ITS Assembly and Commissioning Plans

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CERN

Asian Workshop – 21/11/2018

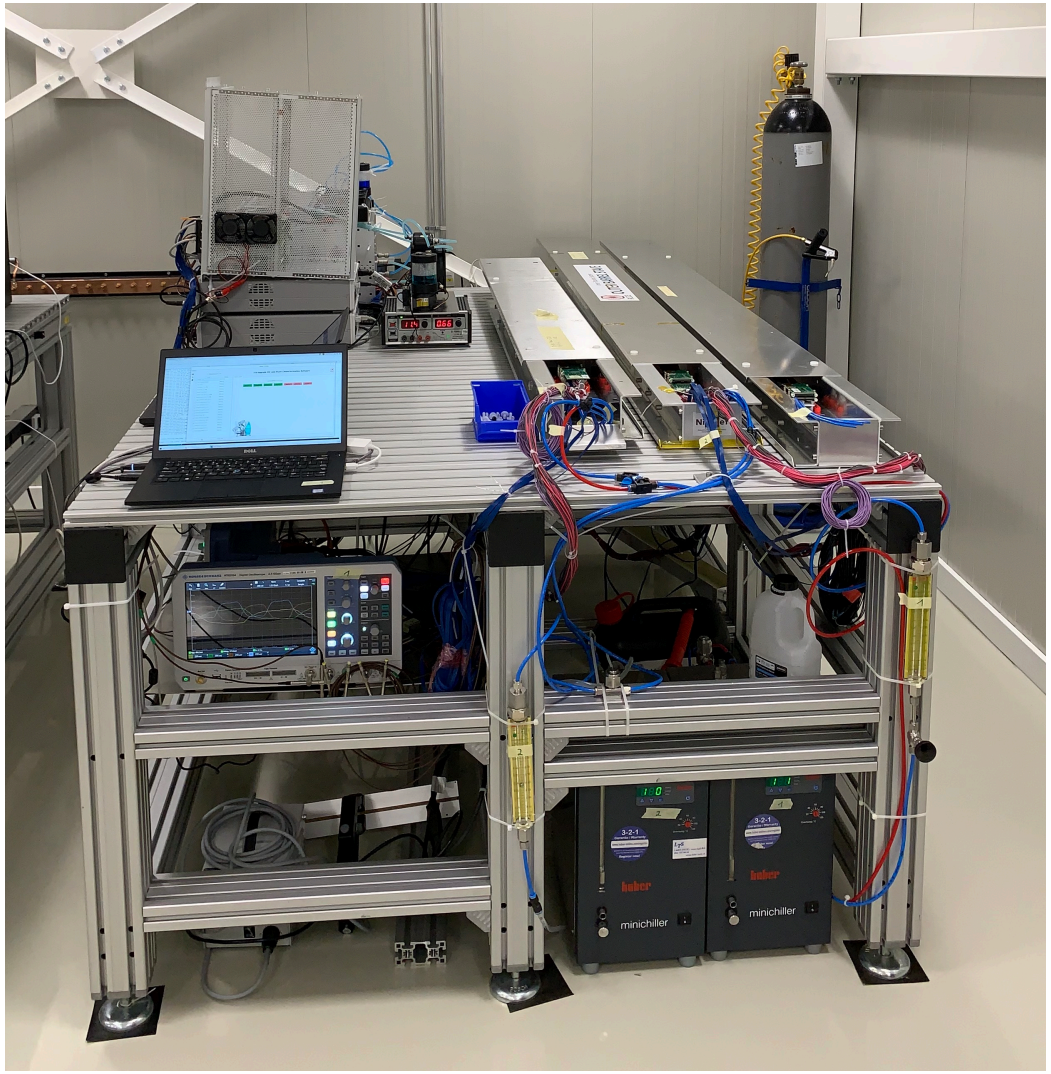
Outline

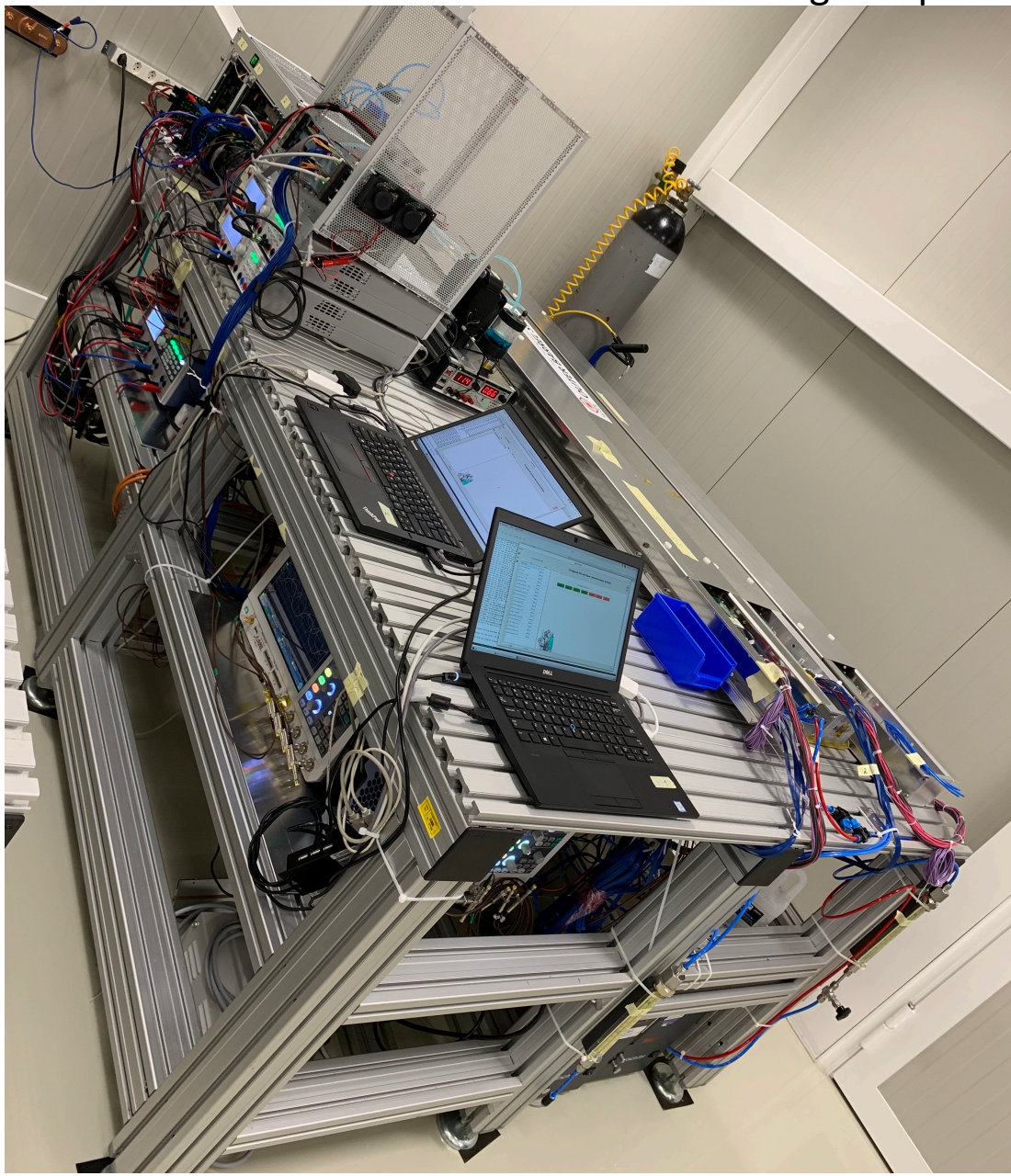
- OB stave testing and layer assembly
- Surface commissioning
- Possibilities to contribute

OB Stave testing and layer assembly procedure

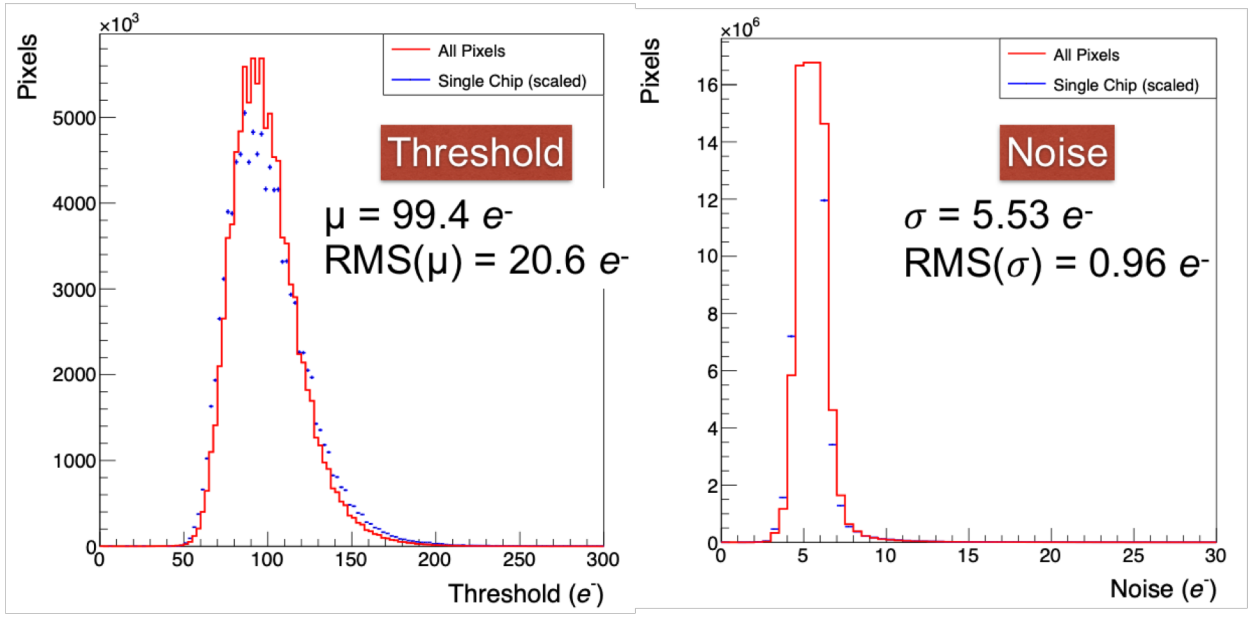
- Stave reception test
- Layer assembly procedure
  - Minor mechanical reworking (including function test if necessary)
  - Installation of the PT-100 sensors and grounding wires on the Staves
  - Installation of a few (3-5) staves on the end wheels (layer)
  - Fast test (30min / Half-Stave) after installation on the layer, using mobile setup that can be moved from layer to layer
  - Metrological survey of the stave
- Installation of the layer in the Service Barrel
  - Connection to the data and power cables
  - Regular testing to detect problems early on
- Connection of the Service Barrel to the Readout Units and Power Boards

OB Stave Reception Setups

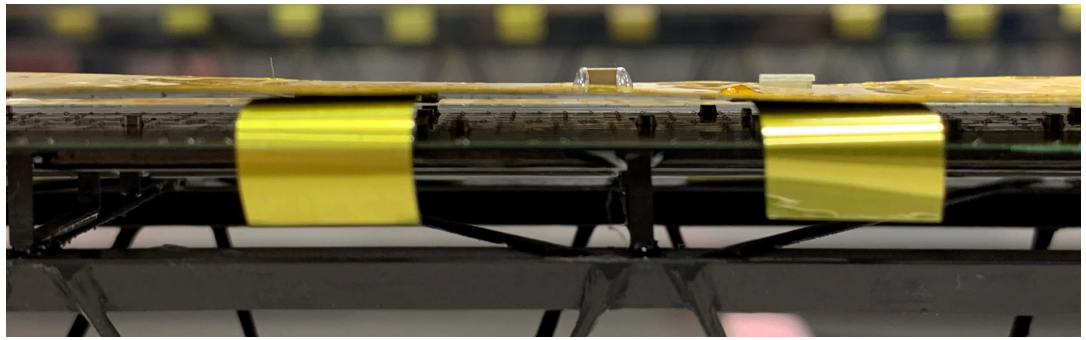


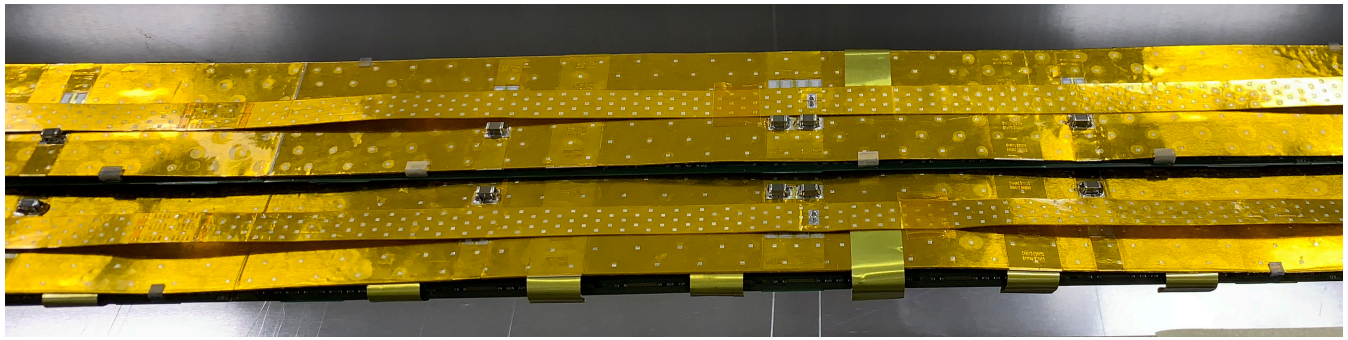


OB Stave Reception Test

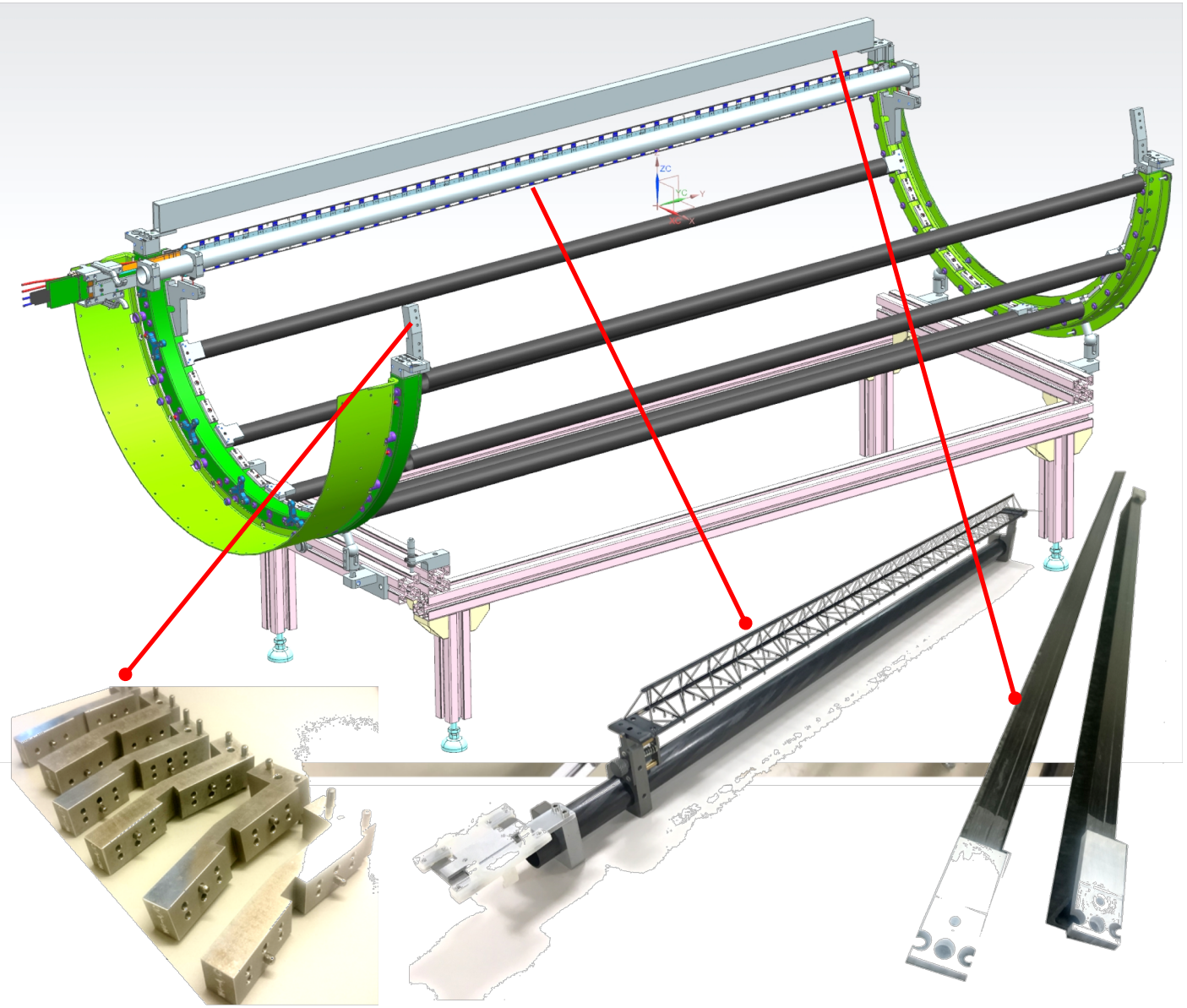


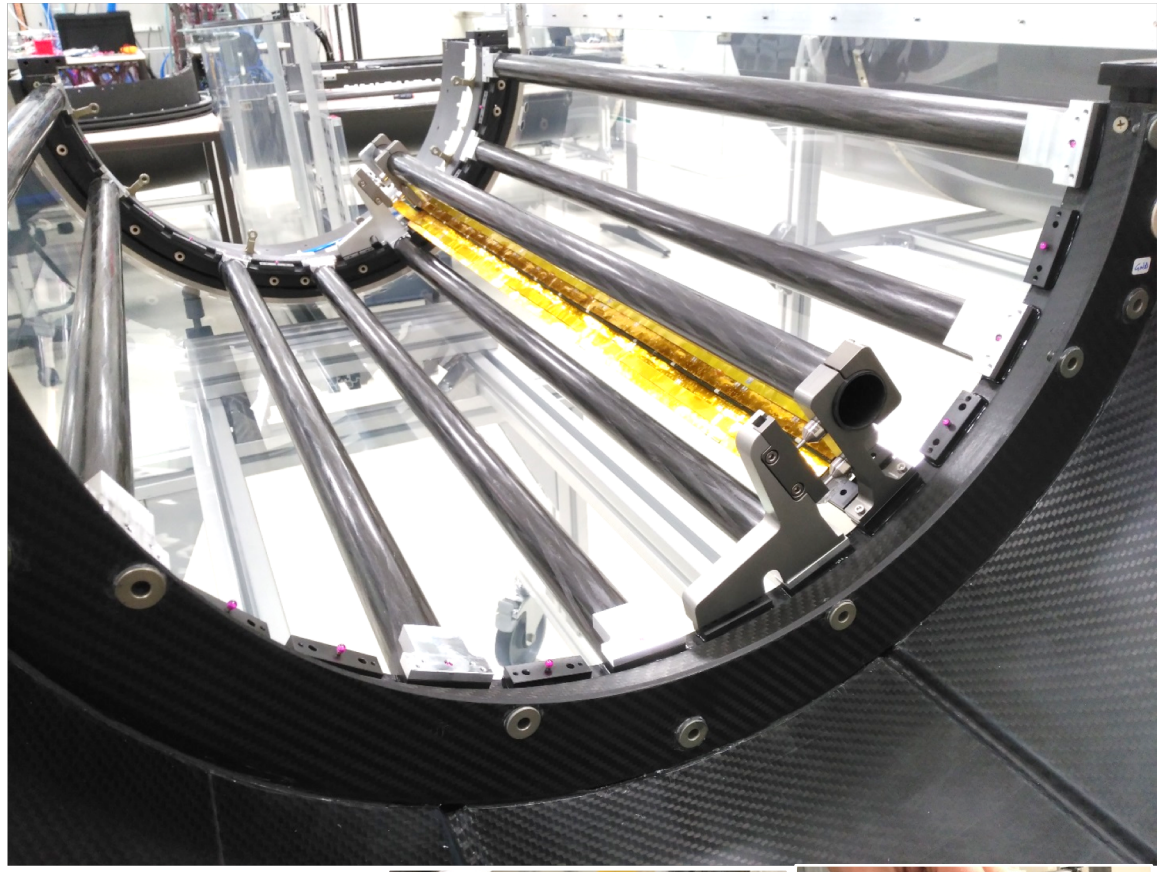
- Parallel test of two staves (1 ML + 1 OL or 2 OL staves)
- Exclusion of transport damage
- Verification of the performance
- Visual inspection of the stave

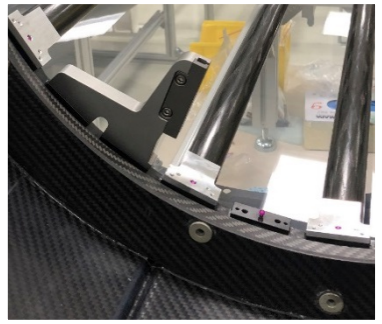


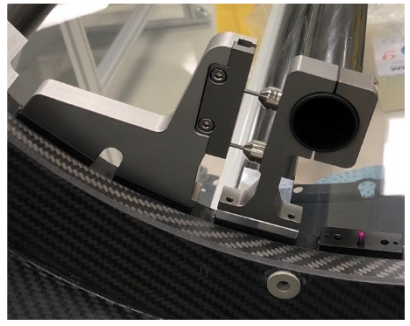


OB Stave testing and layer assembly



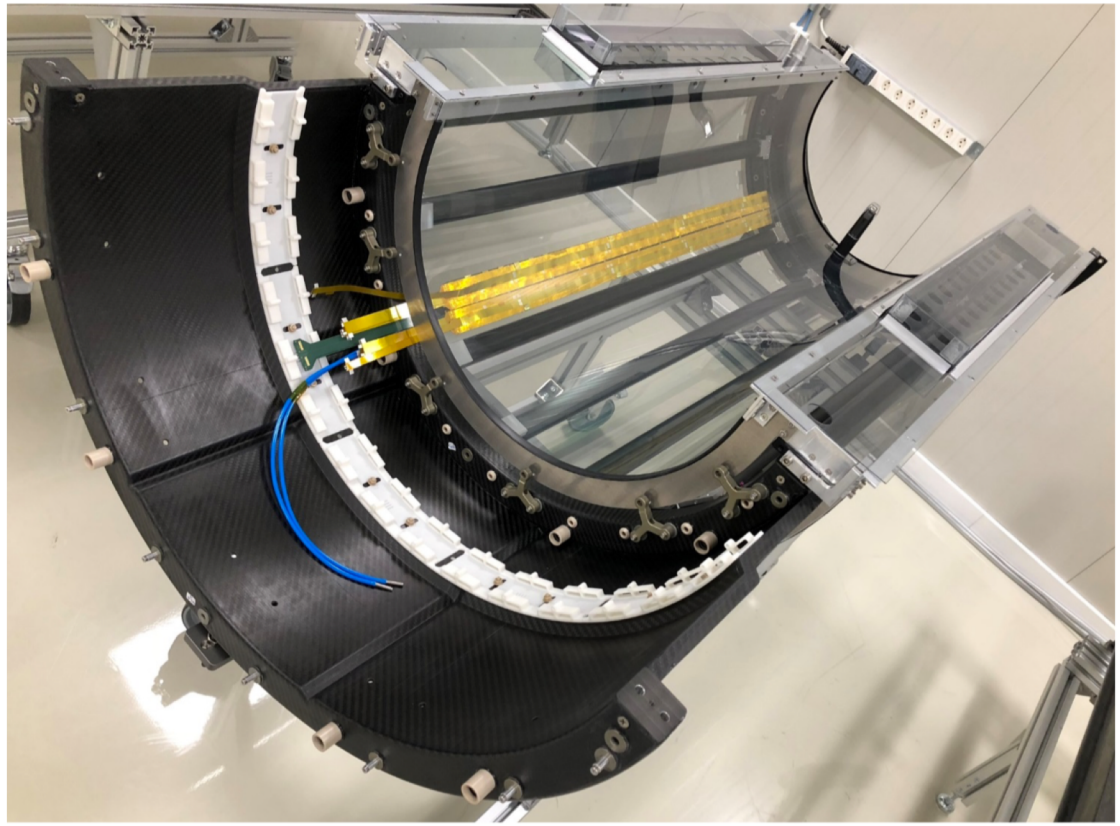




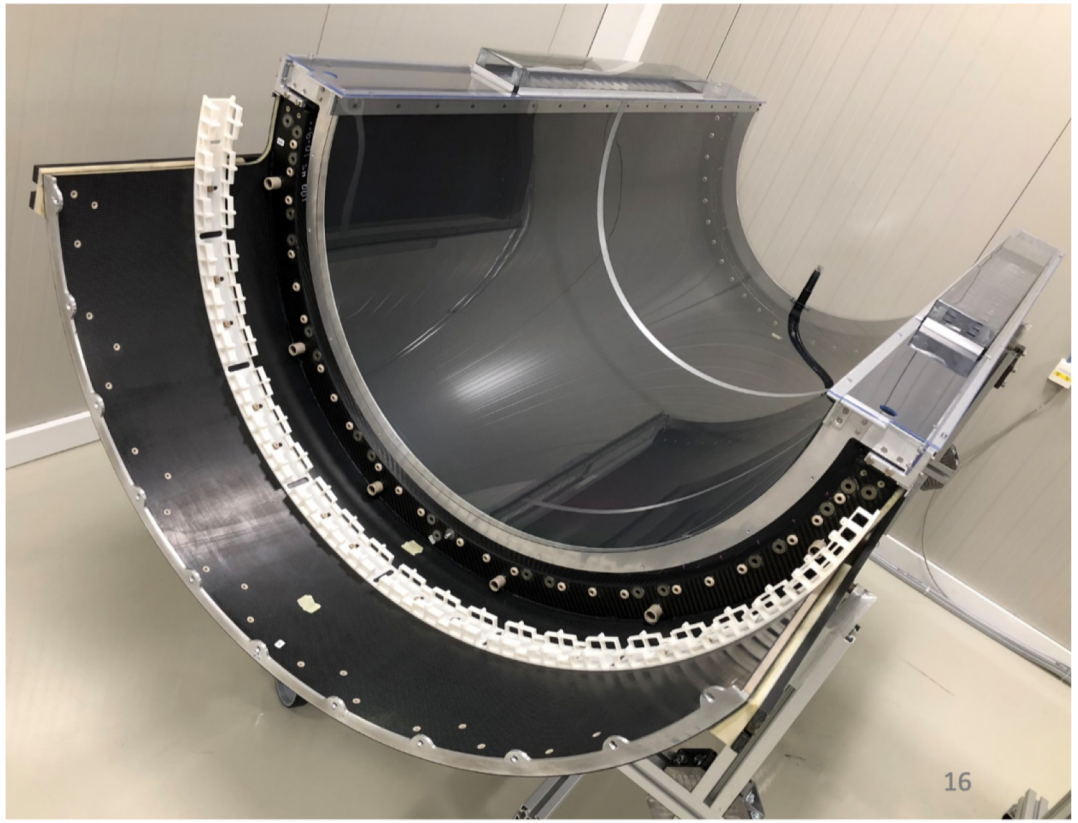


OB Stave layer dry enclosures

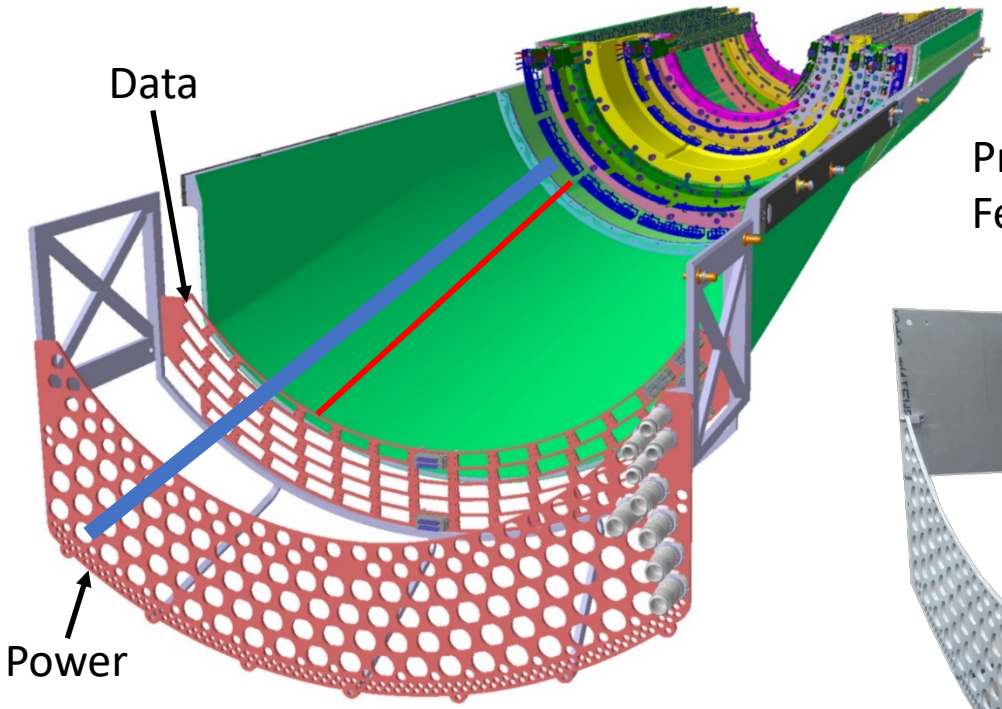
Layer 4 dry air enclosure



Layer 6 dry air enclosure

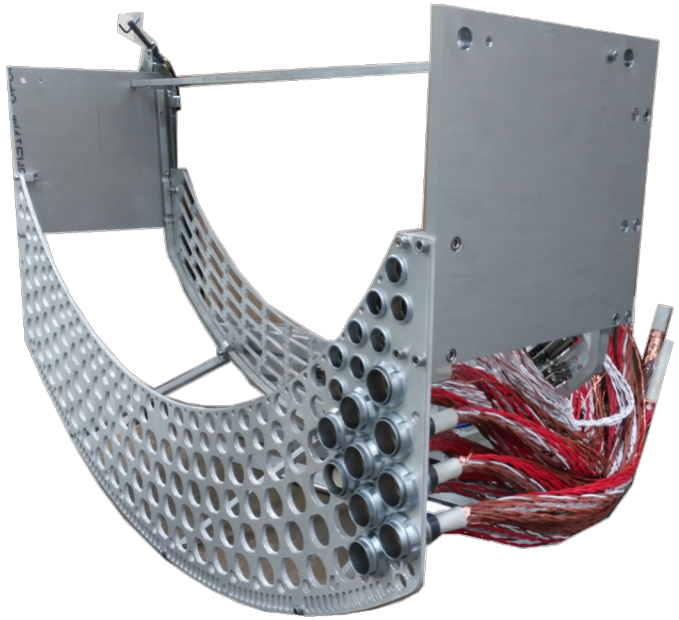


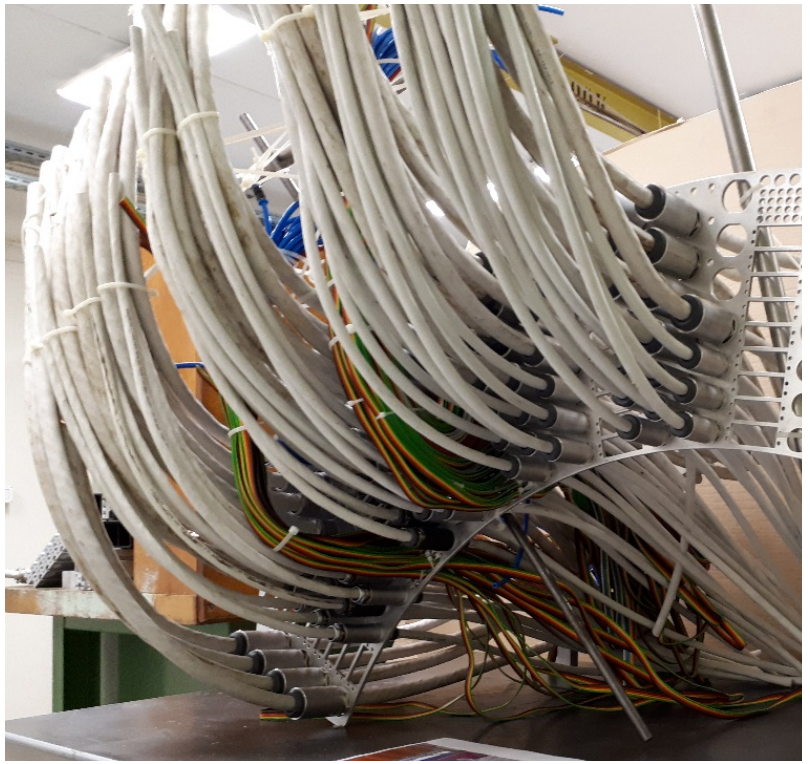
Services Connections



Service Barrel + Patch Panel 2
before cable installation

Prototype of Patch Panel 2,
Few cables installed

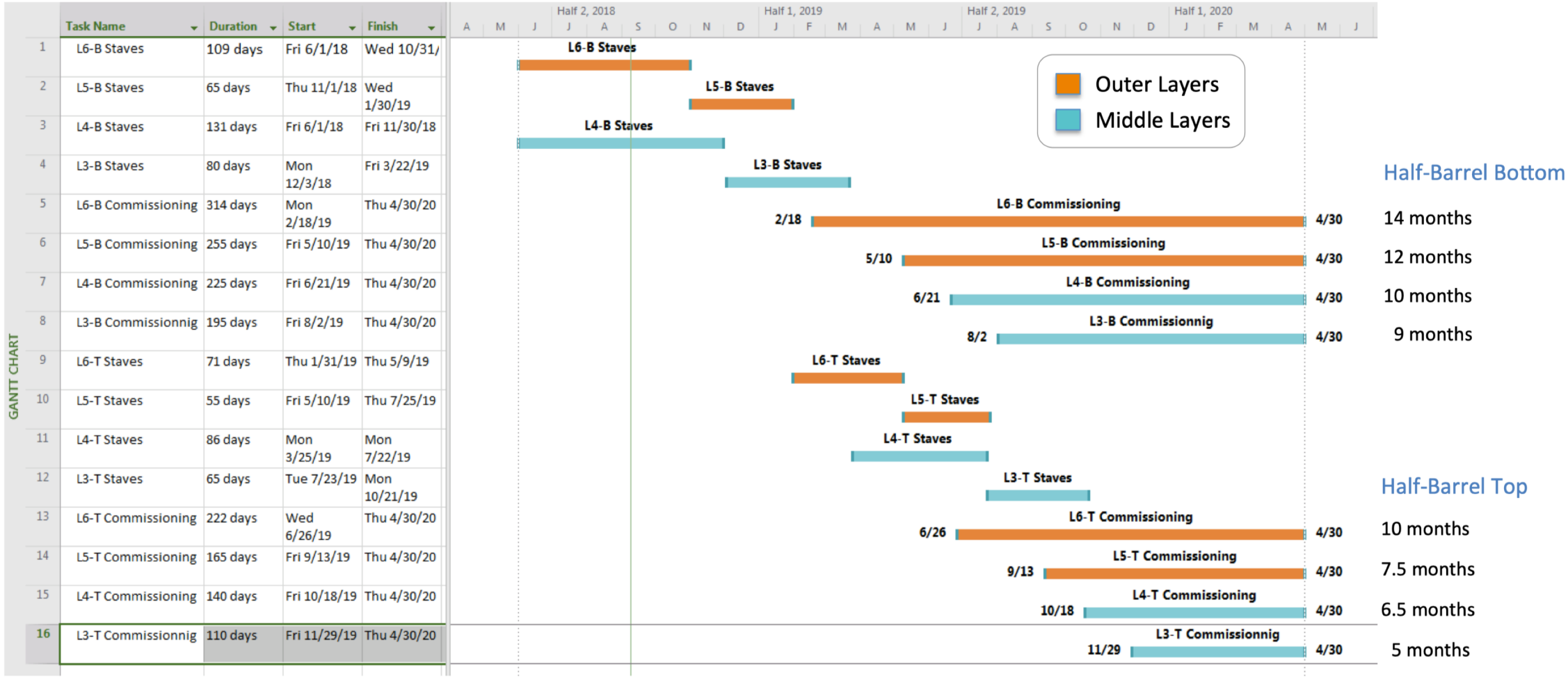




Mock-up of Patch Panel 2,
cables bend like after installation at P2

Very dense cabling, need to test regularly during connection process strain relieve and layout important

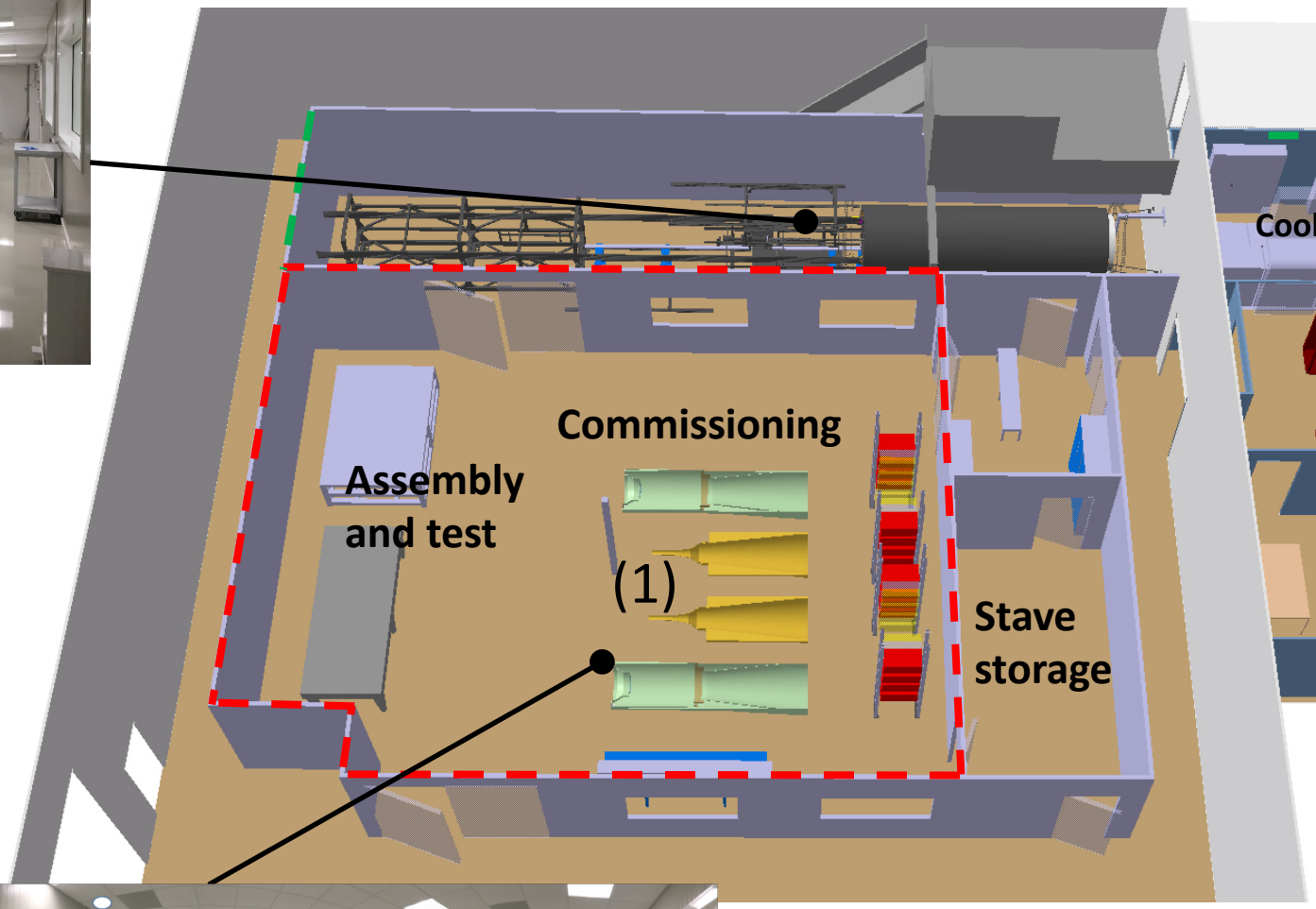
OB Stave testing and layer assembly

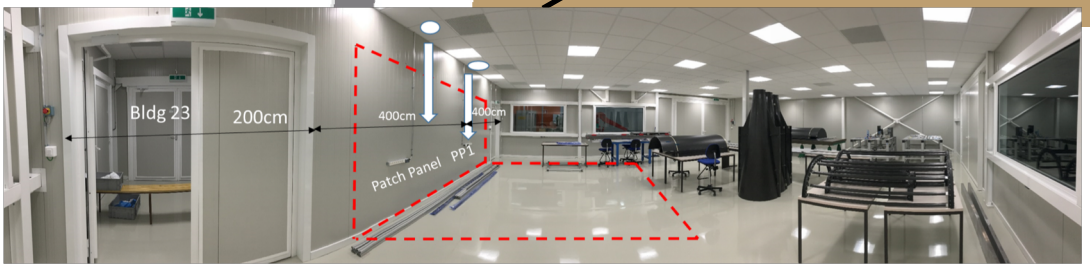


Surface commissioning

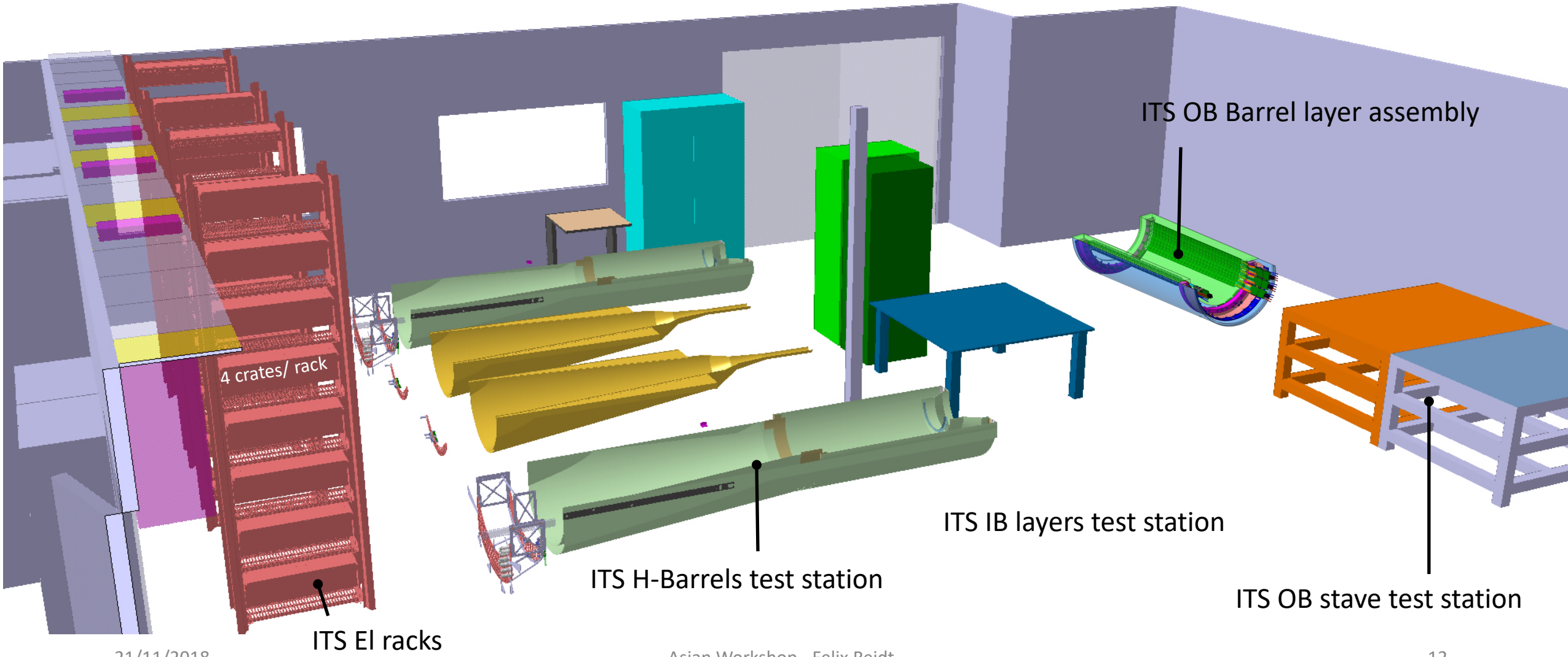
- Running the detector under realistic conditions (except for the beam) on surface
- Using the full system:
  - CAEN LV power supplies
  - Cooling plant (will move to P2 with the detector)
  - Bundle of Readout Unit (RU) and Power Board (PB)
  - Final cables between RU/PB and the detector
  - O2 system with FLP/CRUs + single EPN + storage
  - Final trigger distribution scheme
  - Full DCS system

Surface commissioning





Surface commissioning clean room



Detector Operation

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/MT /EE/ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
System Run Coordinator	CERN	PH	0	0	0	0	1	1	1	1	1	1	1	1
Deputy System Run Coordinator	CERN	PH	0	0	0	0	1	1	1	1	1	1	1	1
On-call Expert I	CERN	PH	0	0	0	0	0	0	0	0	0.3	0.3	0.3	0.3
On-call Expert II	CERN	PH	0	0	0	0	0	0	0	0	0.3	0.3	0.3	0.3
On-call Expert III	CERN	PH	0	0	0	0	0	0	0	0	0.3	0.3	0.3	0.3
Readout Experts (front-end)	Remote	PH or EE	1	2	4	4	4	4	4	4	4	2	1	1
Readout Experts (back-end)	Remote	PH or EE	2	4	8	8	8	8	8	8	8	4	4	4
Power System Expert	Remote	PH or EE	1	1	1	1	1	1	1	1	1	0.2	0.2	0.2
Cooling Expert	Remote	PH or ME	1	1	1	1	1	1	1	1	1	1	0.2	0.2
DCS/DSS Expert	Remote	PH	1	1	1	1	1	1	1	1	1	1	0.5	0.5
Online Software	Remote	PH	2	4	4	4	4	4	4	4	2	2	2	2
Reference System	CERN	PH	0	0	0	0	0	0	0	2	2	2	2	2

About ~12 FTE of expert work, which does not require permanent presence at CERN

Simulation and Reconstruction

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/MT/ EE/ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
Simulation and Reconstruction Coordinator	Remote	PH	1	1	1	1	1	1	1	1	1	1	1	1
Software Librarian	Remote	PH	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calibration	Remote	PH	0.5	1	2	2	2	2	2	2	1	1	1	1
Maintenance of ITS Database	Remote	PH	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.1
Coordination of DAQ Activities	Remote	PH	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Development and Maintenance of DAQ algorithms	Remote	PH	1	1	1	1	1	1	1	1	1	1	1	1
Data Quality Team	Remote	PH	0.5	1	3	3	3	3	3	3	3	3	3	3

About ~8 FTE of software development work, which does not require permanent presence at CERN

Assembly and Commissioning on Surface (1)

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/MT /EE/ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
Coordination	CERN	any	1	1	1	1	1	1	1	1	0	0	0	0
Assembly of Layers in Barrels	CERN	any	1.5	1.5	1.5	1.5	0	0	0	0	0	0	0	0
Routing of services in Service Barrels	CERN	any	2	2	2	2	0	0	0	0	0	0	0	0
Connection of Service Barrels to Detector Barrels	CERN	any	2	2	2	2	0	0	0	0	0	0	0	0
Detector Metrology and Survey	CERN	any	1	1	1	1	1	1	1	1	0	0	0	0
Detector Barrel Commissioning	CERN	any	3	3	3	3	1	1	1	1	0	0	0	0
Readout Electronics Commissioning	CERN	EE/ET	2	2	2	2	1	1	1	1	1	1	1	1
Power System Commissioning	CERN	EE/ET	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0	0	0	0
Cooling System Commissioning	CERN	ME/MT	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0	0	0	0
Commissioning of Detector Installation Tooling	CERN	ME/MT	0.5	0.5	0.5	0	0	0	0	0	0	0	0	0
Global Surface Commissioning	CERN	any	0	0	6	6	6	0	0	0	0	0	0	0

Assembly and Commissioning on Surface (2)

- Global Surface Commissioning:
  - Permanent operation of the full detector → 24/7 shifts necessary
  - 3 shifts per day, 2 shifters at a time → 6 persons / day

- Tasks of the shifters
  - Monitoring of the detector status
  - Data taking
  - Data quality monitoring
  - Testing of running procedures including start/end of run and calibration

Example topics (1)

- Calibration / data analysis
  - Development of an automated supply voltage adjustment procedure:
    LDOs and detector separated by 8m long cables (and power) bus and grounds shared by several modules
  - Threshold scan optimization:
    take standard algorithm used during testing and optimize it for performance using RU/CRU and FLP
  - Alignment using cosmic rays based either on the O2 software or a simple straight track model
  - Analysis of data (noise occupancy, threshold uniformity, performance comparisons)
  - PT-100 temperatures sensors on the staves

Example topics (2)

- Readout
  - Data integrity in exceptional conditions (latch-up recovery)
  - Adding monitoring (counters, timestamp comparison, data quality)
- DCS algorithms
  - Power-up/down sequencing: CAEN system, Power Board, interplay of modules
  - Latch-up recovery (reconfiguration of the affected module and the modules on the same OB stave)
  - Combination and verification of the information from the various temperature sensors (cooling plant, on-stave, environment)
  - Readout of the on-chip ADC
- Services installation (cable preparation, installation and verification)

Expected contributions in 2019 / 2020

- We would expect every institute to contribute with 6 – 12 months FTE at CERN (including the shifts for the surface commissioning)
- Minimum duration of a stay is 2 months
- Contributions can be counted as service tasks for PhD students
- Please approach us with a proposal how you and your students can contribute

Backup

Detector Installation (1)

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/ MT/EE/ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
Mounting and Test of Installation Tooling in the Miniframe	CERN	ME/MT	0	0	0	0	3	0	0	0	0	0	0	0
Installation and Test of Cooling Lines	CERN	ME/MT	0.125	0.125	0.125	0.125	0.125	0	0	0	0	0	0	0
Installation of Ventilation Humidity Ducts and Patch Panels	CERN	ME/MT	0.125	0.125	0.125	0.125	0.125	0	0	0	0	0	0	0
Installation and Commissioning of Cooling Plant in the Cavern	CERN	ME/MT	0	0	0	0	0	0.25	0	0	0	0	0	0
Ventilation Humidity Plant Connection and Commissioning	CERN	ME/MT	0	0	0	0	0	0.25	0	0	0	0	0	0
Removal of Old Cooling Plant and Installation and Test in B167	CERN	ME/MT	0	0	0	0	0	0.08	0	0	0	0	0	0

Detector Installation (2)

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/MT /EE/ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
Data and Power Cables, Optical Fibers, Patch Panels	CERN	EE/ET	0.25	0.25	0.25	0.25	0.25	0	0	0	0	0	0	0
Electronics Crates in the Miniframe	CERN	EE/ET	0	0	0	0	0	0.25	0	0	0	0	0	0
Electronics and Power Supply Racks in the Cavern	CERN	EE/ET	0	0	0	0	0	0.25	0	0	0	0	0	0
DCS and DSS Systems	CERN	PH	0	0	0	0	0	0	0	0	0	0	0	0
ITS OB Installation	CERN	ME/MT/EE/ ET	0	0	0	0	0	0.55	0	0	0	0	0	0
ITS OB Test	CERN	any	0	0	0	0	0	0	1.66	0	0	0	0	0
ITS IB Installation	CERN	ME/MT/EE/ ET	0	0	0	0	0	0	0.55	0	0	0	0	0
ITS IB Test	CERN	any	0	0	0	0	0	0	1.66	0	0	0	0	0

Detector Commissioning

Task	Location	Expertise	2019				2020				2021			
	CERN / Institute / Remote	PH/ME/MT/EE/ ET	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
Standalone Commissioning	CERN	any	0	0	0	0	0.07	0.07	0.07	0.07	0.07	0	0	0
Global Commissioning	CERN	any	0	0	0	0	0.03	0.03	0.03	0.03	0.03	0	0	0

ITS Tasks Summary

Workload Summary (FTE)											
2019				2020				2021			
Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)	Q1 (FTE)	Q2 (FTE)	Q3 (FTE)	Q4 (FTE)
30	36	51	50	47	39	41	39	33	26	24	24

- Workload includes the activities covered by the CERN team
- Peak workload end of 2019 / beginning of 2020.
- Task list to be updated / refined