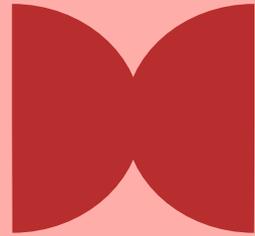


Test beams in DRD Calo

<https://drdcalo.web.cern.ch>

*official logo TBD



And a brief summary of a
recent test beam opportunity
at JLAB

Bob Hirosky 5-Sep-2025

DRD(6) Calorimetry

General R&D collaboration with focus on new calorimeters for future

- fixed-target facilities
- electroweak and Higgs factories
- hadron and muon colliders
- medium and low-energy facilities.

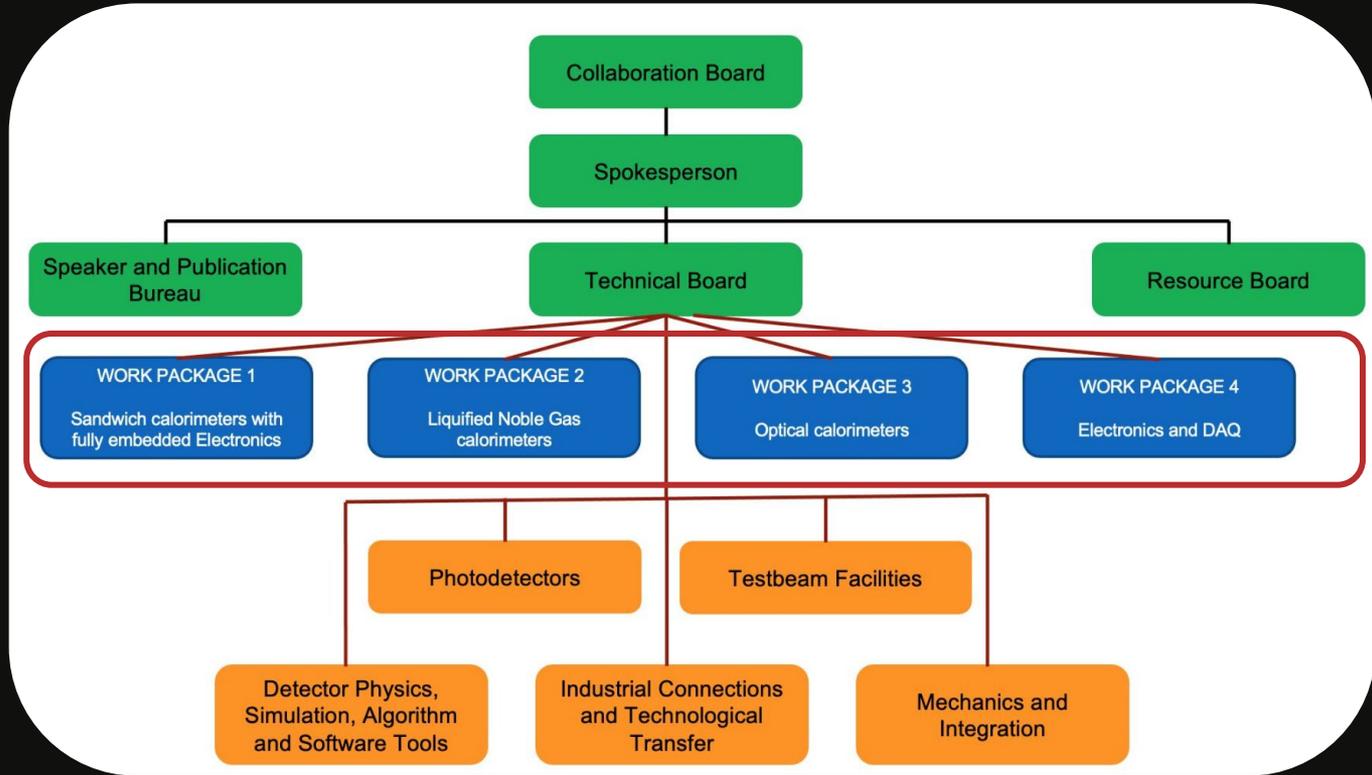
DRD calo is a world-wide collaboration with large involvement from US groups.

We look forward to a SLAC test beam having an integral role in these R&D activities.

[DRD 6 input document for EU strategy](#)

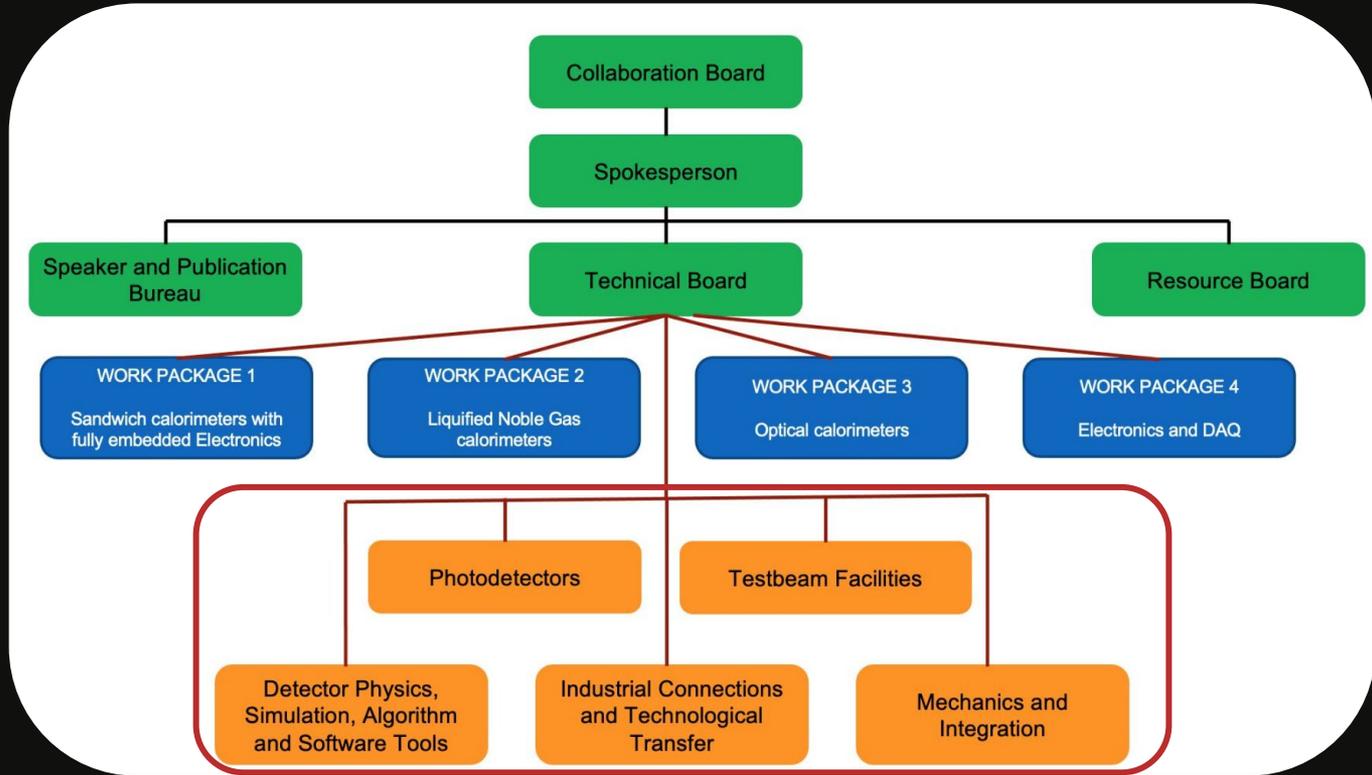
DRD(6) Calorimetry

Work packages are grouped by technology themes each including various groups and sub projects.



DRD(6) Calorimetry

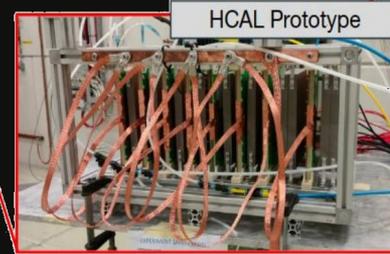
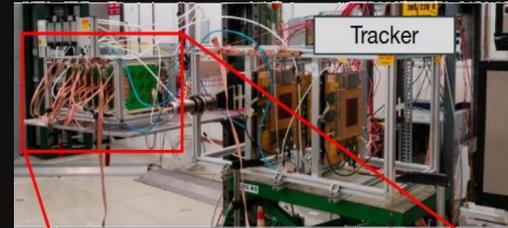
Working groups are intended to enhance synergies in R&D, tool development, instrumentation, test beams (WG3), etc.



I'll summarize some of the planned prototype tests in the next few slides to give an idea of the general needs of this R&D community.

Very active test beam program coordinated with WG3

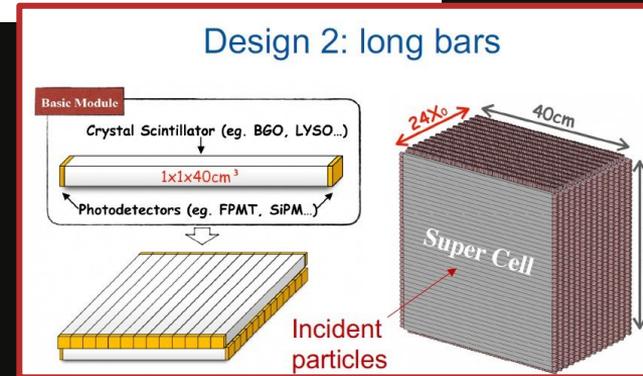
Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
3.1.3	CRILIN	SPS	H2	3x3x2 crystal prototype: final mechanics and SiPM RO
3.1.4	OREO	SPS	H4	3x3x2 crystal prototype PWO-UF + PMT
3.2.3	RADICAL	SPS	H6	LYSO:Ce and LuO:Yb tiles+ DSB1, LUAG:Ce and flavonol WLS
3.3.1	DRCAL	SPS	H8	3 fibers prototypes



MPGD-based HCAL for Muon Collider (2W running in 2025)

Very active test beam program coordinated with WG3

Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
3.1.3	CRILIN	SPS	H2	3x3x2 crystal prototype: final mechanics and SiPM RO
3.1.4	OREO	SPS	H4	3x3x2 crystal prototype PWO-UF + PMT
3.2.3	RADICAL	SPS	H6	LYSO:Ce and LuO:Yb tiles+ DSB1, LUAG:Ce and flavonol WLS
3.3.1	DRCAL	SPS	H8	3 fibers prototypes

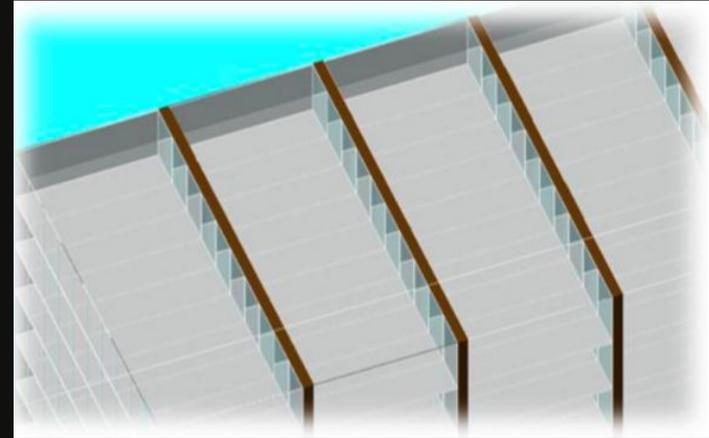


High Granularity Crystal Calorimeter for Higgs Factory
(2W running in 2025)

Summer/fall 2025 CERN program

Very active test beam program coordinated with WG3

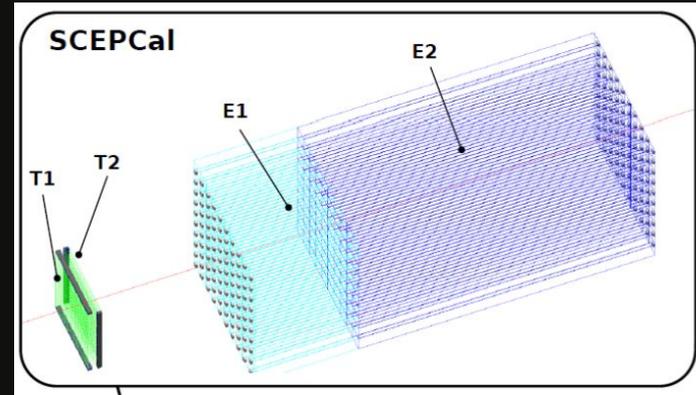
Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
3.1.3	CRILIN	SPS	H2	3x3x2 crystal prototype: final mechanics and SiPM RO
3.1.4	OREO	SPS	H4	3x3x2 crystal prototype PWO-UF + PMT
3.2.3	RADICAL	SPS	H6	LYSO:Ce and LuO:Yb tiles+ DSB1, LUAG:Ce and flavonol WLS
3.3.1	DRCAL	SPS	H8	3 fibers prototypes



High Granularity Crystal Calorimeter for Muon Collider
(2W running in 2025)

Very active test beam program coordinated with WG3

Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
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3.3.1	DRCAL	SPS	H8	3 fibers prototypes

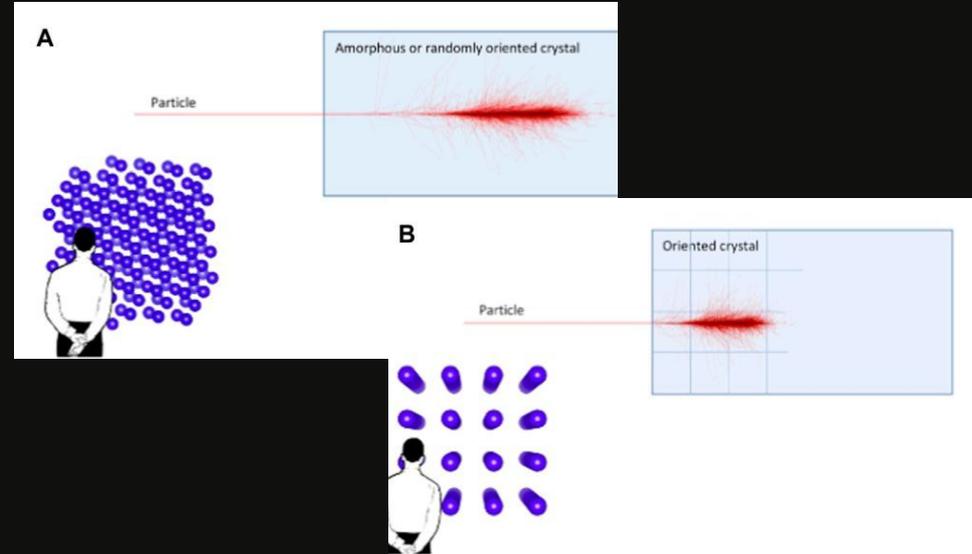


Segmented dual-readout crystal calorimetry MAXICC/Calvision: For IDEA hybrid DR calorimeter concept

- Single crystal and small matrix testing initially (2W running in 2025)

Very active test beam program coordinated with WG3

Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
3.1.3	CRILIN	SPS	H2	3x3x2 crystal prototype: final mechanics and SiPM RO
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3.3.1	DRCAL	SPS	H8	3 fibers prototypes

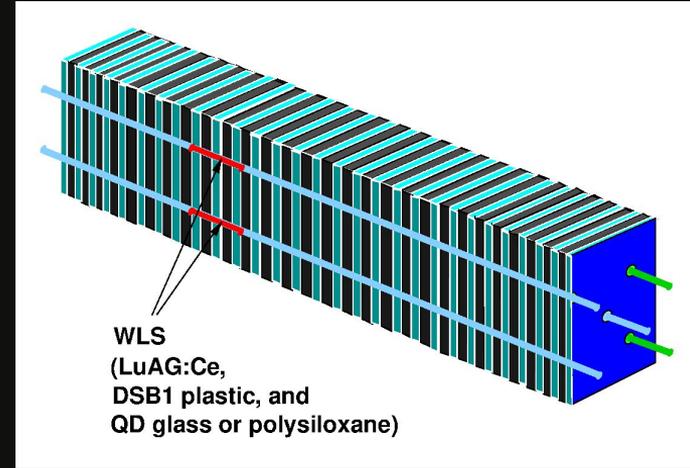


OREO (Oriented crystal calorimeter)
Enhanced stopping power by orienting crystal lattices

- Requires highly parallel beam
- Possible fixed target applications (2W running in 2025)

Very active test beam program coordinated with WG3

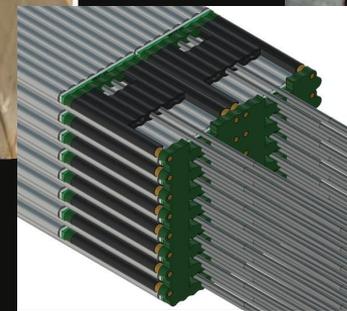
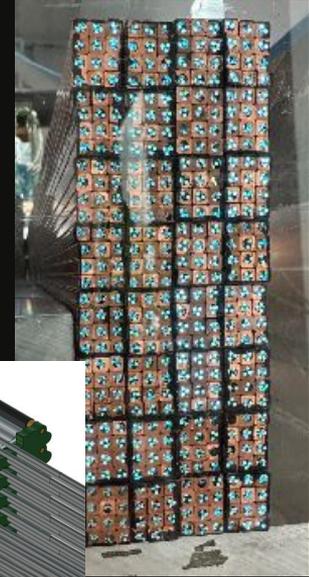
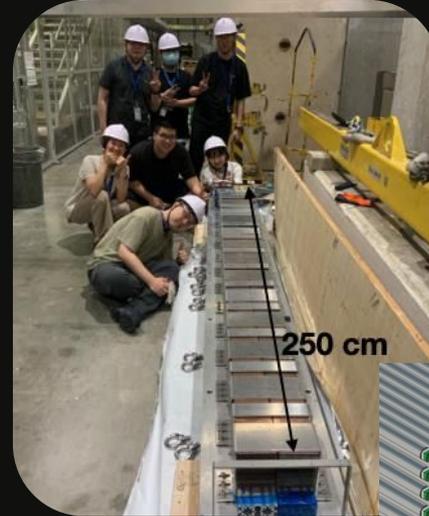
Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
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3.2.3	RADICAL	SPS	H6	LYSO:Ce and LuO:Yb tiles+ DSB1, LUAG:Ce and flavonol WLS
3.3.1	DRCAL	SPS	H8	3 fibers prototypes



RADICAL
 Tungsten/LYSO shashlik EM calo
 Potential for rad hard, compact design,
 with good granularity, timing performance
 (1W running in 2025)

Very active test beam program coordinated with WG3

Task	Name	TB-AREA	Detail	Prototype
1.3.2	MPGD-HCAL	PS	T10	8layer 20x20 cm ² + 4 layer 50x50 cm ²
3.1.1	HGCCAL	PS	T9	4 tile 4x4x1 cm ³ + few layers 3x3 tiles
3.1.2	MAXICC	SPS	H6	full EM proto
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3.2.3	RADICAL	SPS	H6	LYSO:Ce and LuO:Yb tiles+ DSB1, LUAG:Ce and flavonol WLS
3.3.1	DRCAL	SPS	H8	3 fibers prototypes



LARGE Fiber HCAL test program
See Hei Dong's and Ariel's talks
(4W running in 2025)

Tentative calo TB plans for 2026 and beyond at CERN

- Full containment prototypes
- Combined detector test beams

The R&D program includes a large demand for electron (and muon) options

This is a very full program that will want to continue in the LS3 Gap!

TASK	Name	2026				2029 (after LS3)			
		# of weeks	beam type (e+, hadron, muon)	combined with other task	PS/SPS	# of weeks	beam type (e+, hadron, muon)	combined with other task	PS/SPS
1.1.1	SiW-ECAL	2		AHCAL/T-SDHCAL	SPS	2	e±, hadrons, μ	AHCAL/T-SDHCAL	SPS
1.1.2	Highly Compact Calo	2	e+/e-, muon		PS	2 weeks	e+/e-, muon	tracker	PS/SPS
1.1.3	DECAL	2	e+/e-, hadron		SPS/ PS				
1.1.4	SC-ECAL								
1.2.1	AHCAL								
1.2.2	ScintGlassHCAL								
1.3.1	T-SDHCAL								
1.3.2	MPGD_HCAL	2	hadron/neg pion	1 week with CRILIN	2 week PS	2	hadron/neg pion	with CRILIN	2 week PS
1.3.3	ADRIANO 3								
2.0.0	NobelLiquidCalo	1	e+/e-, muon		PS	2	e, had, muon		SPS
3.1.1	HGCCAL								
3.1.2	MAXICC	2	e+/e-, hadron	DRCal?	SPS	2	e+/e-, hadron	DRCal?	SPS
3.1.3	Crilin	2	e+/e-, hadron	MPGD_HCAL @ PS	1 week SPS / 1 week PS	2	e+/e-	with MPGD_HCAL	2 week at SPS
3.1.4	OREO	2	e+/e-	DRCal?	SPS				
3.2.1	GRAINITA					2	e, had, muon		
3.2.2	SpaCal								
3.2.3	RADICAL	2	e+/e-, muon, hadron		SPS	2	e+/e-, muon, hadron		SPS
3.3.1	DRCal	3	e+/e-, hadron, muon		SPS (possible at PS if small size prototype)	3	e+/e-, hadron, muon		SPS (possible at PS if small size prototype)
3.3.2	TileCal								
3.4.1	ScintCal	2	e+/e-, hadron, muon	MAXICC, CRILIN, RADICAL?	SPS	2	e+/e-, hadron, muon	MAXICC, CRILIN, RADICAL?	SPS
3.4.2	CryoDBD Cal								
4.0.0	Electronics								

General wish list items from the calor R&D community

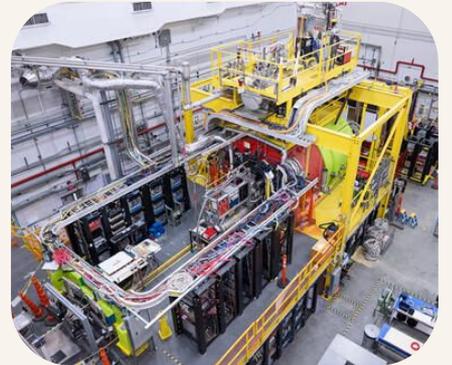
The wish list is similar to what other talks have already presented:

- **Continuing availability of beam facilities. R&D needs are many!**
- Reliable tracking (moderate precision for most calorimeter needs)
 - Expert support for DAQ integration and documentation for analysis
- Precision x-z stage. Rotation option is desirable.
- Timing < 10 ps is desirable
 - A low mass timing reference or clock-to-daq synchronization is needed
 - Calo timing is limited by large Landau jitter, but future detector concepts also include timing layers which will benefit from additional precision.
- Low latency trigger options, self trigger to tracking sync model.
- Common DAQ interfaces (eg EUDAQ) would greatly facilitate R&D among world test beam locations
- Dry nitrogen, ability to use other gas systems. Some interest in supporting cryogenic detectors.
- ...

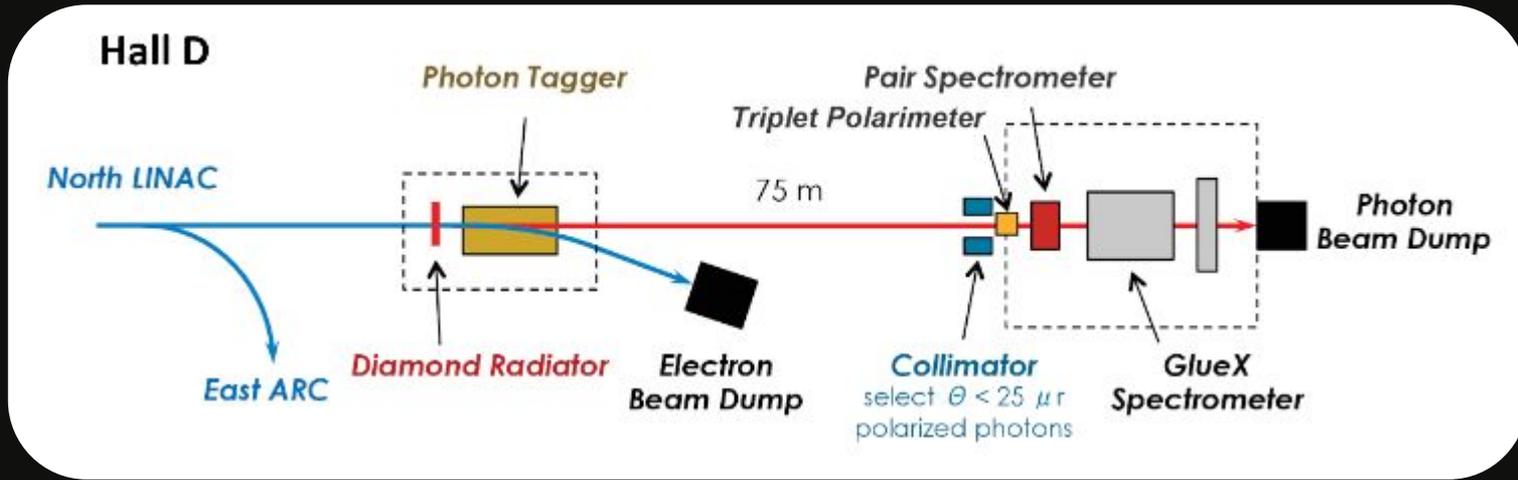
Part 2: comments on a recent experience of running a test at JLab's Hall D

These are just personal (and incomplete) notes based on an opportunity I had to run a test in Hall D last week. But since we are looking at many facilities in this workshop they may be of interest here. (I'm not representing JLAB in any way)

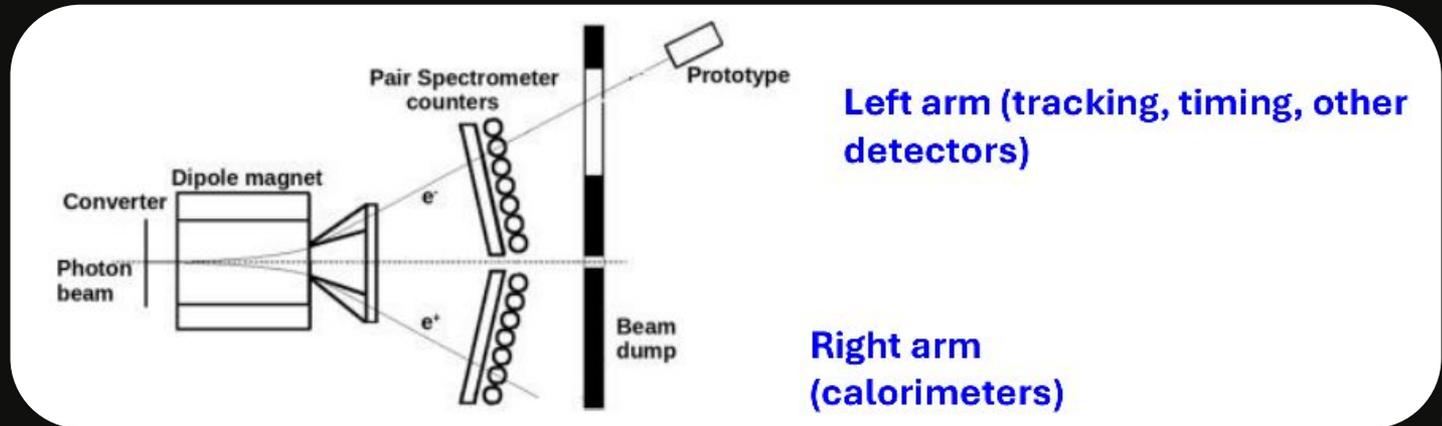
JLab is part of the NP program in the US, but we're all aware of common interests and growing collaborations among the HEP and NP communities in detector R&D areas such as: tracking, calorimetry, MPGDs, wire chambers, sensor development...



Overview of Hall D facility



Production of
'parasitic' tertiary
 e^+/e^- beams from
 γ beam used by
GlueX experiment



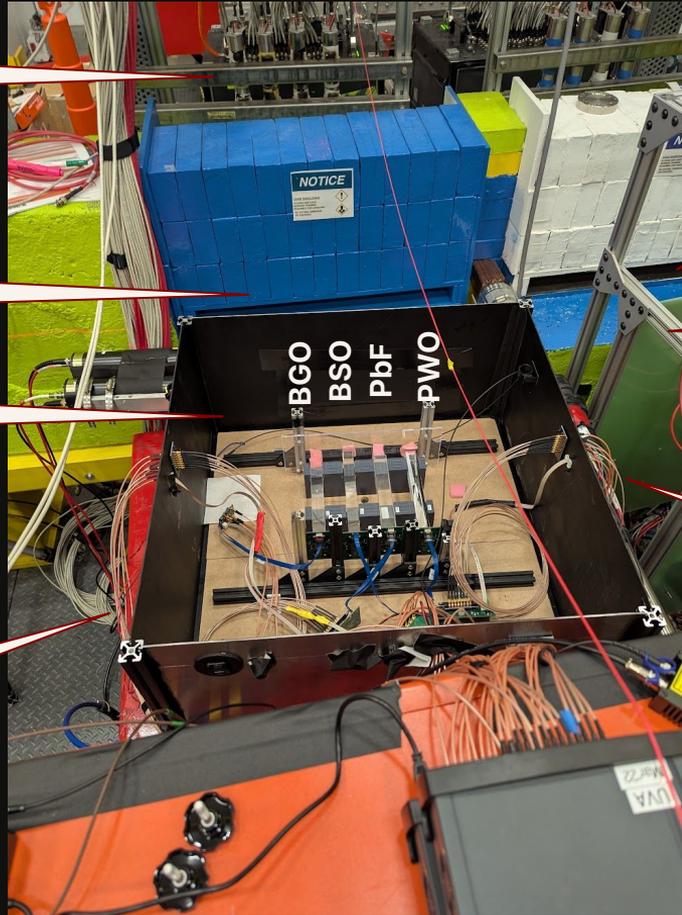
Hall D test area near the GlueX experiment

Beam hodoscope
on e+ arm

e+ beam aperture

CalVision crystal
test box ~25×25"

Movable table
~30"×48"

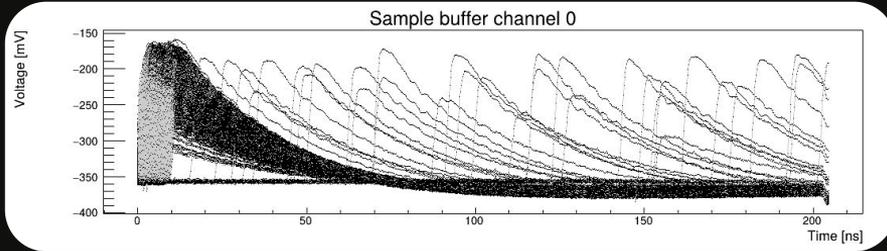


e- beam aperture

Frames for tracking
detectors

beam pipe

CalVision's main goal of this run is to further study S/C light separation in crystal ECAL elements with faster electronics and sampling vs previous test beams.



Overlay of events in PbF crystal. (no tracking used). Late pulses correlate with 4ns bunch spacing of primary beam.

The parasitic test facility seems to be mainly utilized in-house and by close collaborators on JLAB program and EIC. The facility is 'bare bones', but the beam parameters are quite interesting in light of many discussion here, eg see pulse width...

There is enthusiastic about exploring enhancements for testing. I'll try to summarize some of this meeting when I go back to to report on our crystal measurements.

TABLE III. Principal parameters for CEBAF in the 12 GeV era [59].

Energy (hall D)	12 GeV
Energy (halls A, B, and C)	11 GeV
Average current (halls A and C)	1–90 μ A
Average current (hall B)	1–100 nA
Average current (hall D)	0.1–5 μ A
Bunch charge	<0.5 pC
Repetition rate	249.5 MHz/hall
Beam polarization	90%
Beam size (rms transverse)	\sim 150 μ m
Bunch length (rms)	300 fs, 90 μ m
Energy spread	2×10^{-4}
Beam power	<1 MW
Beam loss	<1 μ A
Number of passes	5.5
Number of accelerating cavities	418
Fundamental mode frequency	1497 MHz
Amplitude control	1×10^{-4}
Phase control	0.1 $^\circ$ rms
Cavity operating temperature	2.1 K
Liquifier 2 K cooling power	10 kW
Liquifier operating power	10 MW

Quiz for SLAC folks

Name this detector

