RDC6 Meeting Introduction

Sven Vahsen (Hawaii) and Prakhar Garg (Yale)

June 18, 2024

Context and goals for this meeting

Context/overview

- The CPAD RDCs are currently soliciting white papers (WPs)
- These WPs are intended to lead up to proposals and funding
- This year, funding via the comparative review, in future years via a new FOA
- Funding is limited, and there will be a down-select for WPs endorsed by CPAD
- Only a few White Papers across all RDCs can lead to funding
    - To have any chance of success, make sure WPs match guidance
- That said, all white papers are important, even those where funding is not sought this year
    - → help RDCs and CPAD coordinate / plan

Goals for meeting

- This talk:
    - a) Provide brief background info on RDCs
    - b) Clarify ongoing RDC White Paper (WP) process and timeline
    - c) Provide brief RDC6 background info
- Following talks: hear from white paper proponents

Part a: What are RDCs?

For context, I will show a few slides from a longer presentation by Jonathan Asaadi at the CPAD R&D Collaboration Community Meeting on May 3: https://indico.fnal.gov/event/64324/ (first talk)

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)

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Collaboration

Where the RDC's can work to identify needed R&D, put together work-packages, 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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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

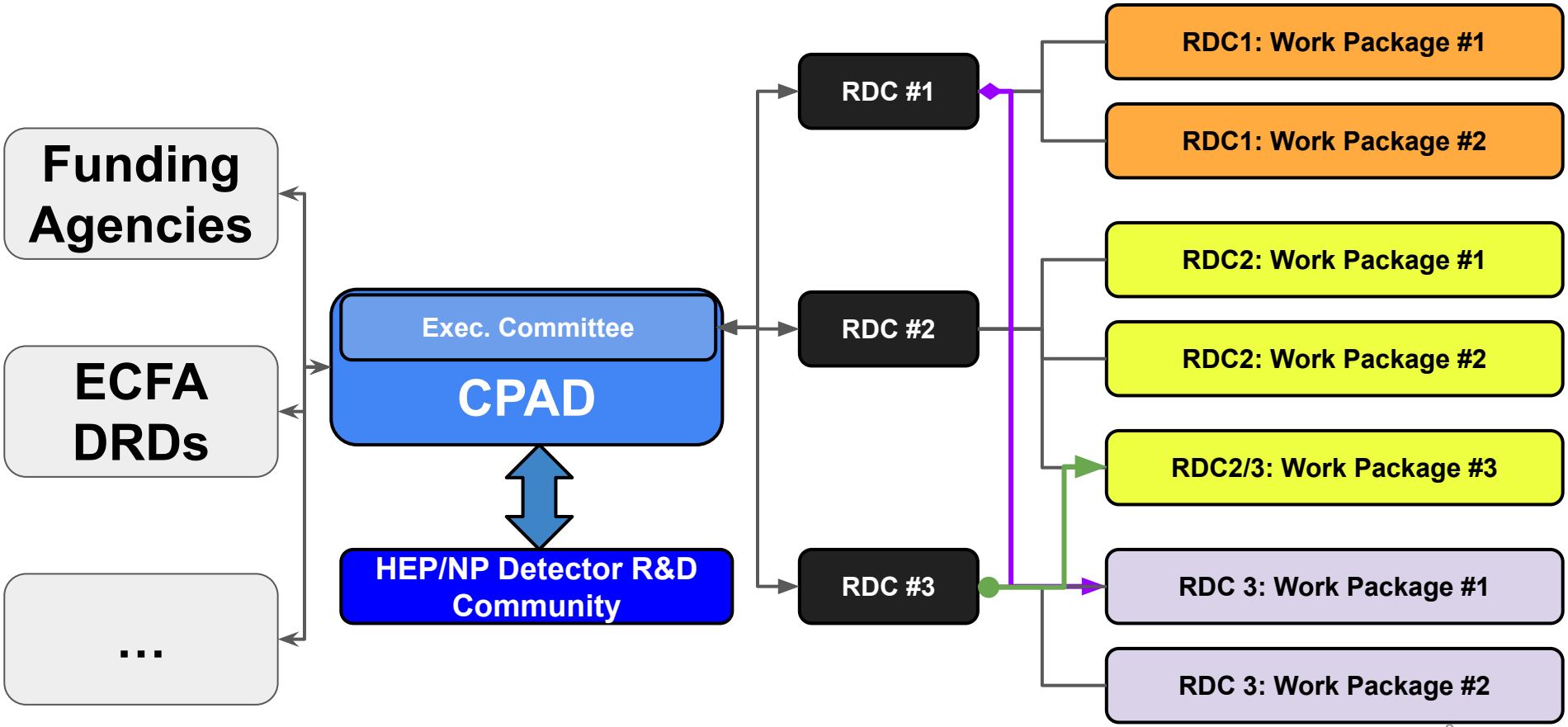
What will the RDC's NOT do?

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 is the envisioned structure (so far)

Jonathan Asaasi



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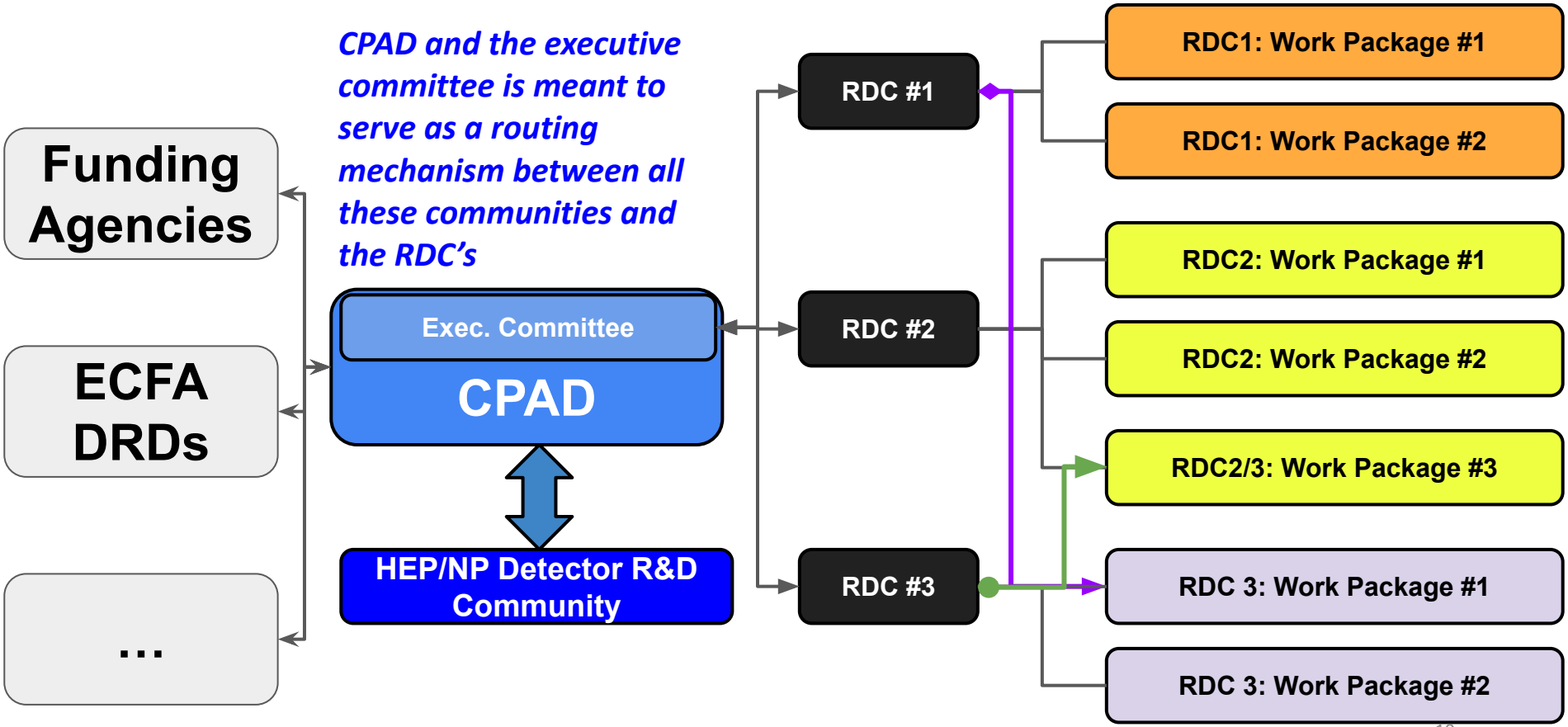

R&D Collaborations - Status

Jonathan Asaasi

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
11	Fast Timing	Gabriele Giacomini, Matt Wetstein

Part b: What are the White Papers being discussed?

For context, I will show a few slides from a longer presentation by Jonathan Asaadi at the CPAD R&D Collaboration Community Meeting on May 3: https://indico.fnal.gov/event/64324/ (second talk)

Some opening thoughts (I)

Jonathan Asaasi

- **<u>Long term:</u> 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 are going to attempt to work with the community to start some of this type of collaborative R&D using the existing comparative review FOA
  - 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

Some opening thoughts (II)

Jonathan Asaasi

- **A Reminder: At time of writing, there is no new funding available to the HEP budget for generic detector R&D. This means that new proposals for CPAD R&D collaborations (RDC's) that are to be submitted to the comparative review FOA need to be limited in number, structure, and scope.**

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  - Number: small; we expect that the RDCs and the community can converge on a few most suitable proposals for this year under these constraints
  - 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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  - 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.
  - 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

Some opening thoughts (IV)

Jonathan Asaasi

- **There will be a large number of great ideas, collaborations, and initiatives which won't fit into the constraints for this year's CPAD RDC proposals**
- **The constraints are number, structure, and scope**
  - e.g. An absolutely transformative sensor idea put forward by multi institutions which requires multi-million dollars in funding in year 1 to get started
    - *The 2025 comparative review FOA just isn't the right vehicle*
  - e.g. An existing technology which can be made 25% more efficient and improve the sensitivity of experiment X in 3 years
    - *While extremely important R&D, something like this is closer to "project specific" R&D and we are targeting other priorities for the RDC's*
- **We will continuously work with all the potential proposals to seek funding mechanisms, to give a venue to highlight this work to the community (via CPAD RDC meetings and engaging with the DRD's), and to promote their R&D**
  - ***Needless to say that the number and the scopes of the proposals to be supported will vary in the coming years when the funding situation changes***

A proposal for how this will work

Jonathan Asaasi

- **The RDCs will work with the community to converge on a few multi-institution proposals (only in 2024) from across the RDC's to submit to the comparative review FOA**
- **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
- **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**

May 3 Meeting

Jonathan Asaasi

- **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))

Jonathan Asaasi

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

Jonathan Asaasi

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

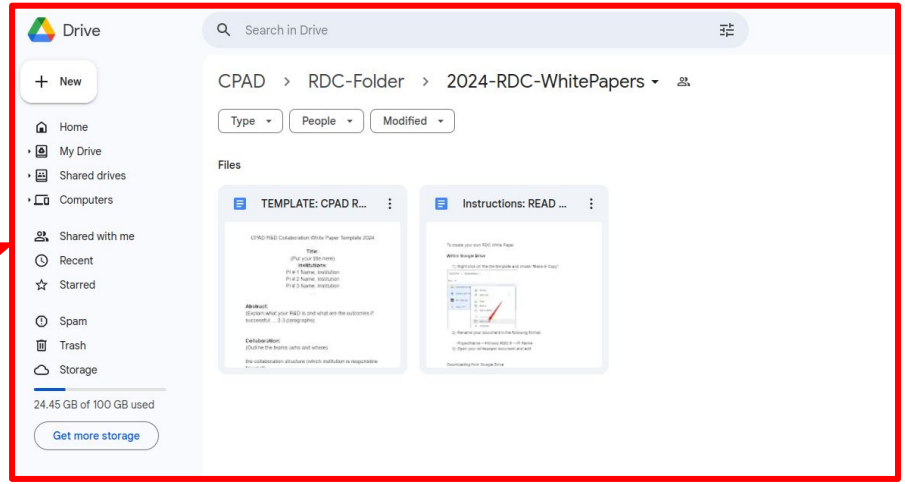
Relevant Links:

- **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

July Meeting

Jonathan Asaasi

- **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**
  - This is a one day virtual workshop
  - We expect active community feedback on these ideas, which will be collected and synthesized by RDC coordinators
- **Late July 2024 the RDC coordinators and the CPAD EC will convene to deliberate**
  - These results are then posted on the CPAD website, communicated with the community and the funding agencies
  - We will work with proponents for proposal preparation to the comparative review

Short-term action items

Jonathan Asaasi

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

Overview of Timeline

- **May 3:** Virtual Town Hall outlining RDC 2024 process
  - **We emphasize that this isn't the process for doing this in the future and instead is to get the ball rolling**
- **May - June:** RDC's are meeting and advertising and encouraging community to form proposals which match the constraints in number, structure, and scope.
  - A few, university lead, multi-institutional, generic ``blue-sky'' focused R&D with limited but growing budget profile
  - Proposal white papers are to be posted on CPAD website
- **Early July:** One day workshop where proponents can present their proposed collaborative research to the community
- **Late July:** CPAD RDC and EC meet to deliberate in line with key R&D priorities
- **July 31st**: LOI's submitted to DOE
- **Sept 4th:** Submission of proposals to DOE

Background on RDC6 topics

- RDC6 covers gaseous detectors (not just MPGDs)
- Past RDC6 topics of interest were previously solicited during
  - Snowmass,
  - at CPAD meetings
  - in a poll earlier this year

Snowmass

- 24 LOIs on MPGDs were submitted
- LOIs were distilled into five solicited White Papers
  - One additional White Paper has further detail
- Summarized in final Snowmass report(s)

	White Paper Topic	**White Paper Leads**
1	MPGDs: Recent advances and current R&D (and the European Strategy)	Klaus Dehmelt, Andy White
2	MPGDs for nuclear physics	Kondo Gnanvo, Matt Posik
3	Recoil imaging for directional detection of dark matter, neutrinos and BSM physics * Multi-frontier w/ CF1, NF10	Dinesh Loomba, Ciaran O'Hare
4	MPGDs for TPCs at future lepton colliders	Alain Bellerive
5	MPGDs for tracking and muon detection at future high energy physics colliders	Anna Colaleo, Kevin Black
6	A TPC-based tracking system for a future Belle II upgrade	Peter Lewis

Report of the Topical Group on Micro-Pattern Gaseous Detectors for Snowmass 2021

https://arxiv.org/abs/2209.05202

IF5 Key Points

Contributions to Snowmass

Five commissioned white papers on MPGDs were developed during the 2021 Snowmass decadal survey. These summarize R&D on MPGDs [1], the future needs for MPGDs in nuclear physics [2] and in three broad areas of particle physics: low-energy recoil imaging [3], TPC readout for tracking at lepton colliders [4], and tracking and muon detection at hadron colliders [5]. A white paper with further details on a proposed TPC tracker for Belle II was also submitted [6].

Key Points The IF05 topical group would like to communicate the following high-level findings to the wider particle physics community:

- **IF05-1**: Micro-pattern gaseous detectors (MGPDs) constitute an enabling technology that is key for large segments of the future U.S. NP and HEP programs, and which also benefits other communities. MPGDs provide a flexible go-to solution whenever particle detection with large area coverage, fine segmentation, and good timing is required.
- **IF05-2**: The technology is relatively young and should be advanced to performance limits to enable future HEP experiments. Support of generic and blue-sky R&D is required to achieve this.
- **IF05-3**: The global HEP community would benefit from U.S. strategy coordination with the ECFA detector R&D implementation process in Europe.
- **IF05-4**: In order to maintain and expand U.S. expertise on MPGDs, The U.S. NP and HEP communities would benefit strongly from a joint MPGD development and prototyping facility in the U.S.

how to map into work packages?

- Areas of R&D Priorities
  (based on Snowmass report, highly preliminary, biased, and non-exhaustive)

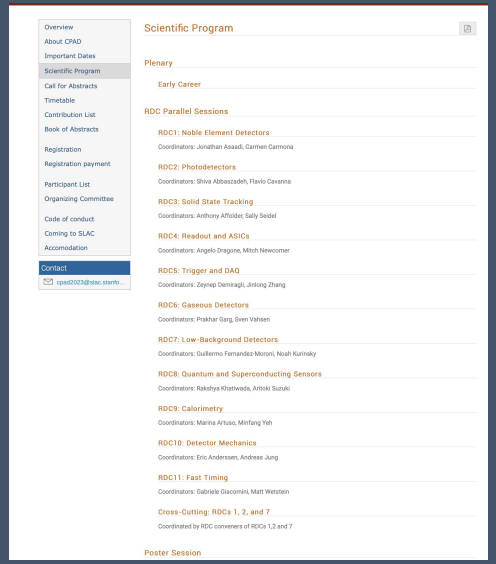
  - **Topic Area #1:** Advance gas TPC readout to performance limits, enabling new experiments
    (DM, neutrinos, existing and future lepton colliders, EIC)
    - Maximize sensitivity by achieving 3d single electron counting (incl. via negative ion drift)
    - Minimize background by developing radio-pure MPGDs
    - Develop matching, highly scalable front-end electronics and readout systems
    - Develop on-detector AI/ML and trigger-driven, highly multiplexed readouts

  - **Topic Area #2:** Advance MPGDs for high-background environments
    (Nuclear physics and future hadron colliders)
    - Develop cylindrical and exotic-shape tracking layers
    - Develop pico-second timing layers
    - Improve radiation hardness, rate capability, robustness against sparking and aging

  - **Topic Area #3**: Establish MPGD development/prototyping(/production) facility in the US

2023 CPAD workshop

- Scope widened to Gaseous Detectors



11:00	**MPGD as tracker for EIC** *51/3-305 - Kavli 3rd Floor, SLAC*	*Sourav Tarafdar* 11:00 - 11:15	
	sPHENIX TPC in the 2023 commissioning run *51/3-305 - Kavli 3rd Floor, SLAC*	*Evgeny Shulga* 11:15 - 11:30	
	Spark protection system for sPHENIX TPC GEMs *51/3-305 - Kavli 3rd Floor, SLAC*	*David Baranyai* 11:30 - 11:45	
	Digital RPC Gas Calorimetry for future colliders *51/3-305 - Kavli 3rd Floor, SLAC*	*Yasar Onel* 11:45 - 12:00	
12:00	**Compact TPC with TimePix Readout as a PID and tracking device** *51/3-305 - Kavli 3rd Floor, SLAC*	*Prakhar Garg* 12:00 - 12:15	

	Status and Future Developments of Micro-pattern Gas Detectors for low-energy nuclear physics applications at FRIB *Dr Marco Cortesi*		
	Gaseous Detector R&D aimed at Recoil Imaging *51/3-305 - Kavli 3rd Floor, SLAC*	*Sven Vahsen* 13:45 - 14:00	
14:00	**High-resolution gas TPCs for next-generation intensity frontier tracking** *51/3-305 - Kavli 3rd Floor, SLAC*	*Peter Lewis* 14:00 - 14:15	
	A Gaseous Argon-Based Near Detector to Enhance the Physics Capabilities of DUNE *51/3-305 - Kavli 3rd Floor, SLAC*	*Dr Tanaz Mohayai* 14:15 - 14:30	
	NEXT-CRAB-0: a high pressure gaseous xenon time projection chamber with a direct VUV camera based readout *Ilker Parmaksiz*		
	Machine Learning for Improved Analyses of High Resolution Gaseous Detector Data *51/3-305 - Kavli 3rd Floor, SLAC*	*Jeffrey Schueler* 14:45 - 15:00	
15:00	**First Light from the MIGDAL experiment: Results from Commissioning Data Using Fast Neutrons** *51/3-305 - Kavli 3rd Floor, SLAC*	*Elizabeth Tilly* 15:00 - 15:15	
	Overview and Status of DRD1 in Europe *51/3-305 - Kavli 3rd Floor, SLAC*	*Maxim Titov* 15:15 - 15:30	

RDC6: Gaseous Detectors

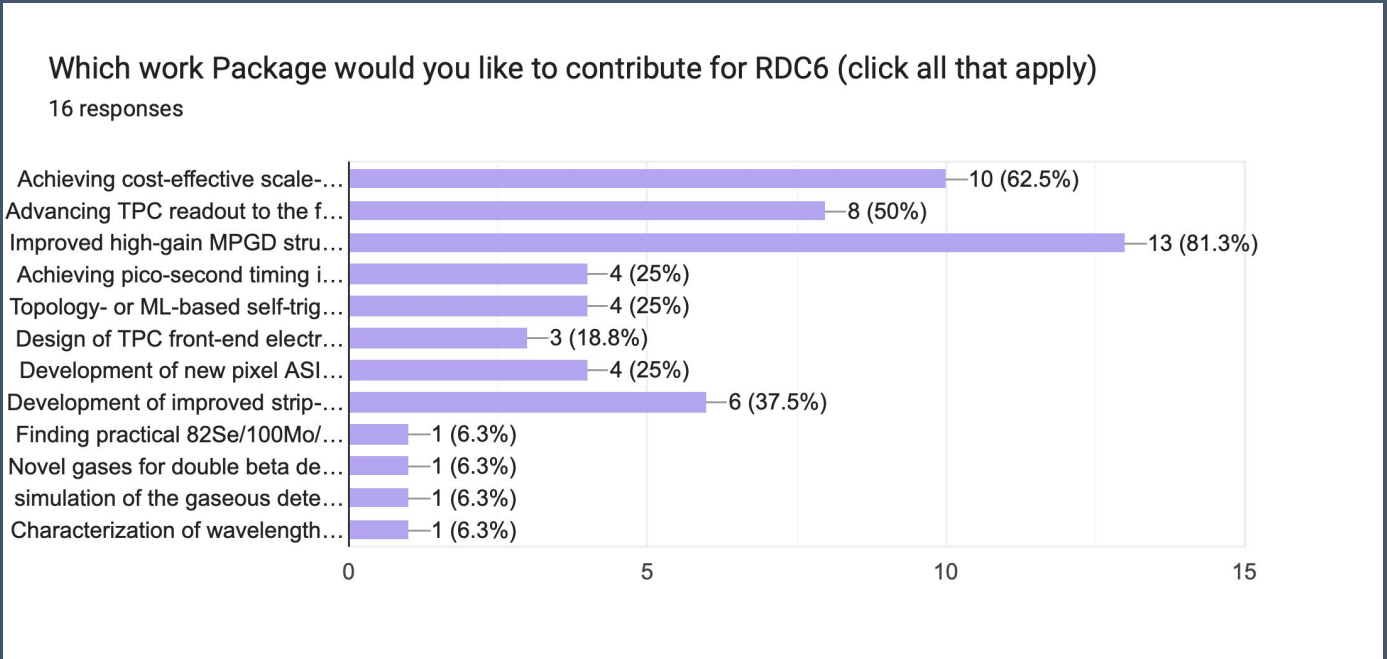
Prakhar Garg
Sven Vahsen

RDC6 Concluding slide at CPAD 2023

- 13 abstracts, 2 parallel sessions, 1 awards talk
- We plan to not replicate the large DRD1 structure in the US.
- Rather, we want to prepare work packages where US groups have specific expertise and strong interest, and then integrate these packages into the DRD1 plans.
- There are some obvious synergies between RDC6 groups working in different fields. For example, highly segmented MPGD-based charge readout schemes are foreseen at DUNE near detector, rare event searches, and at future collider detectors in HEP and NP.
- While specific work packages need proper discussion by the whole RDC6, preliminary ideas floated include:
  1. “Advancing gaseous TPC readout to the fundamental sensitivity limit”
  2. “Improved MPGD structures for nuclear physics and challenging environments” (for gases w/o quencher, negative ion drift, high charge density)
  3. “Achieving cost-effective scaling of gaseous TPCs“
- We will organize meetings to converge on 2-3 highest-priority work packages.
- Meetings will (only) be announced to the RDC6 mailing list. Sign up now! https://cpad-dpf.org/?page_id=1549

Results from subsequent poll

Only 16 responses…



Final Guidelines Regarding Suitable WPs

- Most urgent: reach consensus on a few high-priority work packages to be described in WPs
  - More than one CPAD supported and funded RDC6 white paper this year may be unrealistic, considering funding constraints
  - Other WPs still important for expected new FOA in 2025
- Our guidance on topic
  - Should reflect strengths and desires of active US R&D community
  - Not replicate project-based efforts, but think more broadly and ambitiously
  - Blue sky R&D
  - Collaborative [collaborate within RDC6 and with other RDCs]
  - Probably NP white papers should span HEP as well [given that FOA is HEP?]
- WP Format: follow template - ~ 3 pages
- Some important activities may not be suitable for the current funding scheme, but we are still interested in WPs
  - Example: the push for a DOE (NP+DOE) MPGD production facility or exploration of industrialized production
- We will briefly look at 10 ideas for possible white papers today. We will benefit from consolidating efforts whenever possible.

Possible white paper topics

1. Novel materials for gaseous detectors
2. Machine learning on and near the front end
3. GridPix/Twingrid/Gating
4. Advancing low-energy TPC readout to the performance limit
5. Achieving cost-effective scaling of gaseous TPCs
6. Characterizing the Performance of Novel Charge Readout Structures in High-Pressure Gaseous TPCs
7. Advanced gas amplification structures
8. Picosecond timing (photocathode onto CERN micro-RWELL)
9. US manufacturing of MPGDs

BACKUP

24 LOIs on MPGDs were submitted to Snowmass (links below are clickable)

https://atlaswww.hep.anl.gov/snowmass21/doku.php?id=instrumentation:mpgd

1	CF/SNOWMASS21-CF1_CF0-NF10_NF4-IF5_IF4_Vahsen-189.pdf	31/08/2020
2	EF/SNOWMASS21-EF3_EF4-IF3_IF5-031.pdf	06/08/2020
3	EF/SNOWMASS21-EF4_EF0-AF3_AF0-IF3_IF5_Graham%Ilison-119.pdf	30/08/2020
4	IF/SNOWMASS21-IF2_IF7_IF3_IF4_IF5_IF6-056.pdf	29/08/2020
5	IF/SNOWMASS21-IF3_IF5-EF1_EF4-183.pdf	01/09/2020
6	IF/SNOWMASS21-IF3_IF5_Simone_Mazza-175.pdf	31/08/2020
7	IF/SNOWMASS21-IF5-005.pdf	27/07/2020
8	IF/SNOWMASS21-IF5-EF4-007.pdf	07/08/2020
9	IF/SNOWMASS21-IF5_CF2_AF5_Ferrer-Ribas-020.pdf	27/08/2020
10	IF/SNOWMASS21-IF5_IF0-057.pdf	30/08/2020
11	IF/SNOWMASS21-IF5_IF0-184.pdf	01/09/2020
12	IF/SNOWMASS21-IF5_IF0-193.pdf	08/09/2020 late
13	IF/SNOWMASS21-IF5_IF0_Brunbauer-096.pdf	31/08/2020
14	IF/SNOWMASS21-IF5_IF0_C.Lampoudis-099.pdf	31/08/2020
15	IF/SNOWMASS21-IF5_IF0_Gnanvo_Hohlmann_Posik_Surrow-044.pdf	28/08/2020
16	IF/SNOWMASS21-IF5_IF0_Kondo_Gnanvo-150.pdf	31/08/2020
17	IF/SNOWMASS21-IF5_IF0_M_Hohlmann-040.pdf	28/08/2020
18	IF/SNOWMASS21-IF5_IF0_Marco_Cortesi-103.pdf	31/08/2020
19	IF/SNOWMASS21-IF5_IF3-015.pdf	24/08/2020
20	IF/SNOWMASS21-IF5_IF6-EF4_EF0_COLALEO-068.pdf	30/08/2020
21	IF/SNOWMASS21-IF5_IF9-EF0_EF8-108.pdf	31/08/2020
22	IF/SNOWMASS21-IF6_IF5_Laktineh-Calice-050.pdf	29/08/2020
23	IF/SNOWMASS21-IF7_IF5_H.MULLER-101.pdf	31/08/2020
24	IF/SNOWMASS21-IF8_IF5-NF10_NF0_Ben_Jones-070.pdf	30/08/2020

Links to White Papers

- K. Dehmelt, A. White, M. Alviggi, M. T. Camerlingo, V. Canale, V. D'amico, M. DellaPietra, et al. ”MPGDs: Recent advances and current R&D“, arXiv:2203.06562 [physics.ins-det] (pdf).
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