

CPAD Review - GEC's perspective

Grace E. Cummings

CPAD - A quick reminder of what it is

- **C**oordinating **P**anel for **A**dvanced **D**etectors
 - <https://cpad-dpf.org/>
- Relevance (beyond the obvious) to current P5 climate
 - Creating “research collaborations” for detector R&D
 - Goal → Create “work packages” that can become funding proposals
- Workshop at SLAC this year



Think the European DRDs
but American

CPAD
Workshop

CPAD Workshop 2023

Nov 7 – 10, 2023
SLAC
America/Los_Angeles timezone

Enter your search term

The banner features a red background with a white grid of circles on the left. The text 'CPAD Workshop' is in large white font. Below it, 'CPAD Workshop 2023' is in smaller white font. At the bottom left, the dates and location are listed. At the bottom right, there is a search bar with the text 'Enter your search term' and a magnifying glass icon. The background image shows a person in a white lab coat and mask working with a piece of equipment.

<https://indico.slac.stanford.edu/event/8288/>

The Question on Everyone's Mind - Funding

- Helmut rified for about 10 minutes on the DOE/Office of Science's perspective
- Good news - he wants BLUE SKY
 - the bluer the better
 - He asked that we help in this, and be kinder to blue sky proposals *as reviewers*
- Bad news
 - funding basically allotted for now until ~2025
 - Open proposals in FY24 only for universities
- News
 - Trying to update the funding schemes to allow for better national lab/university collaboration



CalVision Contributions



Progresses of Inorganic Scintillators for Future HEP Calorimeters

Liyuan Zhang and Ren-Yuan Zhu

California Institute of Technology

November 8, 2023

Presentation in the CPAD Workshop 2023, SLAC

Ren-Yuan Zhu, CalTech

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#33-progresses-of-inorganic-sci>

Dual Readout Calorimetry



Bob Hirosky and Grace Cummings

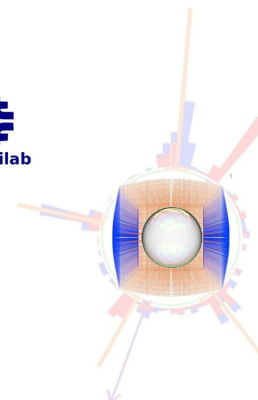


Fermilab

for the Calvision Team

CALVISION co-PIs

Alberto Belloni	Harvey Newman	Andreas Jung
Chris Tully	Ren-Yuan Zhu	Marcel Demarteau
Sarah Eno	Jim Hirschauer	Phil Harris
Bob Hirosky	Hans Wenzel	Jim Freeman
Sergei Chekanov	Jianming Qian	Shuichi Kunori
Steve Magill	Bing Zhou	
Nural Akchurin	Junjie Zhu	



Nov-2023

CPAD Workshop

Bob Hirosky, UVa

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#201-dual-readout-calorimetry-w>

CalVision Contributions



Progresses of In
for Future HE

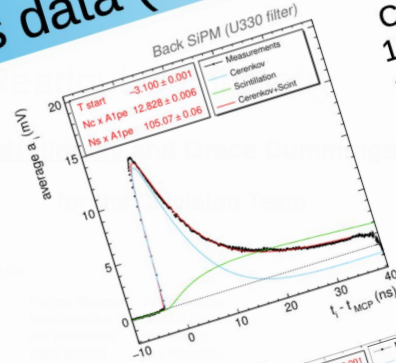
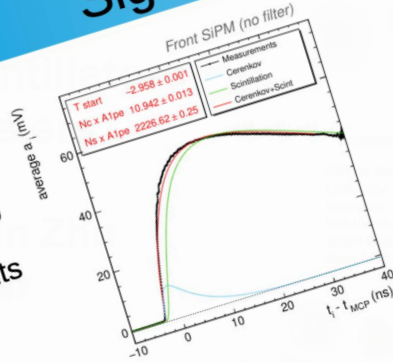
Liyuan Zhang and
California Institute
November 8

Presentation in the CPAD Works

Ren-Yuan Zhu
<https://indico.slac.stanford.edu/event/8288/timetable/?page=1&category=organic-sci>

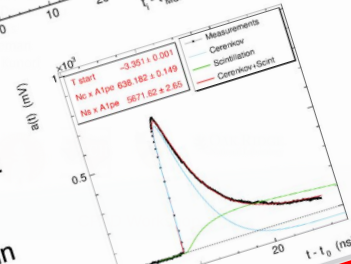
Signal analysis data (BGO)

Fits to
average MIP
signal using
two
components



Correcting for
1PE amplitude
~0.6mV yields
Order of
<20>PE/MIP

Example of showering event
• ~50 MIPs
• Order of a few GeV E loss
• Best fit result ~1k photons in
C component of fit



Very encouraging!

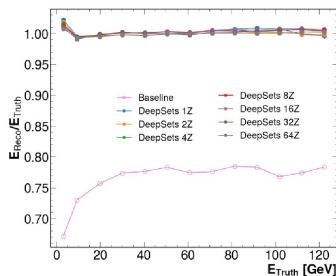
A. Ledovsky 18

First results from a
showering events in BGO!

CPAD Workshop

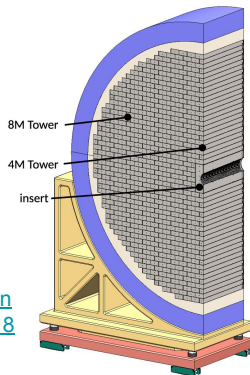
Calorimetry Overview - RDC9, EIC SiPM-on-tile HCALs

ML assisted energy regression!



Ryan Milton, UC Riverside,
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#123-the-optimal-use-of-segment>

Oskar Hartbrich, ONL
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#180-the-lfcal-forward-hadroni>

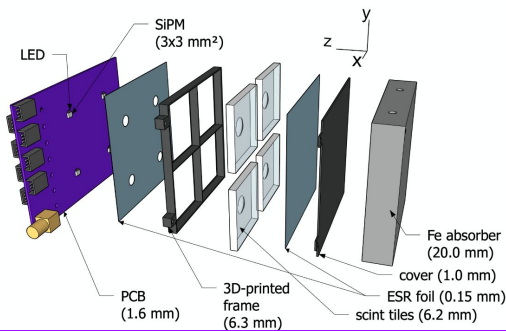


High Granularity LFHcal design and beam tests - HGCROC readout

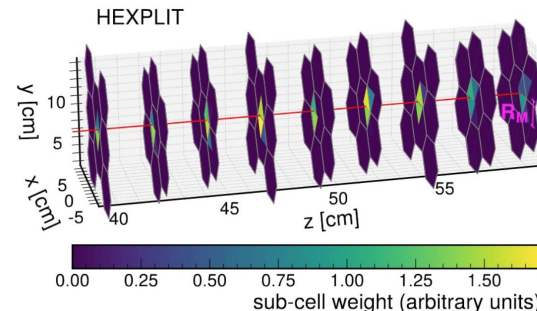
Hexagonal Tiles for higher light yield and stuff



Miguel Arratia, UC Riverside
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#242-sipm-for-the-tile-calorime>
 Miguel Rodriguez, UC Riverside
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#4-studies-of-time-resolution-1>



Neutron Shower position in EIC ZDC w/ staggered hexagons



SiPM-on-tile Beam test at JLab! Hall D, 4 GeV Positrons

Weibin Zhang, UC Riverside,
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#2-beam-test-of-the-first-prototype>

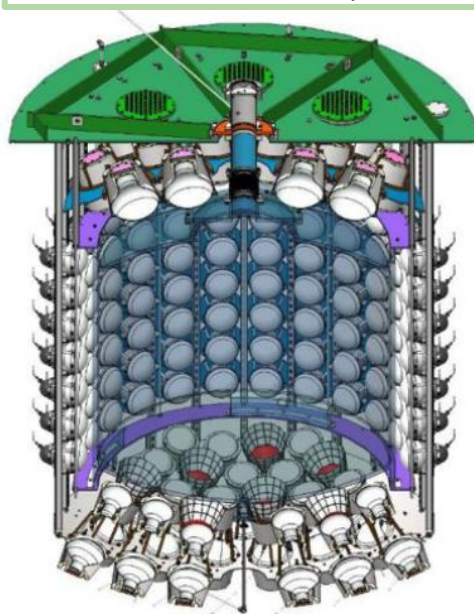
Sean Preins, UC Riverside,
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#3-leveraging-staggered-tessell>

Calorimetry Overview - RDC9, Liquid Scintillator

Dual Readout in Liquid Scint for Neutrinos - EOS (THEIA for DUNE)

Water Based Liquid Scintillation 30 T Demonstrator at BNL

These are concepts and experiments to watch - Cerenkov and Scint separation / light yield boosts using optical methods (dichroicons, arapucas, etc)

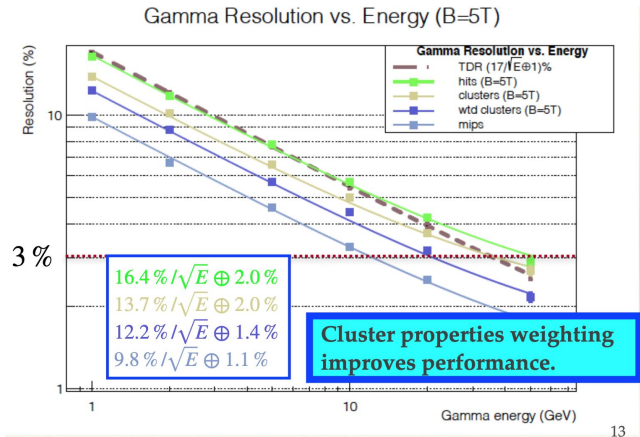
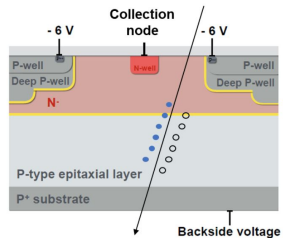


Adam Baldoni, Penn State
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#83-eos-a-ton-scale-hybrid-neut>

Richard Rosero + Sasmit Gokhale, BNL
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#192-water-based-liquid-scintil>

Calorimetry Overview - RDC9, the usual suspects

Monolithic Active Pixel Sensors

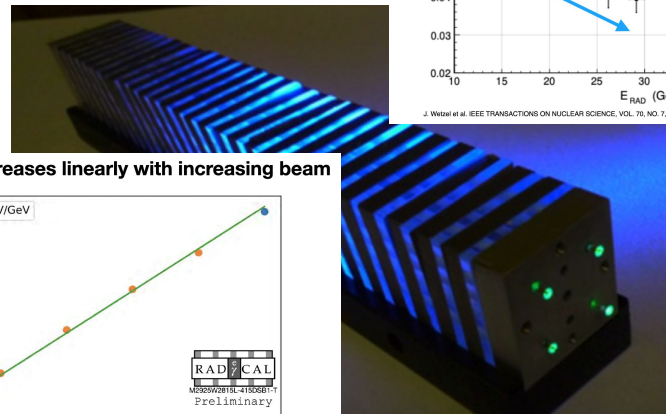


Caterina Vernieri, SLAC
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#116-maps-rd-for-tracking-and-c>
 Jim Brau, Oregon
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#61-radical-ultra-compact-radia>

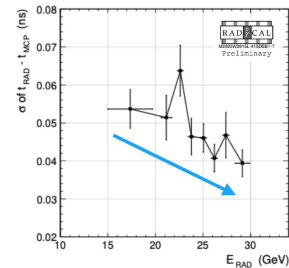
SID design (ILC) w/ fully digital calorimetry - High Granularity at the extreme. PF at its extreme

RadiCAL

New Beam test results from FNAL and CERN



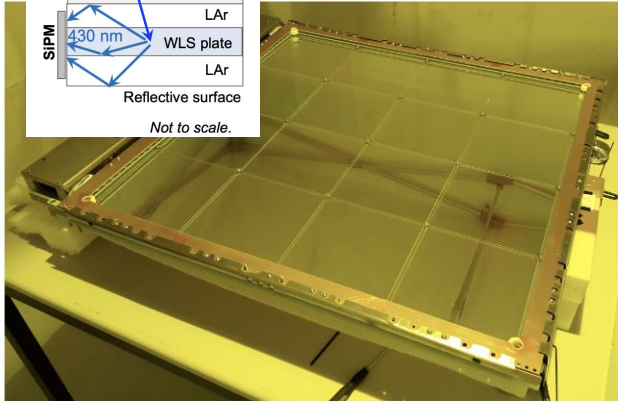
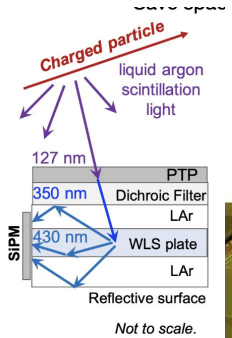
Average signal increases linearly with increasing beam energy



James Wetzel, Coe College and Iowa,
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#61-radical-ultra-compact-radia>

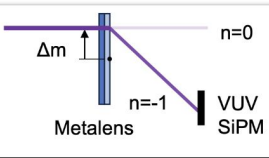
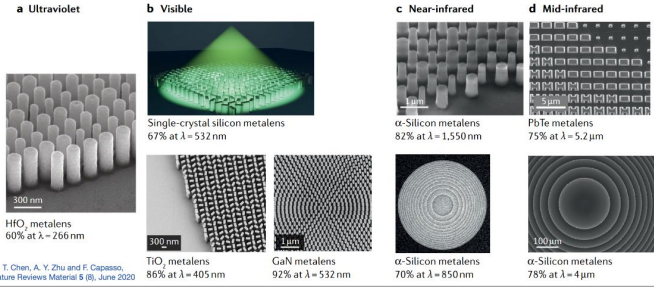
Potentially of interest - Photodetectors

Dichroic filters/traps for DUNE light yield enhancement

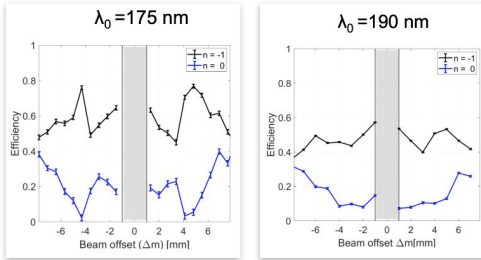


X-arapuca

Wei Shi, Stonybrook
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#21-apex-scale-up-photon-detect>





Alexander Kish, Fermilab
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#197-vuv-light-collection-enhan>



Metalenses for vacuum UV

Transmission of analog optical signals

Analogue optical signal transmission for high-energy physics experiments

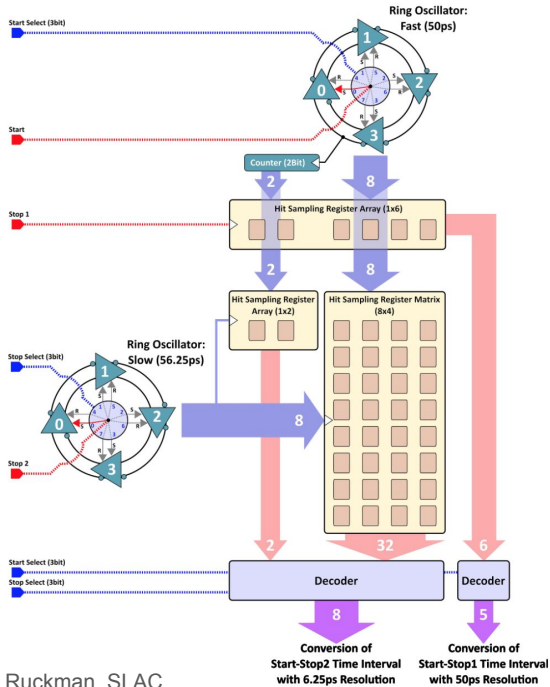
Alexander Kish

Coordinating Panel for Advanced Detectors (CPAD) Workshop
 November 8, 2023
 SLAC

Same guy, different talk
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#196-analog-optical-signal-tan>

Potentially of interest - Electronics

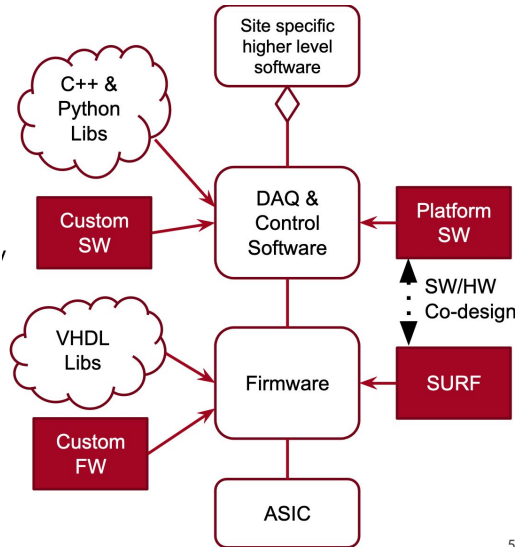
28 nm TDC w/ 10 ps goal



Larry Ruckman, SLAC

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#53-developments-of-reconfigura>

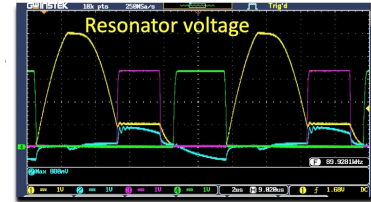
Common software tools for development and prototyping -DAQ!



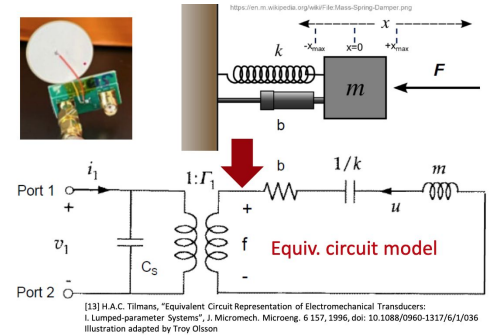
Ryan Herbst, SLAC

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#81-rapid-firmwaresoftware-deve>

Pizeoelectric DC/DC converters on ASICs



A piezoelectric conversion cycle



Adrian Nikolica, Penn

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#219-dc-dc-converters-using-new>

Potentially of interest - Electronics

GEC's highlights!

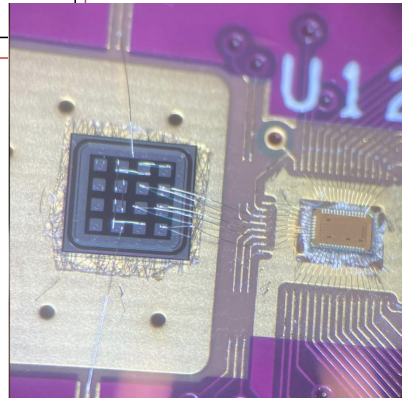
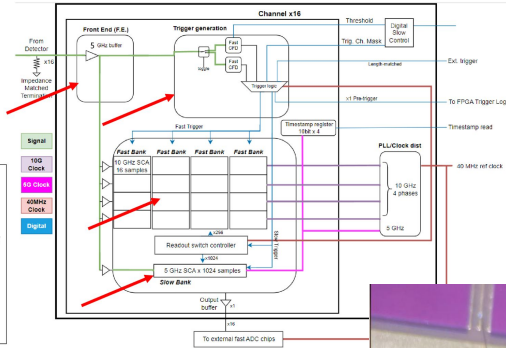


GS/s waveform sampling

Time of Flight for Particle ID at Fermilab Testbeam!

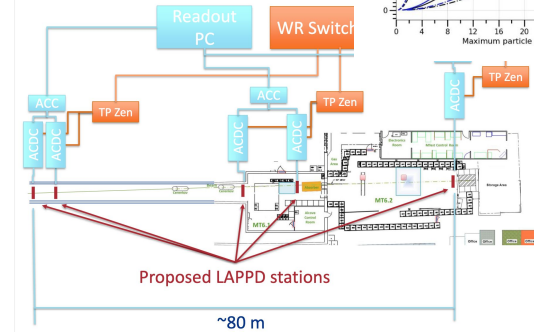
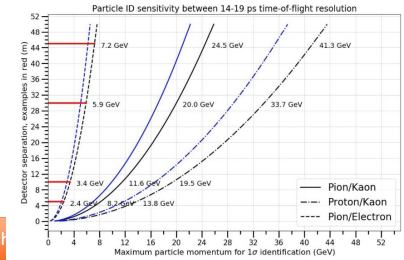
PSEC5

- 65nm TSMC
- 10-bit depth
- 40GSa/s
- 5GHz Analog BW
- 16 channel/chip
- <10mW/ch
- UChicago & Fermilab



Jinseo Park, U Chicago
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#18-design-of-a-40-gssec-10-mwc>

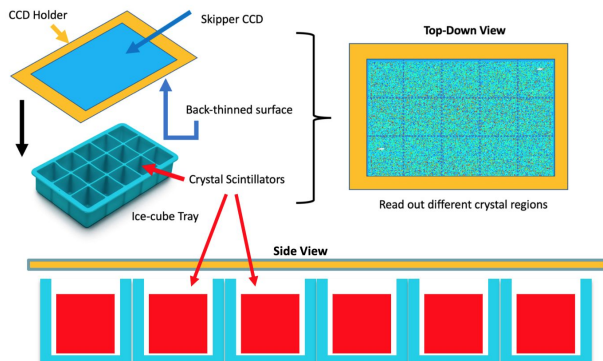
Jennifer Ott, UCSC
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#191-design-updates-for-hpsoc-a>



Joe Pastika
<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#32-lappd-based-tof-system-at-f>

Potentially of interest - Cool and related?

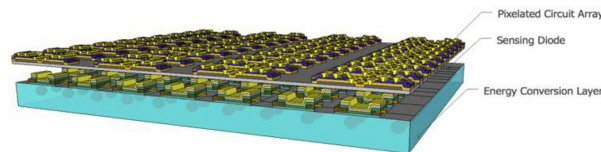
Organic Crystal Scintillator +
Skipper CCD readout for
Direct DM detection



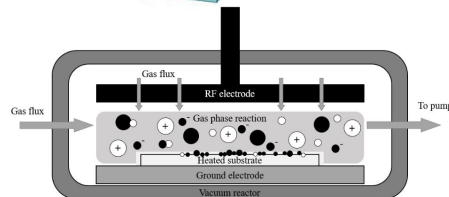
Dan Baxter, Fermilab

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#174-scintillating-crystals-for>

thin-film detectors to replace
silicon! Large coverage!



PECVD:
an example of CVD



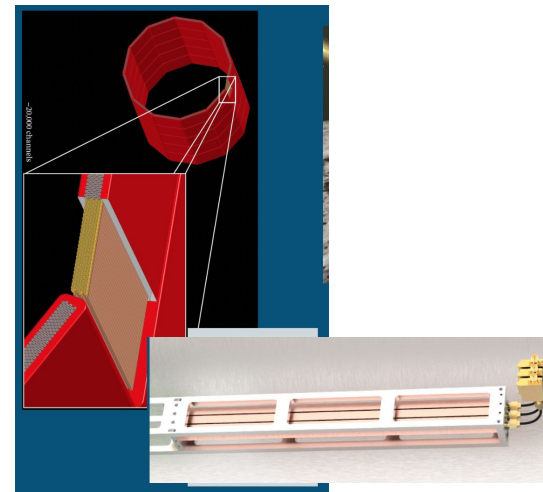
Large scale "roll-to-roll"
deposition/fabrication

CPAD Workshop 2023 – Sungjoon

Sungjoon Kim, University of Illinois

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#179-thin-film-particle-trackin>

Radio Cerenkov (Askaryan
effect) - Waveguide timing or
ultra high energy calo



David Saltzburg, UCLA, Peter Gorham, Hawaii

<https://indico.slac.stanford.edu/event/8288/timetable/?view=standard#160-2023-dpf-instrumentation-a>

Calorimetry “Plan” or takeaways

RDC9: Calorimetry

Jonathan Asaadi and Petra Merkel

<https://indico.slac.stanford.edu/event/8288 timetable/?view=standard#272-workshop-summary-and-next>

- 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

This was probably the only new thing

Summary

- Good conference! Everyone is building cool things
- Calorimetry → needs some inspiration
- Electronics
 - ASICs all the way
 - timing
 - cryo operation (DUNE)
 - Moving to smaller processes
 - Intelligence on chip
- Photodetector
 - timing and large spatial coverage
- Optics
 - a lot to learn from the noble gas folks

My personal
take-away - a lot of
development for
liquid Argon needs a
second look from us!