

# Introduction

Proposed agenda for today:

- (This) introduction
- Discussion
- AOB

# SVT Kickoff Meeting past Friday

Thank you to everyone who participated and made this meeting a success!

Some of the things I (ES) heard:

- We have consensus on our preferred work package structure:
  - WP1 — Sensor development
  - WP2 — Mechanics and cooling
  - WP3 — Sensor electrical interfaces
  - WP4 — Readout and powering
  - WP5 — Integration (and system tests)
  - WP6 — Simulations
  - WP7 — Interlocks, slow control, run control, monitoring
- We may benefit from activating also WP7 early on,
- WP6 may or may not be a full WP; it will need to interface with the WG(s) and we will need a contact from within the DSC, irrespective if WP6 becomes a full WP or not,
- Common terminology: L0—L2 (inner barrel), L3 and L4 (outer barrel), ED0—4 (disks in e direction), HD0—4 (disks in ion direction), etc.
- Institutional interests.

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Institutional interests in a nutshell, as I (ES) heard them:

- 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/>

# Project R&D

Dear current and future R&D participants,

it is time to discuss the next steps in our path, i.e., the FY24 projects. We are trying to get the R&D program fully in sync with the FY boundaries.

## Proposals

1. Please submit your proposals and progress reports (where applicable) to us by July 7, 2023. We aspire to have a DAC meeting well in time to prepare for contracts at the beginning of FY24.
2. We expect progress report from all ongoing projects eRD101 to eRD113. What milestones were achieved. How did our understanding improve. What is left to do?
3. eRD102, eRD103, eRD104, eRD106, eRD107, eRD108, eRD109, eRD110, eRD111, eRD112, and eRD113 may submit continuation proposals if and only if technical risk milestones remain.

These new proposals should be relatively straightforward to write. Keep them short and concise. List whatever technical risks remain, the milestones, deliverables, and two money matrices showing cost/item and funding/institution to close those remaining risks. Also list the representatives for each institution. List all participating members and institutions on the front page. Please also give, if applicable, an outlook for the years past FY24.

Be aware that R&D should not be mixed with PED. If you are not sure, talk to us. The proposals should concentrate on detector R&D tasks that mitigate project detector technical, risk.

## DAC Review Meeting

With the project detector R&D expected to dwindle down at CD-2, we will limit the meeting to a two-day review meeting in the July-August period. The FY24 proposal goals of all continuation projects should be presented as well as a short status report of all FY22/FY23 proposals. More details on this meeting will be announced soon.

Best regards,

Elke, Rolf, and Thomas

P.S. Please distribute this email among your institutional reps/contacts in your project. Thanks!

# R&D P6 Milestones in P6

## Tracking

### eRD108 (MPGD)

- Complete beam test validation of cylindrical  $\mu$ RWELL with prototype [September 2023]
- Complete validation of use of light-weight cylindrical Micromegas with 2D readout patterns as derived from the earlier used cylindrical technology [December 2024?]

### eRD104 (Service Reduction)

- Develop powering scheme based on serial powering to mitigate service space needs of DC-DC scheme. [December 2023]
- Evaluate radiation tolerant FPGAs and high-speed fiber optic transmission option with beam test. Complete prototype multiplexing firmware. [December 2024]

### eRD111 (Si Tracker)

- Report completed on barrel and disc cooling options, allowing cooling choice [December 2023]
- R&D completed for stitching of sensors [September 2024]

### eRD113 (Si Sensors/ITS3)

- End-of-R&D Milestone: EIC vertex sensor quantification finalized [September 2026]  
(Note: link in P6 to EIC large area sensor production start [February 2027])



# Project R&D

- Past (FY23) proposals, presentations, and report: <https://indico.bnl.gov/event/17159/>
- From the 2021 (outdated) Project R&D Plan (link):

## Timeline:

Year	Task
2021	<ul style="list-style-type: none"> <li>• Testing and characterization of MLR1 (Multi-Layer Reticle)</li> <li>• Sensor design for MLR2</li> <li>• MLR2 submission</li> <li>• R&amp;D into powering, stave/disc construction, cooling, overall infrastructure</li> </ul>
2022	<ul style="list-style-type: none"> <li>• Testing and characterization of MLR2</li> <li>• Sensor design for ITS3 ER1</li> <li>• ITS3 ER1 submission</li> <li>• R&amp;D + prototyping into powering, stave/disc construction, cooling, overall infrastructure</li> </ul>
2023	<ul style="list-style-type: none"> <li>• Testing and characterization of ITS3 ER1 and assessment of yield</li> <li>• Assessment and planning for EIC sensor fork of ITS3 design</li> <li>• Fork off sensor design and work on EIC variant for staves and discs (may move to next year depending on results)</li> <li>• ER submission for EIC variant sensor (EIC ER1) for staves and discs</li> <li>• Detailed prototyping into powering, stave/disc construction, cooling, overall infrastructure</li> <li>• Investigation of adaptation of ITS3 design for use in EIC vertex layers (radii, # layers, services from both ends to meet length requirements, etc.) with ITS3 ER1</li> </ul>
2024	<ul style="list-style-type: none"> <li>• Testing and characterization of EIC ER1 and assessment of yield</li> <li>• Si design for EIC ER2</li> <li>• EIC ER2 submission for EIC variant sensor for staves and discs</li> <li>• Detailed prototyping into powering, stave/disc construction, cooling, overall infrastructure using EIC ER1 prototypes</li> <li>• Adaptation of ITS3 design for use in EIC inner layers with ITS2 ER2 (or integration of design into EIC ER2 if necessary).</li> </ul>
2025	<ul style="list-style-type: none"> <li>• Testing and characterization of EIC ER2 and assessment of yield</li> <li>• Complete stave and disks prototypes with EIC ER2</li> <li>• Vertex layers prototypes with ITS2 ER3</li> </ul>

## 4 Cost and Schedule

The following table shows the anticipated costs in US\$ per fiscal year from FY22 to FY26. It is subdivided into the section discussed above. This list is all-inclusive. The project will fund the necessary R&D projects choosing a selection that is generic and of priority for all detector concepts under consideration.

R&D Subsystem	FY22	FY23	FY24	FY25	FY26
<i>Reference Detector – Project (Section 1)</i>					
Si-Vertex (barrel & disks) w/o sensors	340,160	680,820	680,320	567,600	0
Service Reduction	42,840	85,680	85,680	71,400	0

...

### Generic - Alternatives and Improvements to Reference Detector (Section 2)

Si Sensor Development	740,000	852,500	1,189,000	639,000	0
Central Tracker Cylindrical $\mu$ RWELL <sup>4</sup>	130,000	50,000	0	0	0
Central Tracker Cylindrical Micromegas <sup>4</sup>	10,000	50,000	5,000	0	0
GEM TRD <sup>4</sup>	70,000	30,000	60,000	0	0
Time-of-Flight <sup>4</sup>	0	45,000	90,000	90,000	0
Photosensors <sup>4</sup>	180,000	80,000	25,000	0	0
<b>Total (Generic)</b>	<b>1,130,000</b>	<b>1,107,500</b>	<b>1,369,000</b>	<b>729,000</b>	<b>0</b>

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WP1	Sensor development	<ul style="list-style-type: none"> <li>Design</li> <li>•Contribution to ITS3 ER2 and ER3</li> <li>•EIC LAS v1, v2, production</li> </ul> Characterisation <ul style="list-style-type: none"> <li>•Lab, test beam, irradiations</li> </ul>	(Most closely related to eRD113 project R&D)
WP2	Mechanics and cooling	<ul style="list-style-type: none"> <li>•Mechanics of bent vertex layers</li> <li>•Air cooling for vertex layers</li> <li>•Support structure for sagitta layers and disks</li> <li>•Cooling for sagitta layers and disks</li> </ul>	(eRD111 project R&D)
WP3	Sensors electrical interfaces	<ul style="list-style-type: none"> <li>•FPC from sensors to end of layers/disks</li> <li>•Wire bonding (sensor to FPC)</li> <li>•Connection to services (FPC to services)</li> </ul>	(Aspects within eRD111 project R&D scope)
WP4	Readout and powering	<ul style="list-style-type: none"> <li>•Power regulator; SP architecture (data transmission, current source, grounding)</li> <li>•On-/off-sensor data handling, full chain until FELIX</li> </ul>	(eRD104 project R&D)
WP5	Integration	<ul style="list-style-type: none"> <li>•Overall mechanical support and integration</li> <li>•Detector cabling (i.e. cables and routing)</li> <li>•Power supplies and cooling plant</li> <li>•Close collaboration with project engineers</li> </ul>	(Aspects within eRD111 project R&D scope)
WP6	Simulations	<ul style="list-style-type: none"> <li>•Link to tracking working group</li> <li>•(Detailed) SVT detector description</li> </ul>	
WP7	Interlocks, slow control, run control, monitoring	To be activated later on	



# Project R&D

- Progress to date and effort started/-ing covered in our past meeting: <https://indico.bnl.gov/event/19740/>

## Thoughts for FY24

eRD111 — Nicole Apadula

- Modules/Sensor Interconnections
  - Investigate FPC & connections to end of sensor
- Barrel & discs
  - Advance designs, scale up prototypes
- Mechanics, integration, cooling
  - Advance designs, scale up prototypes
  - Converge on cooling, how to integrate into local structure

## To follow in FY24\*

eRD113 — Grzegorz Deptuch

### With CERN team for partnered ITS3 sensors development:

- Data (fast) transmission blocks (RAL)
- Declared readiness for co-developing modified (LP) standard cell libraries (RAL, BNL)
- VFM\_ADC (BNL) presented to ITS3 designer's meeting and targeted completion end FY23
- LDoC\_ULVS proposed for inter RSU data transfer instead of planned line driver (BNL, LBL)
- Synthesis/Verification (BNL/LBL)

### Specific to ePIC SVT sensors:

- Extensive focus on serial powering – shunt regulator IC (RAL), system studies, design adaptations
- RSU data TDMA multiplexing (reduced IpGBT IP resources) \*\*
- External layers and disk arrays

\*Adjustments will be reflected on FY24 proposal.  
\*\* Requires coordination with CERN



- Sensible to emphasize L0—L4; ED0—4, HD0—4
- Routing into and out of disks is fundamentally different for L0—L2 and L3—4, and fundamentally different between barrel and disks; FPC and connections will need effort.
- L0—L2 mechanics do not (fully) carry over from ITS3; needs effort.