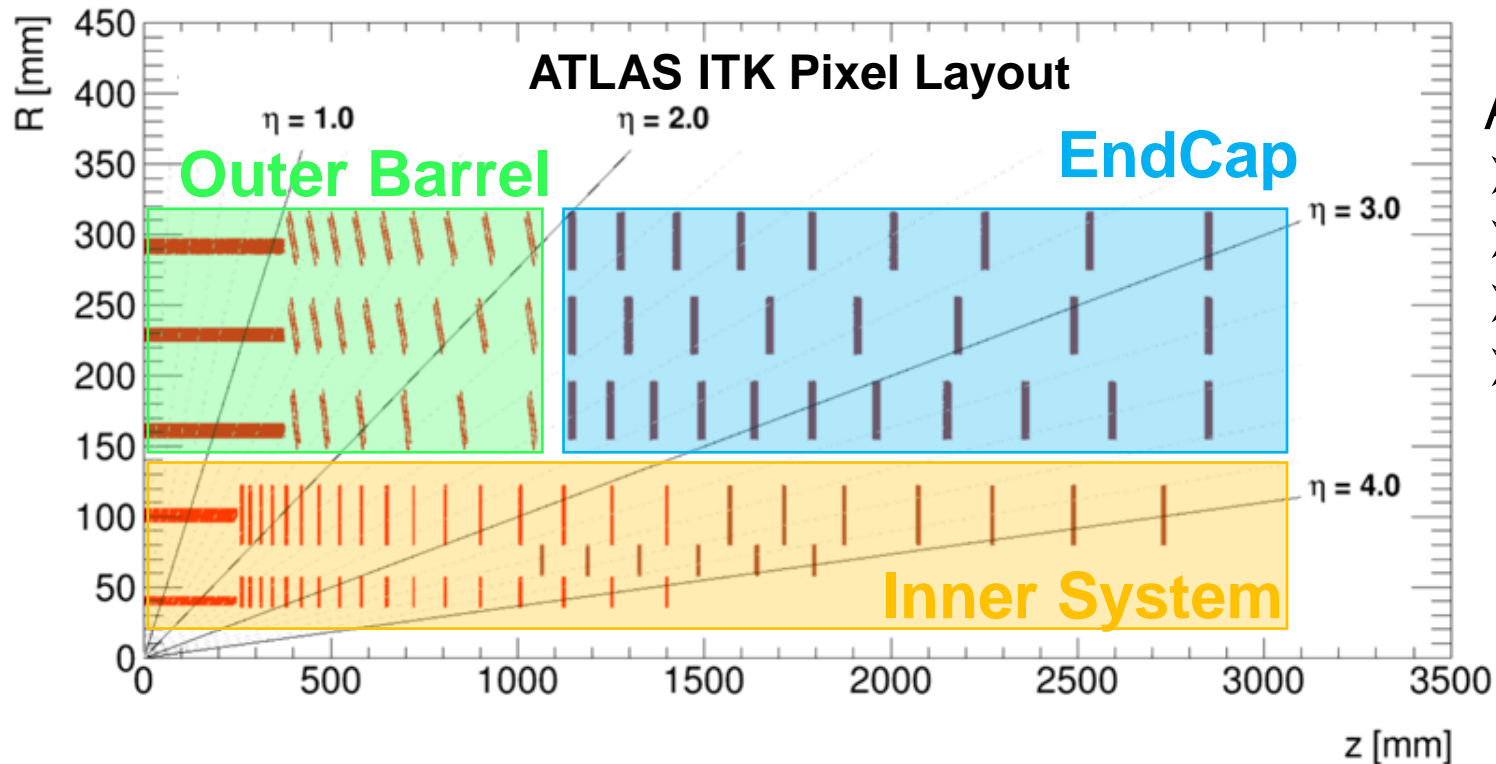
On behalf of the DT group ITk OB contributors



EP-DT
Detector Technologies

Introduction

- EP-DT Leading role in ATLAS ITk Pixel Outer Barrel Mechanics & Modules
 - Module construction, Local Supports, on-detector cooling and global support structures
 - Detector assembly and integration → DT commitments extend up to the **end of LS3**
 - Close collaboration with EP-ADE, Université de Genève, Bonn, CPPM and EN-MME



ATLAS ITk Pixel Outer Barrel:

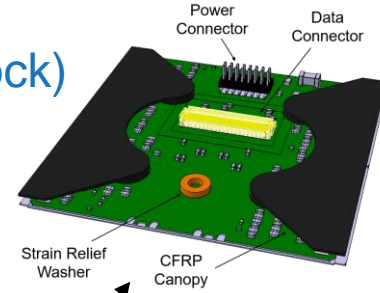
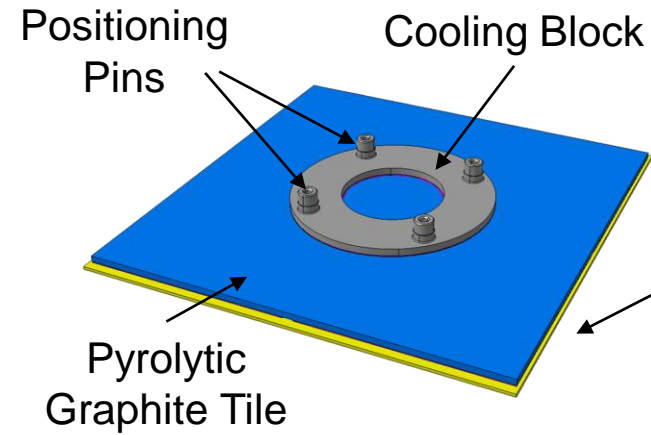
- First pixel detector with tilted layout
- 4472 Pixel Modules (150 μ m thick, planar sensors)
- Active area: 6.94m² (53.5% of Pixel Detector)
- >14 Institutes from five funding agencies



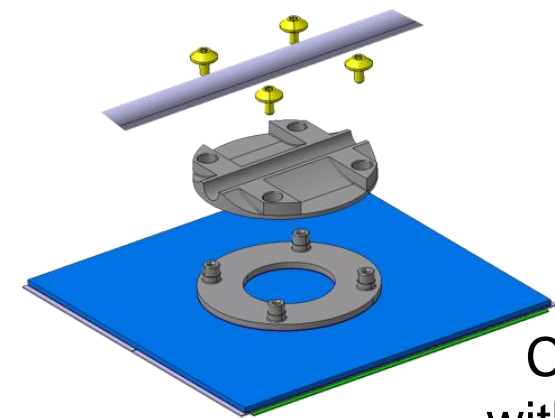
Outer Barrel: Local Supports

Module Cells

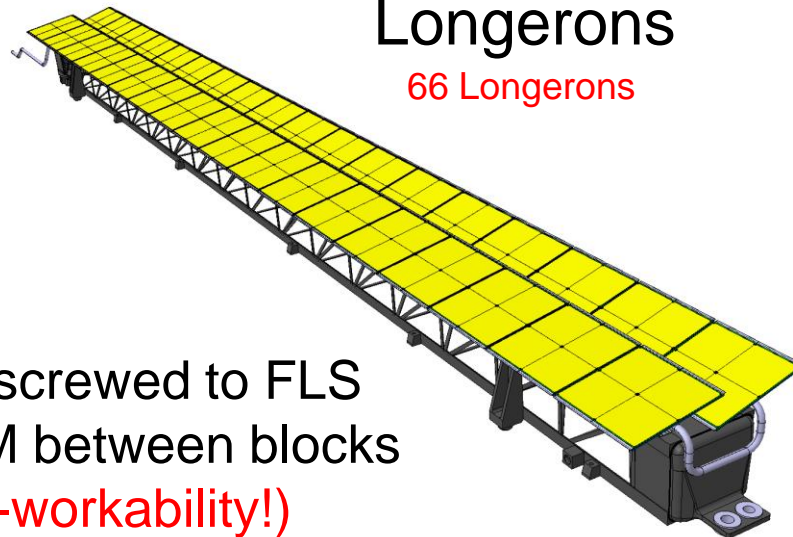
(Module + PG Tile + Cooling Block)



Module Glued on Cell

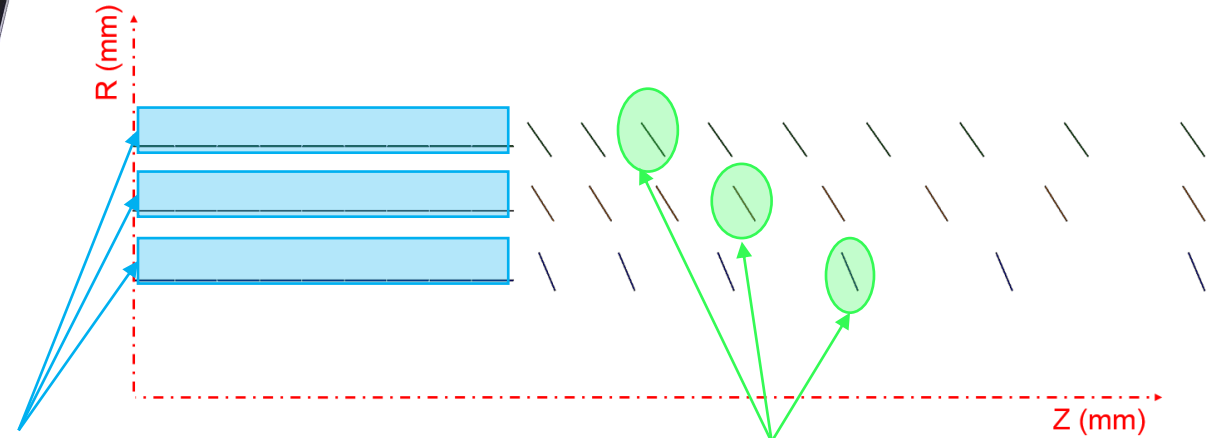


Cells screwed to FLS with TIM between blocks (re-workability!)



Functional Local Supports

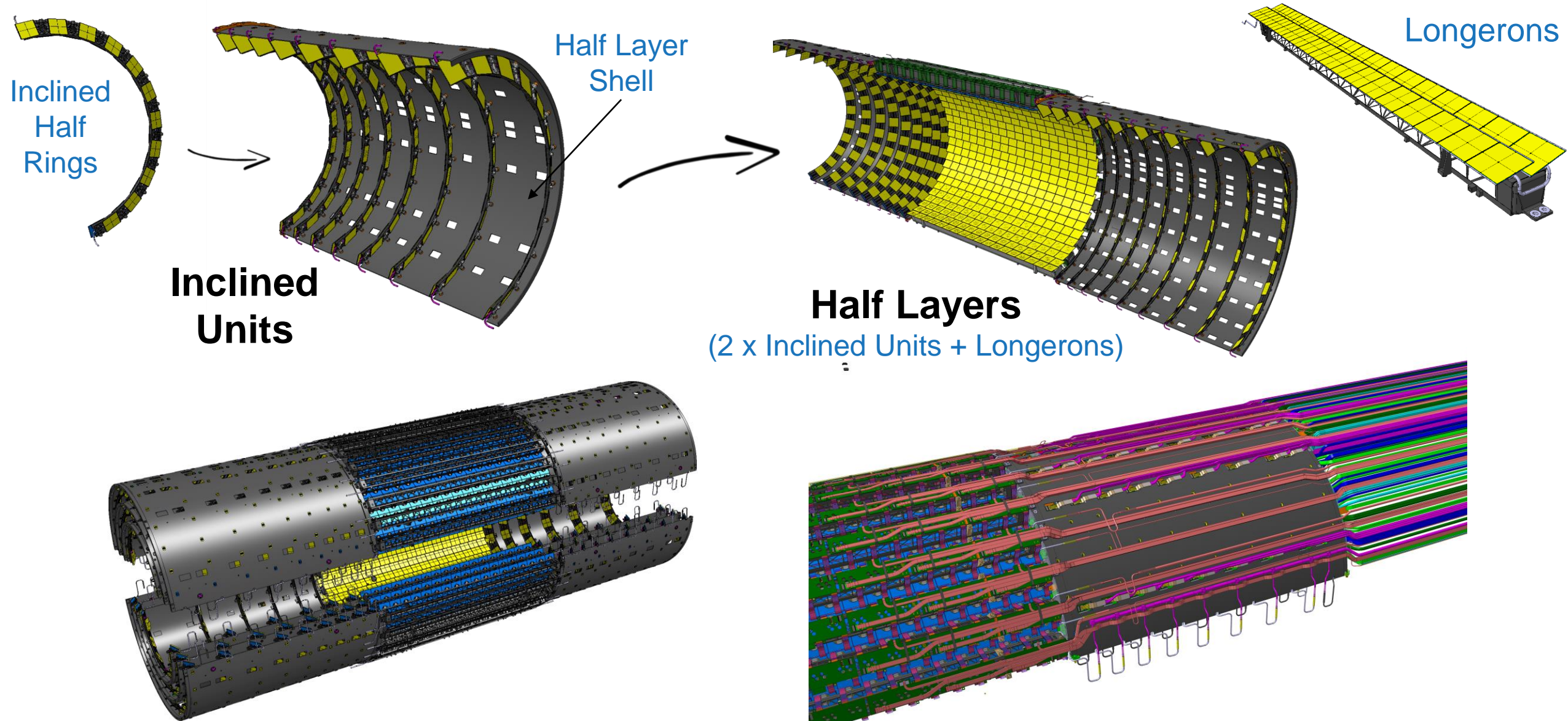
(Base Blocks + Cooling Pipe + CFRP Support Structure)



Inclined Half-Rings

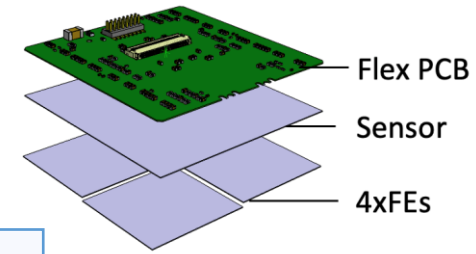


Outer Barrel: Global Support Structures & Services

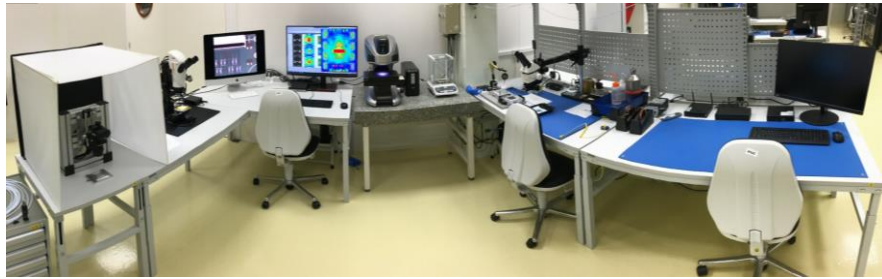


OB Pixel Module Production

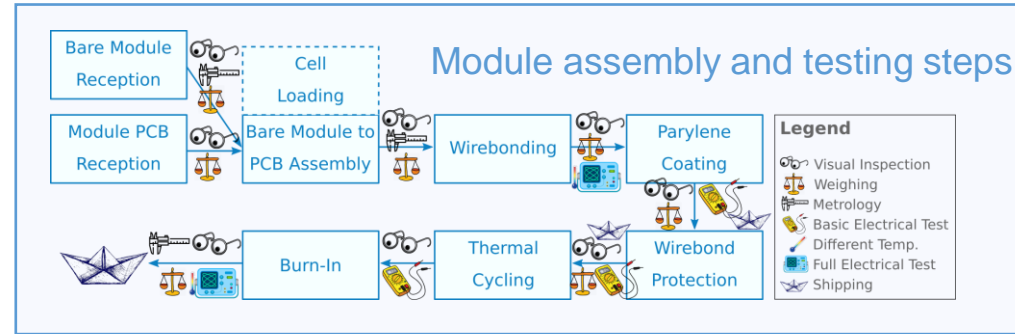
- CERN is one of the **production sites for quad modules for the ITk Outer Barrel** (up to 1200 modules) – close collaboration between EP-DT and EP-ADE.
- Assembly **production line established in DSF cleanroom** including test setups, inspection systems and assembly tooling.



Quad Module

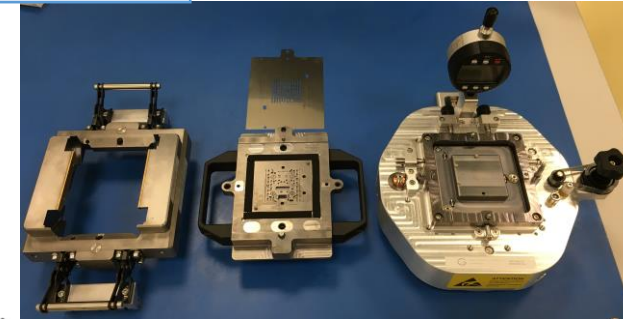


Assembly area in DSF cleanroom



Pre-production has now started with 30+ modules assembled:

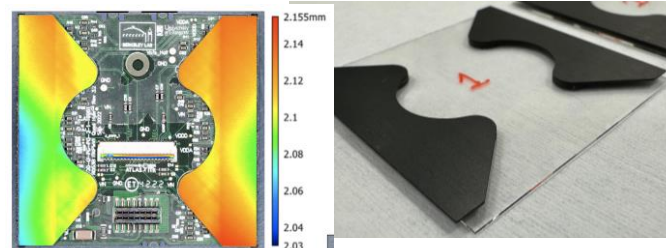
- Strong contributions towards hybridisation vendor qualifications, module QC and flex pre-production
- Including community common items: OB WBMP canopy validations, silicon tile orders, FE chip debugging



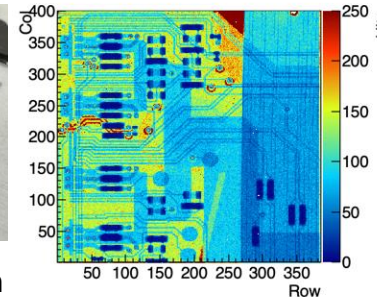
Module Production Assembly Tooling



ATLAS ITkPixV1.1 Quad modules



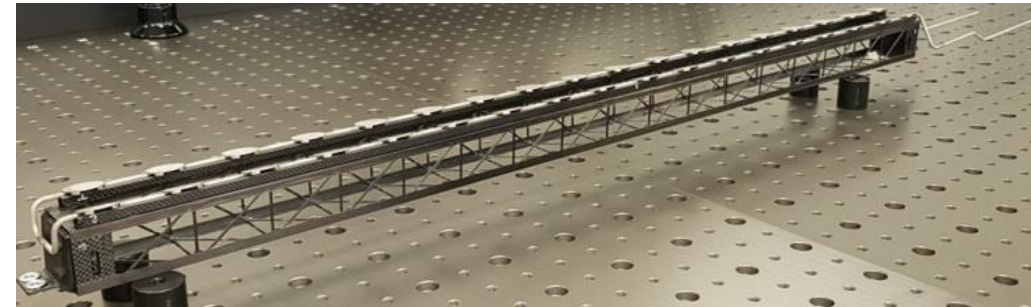
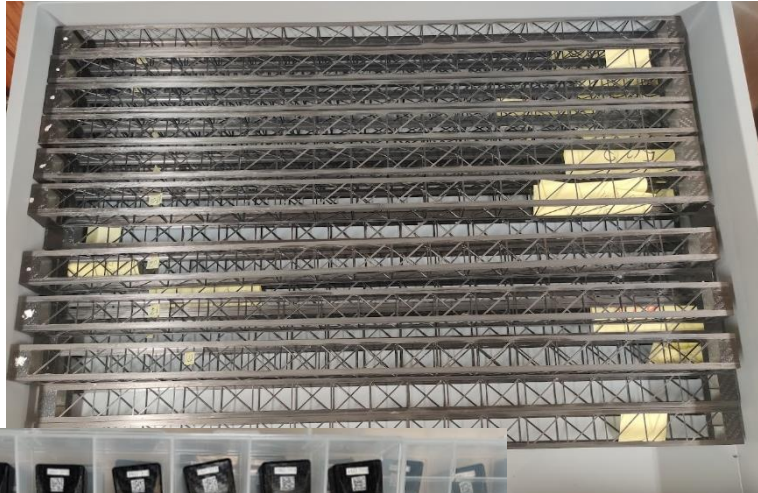
Very first wire-bond mechanical protection assembly trials at CERN



X-ray scan ITkPixV1.1 module (top right chip)

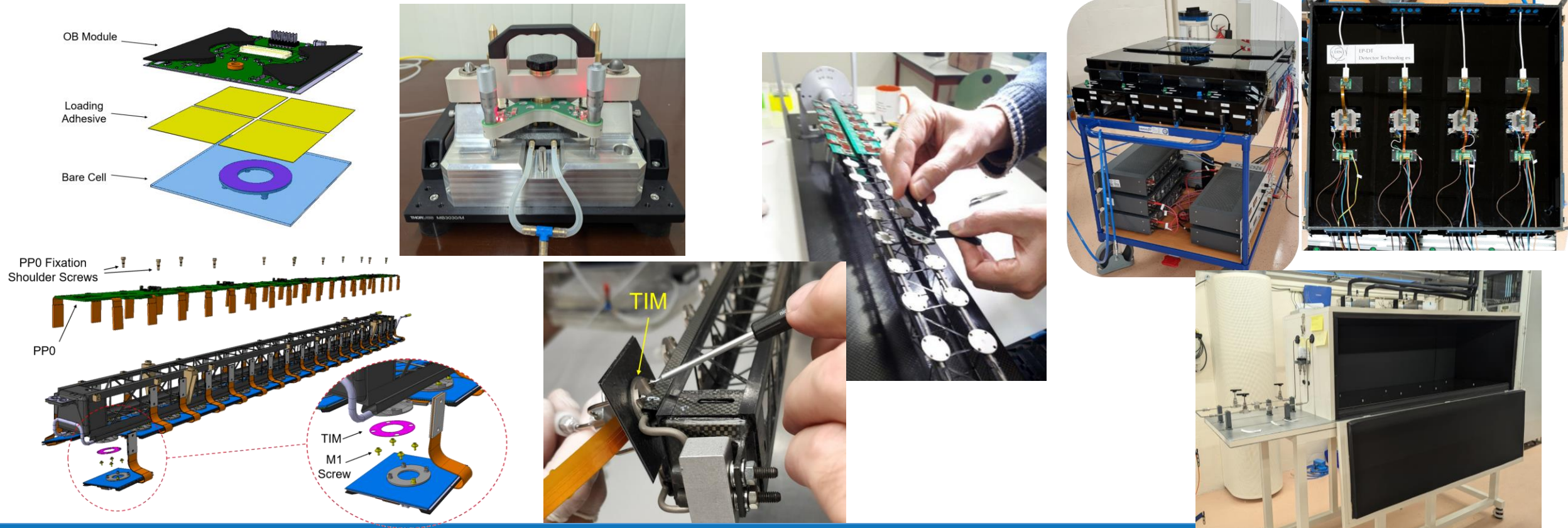
Bare Local Supports (BLS)

- Manufacturing and QC of BLS – DT in collaboration with UNIGE, BONN and CPPM
- **In production** – first sub-system to pass the PRR ([link](#))
- Final raw material and commercial components procured
- Good progress in the manufacturing of components and subassemblies (e.g. CFRP parts, inserts, sleeves)
- **Assembly of first Functional Longeron units recently completed**



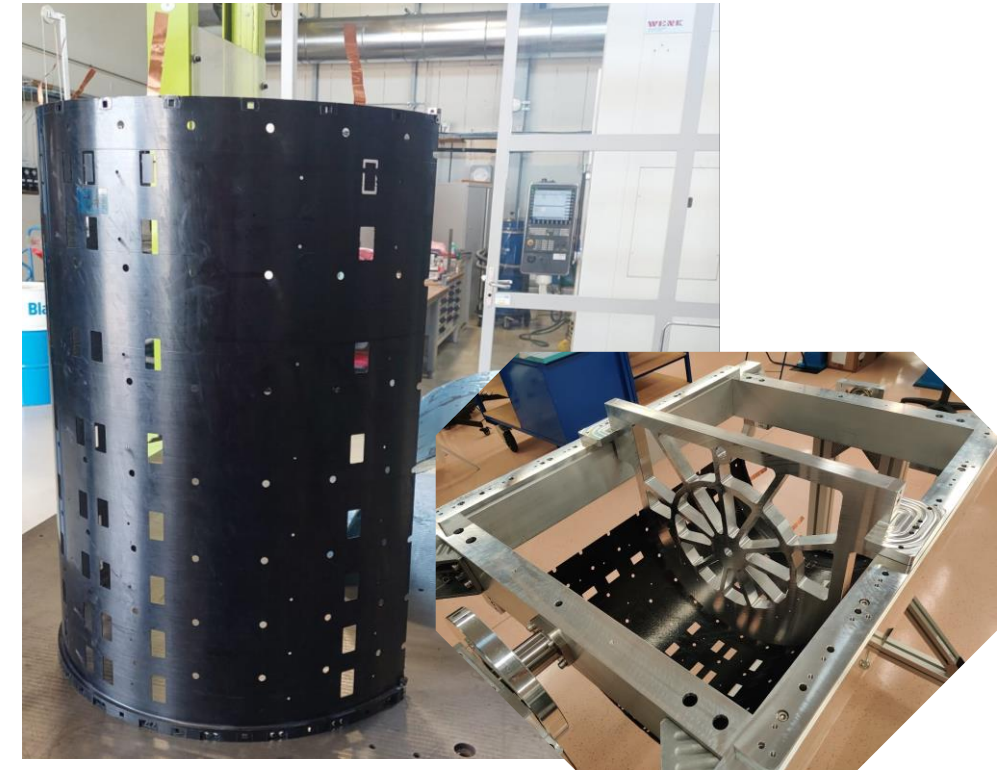
Loaded Local Supports

- CERN (DT + ADE) is a Cell Loading and Cell Integration site
- Currently **in pre-production** – FDR passed in March 2023 ([link](#))
- Tool commissioning and site qualification underway (including QC infrastructure)
 - Deployment & commissioning of DT-developed QC setup at all OB Cell Loading sites
- **First pre-production LLS end of Q3; PRR expected early 2025**



Global Mechanics – Half Layer Shells (HLS)

- DT plays leading role in design of OB Global Supports and on-detector cooling circuit
- Responsibility for design, validation and production of main structures, i.e. HLS and SSS (FDR passed on May 2024 ([link](#)))
- Important step forward in 2023/24 → Full-size prototypes of L3-HLS using in-house mould
- Currently finalising design of shells, moulds and gluing tools for inserts to launch production (PRR October 2024)



Global Mechanics – Service Support Shells & Pipe Extensions

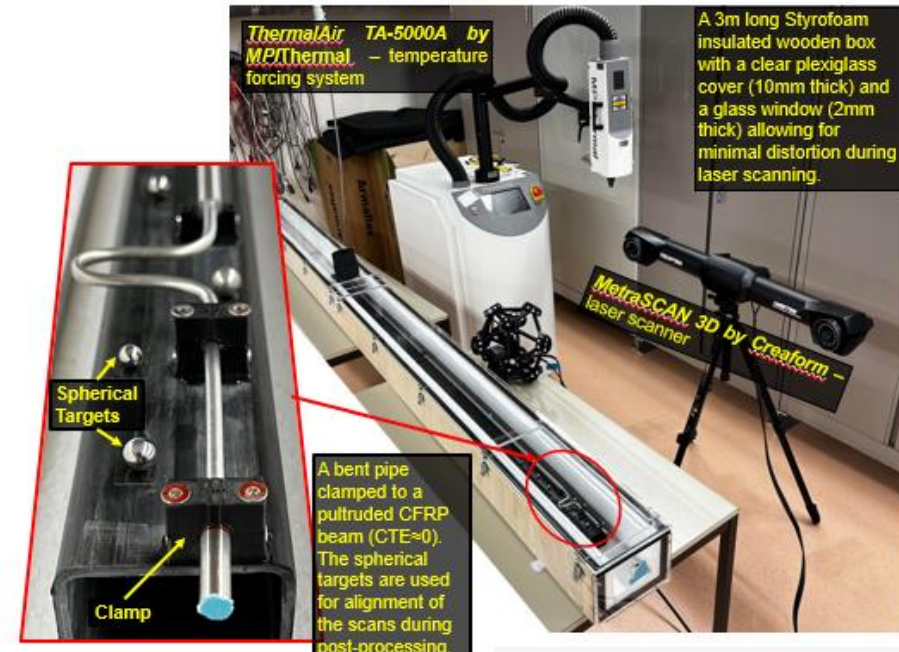
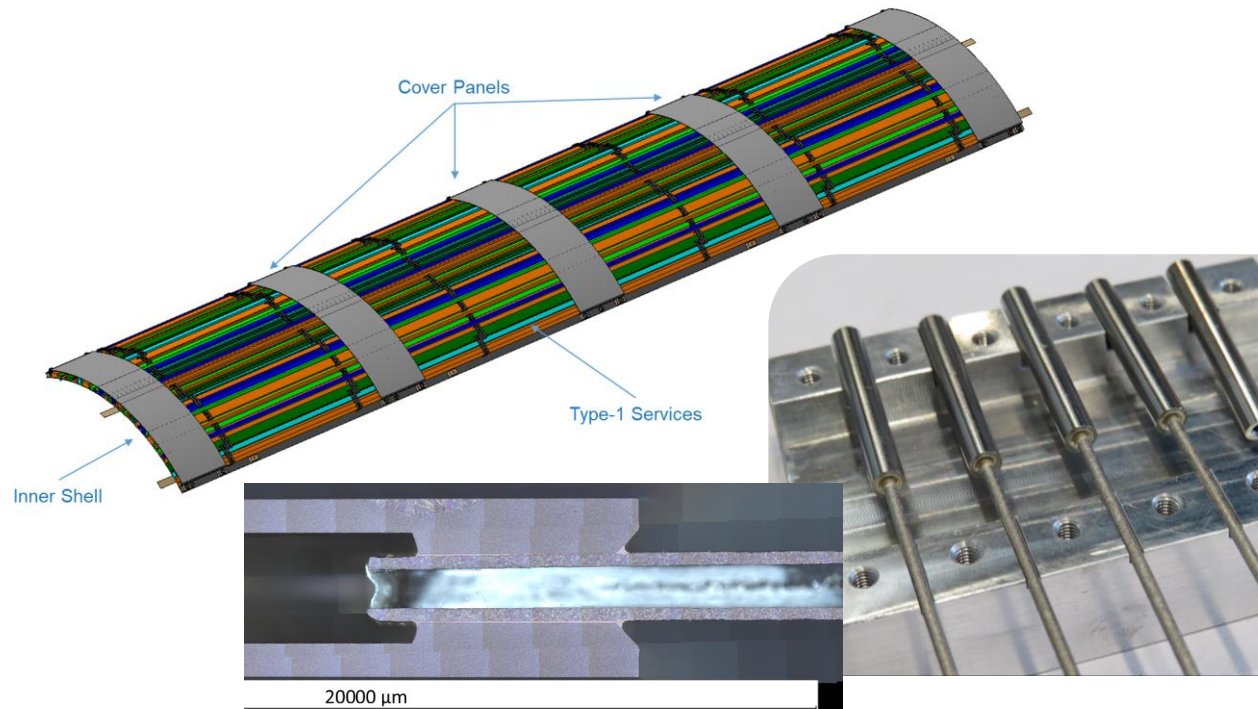
- DT plays leading role in design of OB Global Supports and on-detector cooling circuit

Service Support Shells (SSS)

- Optimised design based on new service management approach with clips
- Documentation in preparation for tender process (SSS will be outsourced)

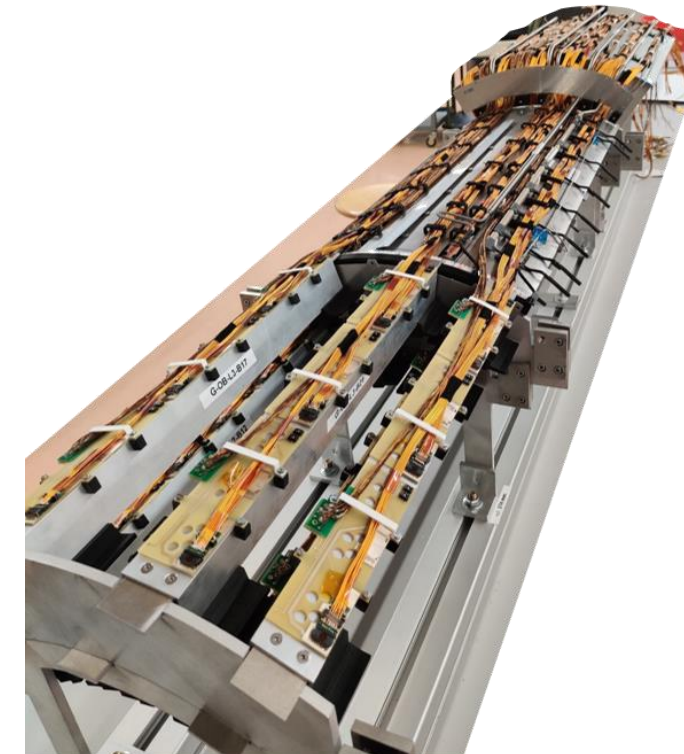
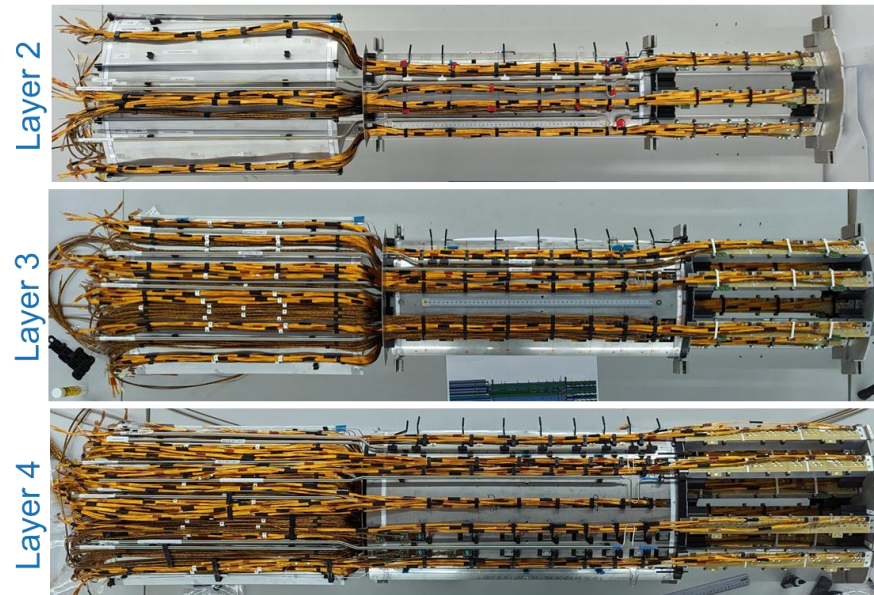
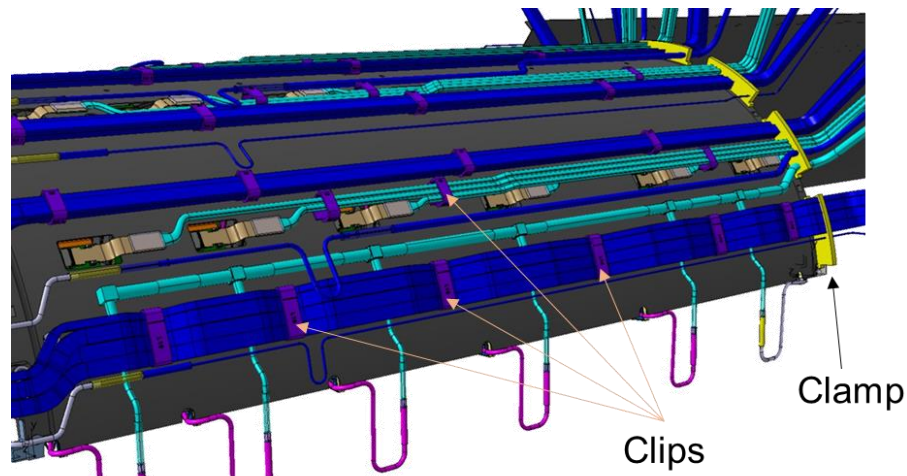
Cooling Pipe Extensions

- Produced in collaboration with EN-MME → Joint effort to develop Ti-Ti EB-Brazing
- Ongoing studies to re-size capillaries to adapt to new PP1 routing
- New setup to assess 3D thermo-elastic deformation in pipes using laser scanner



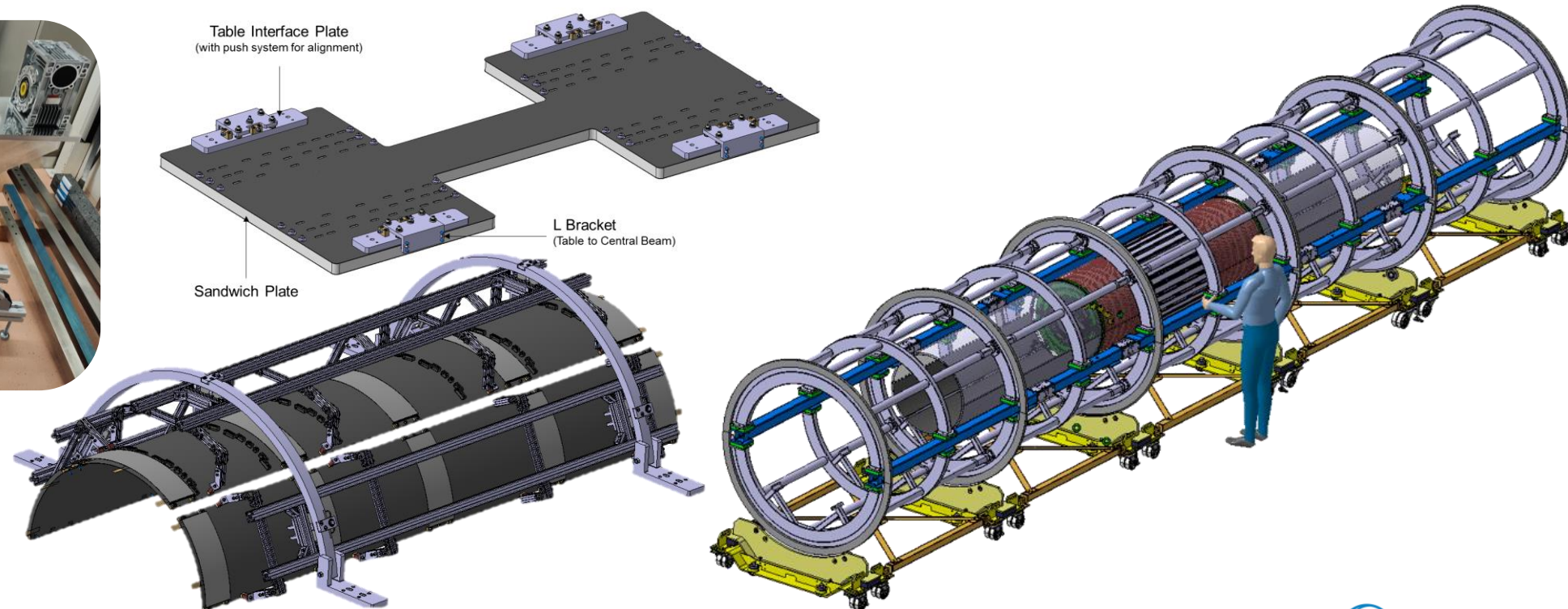
Global Mechanics – CAD Global Model & Service Mock-up

- DT responsible for develop and maintain detailed OB Global CAD Model
- In charge for assembly representative Slice Service Mock-up for design validation
- In 2023, extensive studies to define service routing in OB detector volume
 - Drive design of power & data cable bundles to allow for robust connections to PP0s
 - Assess compatibility with available space/allocated envelopes in different regions
 - Develop appropriate solutions for the service management



Outer Barrel Integration Tooling

- Design and procurement of OB/OS integration tooling (e.g. IU handling frame, reference table, longeron, installation tool, SSS handling frames, service trolleys)
- Finalising design of Rotation Frame and Static Cradle
 - Detailed CAD studies to include interfaces with other tooling items
 - FE analysis for different load cases, including lifting into ITk
 - Expected to launch price enquire in October 2024



Questions?

ITk Integration has begun...

- Outer Cylinder housing ITk
 - Manufactured in US and shipped from Berkley
 - Moved to SR1 clean room last week
 - Installation of L2 and L3 strip barrel cylinders planned for July



LS3 Schedule

nced, LS3 approaching fast, when to start?

