2023 CPAD Workshop
Summary and Closeout
Overall Workshop Stats

246 in person participants
  - 33 remote
  - 54 students
33 parallel sessions with 191 presentation
20 plenary presentations
29 posters
RDC1: Noble Element Detectors

- 5 sessions (3 RDC1, 1 joint RDC1/RDC2/RDC7, 1 joint RDC1/RDC4), 24 presentations + 5 posters
- List of work packages already identified. Based on DRD2, but more packages added to adapt to US groups:
  - Heat Readout: Phonon Sensors
  - Charge Readout: Pixels; Charge+Light; Charge-to-light (EL and Amp.); Ion Detection (EL and Amp.)
  - Light Readout: Increased sensor Q.E./P.D.E; Wavelength Shifters/Expanded Wavelength; Increase Collection
  - Target Properties: Properties and Isotope and chemical; Chemical Purity; Target Response and Modeling; Low Energy / Spurious Signals
  - Scaling-Up Challenges: Radiopurity & Background Mitigation; Detector and Target Procurement/production; Large Area Readouts; Material Properties; In-situ Calibrations; High Voltage; Infrastructure
  - New Initiatives/Novel Architectures: Solid Nobles; Phase Changing Detectors
  - Cross RDC: Data Volume
  - Facility Coordination
- We will plan regular meetings
RDC2: Photodetectors

- 3 sessions (2 RDC2, 1 joint RDC1/RDC2/RDC7) 20 oral and 9 poster
- List of work packages already identified:
  - **Innovative photosensor breakthrough:**
    - Blue skies research aiming to advance single photon detection, VUV sensitive, tunable spectral sensitivity, high granularity and fast timing, radiation tolerance and large area capability.
  - **Large Area Photodetector Systems and Scalability:**
    - Project-specific Research and Development (R&D) for Large Area Photodetector Systems, integrating photo-sensors with advanced readout technologies. Photodetector integration and deployment (overlap with RDC1, 4, 5, 10, 11)
- Planned quarterly meetings
  - Started a shared google drive to coordinate different universities lab capabilities, facilities to identify existing and potential areas for collaboration:
    https://docs.google.com/presentation/d/1_5JCRbVtqJjkyK7p3A7z8Z8cLZ3TKLlokJd_7cvs-M/edit?usp=sharing
  - Will send out survey to identify potential topics for virtual workshop
RDC3: Solid State Tracking

- 3 sessions (1 RDC3, 1 joint RDC3/RDC4, 1 joint RDC3/RDC11), 17 presentations + 1 poster
- List of work packages already identified
  - First suggested work packages based on BRN/Snowmass will need refinement based on community inputs in the near future:
    - Topic Area #1: Adapting non-silicon and novel-configuration sensors
    - Topic Area #2: Scalable, low-mass detector systems
    - Topic Area #3: Trackers for Lepton Colliders
    - Topic Area #4: Trackers for Hadronic Colliders
    - Topic Area #5: Advanced modeling
- Planned regular meetings or workshops
  - Plan general quarterly meetings across the whole workpackage
  - Additional ad-hoc meetings will be necessary to define and follow cross RDC work packages
- Next steps to get towards September 2024 FOA
  - At least 2 “Blue Skies” joint university-national lab partnerships presented
  - Larger cross RDC work package possible based on MAPs and LGAD technologies based on the critical mass of presentation (see next slide)
RDC3/RDC4/RDC10/RDC11 Tracking Work Packages

Common Projects:

- In the short term, we need special meeting in order to define tracking work package across RDCs
  - Do we have central proposals and a set of proposals?
  - Need roadmap technical milestones which are iterative and allow parallel development paths
- Understand the interaction with ECFA DRD3/DRD7 based on the understanding of what the US want to do
  - Do we work collaboratively, in competitions, or divide up needed developments?

MAPs-based trackers

- Do we target general e+e- where most of current activity is OR by even more inclusive (muons/hh/blue sky ideas)?
  - What are the sensor sizes, scale of tracker?
  - What are generic specifications? Are there particular options we need to consider (like power-pulsing for LCs)?
- Do we want to include all system aspects or pick specific elements: some potential items brought up in presentations include pixel matrix, data/command systems, power management, services, mechanics

LGAD-based trackers

- Is there a common general target we can work towards?
- How to we coordinate the ASIC, sensor and system elements?
- Is there common system aspects we want to address as a community?
RDC4: Readout and ASICs

- **57 abstracts, 27 cross RDC abstracts**  4 Sessions, 4 combined sessions
- WP structure will consist of a portfolio of thrusts under an overarching theme. Members will share knowledge and build on shared results to define blue sky goals. Each work package will have a workforce training component.
- WP’s yet to be finalized the ones below indicate thrust. (we will need to interface with DRD7 and understand which projects are collaborations and which are independent thrusts)
  - Front End Control/Readout techniques  TBD & likely merged with other RD’s  Calo Tracking Photon systems
  - Tracking Readouts Feature Extraction for AC strip interpolation  4D Maps
  - Calorimetry readout…  5D detectors  SiPM on tile  eFPGA or SMART processing on detector
  - Fast Timing readout…  Clock/Calib distribution on detector through to ASIC front end
  - HEP relevant Extreme environment models and digital libraries for ASICs
  - Sub 65nm and smaller  SOC universal building blocks design/develop/submit/test/document for future chips
  - High Rate Data Management (Big Data)
    - Aggregation of on Detector Data
    - Data Driven routing
    - Rate/Power optimized Drivers/Receivers
  - Workforce Training & Support -> Contribute input to a more horizontal service under a different umbrella.
    - Mentored ASIC Project led by trainees
    - Instrumentation Specific Certificates/degree programs at Universities
  - Intelligent Data processing (ASICs and Electronics)
    - eFPGA
    - AI/ML
    - Edge Computing
  - System Interfaces
    - Interconnect technologies
  - Powering/Management < may distributed into Front End Readout specific Topics
  - Future … System/Sub-system Aware Design/verification/project organization

- We will keep collecting input from the community until November 30th
- Planned regular meetings or workshops follow up with RDC 1, 9, 3, 11
  - Intention agreed Schedule TBD
- Next steps to get towards September 2024 FOA - Organize projects under Work Package Topics
RDC5: Trigger and DAQ

- 11 abstracts, 2 sessions
- Work packages being discussed
  - Intelligent data reduction and processing (with RDC4)
    - Real-time / low-latency data reduction and feature extraction
    - Fast artificial intelligence and neuromorphic computing on real-time hardware
  - Link technology (with RDC4)
    - High-bandwidth, rad-hard, low-power optical link (>50Gbps)
    - Wireless readout
  - Integrating modern computing architecture and emerging technologies
  - Self-running DAQ system
  - Timing distribution with picosecond synchronization (1ps over 1 km) (with RDC4)
- Regular meetings being planned to further develop the work packages
- Aim consortium proposal(s) to respond September 2024 FOA

Zeynep Demiragli
Jinlong Zhang
RDC6: Gaseous Detectors

- 13 abstracts, 2 parallel sessions, 1 awards talk
- We plan to not replicated 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
RDC7: Low-Background Detectors

- 26 abstracts w/ 23 presentations and 2 posters across 2 (+2 joint) sessions
- Infrequently-held meetings on Tuesdays at noon EST
  - Get on RDC7 mailing list to know when one is happening
- Work with RDCs 1/2/8 to distill suggestions into a viable number of WPs and collaborations to move forward
  - Clearly need to break up WP7 into smaller pieces, some of which may get absorbed into RDC8
  - Some identified WP’s are under-represented at CPAD2023

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RDC8: Quantum and Superconducting Sensors

● Wide range of interests
  ○ 30 abstracts, 6 sessions, 1 joint sessions with RDC 7
  ○ 5 subgroup talks w/ discussions, 2 round table discussions, 24 contributed talks

● Planned meetings: ~(bi)monthly meetings to discuss work packages
  ○ Mailing list + Slack (?) communication
  ○ Second survey (collaborate with RDC7?) to gather more information

● Workshops (to be confirmed through second survey)
  ○ Best practices for cryostat setup → handbook → summer school?
  ○ Amplifiers: How to meet demand by the community. Spec, supply, test facility
  ○ Simulation packages: Share how packages such as G4CMP, COMSOL, HFSS are used

● Work packages
  ○ Review BRN. Update with the latest developments and inputs
  ○ Set milestones → map work package ideas on to it
  ○ Collect ideas through discussions and surveys
RDC9: Calorimetry

- 24 abstracts, 2 sessions, and 1 round table discussion
- List of work packages already identified
  - New materials for calorimetry: Scale-up material (liquid scintillators and water-based liquid scintillators) and Inorganic crystals/glass that are bright, fast, rad hard, dense-UV transparent, and cost-effective
  - Optical coupling and light extraction (WLS)
  - Photon detectors
  - Front-end electronics needs for high energy resolution and picosec timing calorimetry
  - System aspects (mechanical for low mass support & cooling; (electronics) for powering scheme & interconnections; (data processing) for intelligent calorimeter
  - Concepts from the above lines of investigation adapted to hadron identification (TOF, RICH…)
- Infrastructure needs to support our work: improvement of simulation packages with respect to GEANT; Test beam for near-future; and early career support.
- Planned regular meetings or workshops: continue monthly community meeting and cross-RDCs conversations
- Next steps to get towards September 2024 FOA
  - Identify R&D drivers; open for community inputs/comments; final report posted in August
RDC10: Detector Mechanics

- 11 abstracts, 6 Presentations, 3 Joint, +3 Posters, 2 sessions
- List of work packages already identified
  - Will solicit work packages in community survey.
  - Likely to include ‘Ultra-low mass support’, Cooling, Services--intend to grow
- Planned regular meetings or workshops
  - Kick-off meeting in January with initial monthly/bi-monthly meetings to establish and build a community
  - Occasional joint meetings with other RDC or RDC WP with similar cross-cutting needs.
  - DRD Kickoff in December (shared interests at CERN), and FTDM in May 2024 at Purdue
- Next steps to get towards September 2024 FOA
  - Circulate community survey in coming days
  - Identify cross-cut work-packages identified in other RDC’s
  - Grow and diversify mechanics community to reach beyond typical Tracking detector mechanics subjects relevant to other RDC's e.g. cryo, materials
RDC11: Fast Timing

- One session pure RDC11 (4 talks), two 3/4/11 sessions: one with 7 talks about LGADs, one with 5 talks on MAPS. Other talks could fit.
- Work packages:
  - Clock distribution and sync
  - LGADs
  - LAPPD
  - TOF/PID techniques
  - Non-silicon/new materials fast sensors
  - MAPS (3D, monolithic LGADs)
  - ASICs (fast digitizer, ...)
- Online meetings every second month + one in person - next meeting in early December (TBA next week)
- Next steps to get towards September 2024 FOA:
  - Coordination with other RDCs
  - Collect inputs from parties
Transversal Forum on Training and Workforce

- Discussions throughout this week indicated it might be useful to create a transversal forum dedicated to training and workforce development
- Mandate could include:
  - Assisting the RDCs with including training aspects in their work packages and in funding proposals
  - Organization of instrumentation schools, perhaps adjacent to CPAD workshop? Or enhancement of existing school
  - Increased training collaborations funded through DOE Traineeship funds
  - Assist with networking between institutes participating in RDCs to match students and supervisors at labs
  - Etc.
- Need to find volunteers who want to take this on
Workshop Banquet
Thanks to the Local Organizing Team for a great Workshop!

Contact cpad2023@slac.stanford.edu and we will help!

LOC Contacts:
- Noah Kurinsky
- Sander Breuer
- Lorenzo Rota
- Caterina Vernieri
- Kelly Stifter
- Chelsea Bartram

THANK YOU TO OUR INDUSTRY PARTNERS:

Thanks to our admins for making this happen: Jack Heyer, Samantha Thurman, Martha Siegel, Maria Herraez, and Glenna Paige
CPAD 2024
Knoxville, Tennessee

The University of Tennessee
Knoxville

Oak Ridge National Laboratory
CPAD 2024 in Knoxville, Tennessee

At University of Tennessee Knoxville (UTK)
  • In beautiful downtown Knoxville
  • Right next to the Great Smokie Mountains

Around November to December 2024 (tbc)
  • Dodging the college football schedule...

Co-hosted by UTK and ORNL:
  • Tova Holmes (UTK)
  • Lawrence Lee (UTK)
  • Mathieu Benoit (ORNL)
  • Friederike Bock (ORNL)
  • Marcel Demarteau (ORNL)
  • Oskar Hartbrich (ORNL)

Hope to see you there!
Thanks for your participation and have a safe trip home!