R&D Collaboration #1
Noble Element Detectors

Jonathan Asaadi & Carmen Carmona

RDC 1: Noble Element Detectors

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- **Dedicated RDC Email List**
  - cpad_rdc1@fnal.gov
  - To subscribe:
    - Send an e-mail message to listserv@fnal.gov
    - Leave the subject line blank
    - Type “SUBSCRIBE cpad_rdc1 FIRSTNAME LASTNAME” (without the quotation marks) in the body of the e-mail message

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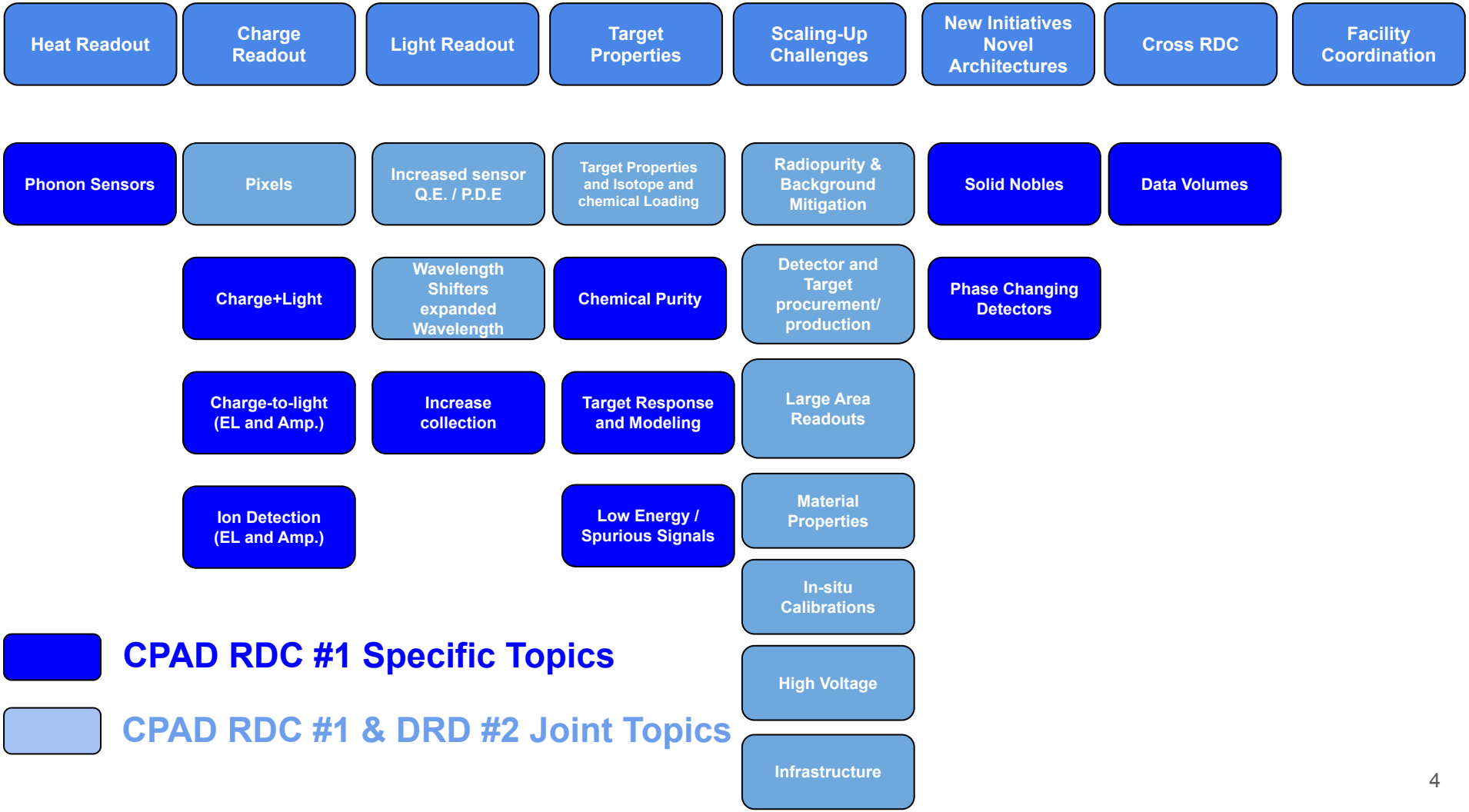
- **Areas of R&D Priorities:** In the broadest sense, these are rearticulations of the BRN 2019 report and Snowmass 2022 reports
  - **Topic Area #1:** Enhance and combine existing readout modalities
    - New ideas in charge detection
    - New ideas in light detection **(Overlap with RDC2)**
  - **Topic Area #2:** New modalities for signal detection
    - Going beyond the current paradigm just collecting electrons and photons
    - Enhancement in the electronics and readout of the detectors **(Overlap with RDC 4,5)**
  - **Topic Area #3:** Challenges in scaling technologies
    - Scaling of purification, radiopurity, doping, high voltage, and other target challenges

Broad Technical Topics for RDC1

Specific Work Package Topics

Individual Work Package Thrusts/Priorities
(Note: I don't have anything here)


Heat Readout
Charge Readout
Light Readout
Target Properties
Scaling-Up Challenges
New Initiatives Novel Architectures
Cross RDC
Facility Coordination
Phonon Sensors
Pixels
Increased sensor Q.E. / P.D.E
Target Properties and Isotope and chemical Loading
Radiopurity & Background Mitigation
Solid Nobles
Data Volumes
Charge+Light
Wavelength Shifters expanded Wavelength
Chemical Purity
Detector and Target procurement/ production
Phase Changing Detectors
Charge-to-light (EL and Amp.)
Increase collection
Target Response and Modeling
Large Area Readouts
Ion Detection (EL and Amp.)
Low Energy / Spurious Signals
Material Properties
In-situ Calibrations
High Voltage
Infrastructure
CPAD RDC #1 Specific Topics
CPAD RDC #1 & DRD #2 Joint Topics

A proposal for DRD2 and RDC1

- If we have parallel collaborations, parallel meetings, and parallel goals the community will remain fractured and the work will remain siloed
- If we build a heavy structure with CERN based efforts and US based efforts and multiply the number of meetings, presentations, reports, and documents the community will be unable (and unwilling) to engage

So, back in November 2023 we presented the idea at the annual CPAD meeting of essentially having DRD2 and RDC1 to act together as one group, with one set of meetings, and to "mirror" (as much as is possible) the areas of work

This idea was also given to DRD2 at their February Collaboration Meeting

- A large portion of DRD2 is already US based
- Many of the physics projects which drive the R&D in DRD2 are US based
- There is also a good background already in place for US/CERN collaboration on liquid noble detectors

There is much here that still needs to be figured out, but I think we started with a good faith discussion in Feb 2024 which we will hopefully expand on

Example open questions:

- Does everyone participating in RDC1 have to have an MOU with DRD2?
  - No, not necessarily. Only in places where direct collaboration with DRD2 will this make sense
- What about research efforts which only US institutions want to pursue (which are out of the scope of DRD2)?
  - Those should be pursued in the RDC context, but DRD2 is open to hearing about this and finding future opportunity to collaborate
- How do we work with "work packages" which involve multiple RDC's and DRD's?
  - Still not clear….lots in flux

RDC 1: Forming/Enhancing Collaborations

- **The primary goal of this, and future meeting, is to further collaboration and coordination amongst new and existing ideas in the Noble Element Community**
  - Where possible, connect ideas and people with resources and expertise which can help further along efforts and/or launch new efforts
  - This is an opportunity to do this outside of the normal “conference” paradigm and to give a platform to highlight R&D that sometimes gets missed or overlooked
- **Secondarily, the goals of this group is to build links to efforts that are happening in other places (e.g. CERN DRD2, other RDC’s, etc) to limit unnecessary duplication and help bring together groups who may not know they are working on the same problem**
  - This will be easiest within the CPAD RDC’s as we get a view of the priorities and efforts that are happening across CPAD
  - The next layer will be in collaboration with DRD2 (Liquid Detectors) which has the greatest overlap with RDC1
  - The more challenging level will be across other DRD’s…but we will work on this
- **Finally, we will work to promote collaborations working on high priority topics (work packages) to try to enhance funding opportunities for those efforts**
  - This effort looks a particular way for 2024
  - **We hope (expect) that this will evolve as the funding landscape evolves in the next few years**

Some thoughts on funding

- The P5 report gives us good reason to be optimistic about instrumentation and detector R&D support in the coming 10 years

HOWEVER,

- **The budget for FY24 is largely already settled, so this means there will be no new money in the upcoming funding period**
- **The budget for FY25 is also already in the process, so major changes are likely not going to be found there**
  - Small “adjustments” (moving money from one pot to another) might be possible, but again this (likely) won’t grow the pie significantly
- **This means it will be 2+ years before the funding profiles in the US begin to match the ambitions laid out in the P5 reports**
  - This is consistent with the previous P5 process
  - There are some “sunny” assumptions in the budget described where allocations become appropriations (e.g. the CHIPs act) which is by no means guaranteed
- **We should be prepared that this will be more like running a marathon and a lot less like running a sprint**
  - Any ambitions with US efforts should require small funding in the first years and then hopefully can grow to larger scale ambitions as new funding mechanisms become realized

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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
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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

A proposal for how this will work

- **The RDC #1 will work with the community and the other CPAD RDC's to converge on a few multi-institution proposals (only in 2024) from across all the RDC's to submit to the comparative review FOA**
- **The outcome of this process (which will only be the process in 2024), will be a few proposals identified as the areas of high priority research within the community**
  - **These proposals and priorities will be communicated with the community and the funding agencies**
- **The process will be clearly communicated, transparent, and have a clear and defined timeline**
  - Note: This doesn't mean that everyone in the community has to engage in it. The comparative review is open to any eligible PI who would like to submit any HEP detector R&D proposal

May 3 Meeting

- **We open submission for 2-3 page “white papers” from the community to ensure we gather input from any interested parties**
  - Many of the RDC’s have already started this process, we just need to collect this information in a “standard template” (see example here)
  - Your ideas should be communicated through the RDC coordinators
  - These “white papers” will be posted to CPAD RDC webpage
  - Period of submission is two months (May and June 2024)
  - We anticipate RDC coordinators are holding meetings between May and June to both advertise this process and work with proponents articulate their research
- **Early July 2024 we will hold a meeting and invite a large number (all?) of the white paper submitters to present their idea to the community and RDC coordinators will collect feedback and synthesize the proposals**
- **Late July 2024 the RDC coordinators and the CPAD Executive Committee will convene to encourage a few of these proposals**
  - These results are then posted on the CPAD website and we will work with proponents for proposal preparation to the comparative review

CPAD R&D Collaboration White Paper Template 2024

Title:
(Put your title here)
Institutions:
PI # 1 Name, Institution
PI # 2 Name, Institution
PI # 3 Name, Institution
…

Abstract:
(Explain what your R&D is and what are the outcomes if successful…. 2-3 paragraphs)

Collaboration:
(Outline the teams (who and where)

the collaboration structure (which institution is responsible for what),

and the links to the relevant CPAD RDC's (list the relevant RDC's and the match to their areas of research priorities))

Timelines:
(Give a rough outline of the timeline for the R&D with any known milestones or deliverables during the proposed 3(4) year funding period 2025 - 2028(9))

Links on the CPAD Website

2024 RDC Collaborative Proposals

For the 2024 Comparative Review, CPAD and the RDC's aim to put forward a small number of university lead, multi-institutional proposals focused on generic "blue-sky" R&D

To this end, we are open to submission of community lead "White Papers" which outline proposals for such consortia. These white papers will be used to help CPAD coordinate and promote groups intending to submit to the DOE Comparative Review in September 2024

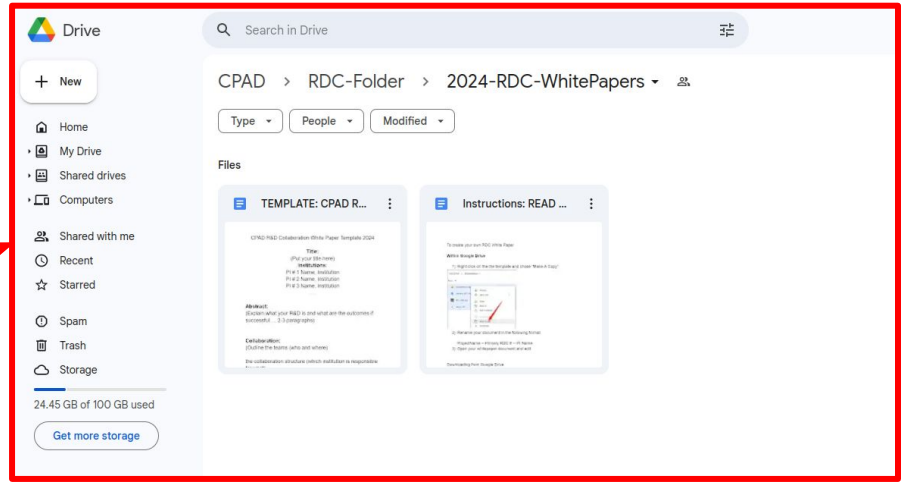
Relevant Links:

- **Comparative Review FOA:** https://science.osti.gov/hep/-/media/grants/pdf/foas/2023/DE-FOA-0003177-000001.pdf
- **2024 RDC White Paper Google Drive** https://drive.google.com/drive/folders/1b7HJZcH2vpf9Di_HSyruXDAP-zgzDo8o?usp=sharing
- **2024 RDC White Paper Template** https://docs.google.com/document/d/1cU7nccoCaFCvFRBffVfNVDLOSciNHzg0VR1ppNZmiRw/edit?usp=sharing

Link to CPAD RDC General Meetings

May 2024 RDC Community Meeting: Indico Link

July 2023 RDC Kickoff Meeting: Indico Link



https://cpad-dpf.org/?page_id=1549

Short-term action items

Take a look at the proposed white paper template and send comments or questions

a. Google Drive Folder: https://drive.google.com/drive/folders/1b7HJZcH2vpf9Di_HSyruXDAP-zgzDo8o?usp=sharing
   i. Note: People can only add/edit (not delete)
   ii. The drive folder is backed up automatically every 24 hrs
b. The goal is to have something light weight, which captures everything we will need to understand what the proposed collaborative research is without making people write a lot of text

Note: will collect a series of Google Docs in a Google Drive folder (no fancy database) with proper access

Conclusions

- **The US instrumentation community via CPAD is working to form collaborations to tackle the larger detector R&D challenges facing the HEP community**
- **It is my sincere hope that this can be done in collaboration and harmony with the CERN based DRD's**
  - Identifying key areas of overlap and looking for areas of opportunity will be a big part of this process
  - RDC 1 (Noble Element Detectors) and DRD 2 (Liquid Detectors) seem like there is an opportunity for natural alignment
    - You have an ally "on the inside" as I am playing a role in the DRD's, CPAD, and the RDC's
- **I hope the process can be done without a heavy hand, as the nature of this work is explorative, adaptive, and prone to failure (it wouldn't be R&D otherwise)**
  - Instead let us focus on bringing together the world experts to tackle some groundbreaking instrumentation. Let us bring together some of the cutting edge resources, processes, and collaborations to allow us to fulfill what only advances in instrumentation can do:

"Measure what is measurable, and make measurable what is not so"

We stand at a decade of HEP with immense ambition and challenge ahead of us to realize the next generation of facilities, detectors, sensors, and experiments which will light the way to the next major discoveries in physics