Coordinating Panel for Advanced Detectors (CPAD): Activities in 2024

Jonathan Asaadi & Jinlong Zhang

Who is CPAD

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DPF Instrumentation Award Committee

R&D Collaboration Conveners

RDC	Topic	Coordinators
1	Noble Element Detectors	Jonathan Asaadi, Carmen Carmona
2	Photodetectors	Shiva Abbaszadeh, Flavio Cavanna
3	Solid State Tracking	Sally Seidel, Tony Affolder
4	Readout and ASICs	Angelo Dragone, Mitch Newcomer
5	Trigger and DAQ	Jinlong Zhang, Zeynep Demiragli
6	Gaseous Detectors	Prakhar Garg, Sven Vahsen
7	Low-Background Detectors (incl. CCDs)	Noah Kurinsky, Guillermo Fernandez-Moroni, Daniel Baxter
8	Quantum and superconducting Detectors	Aritoki Suzuki, Rakshya Khatiwada
9	Calorimetry	Marina Artuso, Minfang Yeh
10	Detector Mechanics	Andy Jung, Eric Anderssen
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The American Physics Society (APS) and Division of Particles and Fields (DPF) Coordinating Panel for Advanced Detectors (CPAD)

CPAD Mission and Goals:

- The Coordinating Panel for Advanced Detectors (CPAD), seeks to promote, coordinate and assist in the research and development of instrumentation and detectors for high energy physics experiments.
- By helping to coordinate the development of both evolutionary and transformative detector instrumentation across the national laboratories and with the university community, CPAD works to ensure the future of high-energy physics experiments.

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It is out of these aspects of CPAD's mission and goals and the work of the Snowmass process which the concept of the formation of Research and Development Collaborations (RDC's) within CPAD was born

Snowmass IF Recommendations

IF-1 Advance performance limits of existing technologies and develop new techniques and materials, nurture enabling technologies for new physics, and scale new sensors and readout electronics to large, integrated systems using co-design methods.

IF-2 Develop and maintain the critical and diverse technical workforce, and enable careers for technicians, engineers and scientists across disciplines working in HEP instrumentation, at laboratories and universities.

IF-3 Double the US Detector R&D budget over the next five years, and modify existing funding models to enable R&D consortia along critical key technologies for the planned long term science projects, sustaining the support for such collaborations for the needed duration and scale.

IF-4 Expand and sustain support for blue-sky R&D, small-scale R&D, and seed funding. Establish a separate agency review process for such pathfinder R&D, independently from other research reviews.

IF-5 Develop and maintain critical facilities, centers and capabilities for the sharing of common knowledge and tools, as well as develop and maintain close connections with international technology roadmaps, other disciplines and industry.

These are where the CPAD RDC's come in

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Some critical aspects from the P5 report

The particle physics community has identified the need for stronger coordination between the different groups carrying out detector R&D in the US. We strongly support the R&D Collaborations (RDCs) that are being established and will be stewarded by CPAD, the Coordinating Panel for Advanced Detectors, overseen by the APS/DPF. The RDCs are organized along specific technology directions or common challenges, and aim to define and follow roadmaps to achieve specific R&D goals. This coordination will help to achieve a more coherent detector instrumentation program in the US, and will help to avoid duplication while addressing common challenges. International collaboration is also crucial, especially in cases where we want to have technological leadership roles. Involvement in the newly established Detector R&D Groups at CERN is encouraged, as are contributions to the design and planning for the next generation of international or global projects. Targeted future collider detector R&D in particular, such as for Higgs factories or a muon collider, is covered in Section 6.5.

The RDC's are in the P5 report as is participation in the CERN based Detector R&D (DRD's)

Principal Ideas behind the RDCs

Detector R&D in many different technology areas is essential to realize many of the future planned experimental efforts spanning all of the frontiers in High Energy / Nuclear Physics

Much of the efforts needed require **collaboration** and **coordination** in order to realize the technologies required

- **Collaboration**: The required expertise/resources/new ideas often live within multiple people, institutions, labs and only by bringing these pieces together can we hope to realize the technological challenges
- **Coordination**: We live in a resource limited funding environment and so we need efforts to be coherent, minimize duplication, and to build off of progress happening elsewhere (both in other technologies and in other places)

Principal Ideas behind the RDCs

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Collaboration

Where the RDC's can work to identify needed R&D, work together to assemble proposals, and aid in the execution of the work

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Coordination

This is what CPAD is meant to help provide and why these collaborations are being formed within our structure/charge

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R&D Collaborations (RDCs) - Status

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See the backup slides for details about each RDC

What will the RDC's do?

Long term goal:

- **Establish collaborations** which can link together facilities, expertise, people, and experience to tackle technology challenges across HEP/NP
- **Facilitate new funding** mechanisms for R&D related to a specific technology area which will take place as part of the collaborations' activities
- Work with the CPAD executive committee, ECFA DRDs, and the broader R&D community to **foster a collaborative, supportive, and coordinated environment for new ideas, blue sky efforts, and non-project specific R&D**

What will the RDC's NOT do?

The RDC's will NOT:

- **Discourage single/small team efforts in R&D**
  - We still need for individual PI's to be able to work in their labs on their favorite ideas and leave room for innovation and unexpected solutions
- **Break up existing organizations / structures**
  - We already have communities within HEP/NP which coordinate on specific technological challenges (e.g. HEP-IC) and we want to utilize/leverage these efforts and communities to help make the CPAD-RDC's successful
- **Discourage project specific R&D**
  - There is some R&D which will/has reach(ed) a level of maturity that it is time to realize it for a specific implementation and the RDCs should encourage this transition from generic to specific R&D

What CPAD has been doing in 2024 to jump start the RDC's

We started with what we had….

- **Long term: the aim is to have different supporting mechanisms for collaborative instrumentation R&D which may have its own dedicated Funding Opportunity Announcement (FOA) and dedicated (new) funding**
  - For FY2025 submission, this is not in place.
  - Therefore, we attempted to work with the community to start some of this type of collaborative R&D using the existing comparative review Funding Opportunity Announcement
  - In the future, the process by which CPAD RDC's work to put together these collaborative proposals will be different
    - This will also be informed by how well this year's process goes

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  - Structure: These should be university lead, multi-institutional proposals with a light-weight collaboration structure (not a structure like the very formal DRD collaborations)
    - These teams can include national labs
    - Where appropriate the multi-institutional teams should designate one lead institution with all other team members proposed as subrecipients.

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  - Scope: The proposals should focus on generic R&D (as opposed to project specific), ``blue-sky'' (having a high-risk high-reward outcome), and have limited but growing budget profile
    - The most important point is to develop the proposals with a strong and coherent technical scope
    - Very likely the most competitive proposals would have components that live in multiple RDC's and are coordinated by multiple RDC groups

What CPAD has been doing in 2024 to jump start the RDC's

- **Over the summer months, the RDC's collected a series of whitepapers and worked with the community to both foster new collaborations and to draw attention to existing R&D efforts**
  - There were some bumps along the way, but the community was largely supportive, open, welcoming and vocal!
  - The landscape also changed and evolved as new efforts, new coordination strategies, and new information about funding became available
    - We worked very hard to be agile with this as well
- **The RDC's collected ~34 whitepapers from across the community**
  - These whitepapers will be posted to the CPAD website
  - End of July we hosted a community workshop where we heard from a subset of these whitepapers (~15) on their proposed R&D (https://indico.fnal.gov/event/65448/)
- **Following the workshop the CPAD Executive Committee and the RDC coordinators worked with proponents to help the highest priority and best fit proposals (subject to 2024 constraints) to submit proposals to the DOE FOA**

Our rubric

Each whitepaper was scored based on a rubric (1-10) across eight different criteria to assess an overall score.

- **Alignment with instrumentation priorities**
  - (1 = Not Aligned at all, 10 = Perfect Alignment)
- **Generic vs Multi-application**
  - (1 = Very project/application specific with no other application, 10 = Very general with many other potential applications)
- **Blue Sky**
  - (1 = Incremental improvement on existing tech, 10 = High Risk and potentially transformational)
- **Cross-RDC Collaboration**
  - (1 = Only applicable to the primary RDC, 10 = High potential to collaborate with teams from many RDC)
- **Strength of the Team**
  - (1 = Weak/Unknown/Unclear Team, 10 = Exceptional Team)
- **Alignment with FY25 Budget Constraints**
  - (1 = Budget needed likely to WAY EXCEED ramped profile, 10 = Small budget for large potential impact)
- **Overall Importance in Instrumentation**
  - (1 = Even if wildly successful, little foreseen impact on the field, 10 = If wildly successful, paradigm changing)
- **Personal Preference**
  - (1 = Not Interested / Unimportant / Dislike, 10 = Exciting / Extremely Important / Strongly Like)

Note: Where RDC conveners had conflicts of interest, their scores were not considered for those whitepapers

Outcomes

There were **three whitepapers** which appeared in the top rankings across the various categories and were ranked at the top in the overall score and blue sky score

1. Smart Dust for Particle Tracking (RDC 4)
2. An exploration of high resistivity sub-kelvin Tc superconductors for particle astrophysics and cosmology detectors (RDC 8)
3. Development of Ultrafast Timing Detectors Using Wide Band Gap Semiconductor Materials (RDC 3)

There were **two additional white papers** which appeared in the majority of the top rankings

4. Development of Radiation Hard Ga2O3 Detectors for High Energy Physics (RDC 3)
5. Characterizing the Performance of Novel Charge Readout Structures in High-Pressure Gaseous TPCs (RDC 6)

Outcomes

Based on this, we communicated with the whitepaper proponents and put them in contact with the RDC coordinators to have them assist in preparing their proposals for the upcoming comparative review.

We communicated with our DOE program manager to make him aware of the process and outcome

We also had the RDC coordinators provide a letter of collaboration as part of their proposal which read:

Dear <Principal Investigator Name>,

If your application entitled, "<Application Name>," is selected for funding under the FY2024 Continuation of Solicitation for the Office of Science Financial Assistance Program, it is my intent to collaborate in this research by supporting the work via the Coordinating Panel on Advanced Detectors (CPAD) R&D Collaborations (RDC's) which has identified this work as an area of high priority and will help provide coordination, information about experts and facilities, and a monthly venue to highlight the progress made by members of the research team to the broader instrumentation community.

Thank you for the opportunity to participate.

Sincerely,

<Collaborator's Name and Signature Block>

Thoughts on the process….

- **At time of writing, we don't know the outcome of the comparative review, so we don't know how successful the process was on the outcome of the funding…**
- But, **funding isn't the only mechanism by which we can measure success….**
  - The process certainly generated a lot of discussion and opportunity for people to be made more aware of collaboration opportunities
    - The Microelectronics Science Research Center Projects for Energy Efficiency and Extreme Environments FOA saw significant coordination from RDC 4
    - New R&D collaborative efforts were started based on this process
    - We are also aware of RDC coordinators spending time working with proponents to help them bring the most effective version of their proposals forward
- **As new funding opportunities present themselves, the RDC's are also an effective way to communicate this, raise awareness, and hopefully have people prepared to address them with teams and ideas**
  - E.g. Defense Advanced Research Projects Agency (DARPA) Quantum Sensing of Neutrinos (QuSeN) program
  - Quantum Information Science Enabled Discovery (QUANTISED 2.0) for High Energy Physics saw significant coordination from RDC 8
  - Speaking only for myself, this coordination effort has certainly spurred forward my thinking and efforts to build collaborative bridges into new areas of research

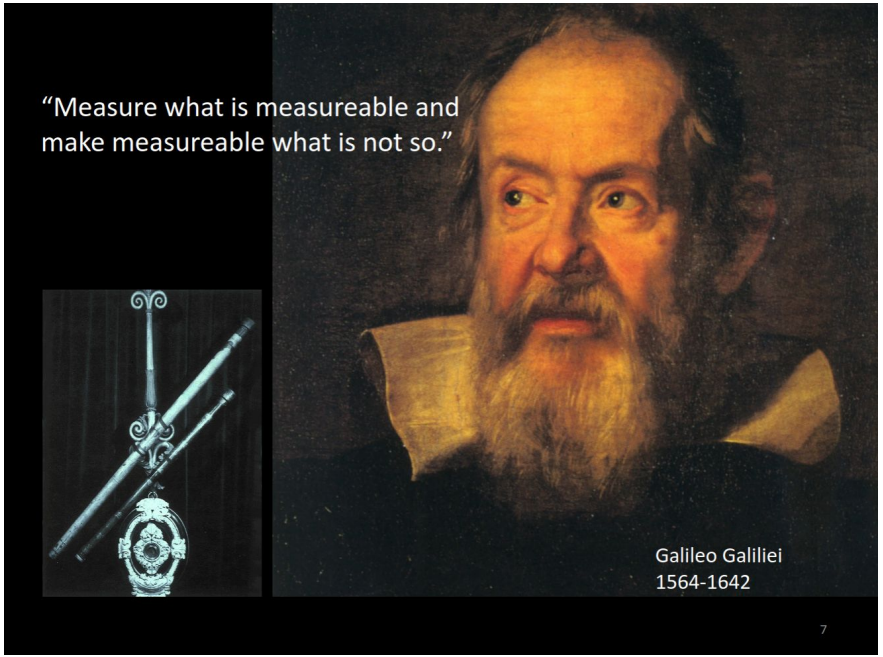
What will the RDC's be doing in 2025?

- **Answering this questions is part of what we hope can be done during this workshop.**
  - That said, parallel session are very full (thanks to the large participation of our amazing community), so finding time to discuss this in detail will be challenging
- **We are very interested in hearing from the community on how we can make CPAD and the RDC more effective as we await additional funding opportunities and vehicles for the various avenues of R&D**
  - Obviously a new administration makes it difficult to predict what the coming year(s) will look like
  - We have to remember that this is not a sprint! The successful sustainment and growth of instrumentation within HEP will require a tremendous amount of effort and willingness to engage
    - This willingness to engage with the process will need to be sustained even in the absence of large financial benefits.

All that said, we do believe in the **people** (CPAD and the RDC conveners), we believe in the **program** (with an extremely engaged PM from DOE), and **the mission** (the development of both evolutionary and transformative detector instrumentation across the national laboratories and with the university community)

To quote a former chair of CPAD….

“Make instrumentation a most attractive setting which provides a challenging environment, to develop, recruit, and retain the best and brightest throughout the world”



[Slides from Ian Shipsey’s 2017 CPAD Intro Talk]