
WP2: Low mass mechanics and thermal management. Kick off meeting

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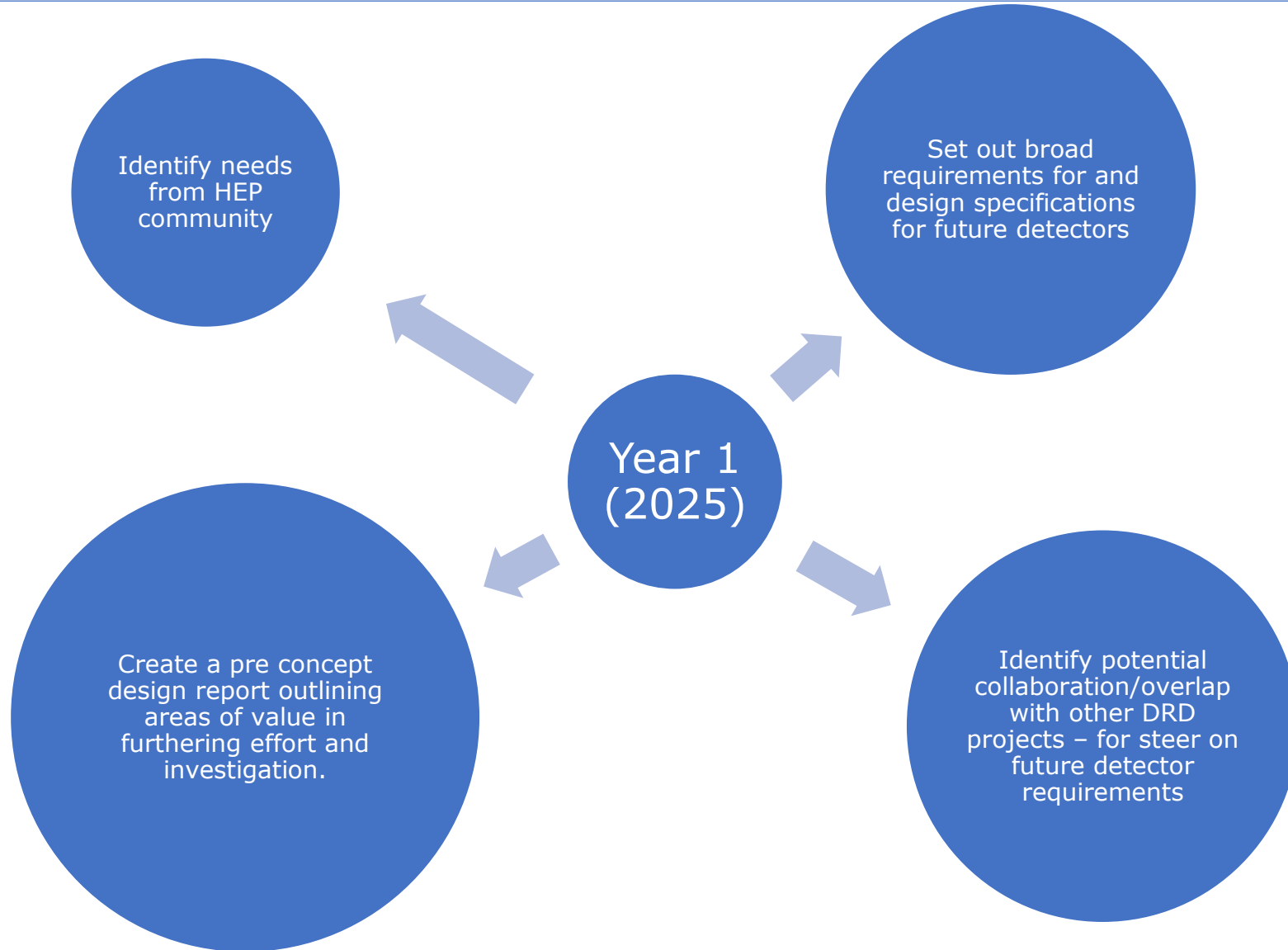
31 January 2024

Project 2.1: Advanced Mechanical Tracker Structures

Tasks and Goals –

1. Detector Design Paradigms:
 - A. Primary Goal - Reassess conventional planar tracking detector designs using modern materials, manufacturing techniques, and blue-sky thinking to explore innovative mechanical structures.
2. Advanced Materials & Manufacturing:
 - A. Primary Goal - Utilise orthotropic materials to optimise mechanical and thermal performance while minimising material budget.
 - B. Extended Goal - Leverage Advanced Digital Manufacturing (ADM) techniques, including Additive Manufacturing (AM), Hybrid Manufacturing, and tow-steering, to enable non-planar, complex geometries.
3. Integration & Structural Optimisation:
 - A. Primary Goal - Integrate services (e.g., cooling channels) directly into mechanical structures to enhance performance and reduce material overhead.
 - B. Extended Goal – Develop predictive tools to optimise orthotropic, complex, and service-integrated structures.
4. Quality Assurance & Reliability
 - A. Primary Goal – Establish Non-Destructive Testing (NDT) and QA/QC protocols for non-traditional structure to ensure long-term reliability.
 - B. Extended Goal – Investigate synergies with other Detector R&D (DRD) initiatives to further refine design approaches.

Project 2.1: Advanced Mechanical Tracker Structures



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Milestones and Deliverables

Label	Topic	Month	Description
M2.1.1	Design specifications	6	Design specifications are needed to ensure that the pursued designs have relevance. They will be based on current generation detector specifications and informed estimates of requirements for future detectors.
M2.1.2	Pre-Concept Design Report	12	This pre-Conceptual Design Review (pre-CDR) report will evaluate and report advancements in the areas mentioned above. It will guide and steer the direction of work over the following 12 months.

	Institute	Effort [FTE/year]		Material budget [kCHF]		
		available	required	available	required	
1.	Setting up a kick off meeting with institute contacts in mid to late Feb. 2025. Email to follow.	CERN	2.0	2.0	100	100
		DESY	0.2	0.5	0	10
		Nikhef	0.5	0.5	10	50
2.	Define process of gathering specifications for design task.	Purdue University	1.0	2.0	15	50
		University of Oxford	1.0	2.0	50	100
3.	Documentation of design, analysis and test timelines and efforts from each institute.	University of Liverpool	0.7	1.7	0	45
		Bristol Composites Institute	1.0	1.5	4	50
4.	Understand potential overlaps and collaboration with other DRDs	National Composites Centre	0.1	0.5	1	15
		STFC-RAL	0.5	1.0	10	30
		INFN PISA	0.5	0.8	50	50
	Total		7.5	12.5	240	500

Project 2.2: Characterization of Material Properties & Database Development

Tasks and Goals –

1. Material Testing Protocols:

- A. Primary Goal – Identify ISO / ASTM standard test procedures for each material category, document step-by-step testing procedures including specimen preparation, testing equipment, environmental conditions, and measurement techniques that can be recreated across the laboratories using controlled environmental conditions.
- B. Extended goal – Develop degradation models for materials using available irradiation facilities.

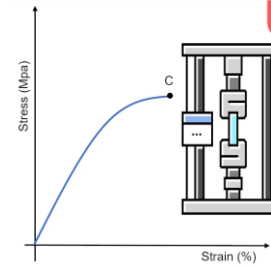
2. Documentation & Database Development:

- A. Primary Goal – Standardize reporting guidelines as per ISO/ASTM standards to be able to enable automated database entries using strong GUI and back-end database structures/protocols.
- B. Primary Goal – Revamp and reuse the existing MaxRAD database at CERN with enhanced GUI and back-end database management.

WP2 – Project 2.2 : Approach to the tasks

- Reach out to institutes for list of equipment and contact person for characterization tests.
- Identify lead times, machine availability and needs of each institute
- Increase # of participating institutes
- Explore opportunities and collaboration with other DRDs for material characterization needs/testing

Identify needs from HEP community



Round robin testing of samples to ensure uniformity in results

- Tensile tests for carbon fiber composite laminates across institutes
- Thermal conductivity tests
- Standardized samples from a single institute sent to all testing facilities and cross comparison of results

Year 1 (2025)

- Integration options between IMHOTEP and MaxRAD
- Opportunities to explore use and development of AI based search algorithm that can answer to prompts like

Explore current MaxRAD database revamp options and AI based smart search algorithms*



"hey MaxRAD what is the best gamma radiation tolerant adhesive to use with Kapton?" *

* Proposal by Nicola Pacifico

Documentation guidelines per ISO/ASTM standards for automated input into database

- Reach out to institutes for list of equipment and contact person for characterization tests.
- Identify lead times, machine availability and needs of each institute
- Increase # of participating institutes



WP2 – Project 2.2 : Immediate Next steps

1. Setting up first working meeting with institute contacts in mid to late Feb. 2025. Expect doodle from Sushrut within a week to set up this meeting.
2. Sample preparation for round robin testing – tensile test and thermal conductivity test to start with – potential choice of material – PatzF6/IM7 cyanate ester plain weave (plenty available at Purdue/Sushrut can make and send samples quickly) open to other materials – will discuss in the first working meeting.
3. Documentation of test timelines and efforts from each institute.
4. Approaching other DRDs for collaboration on material testing efforts.

Institute
CERN
DESY
University of Oxford
Bristol Composites Institute
INFN Perugia
Purdue University
Cornell Laboratory
Florida Institute of Technology

Deliverables for 2025 (12 months)

Label	Topic	Month	Description
M2.2.1	Identification of community needs	6	Definition of the community needs (e.g. material families to be considered in the database, properties to be measured/stored).
M2.2.2	Standardised test protocols & lab infrastructure archive	12	Deliver first calibrated material tests for two thermal and mechanical material samples with round-robin tests conducted across participating labs. Standardised reporting protocols and documentation agreed upon. List of available test facilities across participating institutes.

Thank you.

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Indico Page - <https://indico.cern.ch/category/19434/>

Website - <https://drd8.web.cern.ch/>