

TDR Progress Updates for EEEMcal

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ePIC Calorimetry Meeting

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Backward Ecal Updates for “Red” TDR Summary Items

(Blue: updates since last report)

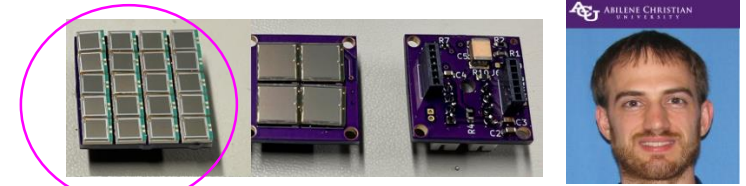
○ Detector design

- Test beam results – these are for integrated performance and full readout chain
 - Crystal+SiPM readout module tests planned for Fall’24 (DESY, JLab) Beam test request DESY: Late Oct-Nov 2024.
 - 5x5, 25 channel prototype design by JCJlab/Orsay : Can reuse existing MIT 5x5 prototype e.g. crystals
 - NSF proposal—still awaiting decision; Alt beam test readout funding:
 - **Identifying individual group funding for putting in ~immediate siPM order** as to receive in time for assembly in September time-frame. (minimum 12 -channels-worth needed.)
 - Starting process with Sasha Bazilevsky now for obtaining project funding for adapter board fabrication/assembly, FEB, ...

○ Read-out

- Radiation tests – these are for the SiPMs
 - Successfully responded to sooner-than-expected timeline for UC Davis Irradiation Tests. **TODAY** currently finishing 2nd day participation in these tests today (UCR, Ohio U, Gerard/IU, Tim Carmada BNL) !!!
 - Full report in future from UCR later
 - Our group irradiated different single area/pixel size choices and 20-3mm² full adapter board design
 - Recent first results from new prototype 20-3mm siPM’s
 - More on siPM decision on next slides
- FEB
 - Summer 2024 , Tests: Fall 2024
 - Because of focus on UC Davis irradiation testing, expect to turn to more detailed FEB planning soon
 - Testbeam : exploring full Readout chain important for precision calorimetry.

siPM Further Updates



Other recent updates:

- First test results from new 20-3mm² siPM prototype adapter boards presented by Larry Isenhower Abilene Christian University [Larry: extended 4-6mm design (help from IU), had fabricated, reflow soldered siPM's at ACU!]
 - This board was irradiated yesterday. Expect followup results on soon
- Ardavan/Hamamatsu: expect similar-to-recent, up to 4 month siPM delivery time. Current Testbeam Strategy : decouple siPM ultimate decision - make initial decision for fast purchase in order to receive remaining needed numbers of siPM' for October testbeam.
- Testbench developments underway for this summer (ACU, Lehigh, Ohio U) finalized siPM decision results also for testing of testbeam orders late summer.

siPM Model Choice/Decision Considerations:

- Tradeoff's pixel pitch/sizes: dynamic range, resolution, linearity, characteristics near-low E threshold (5 MeV)
- At low energies photostatistics are most important (Crytur modeled SiPM characteristics and found PDE difference - points to 15um SiPM). Lowest energy expected 50-100 MeV for shower (per tower 5 MeV)
- At higher energies (GeV scale) the constant term dominates, which is dominated by linearity.
- Larger 6x6mm SiPM have higher capacitance. Putting SiPMs together into a matrix (needed for large area homogeneous blocks) may further increase capacitance. Could point to 3mmx3mm size as the best choice.
- Irradiation tests carried out: developing projections for estimating the largest impact of radiation damage on resolution in the low signal size regime. Highlighting need for UC Davis test results.

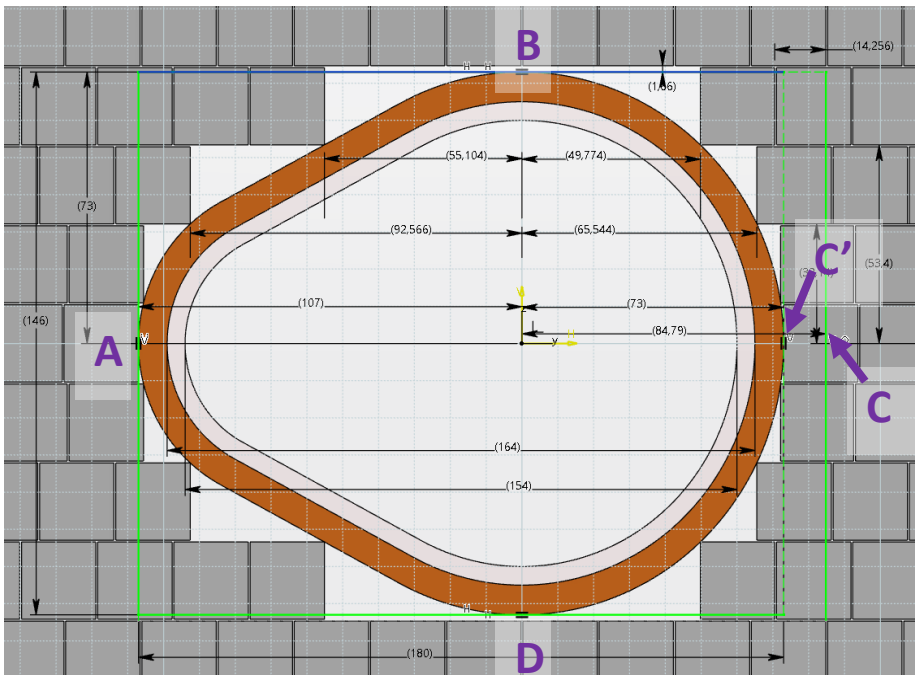
Current Pseudorapidity coverage

Pseudo-rapidity value of crystal edge (with $z = -175$ cm – latest value in [geometry database](#)) :

➤ **Outer radius:** 63,5 cm -> $\eta = 1.74$

➤ **Inner « radius »** depends on ϕ (and crystal configuration around the beampipe):

It ranges between 10.7 cm ($\eta=3.49$) and 8,48 cm ($\eta= 3.87$). If one value is needed for spreadsheet, use $\eta= 3.49$




- **A** ($x=-107$ mm): $\eta = 3.49$
- **B/D** ($y=\pm 74.66$ mm): $\eta = 3.85$
- **C** (option 1): $\eta = 3.72$ ($x=84,79$ mm)
- **C'** (option 2): $\eta = 3.87$ ($x=73$ mm) ; **0.15 higher η**

Backup

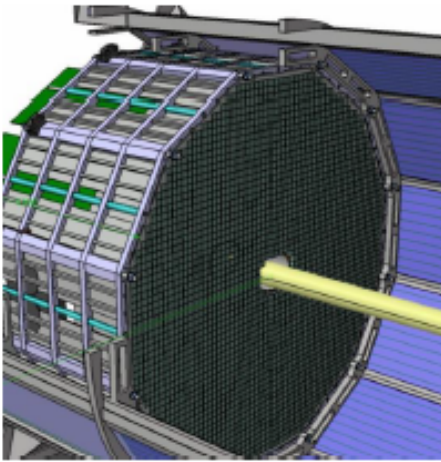
Reminder : TDR Status/plans

- Carlos presentation in February

Justin Frantz, Carlos Munoz, Tanja Horn, and the rest of the EEEMcal group



Backward ECal TDR planning



- **Detector design**
 - Overview
 - Detector requirements
 - Radiation requirements
 - Radiator (PWO)
 - Test beam results
- **Performance**
 - Single particle studies w/ & w/o material
 - Clusterization
 - Full event reconstruction (including background)
- **Mechanics**
 - Stacking layout
 - Support frame
 - Stress simulation
- **Read-out**
 - SiPM choice
 - Radiation tests
 - SiPM boards
 - FEB
- **Cooling**
 - Heat load simulations
 - Prototype measurements
- **Monitoring systems**
 - LED
 - Temperature
- **Integration**

"from previous work"
"ready to write up"
"partially ready to write up"
"lots to do"

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nECal siPM's Irradiation – Finalized Exposures

	Beam Flux (cm ⁻² s ⁻¹)	Time (seconds)	Total Fluence (cm ⁻²)	MeV n equiv fluence	Number of SiPMs/board	
1	1a	1.00E+08	540	5.40E+10	8.10E+10	Whole board of 20-3015 sipms
	1b	1.00E+08	540	5.40E+10	8.10E+10	3 S14160-3010PS (3mm, 10um pitch)
		1.00E+08	540	5.40E+10	8.10E+10	2 S14160-3015PS (3mm, 15um pitch)
2		1.00E+08	540	5.40E+10	8.10E+10	2 S14160-6015 (6mm, 15um pitch)
		1.00E+07	540	5.40E+09	8.10E+09	3 S14160-3010PS (3mm, 10um pitch)
		1.00E+07	540	5.40E+09	8.10E+09	2 S14160-3015PS (3mm, 15um pitch)
		1.00E+07	540	5.40E+09	8.10E+09	2 S14160-6015 (6mm, 15um pitch)
3		1.00E+07	35	3.50E+08	5.25E+08	2 S14160-3010PS (3mm, 10um pitch)
		1.00E+07	35	3.50E+08	5.25E+08	2 S14160-3015PS (3mm, 15um pitch)
		1.00E+07	35	3.50E+08	5.25E+08	2 S14160-6015 (6mm, 15um pitch)
as carlos suggests if we can retest this last bunch, and then re-irradiate, then shoot for longer on these to make 4e9?						

All four initial exposures completed yesterday, possibly one more re-irradiation today after post-testing. Post-testing all remaining also underway.

same exposure time