ePIC Collaboration meeting 2025

Villa Mondragone – January 20-25, 2025

SVT workfest – WP4 session

SVT IB prototyping, FEA and plans

Intro & Overview

Domenico Elia (INFN Bari)

SVT IB @ workfest – WP4

Outline

- (This) Introduction:
  - ✓ latest updates on prototype activity planning
  - ✓ impact on preliminary production timeline
- Detailed contributions on IB prototyping & FEA studies:
  - ✓ "Bending and assembly of the L0/L1 layers" @INFN (M. T. Camerlingo)
  - ✓ "IB mechanics and FEA studies" @INFN (R. Turrisi)

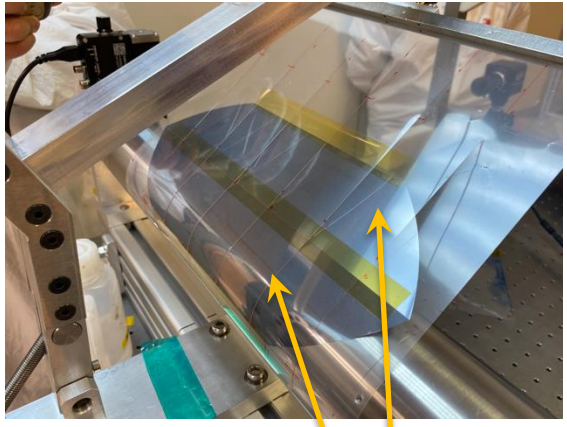
Contributions including IB in other sessions:

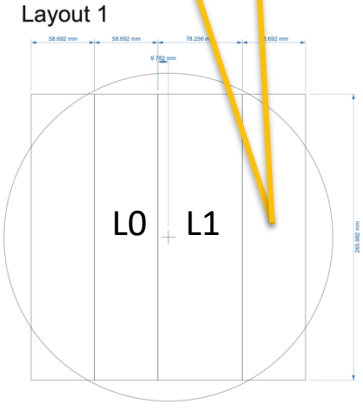
- *"SVT cooling" @LBNL (N. Apadula, earlier today)*
- *"IB readout and SVT RDO board development" @ORNL (J. Schambach, on Thursday)*
- *"Electrical Interfaces" @STFC/INFN (M. Borri, on Friday)*
- *"IB powering" @Birmingham (J. Glover, on Friday)*

IB prototyping activity

Current status:

- working with dummy silicon pieces (from DISCO):
  - ✓ available since september in Bari
  - ✓ lot of improvements in bending tools/procedures
  - ✓ now dealing with large (“double-sensor”) bending →
    - → see details in Maria Teresa’s talk
- available material and next arrivals:
  - ✓ some “half-moon” (missing corners) pieces
  - ✓ 4 x L0 and 4 x L1 → ok for 2 prototypes (but no spares …)
  - ✓ just enough for next 2 planned steps:
    - → IBL01_P2 (finalize bending/assembly)
    - → IBL01_P4 (finalize local support + test in thermal chamber)





IB prototyping activity

Revised plan needed:

Prototype	Components	Goal	Date
IBL01_P1	• 2 naked silicon L1 sensors • L1 local support structure (3-D printed) • outer support shell/frame (machined in PEEK)	• finalize half-layer assembly procedure	2024/10 → **ongoing**
IBL01_P2	• IBL01_P1 • 2 naked silicon L0 sensors • L0 local support structure (3-D printed)	• finalize half-barrel assembly procedure	2024/10 → **2025/03**
IBL01_P3	• 2 naked silicon L1 sensors • L1 local support structure (carbon foam) • outer support shell (carbon fiber, to be defined)	• thermal chamber test	2024/11 → **2025/07**
IBL01_P4	• IBL01_P3 • 2 naked silicon L0 sensors • L0 local support structure (carbon foam)	• thermal chamber test	2024/11 → **2025/07**

→ need to check if (and which) L1 outer support shell needed
→ starting investigations on carbon foam (half-ring) and carbon fiber (longerons) machining
→ number of dummies on the critical side: evaluating new procurement, timeline not under control here …

IB prototyping activity

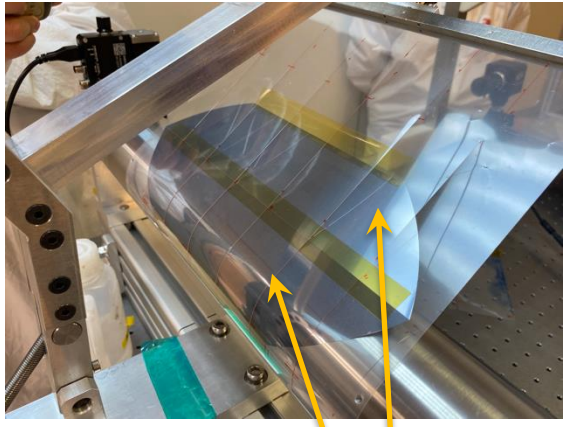
Preparation for thermal tests @INFN Pavia:

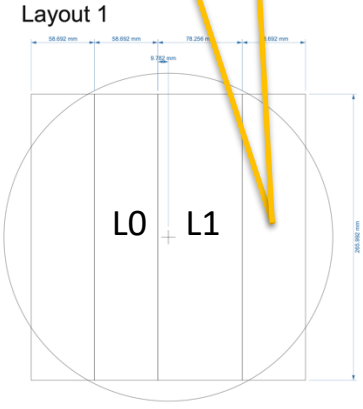
- setting up for tests in a climatic chamber Galli Genviro-030LC
- starting on design and production of transportation boxes:
  - ✓ to be used for transport of SVT inner layer assemby prototypes in Italy and final detector assemblies in US
    - → different prototypes will be needed along the various phases
    - → work ongoing, see more in Rosario's talk

IB prototyping activity

Current status:

- working with dummy silicon pieces from DISCO:
  - ✓ available since september in Bari
  - ✓ lot of improvements in bending tools/procedures
  - ✓ now dealing with large (“double-sensor”) bending →
    - → see details in Maria Teresa’s talk
- available material and next arrivals:
  - ✓ some “half-moon” (missing corners) pieces
  - ✓ 4 x L0 and 4 x L1 → ok for 2 prototypes (but no spares …)
  - ✓ kapton-embedded pieces (Rui de Oliveira @CERN):
    - → expected ready by end January
    - → same as for naked dummies: 4 x L0 + 4 x L1 (2 + 2 needed)
    - → IBL01_P5 (thermo-mechanical prototype)





IB prototyping activity

Revised plan needed:

Thermo-mechanical prototype:

→ waiting for 8 embedded dummies (4 needed)

→ need to add some preliminary cooling layout

→ results from simulation studies have to come before

Prototype	Components	Goal	Date
IBL01_P1	• 2 naked silicon L1 sensors • L1 local support structure (3-D printed) • outer support shell/frame (machined in PEEK)	• finalize half-layer assembly procedure	2024/10 → **ongoing**
IBL01_P2	• IBL01_P1 • 2 naked silicon L0 sensors • L0 local support structure (3-D printed)	• finalize half-barrel assembly procedure	2024/10 → **2025/03**
IBL01_P3	• 2 naked silicon L1 sensors • L1 local support structure (carbon foam) • outer support shell (carbon fiber, to be defined)	• thermal chamber test	2024/11 → **2025/07**
IBL01_P4	• IBL01_P3 • 2 naked silicon L0 sensors • L0 local support structure (carbon foam)	• thermal chamber test	2024/11 → **2025/07**
IBL01_P5	• 2+2 silicon L0+L1 sensors with heaters • L0+L1 local support structures (carbon foam) • outer support shell (carbon fiber, to be defined) • air distribution inlet & outlet (to be designed) • PT1000 sensors (to be glued on heater surface)	• wind tunnel test	2024/12 → **2025/10**

IB prototyping activity

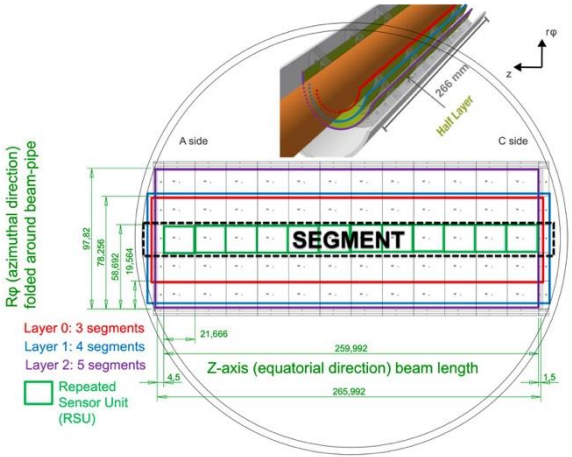
Further steps in the prototyping campaign:

- exploting IBL01_P5 (first themo-mechanical proto):
  - ✓ wind tunnel test → timeline: ~ end 2025 / beginning 2026
  - ✓ informing updated design of mechanics/cooling → ~ spring 2026
- next to next prototypes with ER2 (pad) wafers:
  - ✓ available number of wafers: 24 pad wafers + 12 wafers

IB prototyping activity

Prototyping in 2026 with ER2 (pad) wafer:

- what is going to be available for SVT:
  - ✓ **24 ER2 pad wafers** (w/ pads w/o sensor)
  - ✓ **12 ER2 wafers** (w/ pads & sensor)



- IB HB prototype with ER2 pad wafers:
  - ✓ full proto (including FPCs) suited for mechanical tests
  - ✓ min required pieces (not considering failures/breakings):
    - 2 x 3 segments + 2 x 4 segments + 4 x 5 segments = **8 pad wafers**
    - ideally 2 HBs (mechanical matching tests) → 2 x 8 = **16 pad wafers** with given segments distribution

- IB HB prototype with ER2 wafers:
  - ✓ full proto (including FPCs) suited for mechanical/cooling/electrical post-assembly tests
  - ✓ suitable also for powering/DAQ/DCS development on close-to-final setup system
  - ✓ min required pieces (not considering failures/breakings and sensor yield): **8 wafers**

IB prototyping activity

Further steps in the prototyping campaign:

- exploting IBL01_P5 (first themo-mechanical proto):
  - ✓ wind tunnel test → timeline: ~ end 2025 / beginning 2026
  - ✓ informing updated design of mechanics/cooling → ~ spring 2026
- next to next prototypes with ER2 (pad) wafers:

Prototype	Components	Goal	Date
IBL012_P6/7	• 2+2+4 ER2 pad wafer L0+L1+L2 sensors (x 2 HB?) • L0+L1+L2 local support structures • gloabal support mechanics (advanced design) • FPCs (advanced design) • air distribution inlet & outlet (advanced design)	• first complete IB HB prototype w/o sensors • including test of wirebonding to FPCs • final test on HB support mechanics • possibly built 2 complete HBs (to allow HB mechanical support matching test)	**2026/07**
IBL012_P8	• 2+2+4 ER2 wafer L0+L1+L2 sensors • L0+L1+L2 local support structures • mechanics, FPCs, cooling (~final/advanced design)	• complete IB HB prototype w/ sensors • qualification model w/ bent sensors for cooling + powering/DAQ/DCS finalisation	**2026/10**

→ need to start on L2 prototyping asap (discussions ongoing)