Welcome to the ePIC SVT working meeting

Warm thanks to CFNS for hosting us, and Melissa Laguerre in particular.

Thank you all for participating.

CFNS Code of Conduct

CFNS Members and visitors are expected to respect our community values:

Integrity

We honor our commitments and act ethically. We do not fabricate, falsify, or plagiarise in our research. We are fair and objective in reviewing our peers' work, consistent in giving proper credit and attribution in our own, and prompt in correcting the literature when errors in our own work are detected.

Responsibility

We hold ourselves and each other accountable for our actions and for our commitments. We contribute positively and value the members of the community and their perspectives. We take actions to ensure the health, safety, and welfare of ourselves and the community.

Respect

We value everyone and the contributions they make. We welcome differences of perspective, belief and opinions, and act always with common courtesy and civility. We do not bully, harrass, or discriminate against. We recognize that all members of the community play a role in its success.

Teamwork

We work cooperatively and supportively. We value our many partnerships in the community, which contribute to the advancement of science, technology, and education.

Some practical info

First things first:

> **Parking – permit or ticket – please consider returning the permits, if possible,**

> **Coffee – today C123, tomorrow morning here in C133 (concurrent ad-hoc meetings)**

> **Internet – eduroam,**

> **Restrooms – this floor, hallway towards the Math tower,**

Information we will hopefully not need:

> **Multiple staircases in the hallways if there were a need to evacuate,**

> **Nearest AED device is on this floor near the elevators; first aid kit in the room,**

> **Emergency number 911 – campus police 333 from any campus phone or 631 632 333**

Some practical info

We are here

Lunch:

On Campus:
- Simons Center SC Café –11:30am to 2.30pm; 631-632-2881

- East Side Dinning
    Cocina Fresca: 11:30am to 6:30pm
    Emporium Market: 10am to 3pm

- Student Activity Center
    Dunkin': 8:30am to 2:30pm
    Halal Wayz Food Truck: 10am to 6pm

Near LIRR train station, walking distance:
- Green Tea Restaurant – 11am to 3pm; 631-689-1111
- The Bench Bar and Grill --11:30am to 11pm; 631-675-1474

+ Offsite options within driving distance.

Some practical info

Dinner:

    Many good options in Port Jefferson,

    Informal group dinner,

        When: tomorrow (Thursday), starting at around 18:30

        Where: Pita House – 2016 Route 112, NY 11763

        Who: add yourself to the list or email Ernst by 2pm today if interested

Group picture:

    Suggest start of the morning break tomorrow on Zoom (remote)
        and at the Umbilic Torus (in person)

SVT "cheat sheet"

SVT Concept
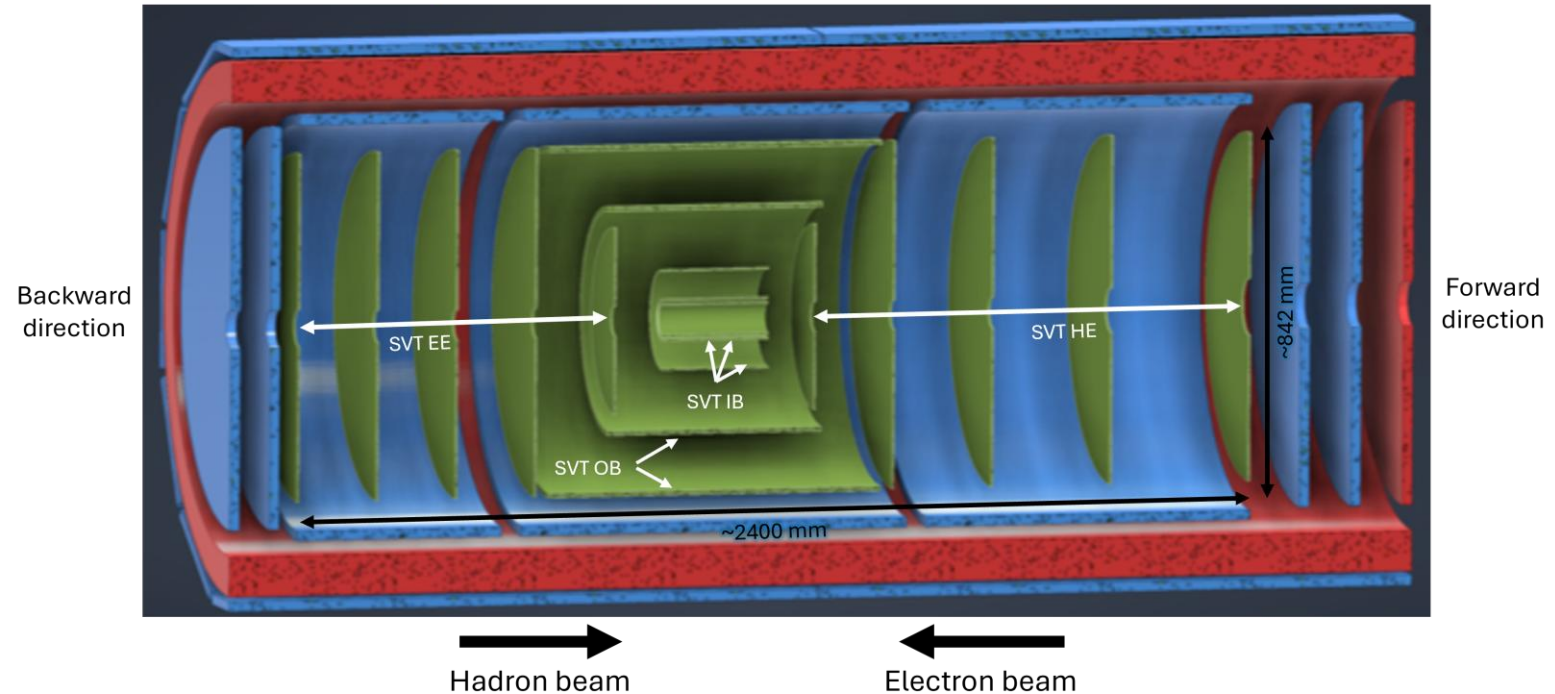
Inner Barrel (IB)
   Three layers, L0, L1, L2,
   Radii of ~ 36, 48, 120 mm
   Length of approx. 27 cm
   $x/X_0 \sim 0.05\%$ per layer
   Curved, thinned, wafer-scale sensor

Outer Barrel (OB)
   Two layers, L3, L4
   Radii of ~ 27 and 42 cm
   $X/X_0 \sim 0.25\%$ and $\sim 0.55\%$
   More conventional structure w. staves

Electron/Hadron Endcaps (EE, HE)
   Two arrays with five disks
   $x/X_0 \sim 0.25\%$ per disk
   More conventional structure w. halve disks

SVT ; MPGDs ; TOF (fiducial volume) ;

Backward direction

Forward direction

SVT EE

SVT HE

SVT IB

SVT OB

~842 mm

~2400 mm

Hadron beam   Electron beam

Constrained by beampipe + 5mm at the inner barrel and disk radii; $r_{SVT} < 43$ cm; $-105 < z_{SVT} < 135$ cm,

Lengths for L2—L4 increase so as to project back to z = 0; disk radii adjust accordingly,

**Optimized for acceptance and resolutions within constraints,**

Clamshell of detector halves; beam-pipe bake-out with SVT installed,

OB staves, IB halves, and half Disks will be shipped to BNL – installation sequence OB, IB, disks.

SVT Sensor and Ancillary ASIC

1. ITS3-like Inner-Barrel layers
- Re-use the **ITS3 sensor** as is
- Adapt the ITS3 detector concept to the EIC:
  - Mechanics of bent layers — sensor and support — for the larger EIC radii
  - Services and cooling design and routing for the EIC acceptance requirements
  - Considerations related to in-situ beam-pipe bake-out at the EIC
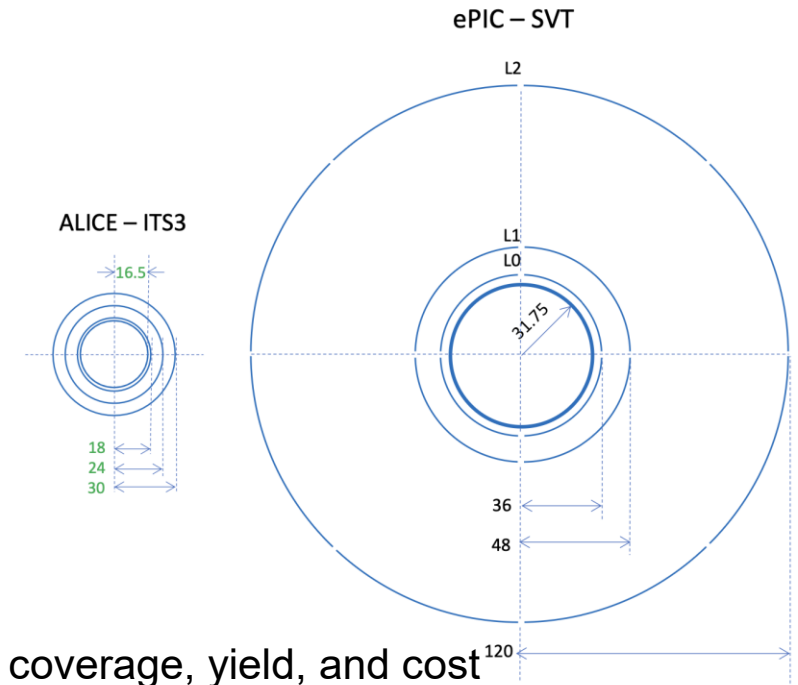
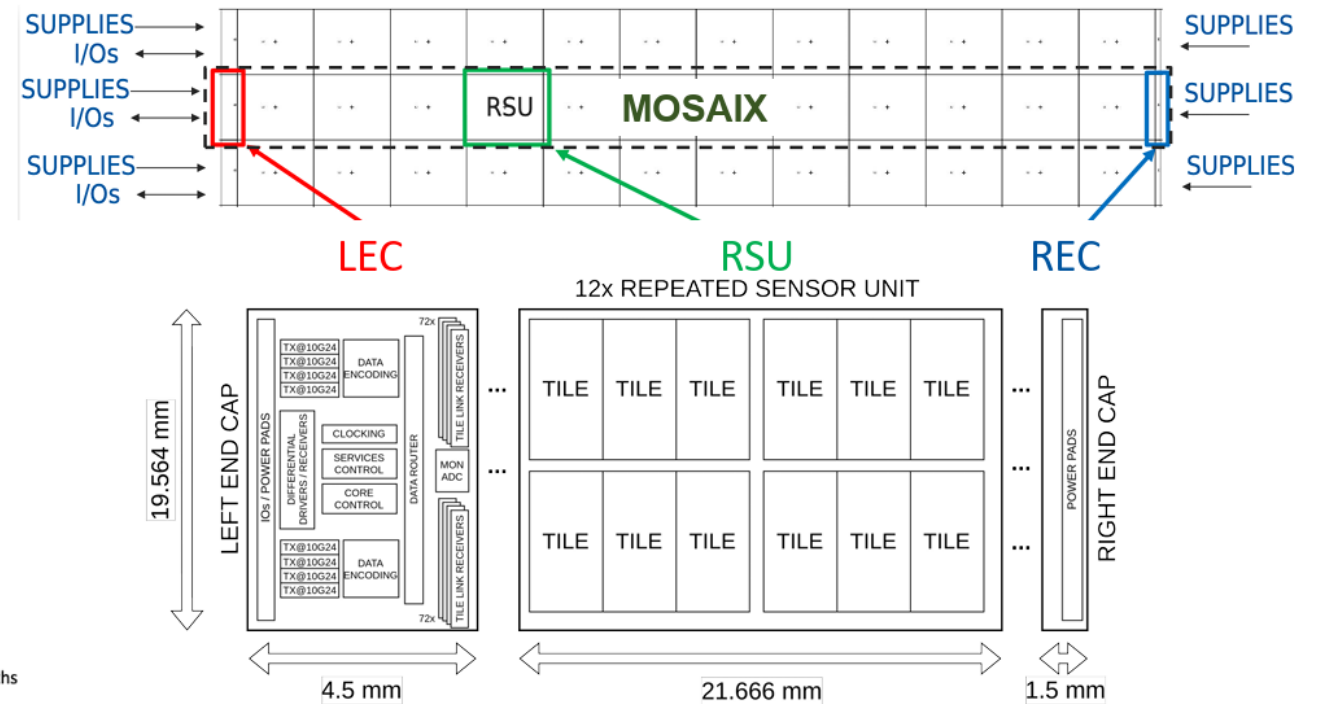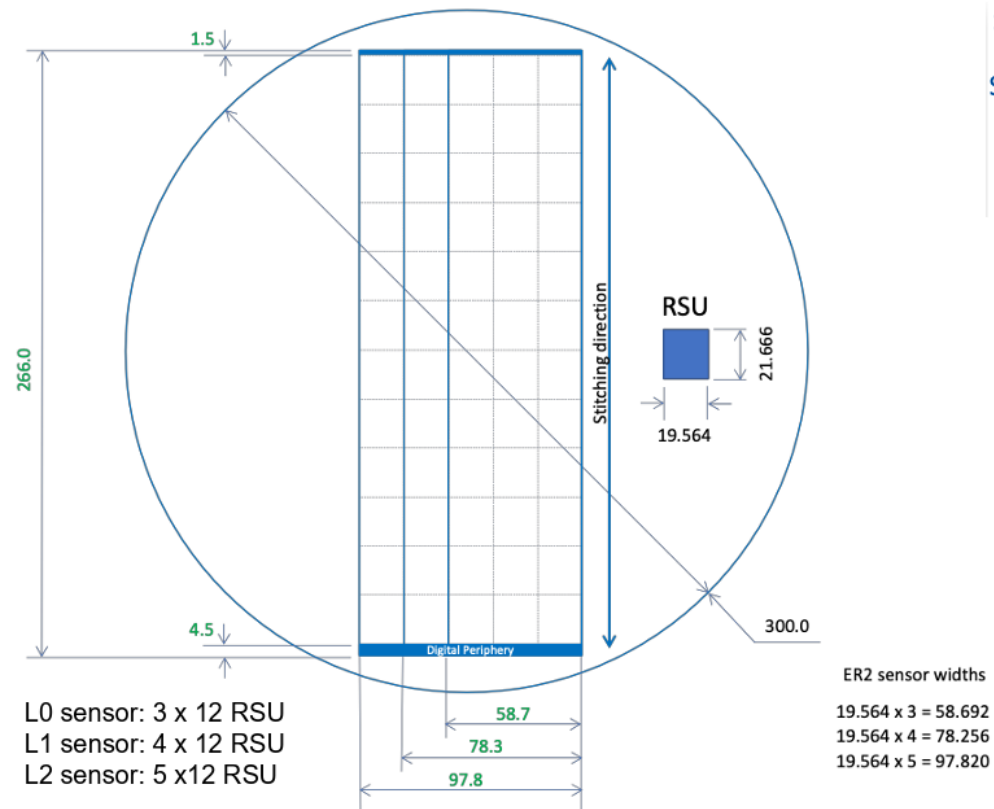**2. EIC variant for the staves in the Outer Barrel and the Endcap Disks**
- **EIC Large Area Sensor (LAS)**, i.e. ITS3 sensor optimized for large-area coverage, yield, and cost
  - EIC LAS will be stitched, but not to wafer scale; functionality and interfaces stay largely unchanged
  - Size(s) of the EIC LAS defined by requirements for full coverage and yields, cost; studies have shown 5 and/or 6 RSUs
  - Approximately 4,000 EIC-LAS sensors will be used in the OB and Disks,
- More conventional carbon composite mechanical support structures with integrated cooling
- Lightweight electrical interfaces with **Ancillary ASIC** and aluminum flexible printed circuit technology

Ongoing characterization – wafer-probing development, irradiation and test beams, thermal and mechanical tests,

Preparation for production testing – probing of all ER3, EIC-LAS, ancillary ASIC.
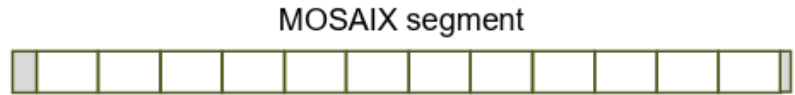
MOSAIX

- MOSAIX (ER2) is a full feature prototype of the sensor for ALICE ITS3 and ePIC SVT IB,

- Wafer scale sensor design using the stitching technique,

- Process: TPSCo 65 nm CMOS Imaging Sensors,

- MOSAIX design leads to production sensor (ER3)

L0 sensor: 3 x 12 RSU
L1 sensor: 4 x 12 RSU
L2 sensor: 5 x12 RSU

ER2 sensor widths
19.564 x 3 = 58.692
19.564 x 4 = 78.256
19.564 x 5 = 97.820

MOSAIX to EIC-LAS

Inner Barrel

MOSAIX segment

Outer Barrel, E/H Endcaps

EIC-LAS and ancillary chip

- 12 RSUs
- 8 data links
- 7 slow control links
- Direct powering

Improve yield and coverage →

Lower material budget →

Lower material budget,
fit integration requirements →

Lower material budget,
fit integration requirements →
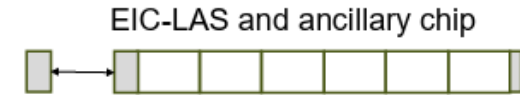
- **5 or 6 RSUs**
- **Single data link**

⎫ EIC-LAS

- Multiplex slow control
- Serial powering

⎫ Ancillary ASIC

Powering and Readout

Inner Barrel will be directly powered and read out, adopting (and adapting) the ITS3 design,

Doing so for the outer barrel and/or disks would incur prohibitive service loads,

Instead, the outer barrel and disk design uses:

- serial powering of up to 4 EIC-LAS sensors,

- Multiplexing of slow control,

Powering and readout scheme for the Outer Barrel and Disks
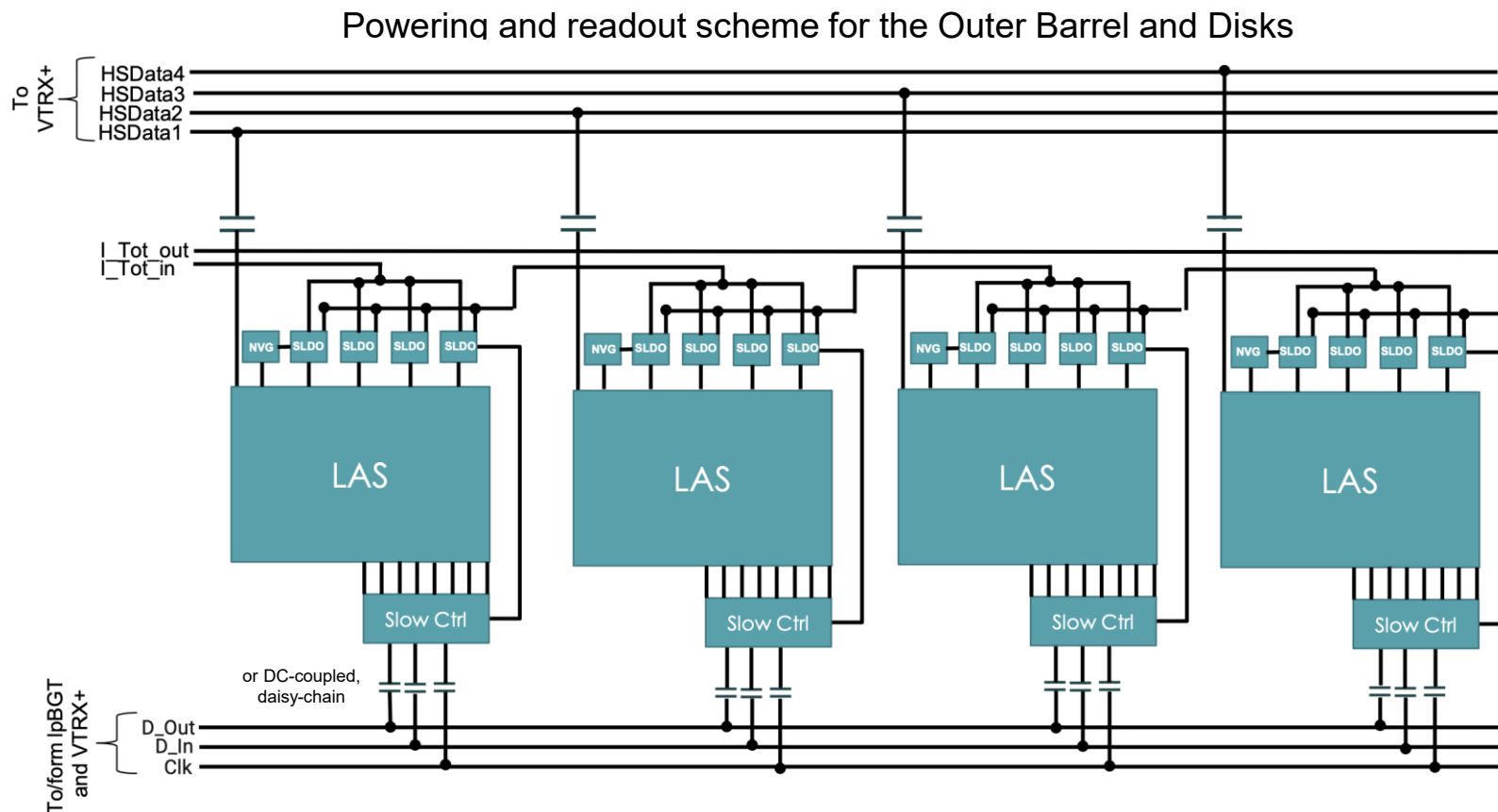
Transition to fiber near the sensor; aggregate fibers outside of the detector and before the FELIX DAC board,

Configuration and powering of VTRx+ and FPC slow control will be handled by one or more types of control board

References

Recent overviews:

- 10th Detector Advisory Committee meeting – SVT talks by Joao de Melo, Iain Sedgwick, Ernst Sichtermann, c.f. https://indico.bnl.gov/event/26584/

- 2025 Detector R&D Day – SVT talk by Laura Gonella, c.f. https://indico.bnl.gov/event/27200/

January 2025 SVT workfest at the ePIC collaboration meeting, c.f. https://agenda.infn.it/event/43344/

SVT top-level indico: https://indico.bnl.gov/category/496/

Main mailing list: https://lists.bnl.gov/sympa/info/epic-svt-ib-l

Indico for this meeting: https://indico.bnl.gov/event/28216/ -- **speakers, please upload your materials**

Project and Timelines

Schedule

- The schedule is driven by:
  - **To hold the date for the CD-2 IPR of June 2026**
  - To keep the (inter)national user community engaged and limit the danger to lose groups
 - all subdetectors need to be more or less ready at the same time to be assembled to ePIC
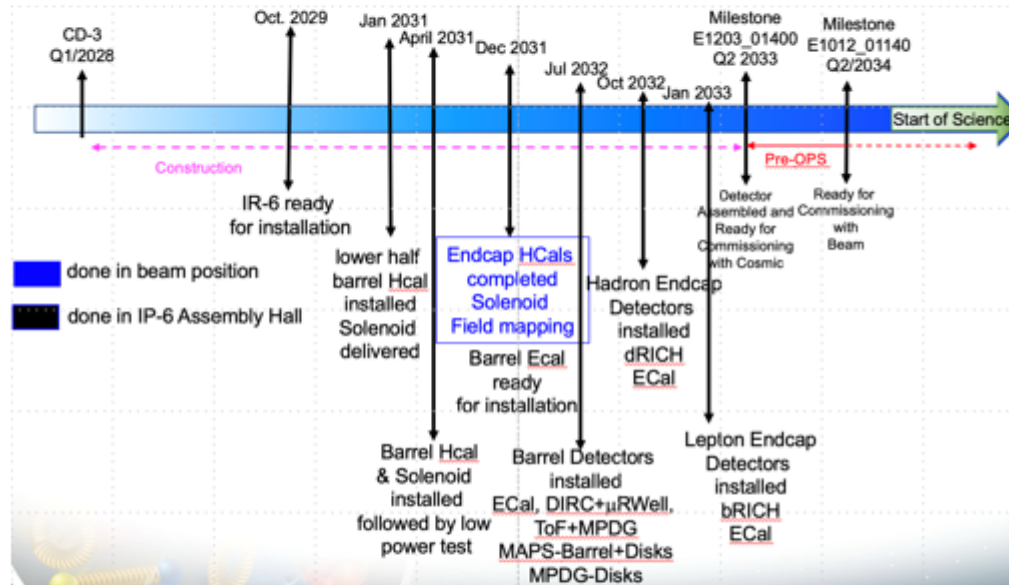
- The schedule drivers are:
  - Superconducting Solenoid → CD-3A item
  - Silicon Sensors (MAPS, AC-LGAD & ASTROPIX)
  - ASIC long time frames only one ASIC designed from scratch all others are modifications to existing ASICS
  - Items with long production times, single vendor and complex assembly
    → CD-3A & CD-3B
  - International agreements driving in-kind and MAPS design (agreement with CERN)
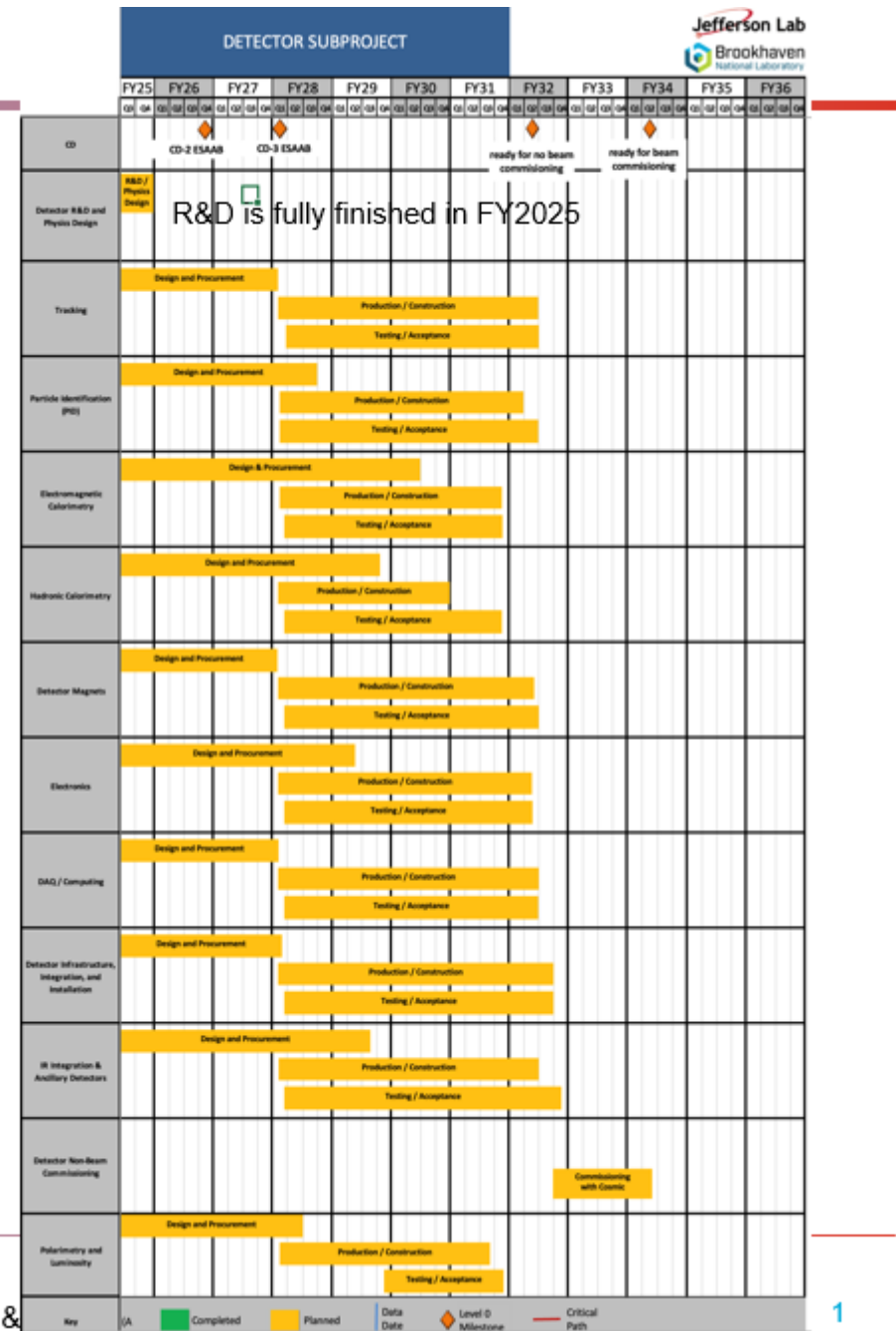
Project Phases
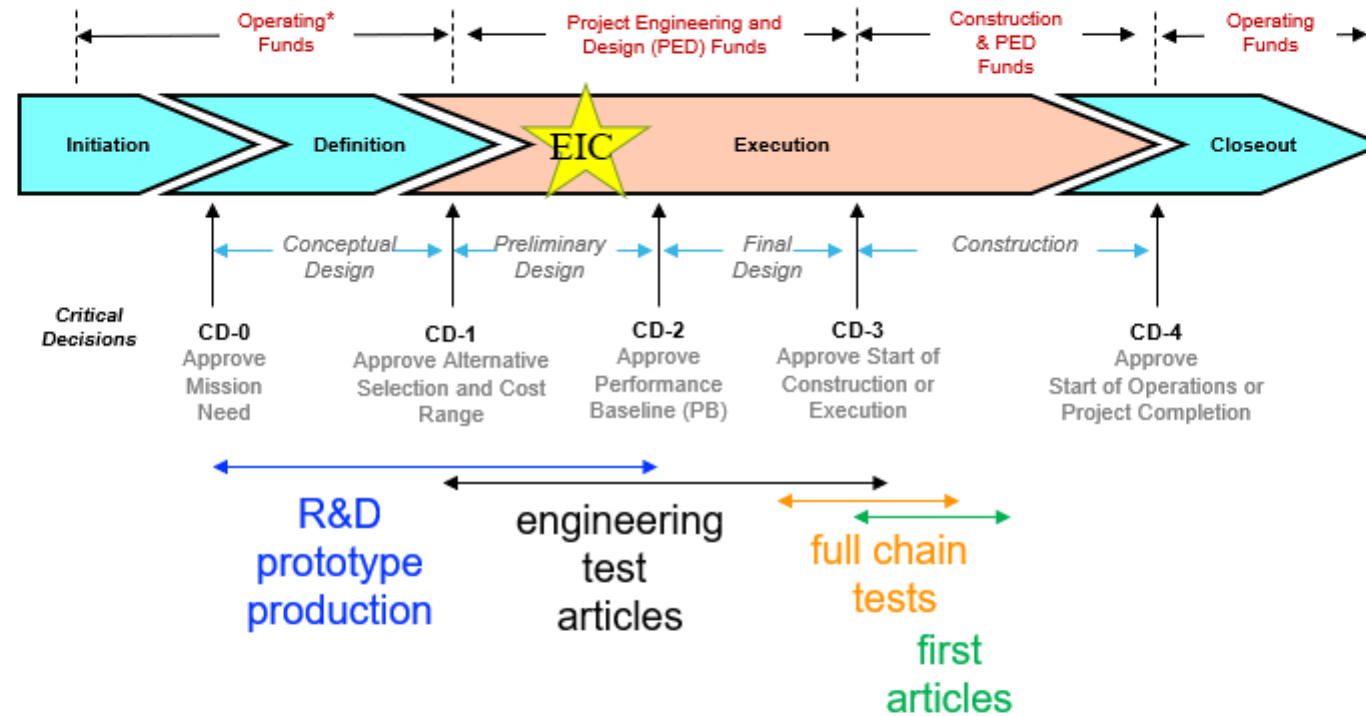
This meeting

Some practical info

We aim to make/keep this a focused/specialized working meeting,

Deliverables include e.g. finalizing v2 of the 15-page short pre-TDR,

Wednesday:
>   sensors and ancillary ASIC
>   powering
>   cooling

Thursday:
>   electrical services
>   integration

Friday:
>   inner barrel, outer barrel, disks
>   simulations

Each day starts at 10am to allow for some pre-work and ends with discussion and action items.

Introductions