

RDC #3

Solid State Tracking

Introduction

Welcome

- We are very excited to see everyone
- There are three RDC3 sessions:
 - Tuesday 1600-1800: Sensors/modules/interconnections
 - Wednesday 1100-1230: MAPs (joint with RDC4: ASICs)
 - Thursday 1600-1800: LGADs (joint with RDC11: Timing)
- There are also many sessions related to Solid State Detectors:
 - Tuesday 1330-1600: RDC4: Circuits and Architectures for 4D tracking and calorimeters
 - Wednesday 1330-1600: RDC4 Big Data Management
 - Thursday: 1100-1230: RD10: Mechanics and Cooling
 - Thursday: 1330-1600: RDC4: Methodologies, Tools, IC Block, SoCs, and Workforce Development

RDC 3: Solid State Tracking

- RDC Coordinators

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- Dedicated RDC Email List

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UCSC-SCIPP
Silicon Sensors,
Modules and
Tracking Systems



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Silicon Sensors,
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Trackers

Meetings

- We had an RDC3 Introductory Meeting on Oct. 4th:
<https://indico.fnal.gov/event/61509/>
- At it, there was a series of 2-3 page flash-talks where groups got to introduce themselves, what they are doing presently, and their future interests.
 - If you didn't present, please send us a few slides and we will add it to the agenda to collect everyone's interests in one place
 - We are still looking for a good method to gather all our material.
- We plan to have regular ~quarterly meetings of RDC3 in order to keep in touch, communicate new information, discuss how we are interacting with DRD3,....
 - We may have ad-hoc meetings when necessary for grant planning,....

Goals for this week:

- Improve understanding of the size and interests of the community in order to better organize and start gathering around a few ideas for funding proposals, and common projects
 - RDC3 should be community driven; we want to be facilitators working towards common projects and goals
- Learn about all the great new ideas and developments in the US
 - There is a notable critical mass around MAPs and LGAD-based systems
 - At the end of these sessions, we have reserved a few minutes to start collecting thoughts on common goals, areas needing development, etc.

Longer Term R&D Priorities

- Directions encompassed in BRN and Snowmass Reports
- Areas of R&D Priorities
 - Topic Area #1: Adapting non-silicon and novel-configuration sensors
 - Improved costs, area, radiation tolerance, performance
 - Topic Area #2: Scalable, low-mass detector systems
 - MAPs based tracking
 - Topic Area #3: Trackers for Lepton Colliders
 - Similar requirements for timing and spatial resolution
 - Topic Area #4: Trackers for Hadronic Colliders
 - Extreme radiation with fine timing and spatial resolution
 - Topic Area #5: Advanced modeling

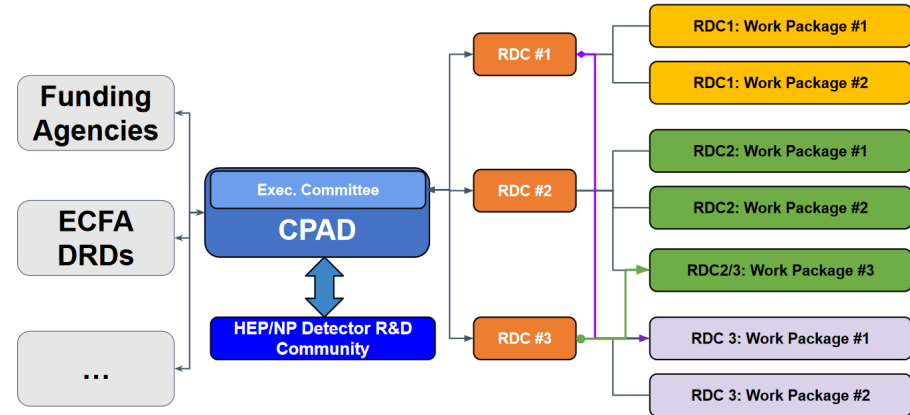
PRD	Thrust
PRD 18: Develop high spatial resolution pixel detectors with precise per-pixel time resolution to resolve individual interactions in high-collision-density environments	Thrust 1: Lepton colliders, requiring timing on the order of 10 ps; pixel pitch on the order of 10 microns Thrust 2: Hadron colliders, requiring timing resolution down to 1 ps to achieve HL-LHC-like pileup, in a high radiation environment (up to fluences in the order of $10^{18} n_{eq}/cm^2$)
PRD 19: Adapt new materials and fabrication/integration techniques for particle tracking	Thrust 1: Adapting non-silicon and novel-configuration sensors (diamond, large-bandgap semiconductors, thin film materials, nanotechnology, 3D sensors, new emerging materials) with new industrial partnerships Thrust 2: Development of readout electronics matched to new sensor characteristics, including new processing such as 3D-integration
PRD 20: Realize scalable, irreducible-mass trackers	Thrust 1: Highly integrated monolithic, active sensors Thrust 2: Scaling of low-mass detector system Thrust 3: Systems for special applications: space-based tracking detectors, and dedicated searches for rare processes and dark matter

Table 20 of BRN

- IF03-1 Develop high spatial resolution pixel detectors with precise per-pixel time resolution to resolve individual interactions in high-collision-density environments
- IF03-2 Adapt new materials and fabrication/integration techniques for particle tracking in harsh environments, including sensors, support structures and cooling
- IF03-3 Realize scalable, irreducible-mass trackers in extreme conditions
- IF03-4 Push advanced modeling for simulation tools, developing required extensions for new devices, to drive device design.
- IF03-5 Provide training and retain expert workforce to enable future tracking systems to be designed, developed, constructed and simulated.
- IF03-6 Nurture collaborative networks, provide technology benchmarks and roadmaps and funding in order to develop required technologies on necessary time scales, costs and scope.

Our vision of the scope of RDC3

- Future systems will be very challenging and require co-design at the early stages to reach the targets our physics goals demand
 - Silo'd designs which worked for the LHC and HL-LHC upgrades cannot work in our opinion
- In the long term, we would like to target larger work packages which will study the topic areas on the previous slide
 - Requires working closely with other RDCs and DRDs at the beginning
 - DRC4 (Readout and ASICs), DRC10 (Detector Mechanics), DRC11 (Fast Timing), ECFA DRD3 (Solid State), ECFA DRD7 (Electronics), ECFA DRD8 (Integration)
 - How we work with the ECFA DRDs is not clear but such collaboration is welcomed on both sides
 - In addition to the sensor elements themselves, we need to make sure we can read them out, support and service the full system.



Funding in the near term

- For the foreseeable future (next 2 years), there is no new earmarked funds within CPAD from the DOE for R&D
- The presentation of the P5 report at the Dec. 7-8th HEPAP may give some guidance.
 - How to fund our work and the split between the frontiers (R&D, Energy, Intensity,...) is not clear
- In the next year, only available path is in the FOA: DE-FOA-0003177, section 5F, page 63 for multi-institutional projects
- At the first RDC3 meeting, we were encouraged to promote:
 - Blue Skies proposals
 - Teams working together more: as in ~2-3 options of common submission to foundries for CMOS MAPs, more common submissions in LGADs and electronics for it
 - Holistic (non-silo'd) design and development
- Because of the above, we propose we pull together a few multi-institutional proposals for submission before September 2024 for Blue Skies or non-experiment specific general R&D for timing and MAPs