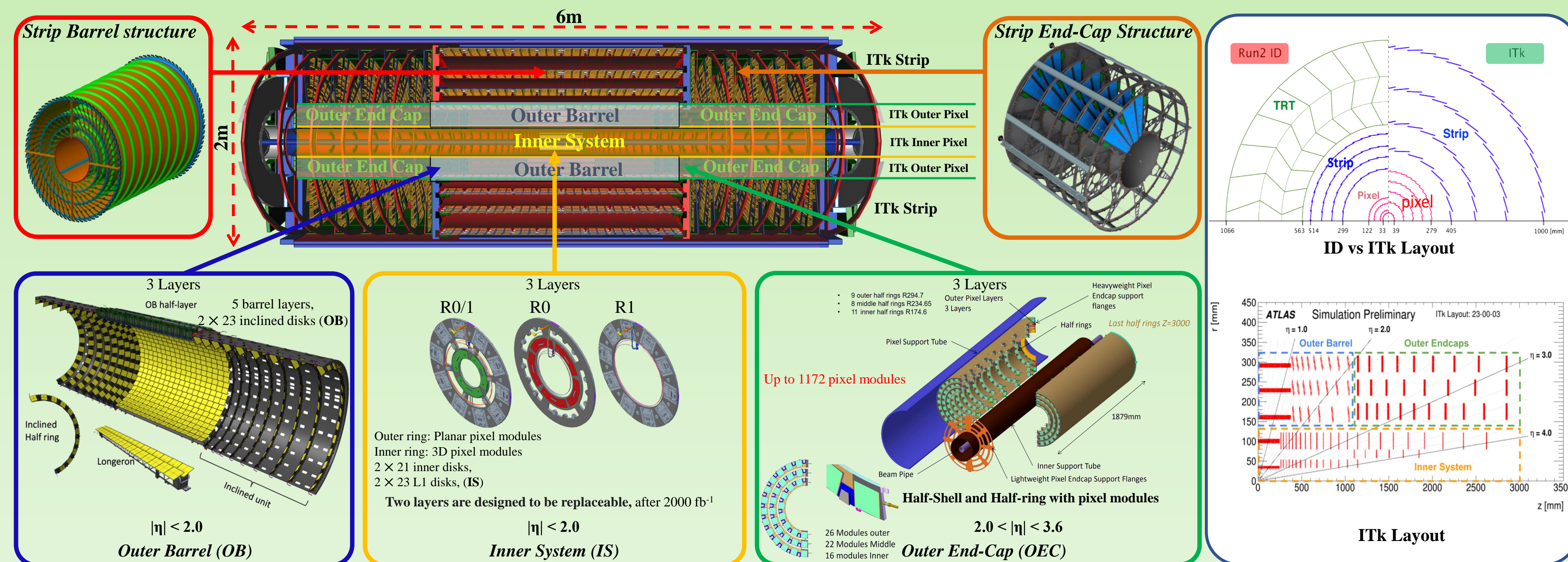
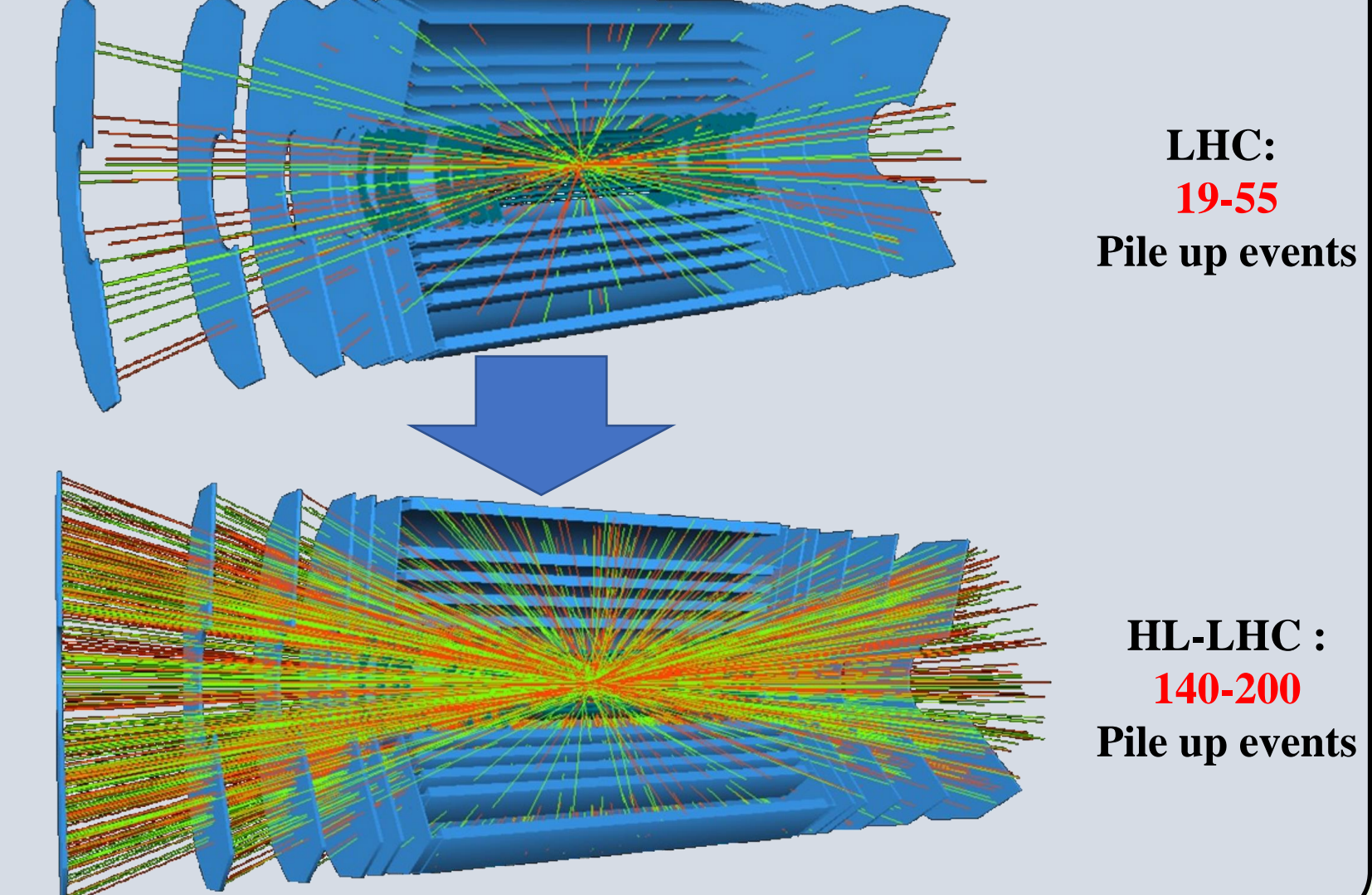


## New ATLAS Inner Tracker (ITk)



- The LHC will be upgraded to High-Luminosity (HL)-LHC
- Scientific goals:
  - Exploring the properties of the Higgs boson with higher precision.
  - Searching for new particles and phenomena beyond the Standard Model.
- HL-LHC will provide from 2029
  - Proton-proton collisions with up to 14 TeV center-of-mass energies.
  - Average collisions/bunch crossing:  $(\mu) \sim 20 \Rightarrow (\mu) \sim 200$  (pile-up).
  - IntLdt  $\sim 4000 \text{ fb}^{-1}$  of integrated luminosity, an order of magnitude more than current data.
  - ATLAS detector will be upgraded

- Requirements for pixel detector & readout:**
- High trigger rate: 1 MHz
  - High granularity: occupancy at 1 %.
  - Low mass mechanics, cooling and serial powering to minimize material budget
  - Radiation tolerant: up to  $2 \cdot 10^{16} \text{ neq cm}^{-2}$
  - Extended tracking coverage:  $|\eta| = 2.5 \rightarrow 4$



**Upgrade summary**

ITk (ID)	Area (m <sup>2</sup> )	# Modules	# Channels (M)	Pseudo-rapidity  η	Instantaneous luminosity (L)	Integrated luminosity (LLdt)
Pixels	~13 (1.9) <b>~6.8x</b>	~9700 (2000) <b>~4.8x</b>	~5100 (92) <b>~55x</b>	<4 (<2.5) <b>~2x</b>	$7 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ <b>~7x</b>	4000 fb <sup>-1</sup> (300 fb <sup>-1</sup> ) <b>~13x</b>
Strips	~165 (61) <b>~2.7x</b>	~17888 (4088) <b>~4.8x</b>	~60 (6.3) <b>~9.5x</b>			

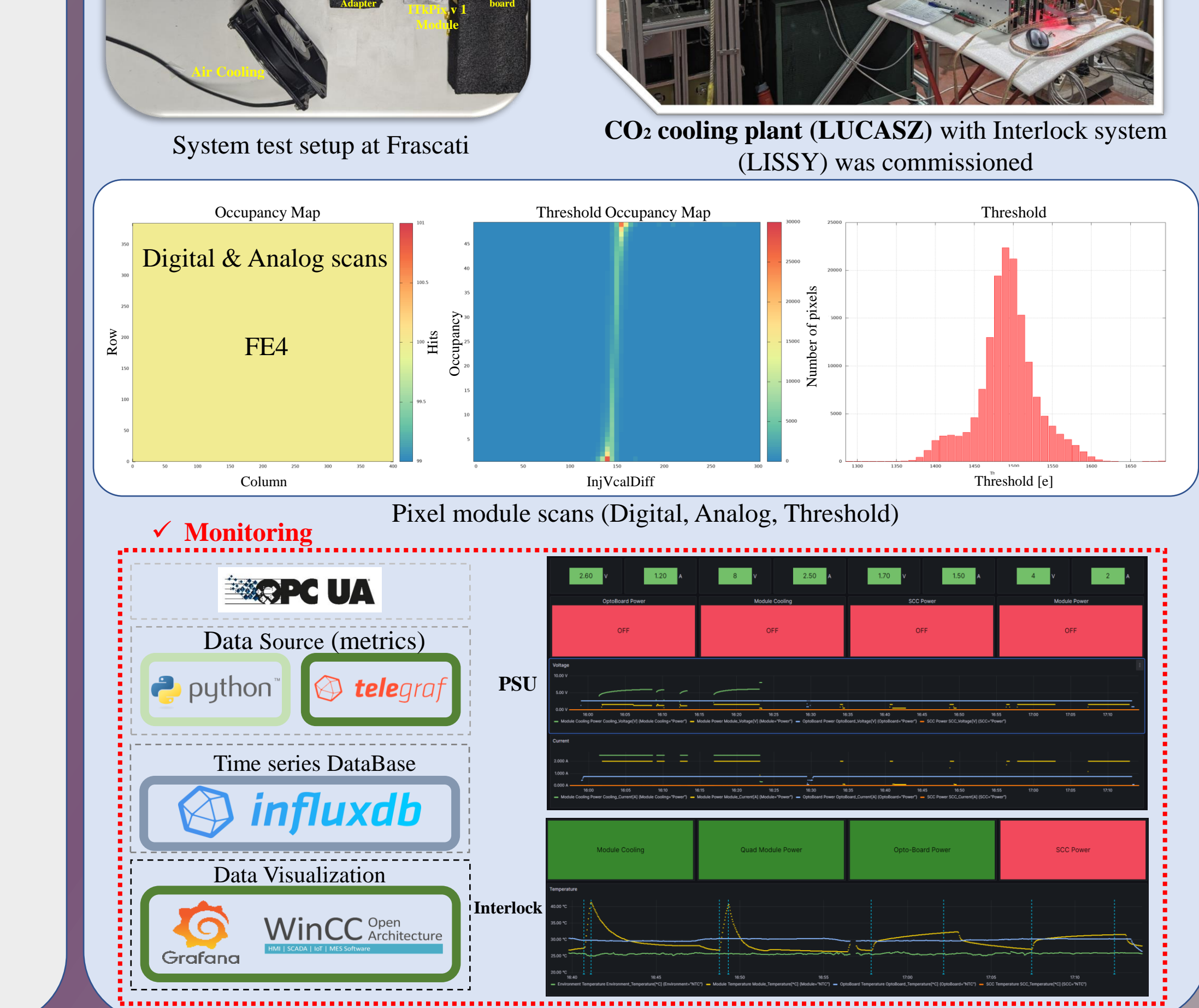
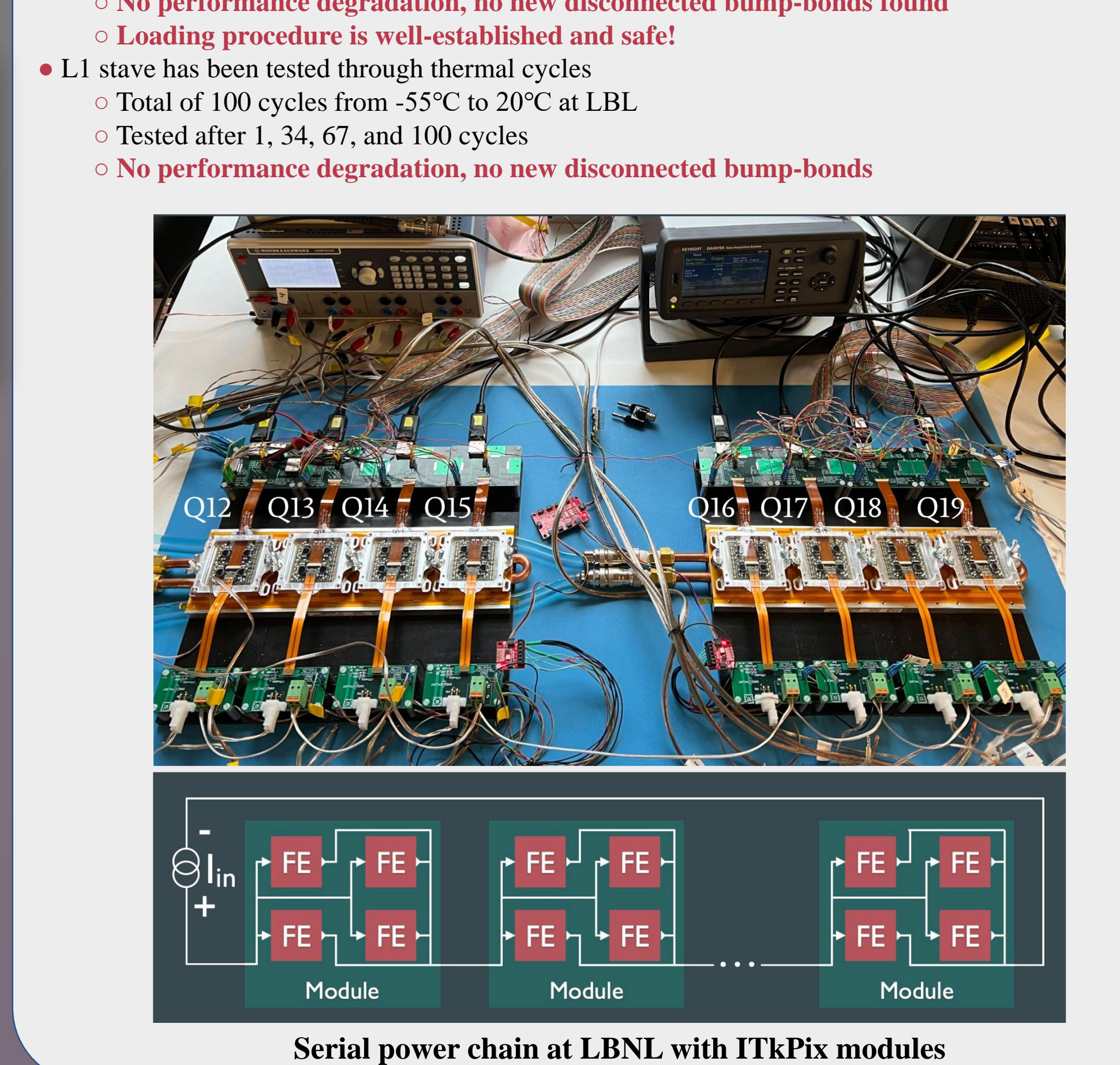
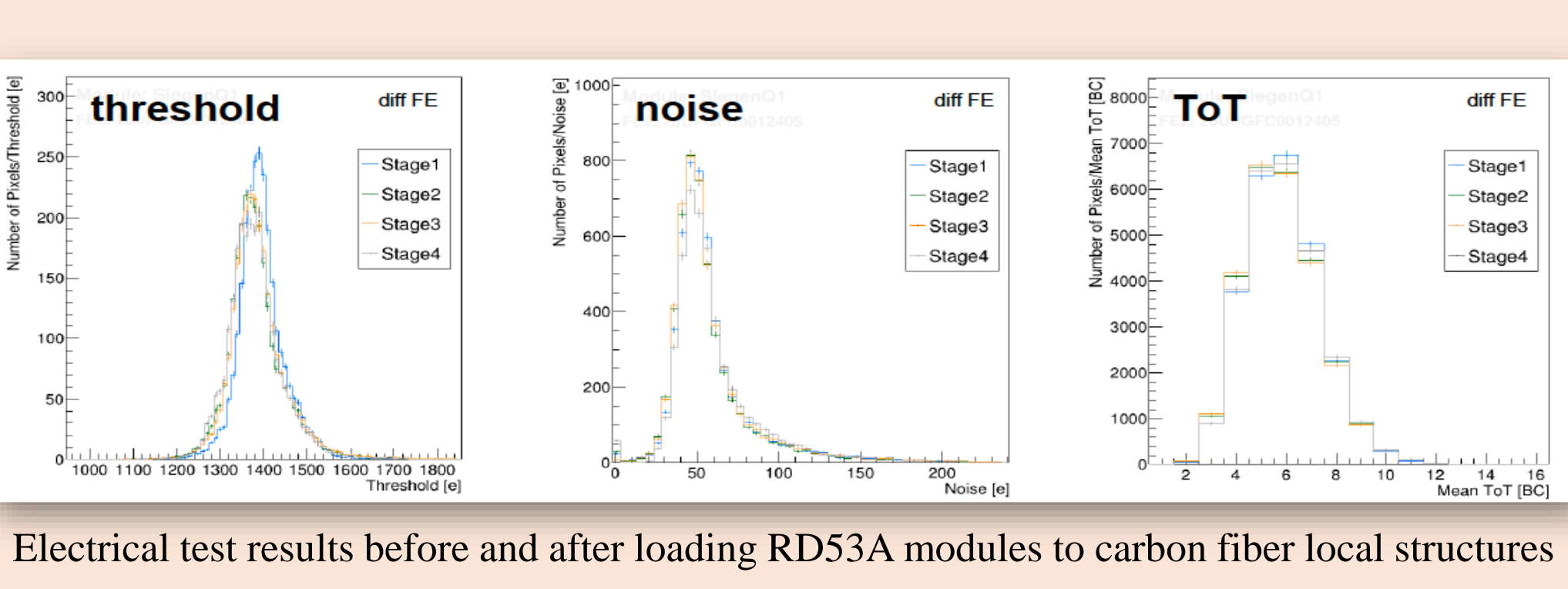
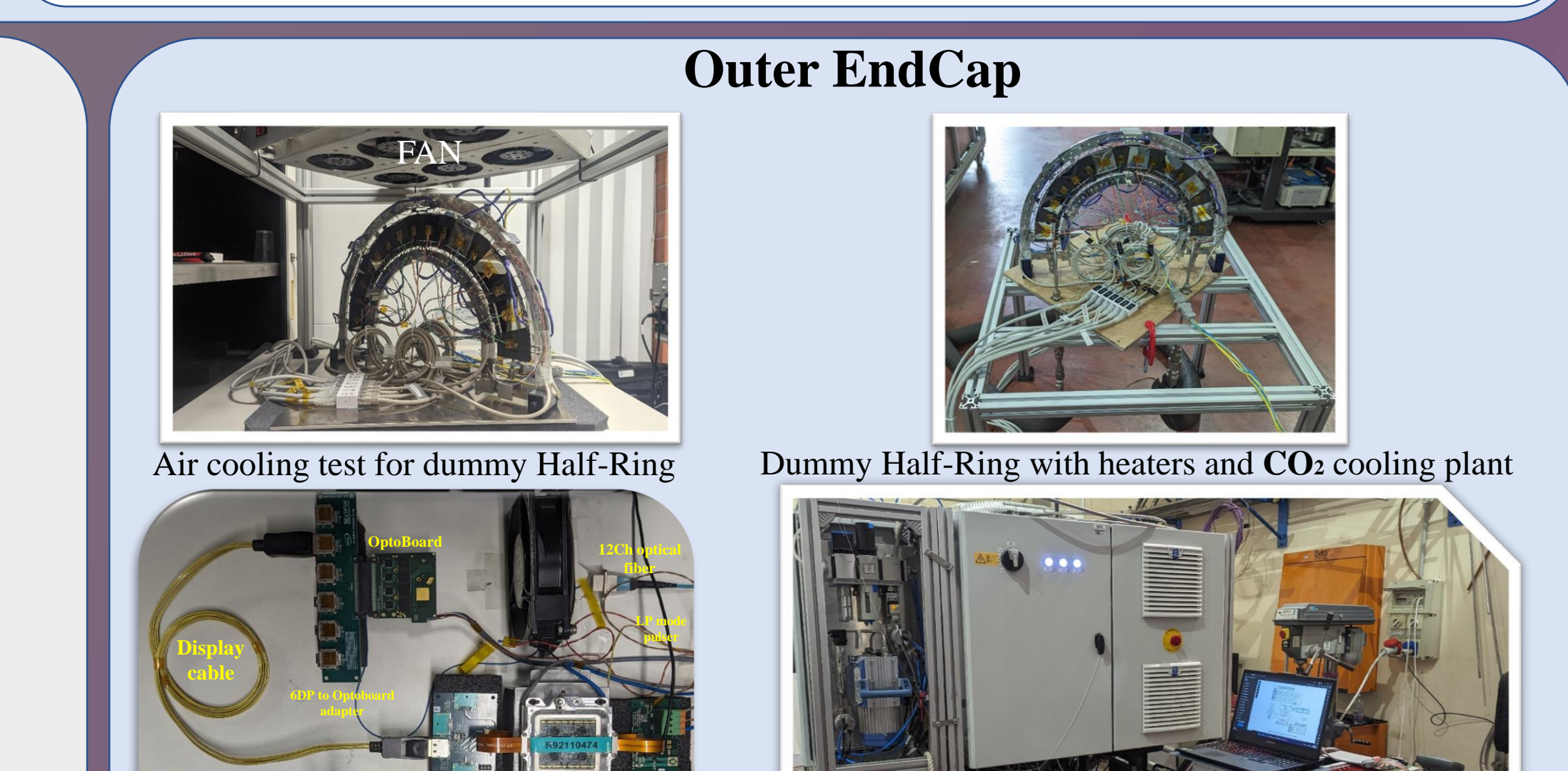
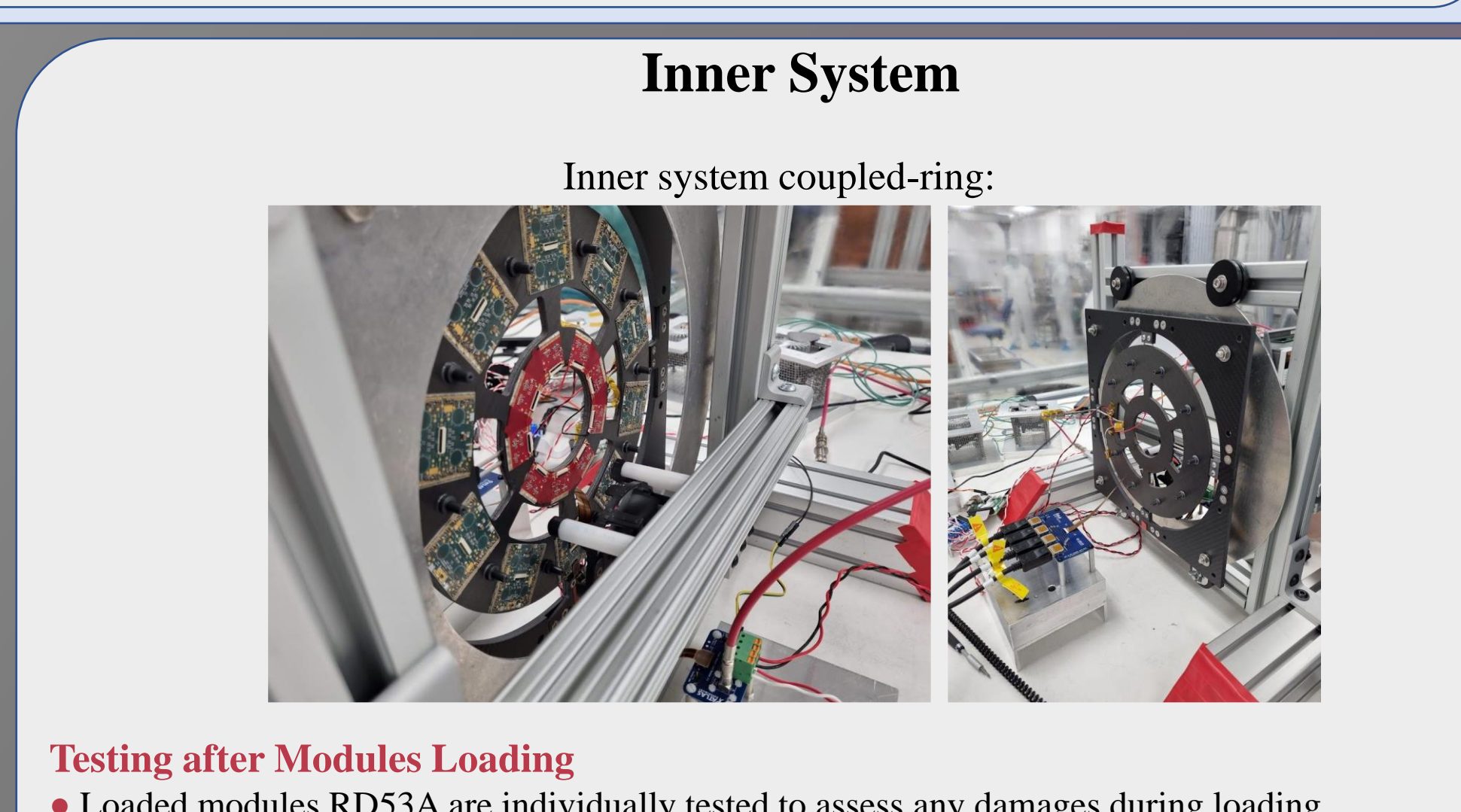
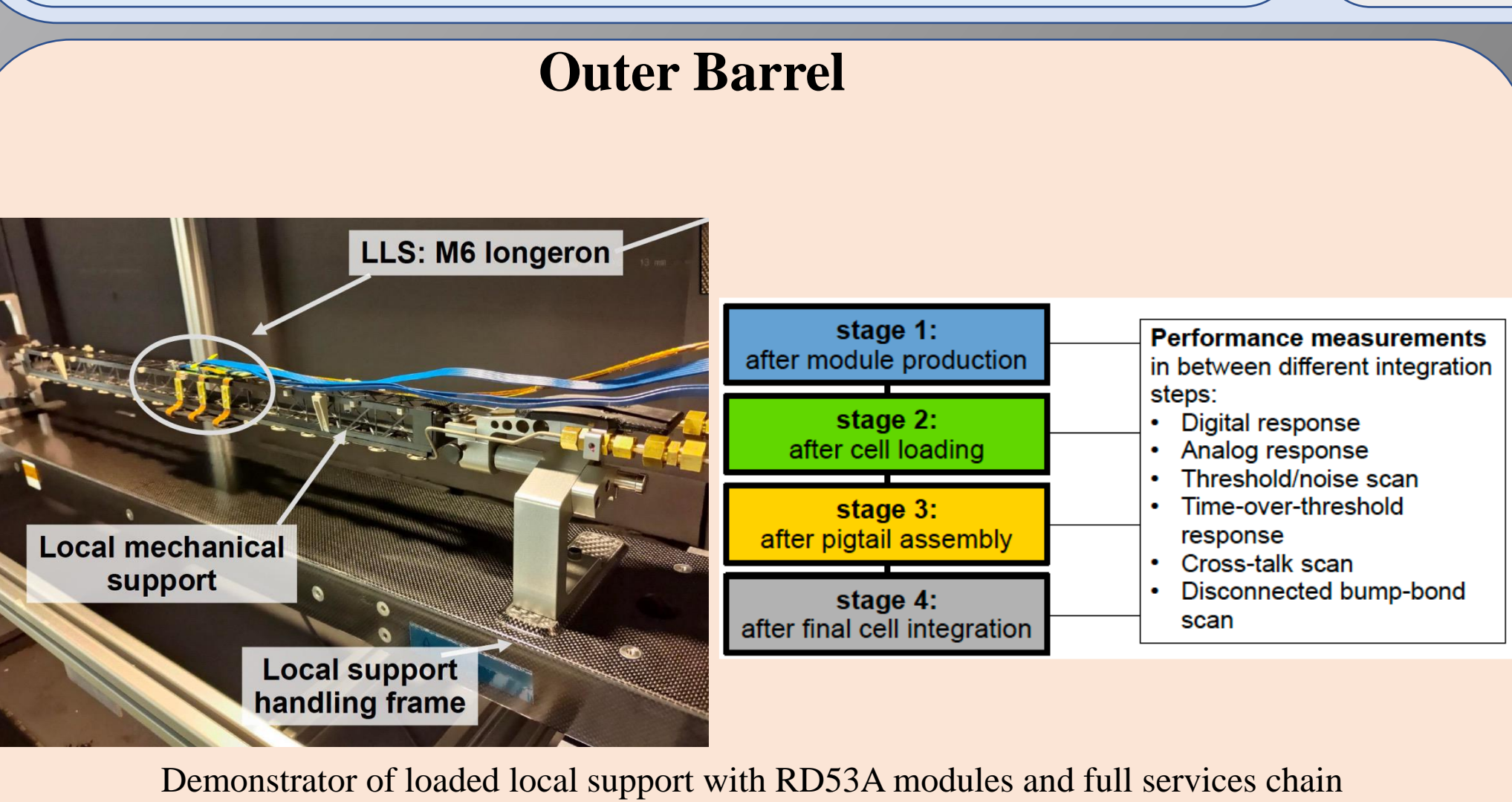
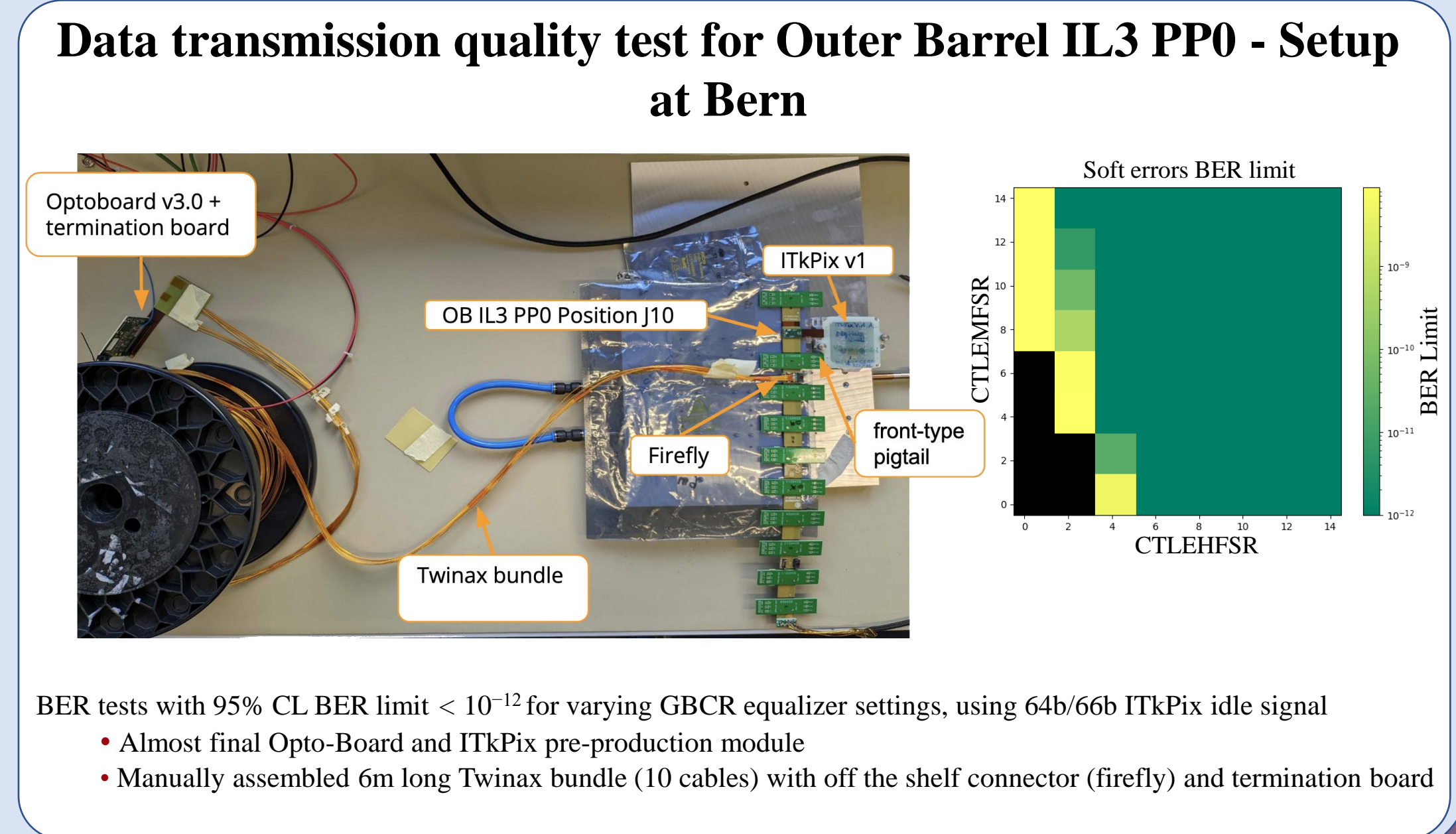
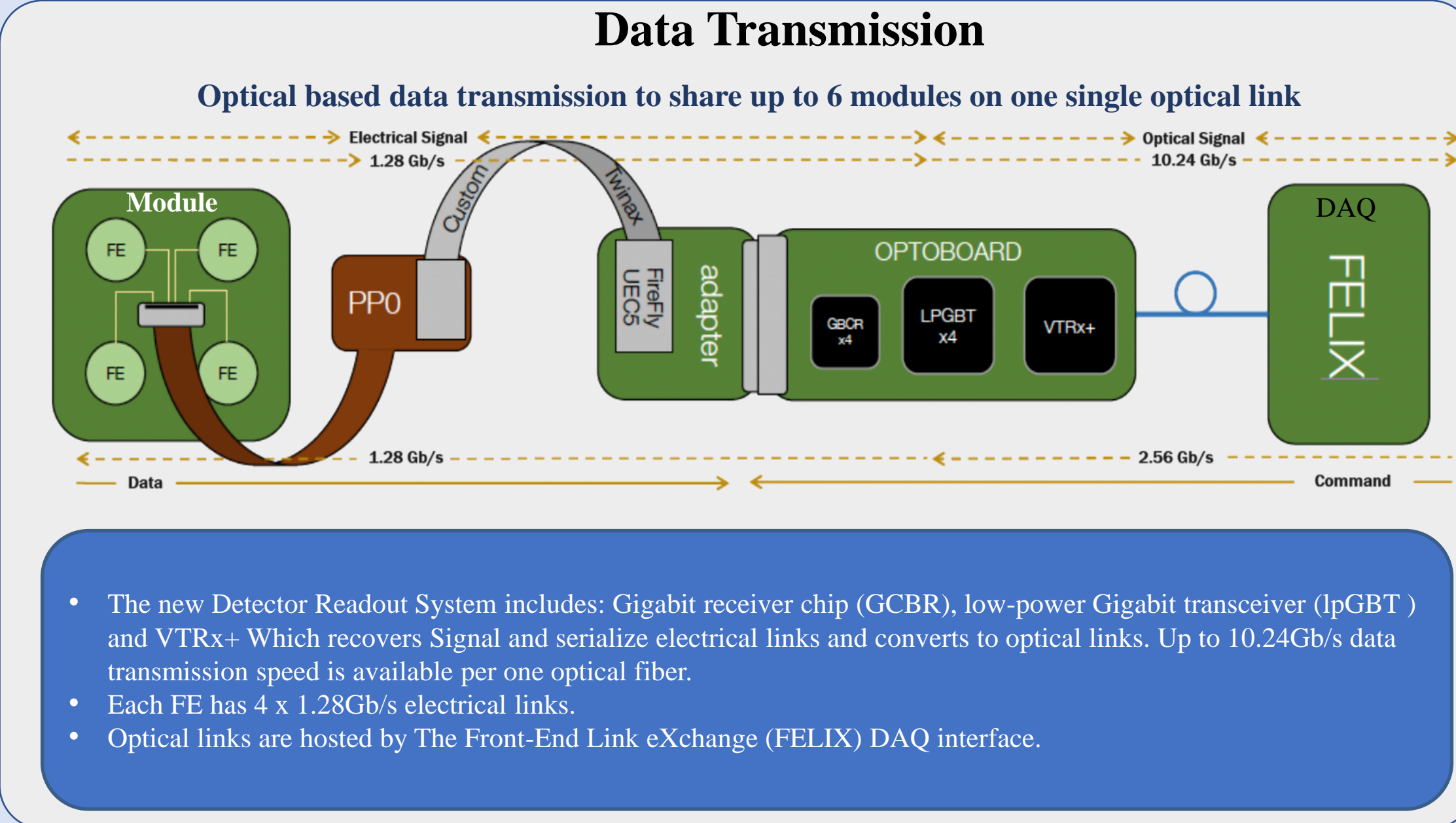
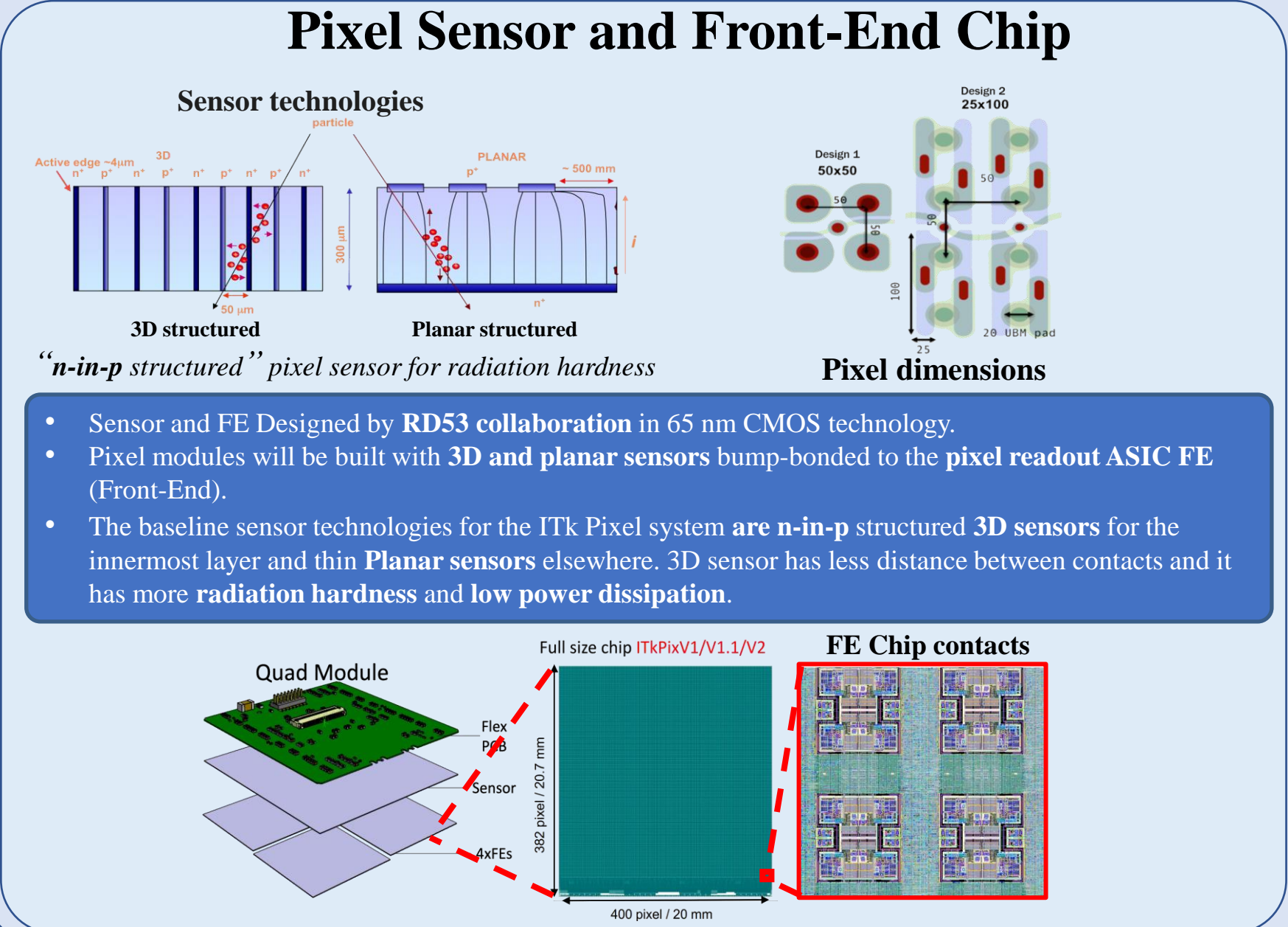
- The Inner Tracker (ITk) will fill the space of the ID with a radius of 1 m and a length of 6 m.
- Design of the ATLAS all-silicon ITk inner tracker.
- ITk is full Silicon based system which is divided Pixels and Strips.
- Reduced material: Carbon Fibre structures
- Advanced serial powering, data link sharing

Current ATLAS Inner Detector should be replaced for High Luminosity Large Hadron Collider (HL-LHC) by new with all-silicon based Inner Tracker (ITk) with similar or better performance in harsher conditions. ITk production will be a global effort with more than fifty institutes in the world.

## ITk Pixel System Test

- The ITk Pixel System includes several components and stages to scale up testing from individual modules to sub-detectors which covers common methodology:
- Connect various flexes and electrical services Testing the ITk Pixel System Test module performance at each step
    - Production → Reception → Loading → With proper services
    - Connectivity, digital scans, disconnected bump-bonds, etc.
  - Verify thermal performance with CO<sub>2</sub> cooling
  - Verify serial power chain
  - Verify data transmission quality

- Measurement and control of environmental condition (T, dew point)
- Detector Control System:
  - Voltage Drop among modules and T
  - Environmental conditions: T, dew point
- Interlock to ensure:
  - T on modules below +40 °C and dew point < -60 °C
- DAQ with optical readout (OPTOBOARD) using FELIX board



## REFERENCES

- ATLAS Detector: 2008 JINST 3 S08003
- TDR the ATLAS ITk Pixel Detector: ATL-COM-UPGRADE-2017-020, CERN-LHCC-2017-021