Short summary: ePIC SVT kickoff meeting past June 9, 2023

Laura Gonella (Birmingham) — Ernst Sichtermann (LBNL)

ePIC Silicon Vertex Tracker

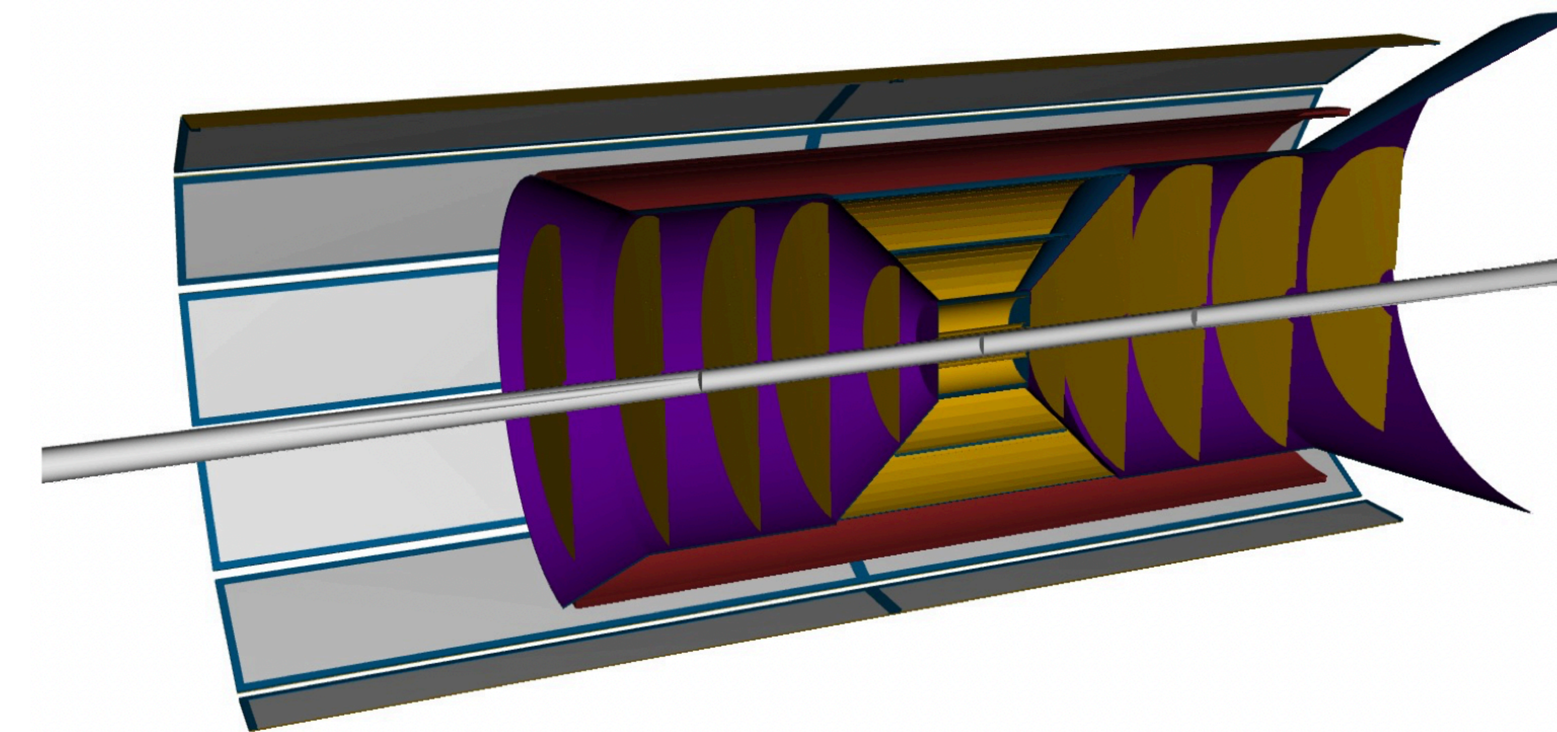
The SVT subsystem is described on the wiki; it is based around a 65nm MAPS sensor and currently consists of five barrel layers (L0—L4), five disks in the hadron-going direction (HD0—HD4), and five disks in the electron-going direction (ED0—ED4).

The **SVT R&D phase** is ongoing. Relevant timelines include:

- EIC vertex sensor qualification in September 2026, concurrent with ALICE-ITS3
- EIC Large Area Sensor production start in (not before) February 2027

The **SVT construction phase** will (mostly) follow the R&D phase. Relevant timelines include:

- CD-3, Approve Start of Construction / Execution, is currently anticipated for Spring 2025,
- SVT construction is estimated to take 3—4 years in a technically driven schedule



ePIC SVT kickoff meeting past June 9, 2023

- The SVT-DSC aims to develop, construct, and operate a well-integrated, large-acceptance, low-mass, high resolution tracking and vertexing solution for ePIC based on Monolithic Active Pixel Sensors (MAPS) in 65 nm technology,

- The main goals for the kickoff meeting past June 9, 2023 were:
  - Agreed-on work-packages,
  - How the work will be shared among interested institutions during the remainder of R&D and during construction,
  - Help create common understanding of the current SVT baseline to facilitate efficient collaborative work.

- Agenda and presentations may be found at:
  https://indico.bnl.gov/event/19823/

- Thank you to all who participated!

ePIC SVT DSC kickoff meeting

Friday Jun 9, 2023, 10:00 AM → 3:00 PM US/Eastern

Description https://cern.zoom.us/j/61734290399?pwd=bUkzYy94U0xaWnFkWmdTSjI4YkNIZz09

10:00 AM → 10:20 AM **Welcome and Introduction to the ePIC SVT** — 20m
Speaker: Ernst Sichtermann (Lawrence Berkeley National Laboratory)
SVT-DSC kickoff - i...

10:25 AM → 12:45 PM **Interests and planned contributions to the ePIC SVT**

- 10:25 AM **UK groups** — 20m
  Speaker: Georg Viehhauser (Oxford U.)
  UK SVT kick-off.pdf; UK SVT kick-off.pptx
- 10:50 AM **Korean groups (TBC)** — 10m
  Speaker: Youngil Kwon (Yonsei Univ.)
- 11:00 AM **Czech Republic groups** — 10m
  Speaker: Lukas Tomasek
  TOMASEK_ePIC-SV...
- 11:15 AM **Oak Ridge National Laboratory** — 10m
  Speakers: Joachim Schambach (Oak Ridge National Laboratory), Kenneth Read (Oak Ridge National Laboratory)
  EIC SVT-ORNL.pdf
- 11:25 AM **MIT** — 10m
  Speaker: Gian Michele Innocenti (member@cern.ch)
  20230609_ SVTKic...
- 11:40 AM **INFN groups** — 15m
  Speakers: Domenico Elia (INFN Bari), Domenico Elia (INFN Bari), Giacomo Contin (Universita' di Trieste e INFN Trieste)
  20230609_INFN_e...
- 11:55 AM **Purdue University** — 10m
  Speaker: Andreas Werner Jung (member@cern.ch)
  ePIC-SVT-DSC-062...
- 12:10 PM **Brookhaven National Laboratory** — 10m
  Speaker: Grzegorz Deptuch (BNL)
  BNL_ePIC_SVT_06...
- 12:20 PM **Los Alamos National Laboratory** — 10m
  Speakers: Ming Liu (Los Alamos), Xuan Li (Los Alamos National Laboratory)
  LANL_EIC_SVT_pro...
- 12:30 PM **Lawrence Berkeley National Laboratory** — 10m
  Speaker: Ernst Sichtermann (Lawrence Berkeley National Laboratory)
  ePIC-SVT - Berkeley...

12:45 PM → 12:55 PM **Break** — 10m

1:00 PM → 1:40 PM **Technical overview of the ePIC SVT** — 40m
Speaker: Laura Gonella (University of Birmingham)
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1:45 PM → 2:45 PM **Discussion** — 1h

2:50 PM → 3:00 PM **Close-out, next steps, and AOB** — 10m
Speakers: Ernst Sichtermann (Lawrence Berkeley National Laboratory), Laura Gonella (University of Birmingham)

Work packages

WP	Name	Description
WP1	Sensor development	Design •Contribution to ITS3 ER2 and ER3 •EIC LAS v1, v2, production Characterisation •Lab, test beam, irradiations
WP2	Mechanics and cooling	•Mechanics of bent vertex layers •Air cooling for vertex layers •Support structure for sagitta layers and disks •Cooling for sagitta layers and disks
WP3	Sensors electrical interfaces	•FPC from sensors to end of layers/disks •Wire bonding (sensor to FPC) •Connection to services (FPC to services)
WP4	Readout and powering	•Power regulator; SP architecture (data transmission, current source, grounding) •On-/off-sensor data handling, full chain until FELIX
WP5	Integration	•Overall mechanical support and integration •Detector cabling (i.e. cables and routing) •Power supplies and cooling plant •Close collaboration with project engineers
WP6	Simulations	•Link to tracking working group •(Detailed) SVT detector description
WP7	Interlocks, slow control, run control, monitoring	To be activated later on

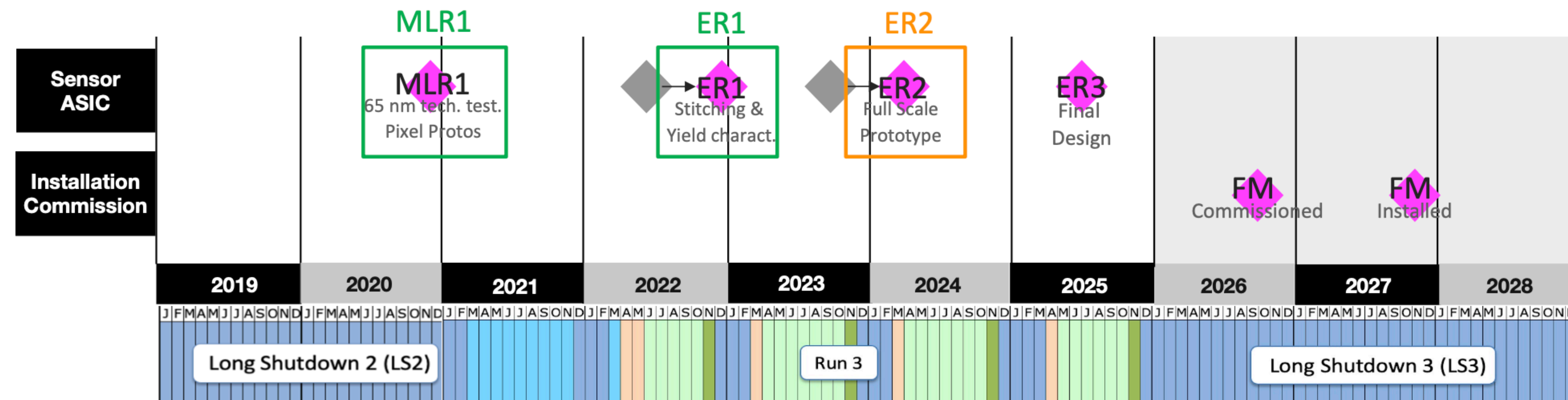
Draft structure coming into the meeting reproduced here.

Productive discussion:

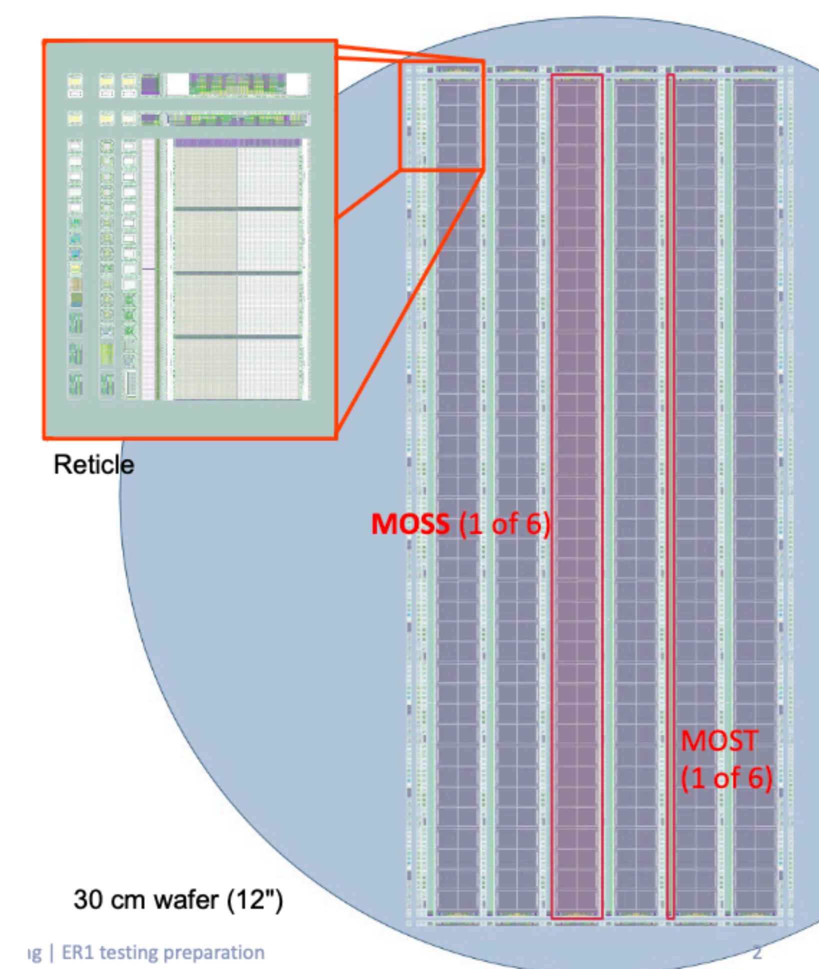
- Overall consensus,
- Maps rather well onto R&D,
- WP5 may become Integration and System Tests,
- WP6 Simulations — integral to the DSC, be it as a WP or through a contact person; obviously needs to interface with WGs,
- May want to activate WP7 early on.

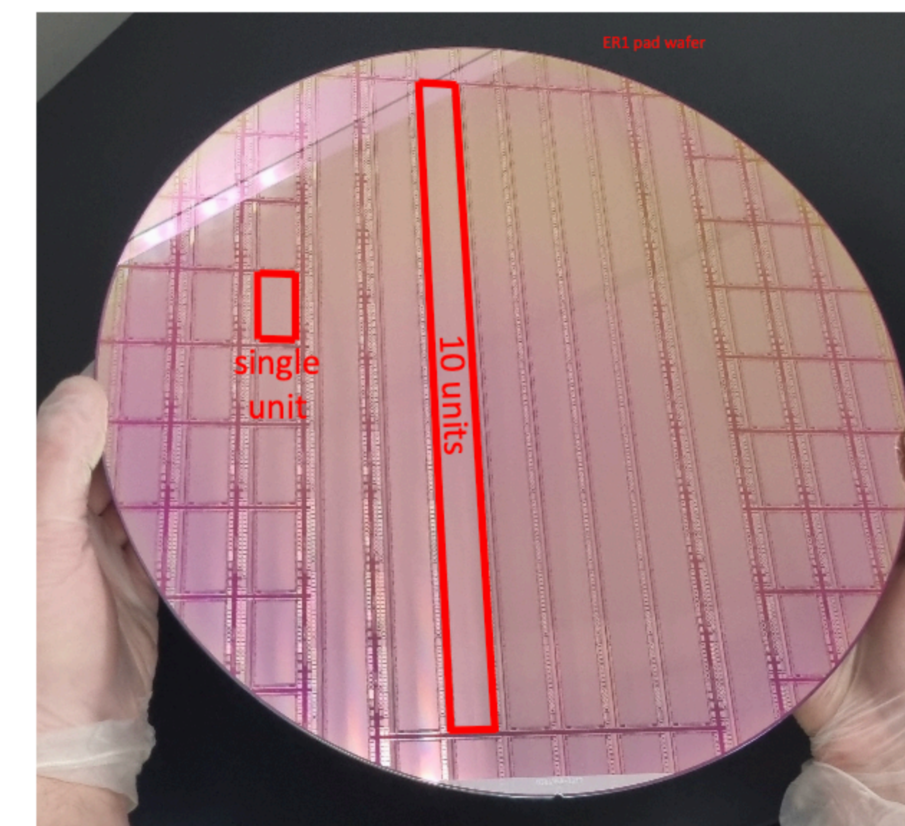
Technical Aspects — Sensor

- TPSCo ISC 65 nm CMOS Imaging technology, 300 mm wafers + stitching



- ER1(Q4 2022)
  - MOSS and MOST sensors; exploratory designs for proof of principles and learning methodology and yield
  - Also, small prototypes and test chips
  - First, single unit MOSS can be powered and responds correctly to slow control commands

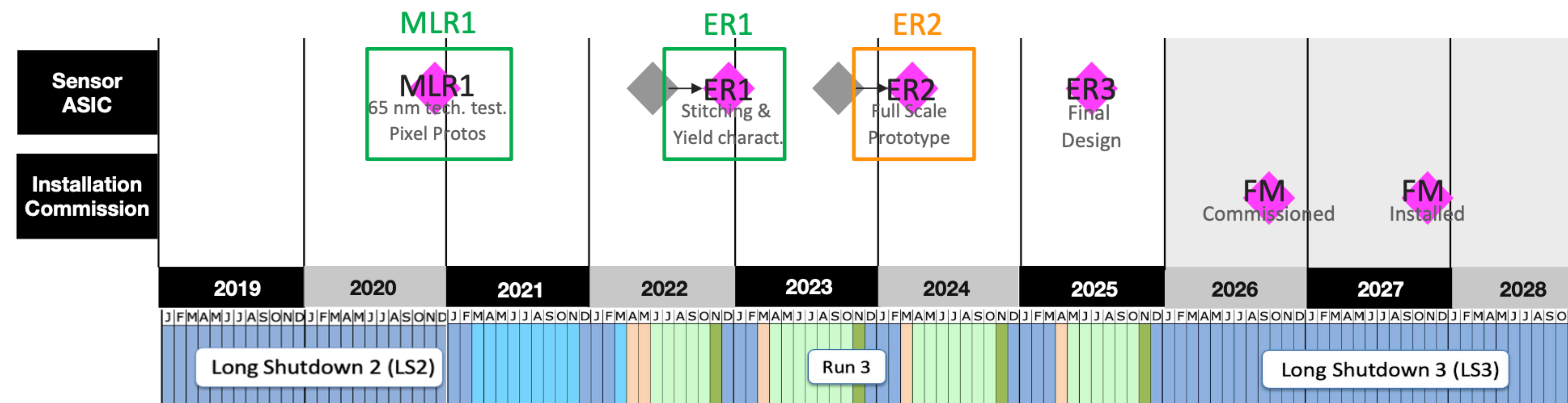




https://indico.cern.ch/event/1280150/

Technical Aspects — Sensor

- TPSCo ISC 65 nm CMOS Imaging technology, 300 mm wafers + stitching



- ER2 (Q1 2024)
  - Sensor aims to satisfy ITS3 requirements
  - Not an evolution of MOSS/MOST; substantial redesign of existing circuits, new features

- ER3 (Q2 2025)
  - Final design/production

The EIC LAS sensor will be based off the ER2 and ER3 designs

https://indico.cern.ch/event/1280150/

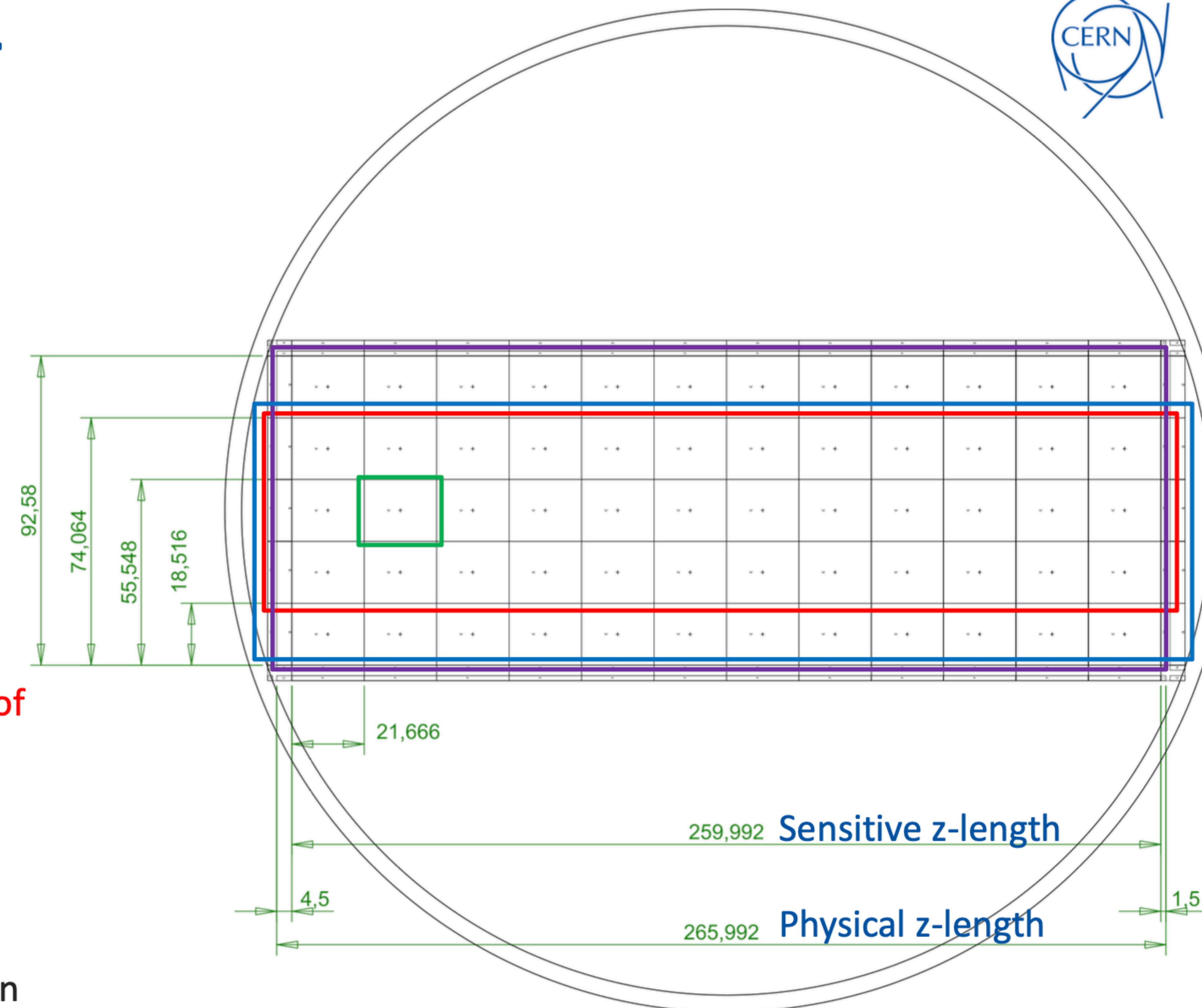
Technical Aspects — Sensor

ER2 Stitched Sensor

Layer 0: 12 x 3 repeated units+endcaps

Layer 1: 12 x 4 repeated units+endcaps

Layer 2: 12 x 5 repeated units+endcaps



ER2 Stitched Sensor is **not** a direct evolution of MOSS +/- MOST

MOSS and MOST were true exploratory designs for proof of principles and learning methodology and yield

ER2 Sensor aims to satisfy ITS3 requirements

Existing circuits need substantial redesign

New features to be added

https://indico.cern.ch/event/1280150/

Note: these dimensions are updated and somewhat different from the 18.85 by 30.00 mm RSU size used so far in simulations and initial design concepts. Effects under study (radii, tiling, etc.). Aim for implementation in the July simulation campaign.

Institutional Interests

In a nutshell:

- UK groups: “end-to-end” interest in L3 and L4,
- Czech groups: sensor characterization, testing, QA; module assembly, testing, QA; …
- ORNL: eRD104, eRD113 R&D; readout & DAQ; possibly qualification/testing of sensors,
- MIT: CERN-base, interests in eRD104, eRD111, eRD113; interest in L0—L2,
- INFN: eRD111, eRD113 R&D; interests L0 and L1 (sensor characterization/tests, bending, interconnect, FPC)
- Purdue: cooling, electrical interfaces, (global) mechanics, power; disks,
- BNL: eRD113 R&D; emphasis on sensor design,
- LANL: eRD111, eRD113 R&D; (hadron) endcap disks,
- LBNL: eRD111, eRD113 R&D; L0—L3, disks,
- (Korean groups: sensor development, disks).

Quite obviously, this does not do justice to the presentations: https://indico.bnl.gov/event/19823/