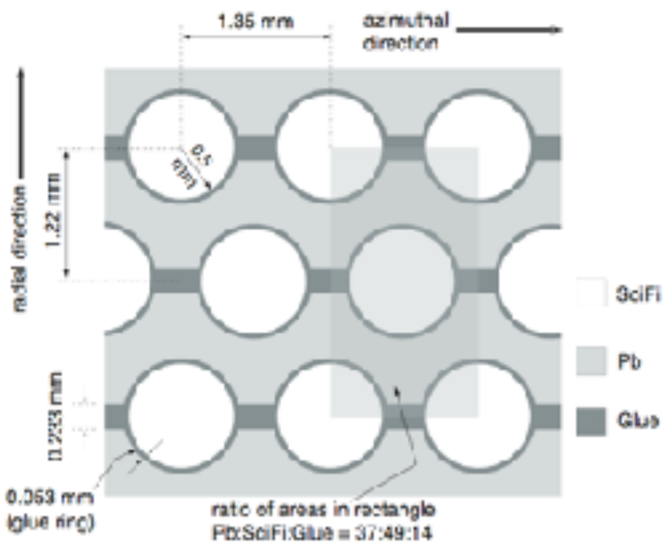
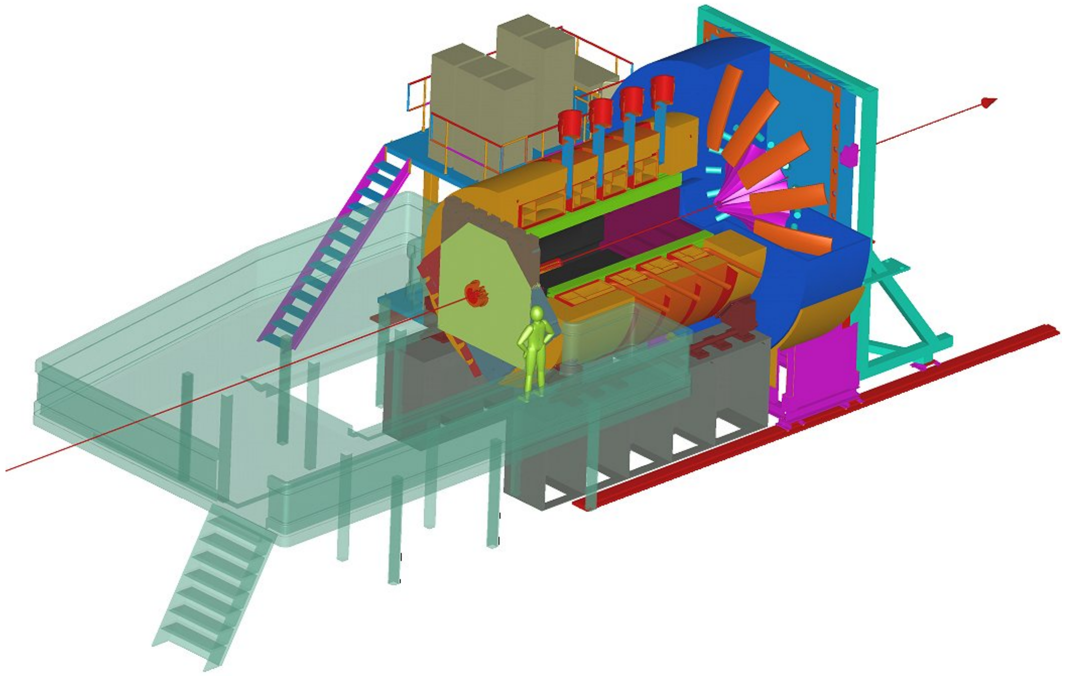




GlueX Barrel ECAL - Production and Assembly

In-Person Barrel Imaging Calorimeter Meeting

Argonne National Lab

June 12-16, 2023

Z. Papandreou

University of Regina | Faculty of Science

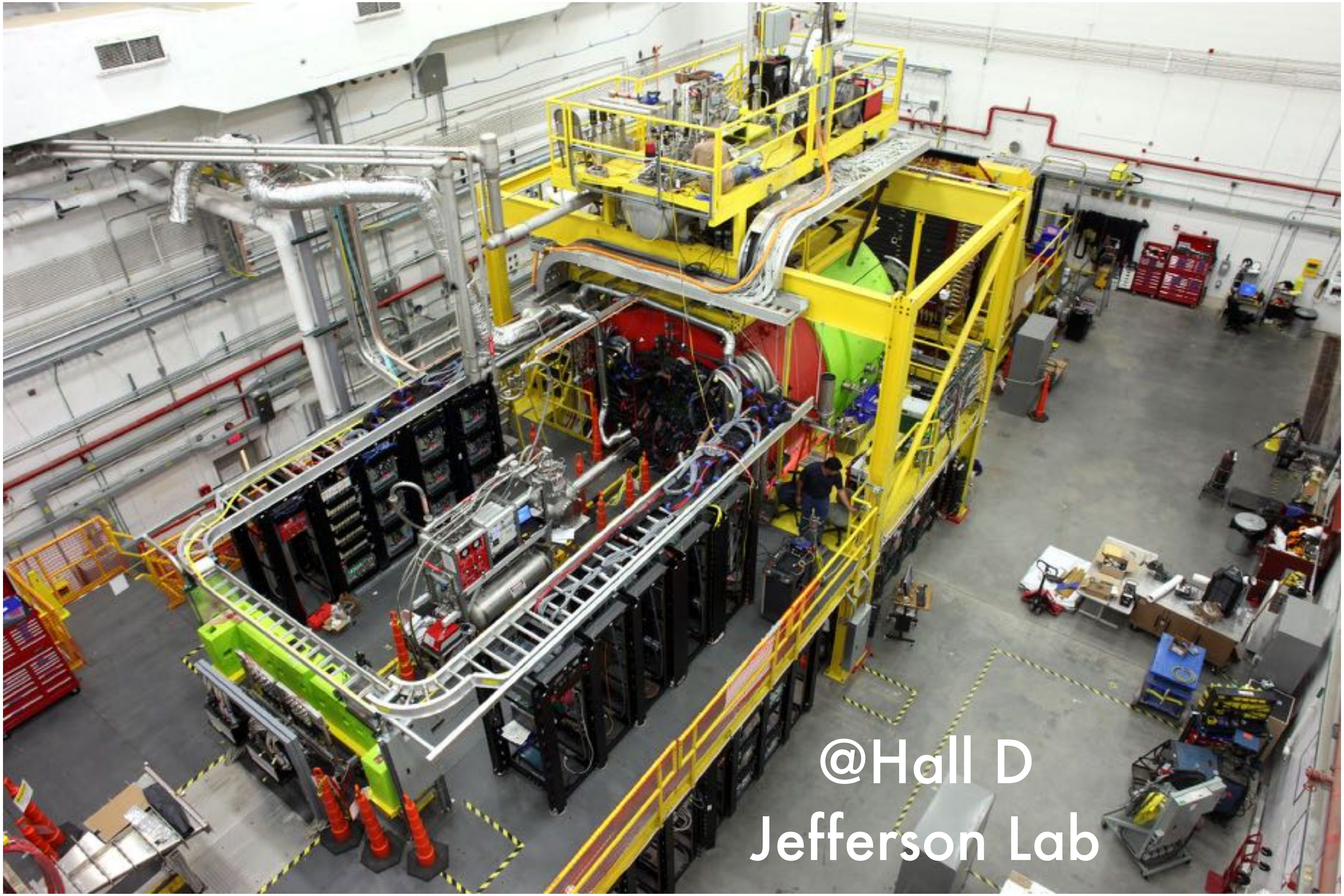
NSERC CRSNG

GlueX

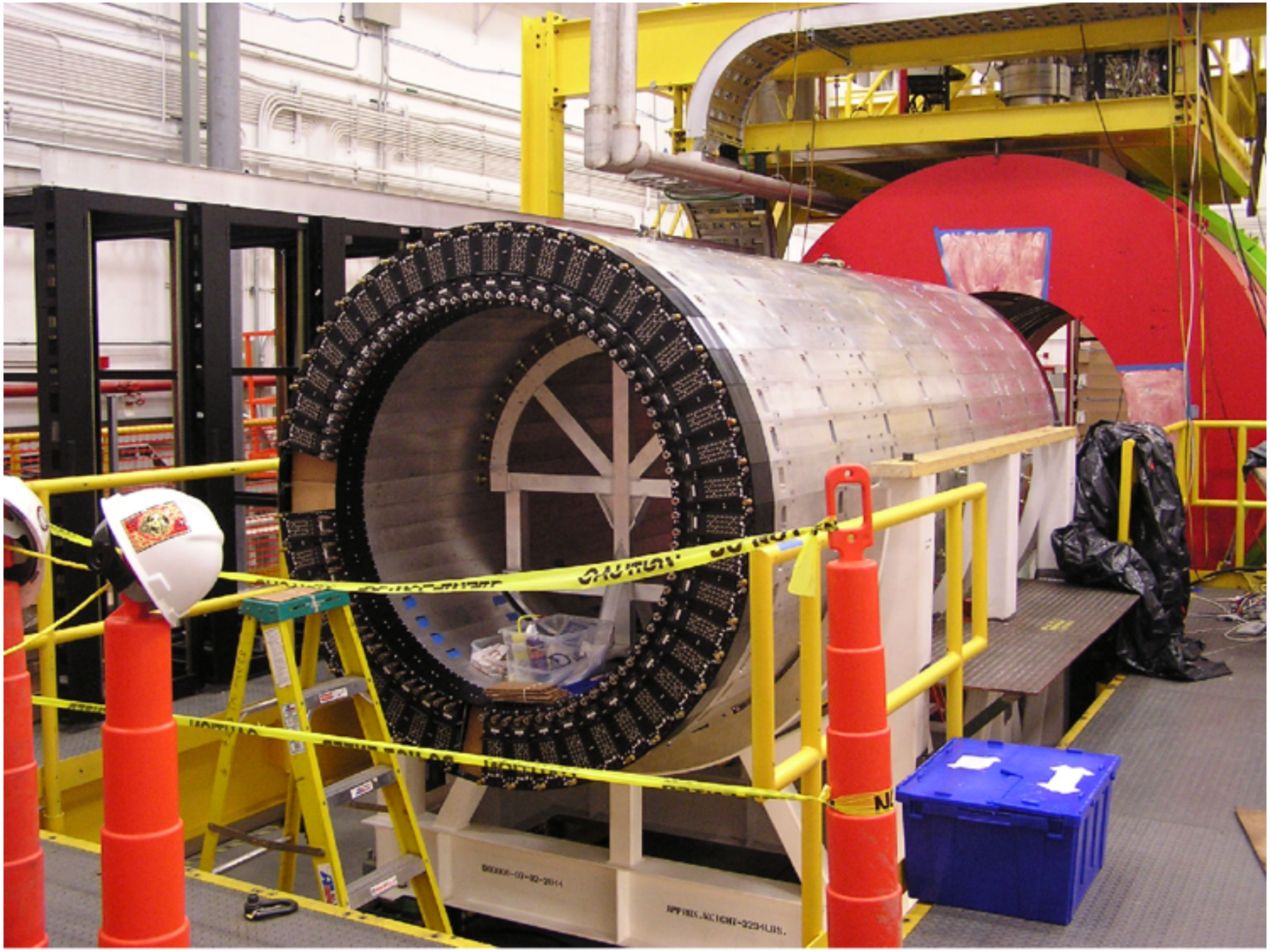
GlueX-BCAL Construction

- Overview
- Procurement & Preparations
- Construction Prototype
- Production Assembly line, QA/QC
- Machining and Shipping
- Assembly and Installation
- Paperwork...

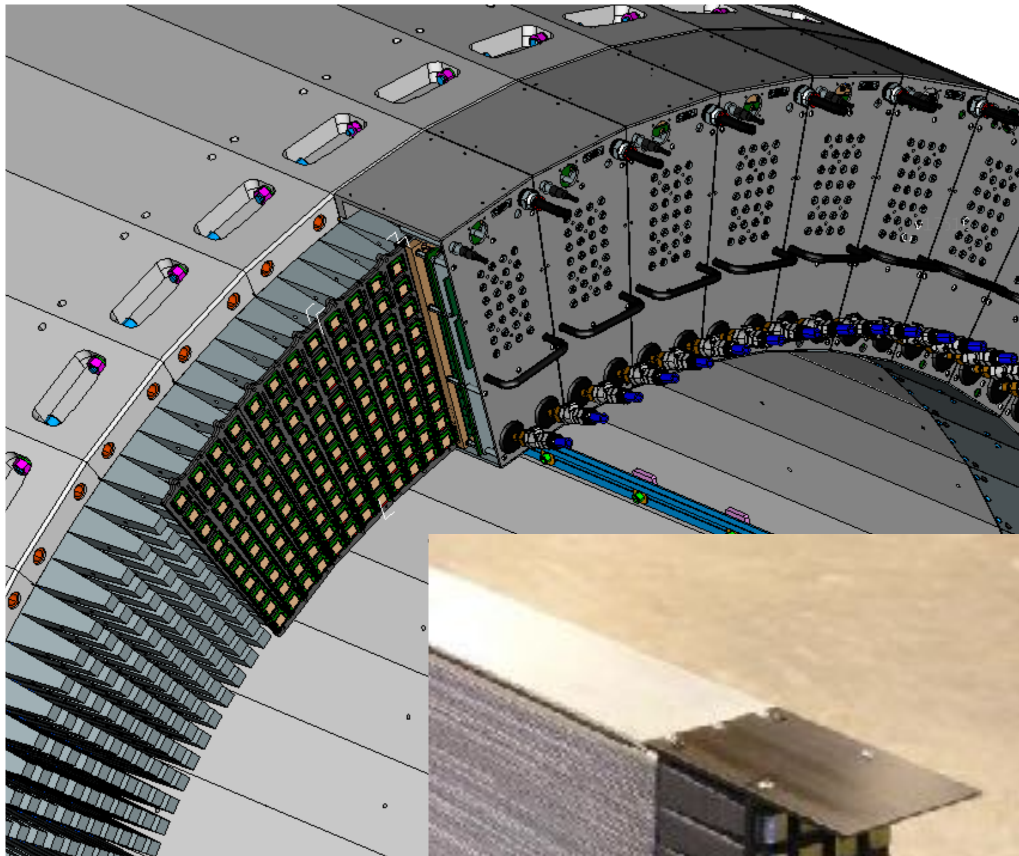
The GlueX Detector



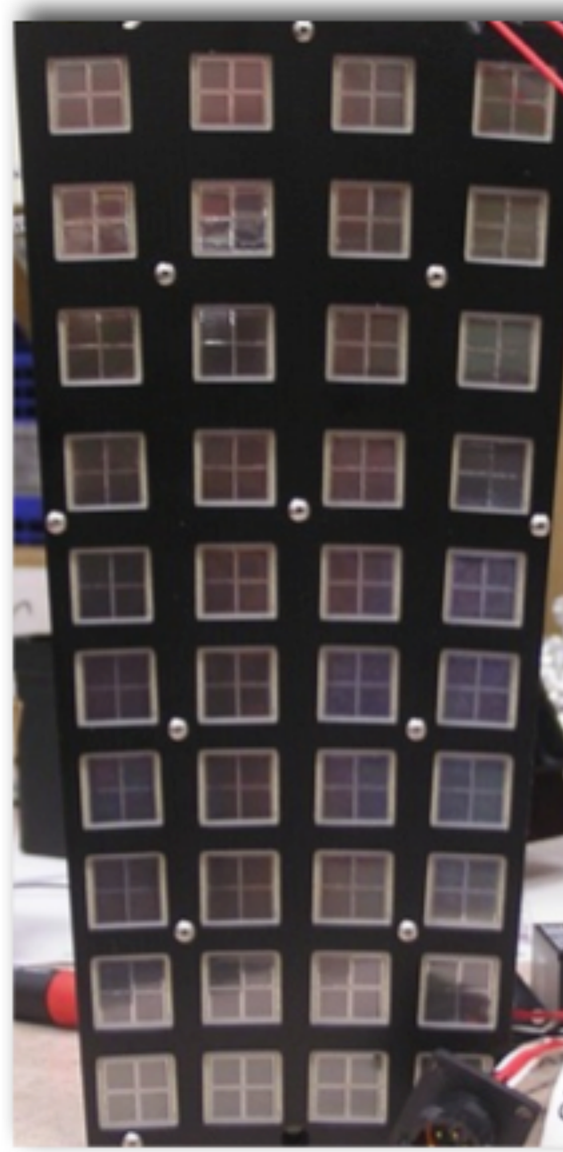
The Barrel Calorimeter



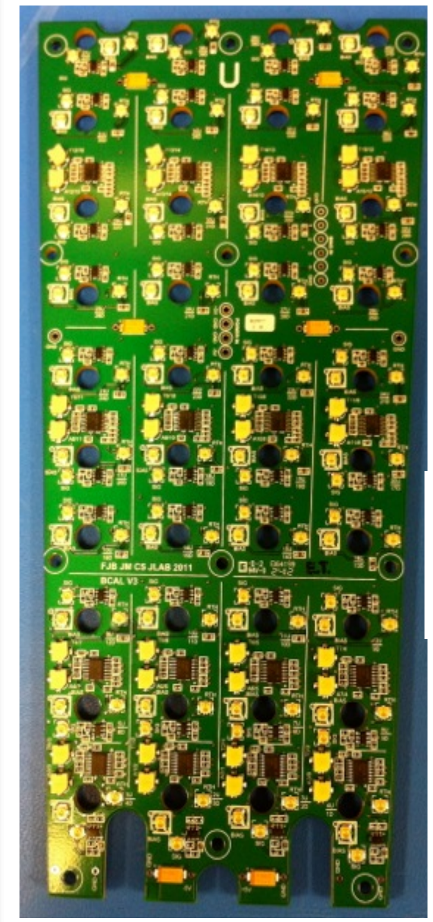
SiPM Readout Assemblies



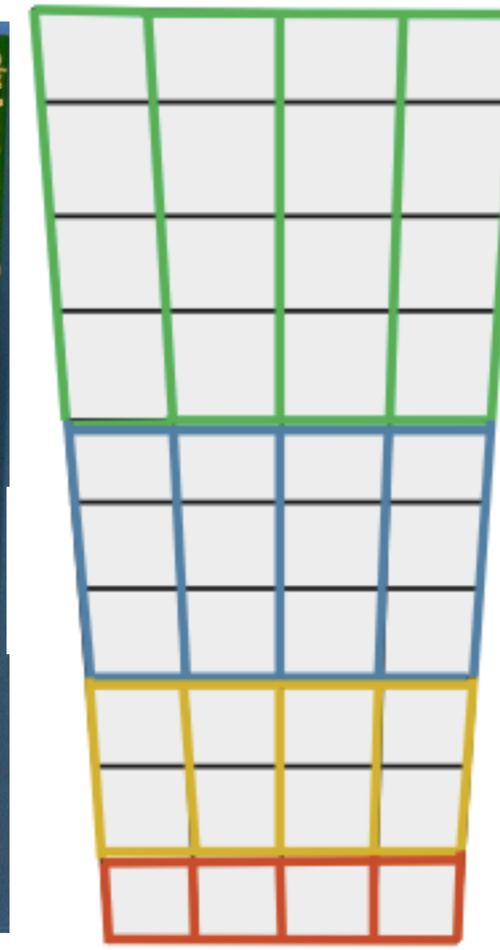
Light guides



Assembly

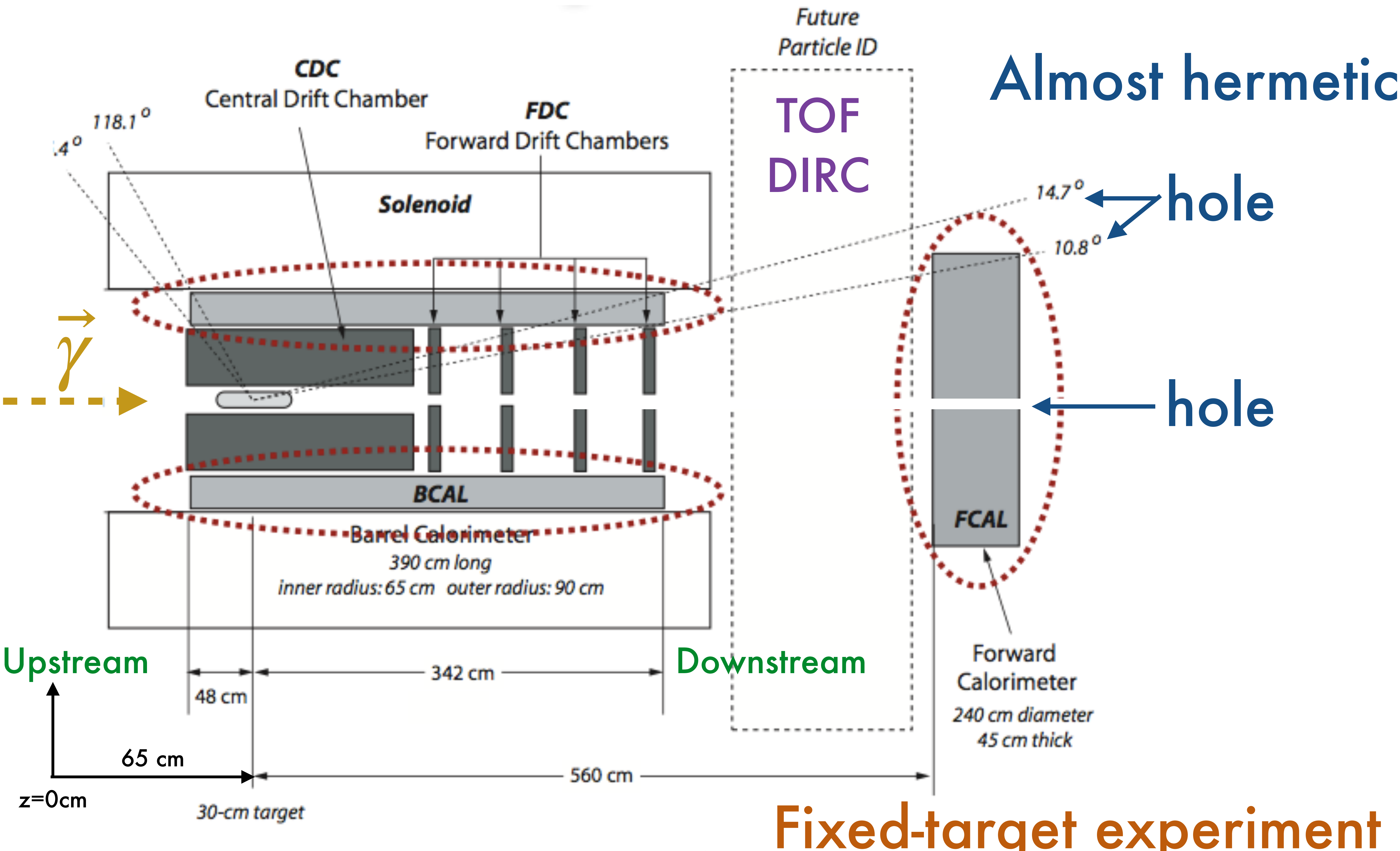


Electronics

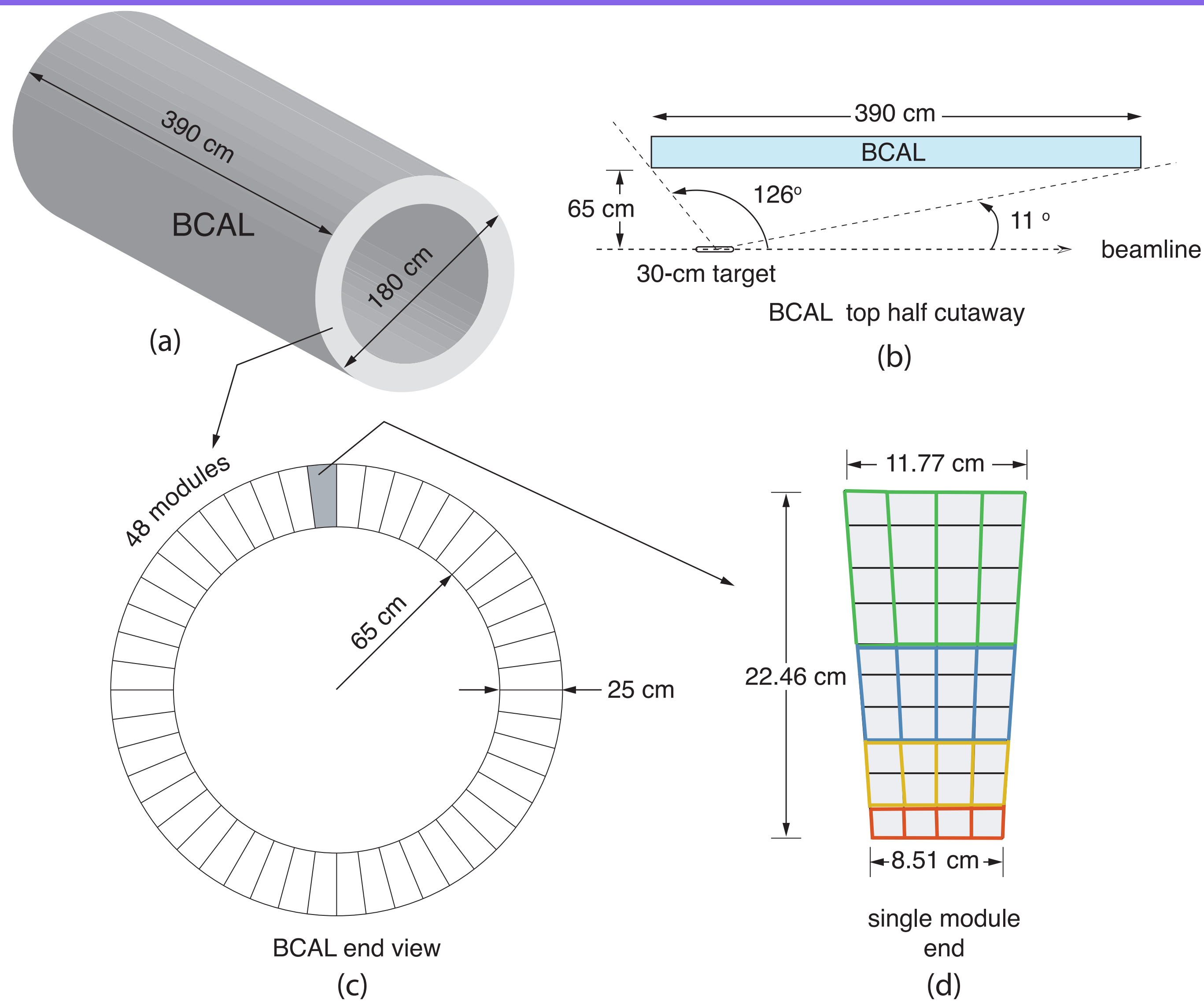


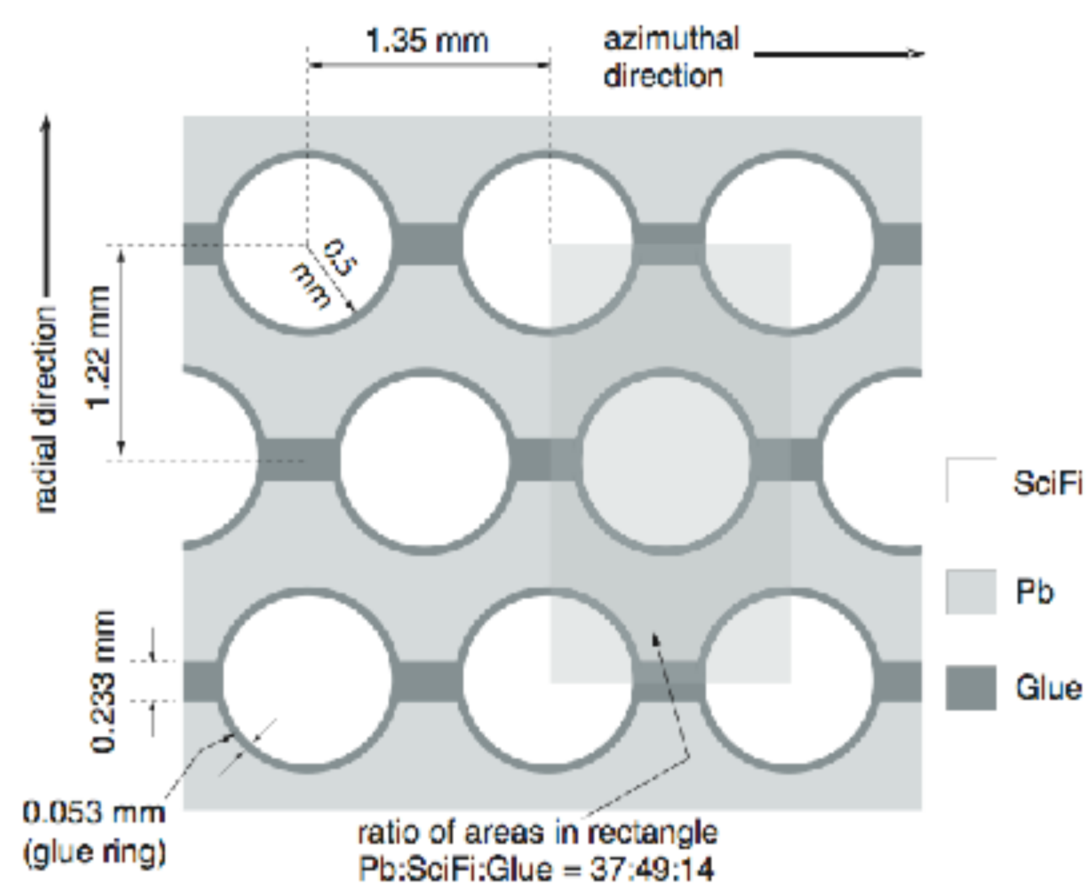
Summing Scheme

Calorimetry



The Barrel Calorimeter



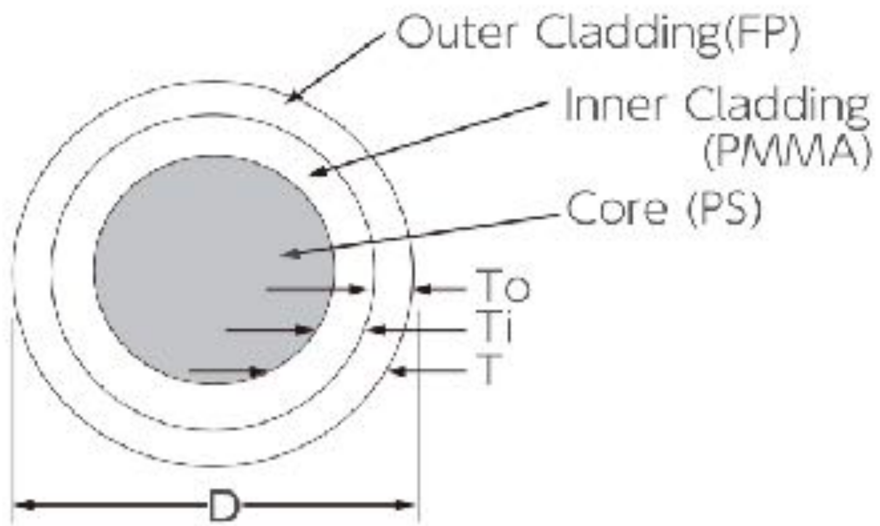


- 48 azimuthal sections (**modules**) → **sectors for bECAL**
- Reconstructs γ showers from π^0 and η decays
- Provides timing information (neutrals/charged)
- With the CDC it provides charged particle PID

- Sampling calorimeter (9.5% sampling fraction)
- 750,000 double-clad scintillating fibers
- BCAL: 25 tonnes

Fiber Type

Multi-Cladding (M)



Cladding Thickness[2]: T=2%(To)+2%(Ti) =4% of D

Numerical Aperture : NA=0.72

Trapping Efficiency : 5.4%

Formulations[1]

Description	Emission Color	Emission Spectra	Emission Peak[nm]	Decay Time [ns]	Att.Leng.[2] [m]	Characteristics
SCSF-78	blue	See the following figure	450	2.8	>4.0	Long Att. Length and High Light Yield
SCSF-81	blue		437	2.4	>3.5	Long Attenuation Length
SCSF-3HF(1500)	green		530	7	>4.5	3HF formulation for Radiation Hardness

1) Test fibers are Non-S type, 1mmϕ.

2) Measured by using bialkali PMT and UV light(254nm).
Quality control is made by another measurement of the transmission loss every batch.

Procurement

Specs to Vendors

BCAL Readout Specifications.pdf	May 28, 2009 at 8:21 AM
Bcal_fiber_specs_signed.pdf	May 19, 2009 at 10:16 AM
bcal_lead_spec_draft_v4.pdf	Dec 9, 2008 at 12:26 PM
bcalreadout_specs.pdf	May 19, 2009 at 10:16 AM
D00000-01-07-3000Rev-27881.pdf	May 18, 2023 at 6:44 AM
D000000107S004 RevA27925.pdf	May 18, 2023 at 6:44 AM
MSDS_lead.pdf	May 19, 2009 at 10:16 AM
SIPM_evaluation_v227928.docx	May 18, 2023 at 6:44 AM
W027Leadspec.pdf	May 19, 2009 at 10:16 AM

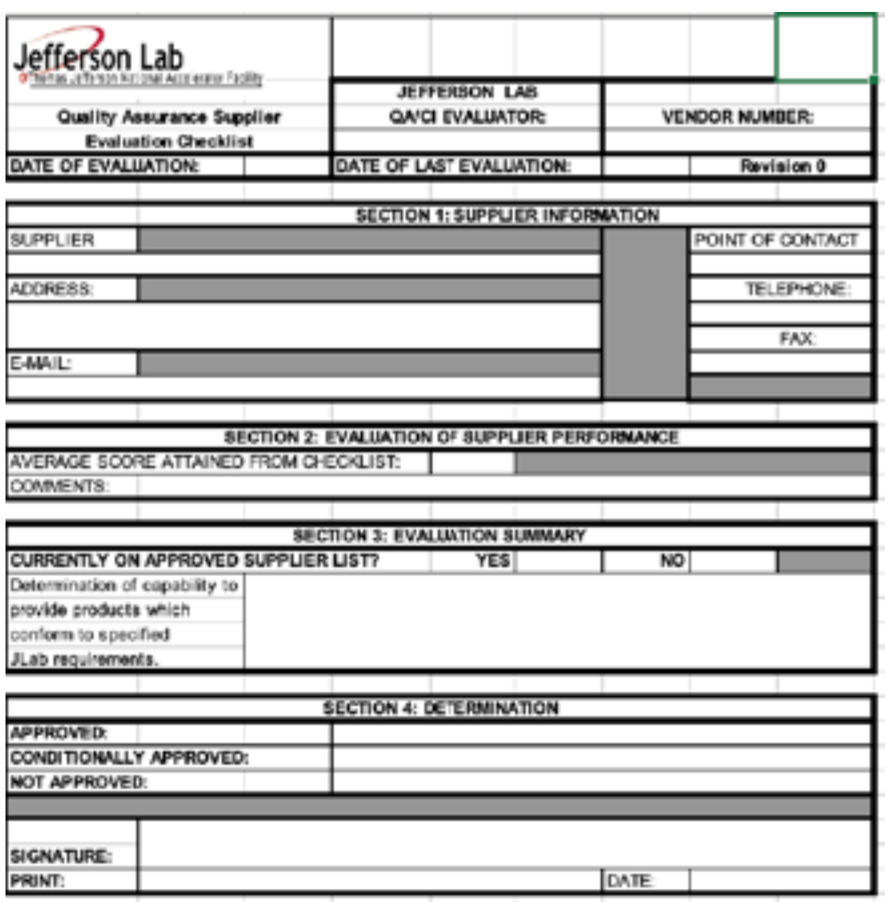
(These conversations have started for bECAL)

Construction Preparation

- Fiber shipments: Long-Lead Procument JLab12
- Lead coil shipments
- Tooling, Materials, supplies (epoxy, safety, etc)
- Grounded Cu table for fiber handing
- Swager - plastically deforms lead coils
- Two Construction Presses
- Construction Prototype - fall 2009
- Matrix machining - industry
- Transportation, customs, reporting

Tiger Team Review

QA Supplier



Jefferson Lab

Quality Assurance Supplier Evaluation Checklist	JEFFERSON LAB QA/CI EVALUATOR:	VENDOR NUMBER:
DATE OF EVALUATION:	DATE OF LAST EVALUATION:	Revision 0

SECTION 1: SUPPLIER INFORMATION

SUPPLIER | POINT OF CONTACT
ADDRESS: | TELEPHONE:
FAX:
E-MAIL:

SECTION 2: EVALUATION OF SUPPLIER PERFORMANCE

AVERAGE SCORE ATTAINED FROM CHECKLIST:
COMMENTS:

SECTION 3: EVALUATION SUMMARY

CURRENTLY ON APPROVED SUPPLIER LIST? YES NO
Determination of capability to provide products which conform to specified JLab requirements.

SECTION 4: DETERMINATION

APPROVED:
CONDITIONALLY APPROVED:
NOT APPROVED:

SIGNATURE:
PRINT: DATE

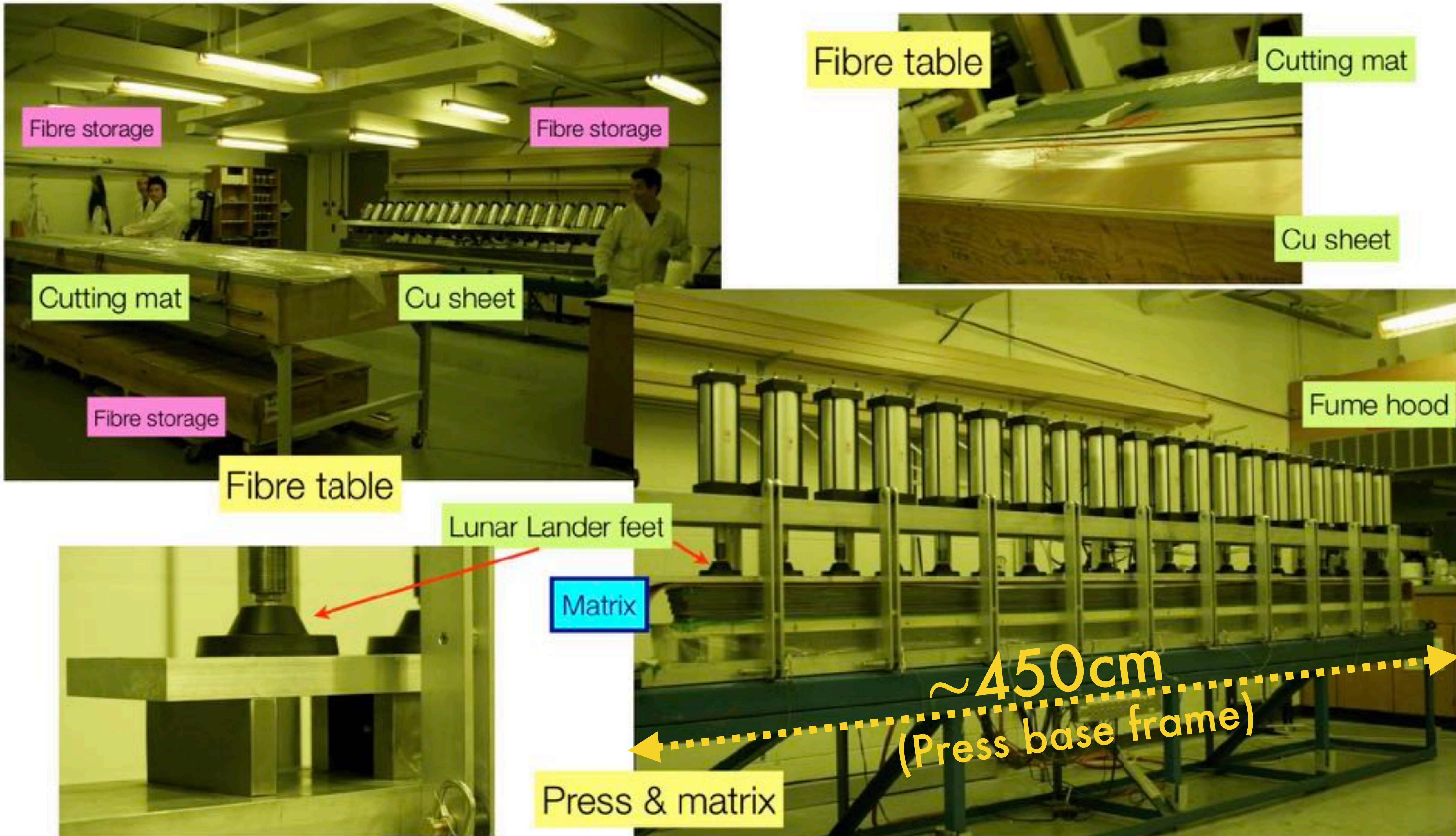
BCAL readiness review

z. papandreou
university of regina
november 4, 2009

on behalf of the GlueX-Regina Team:
J. Chan, B. Giesbrecht, K. Janzen, S. Katsaganis,
G. Lolos, A. Semenov, I. Semenova, Y. Sun, K. Vut
A. Watson
thanks to:
Dept.Phys. (J. Lockert, N. Ashton), Fac. Science (
(safety) ORS (H. Yum), Supply Management, Facili

After completion of construction prototype

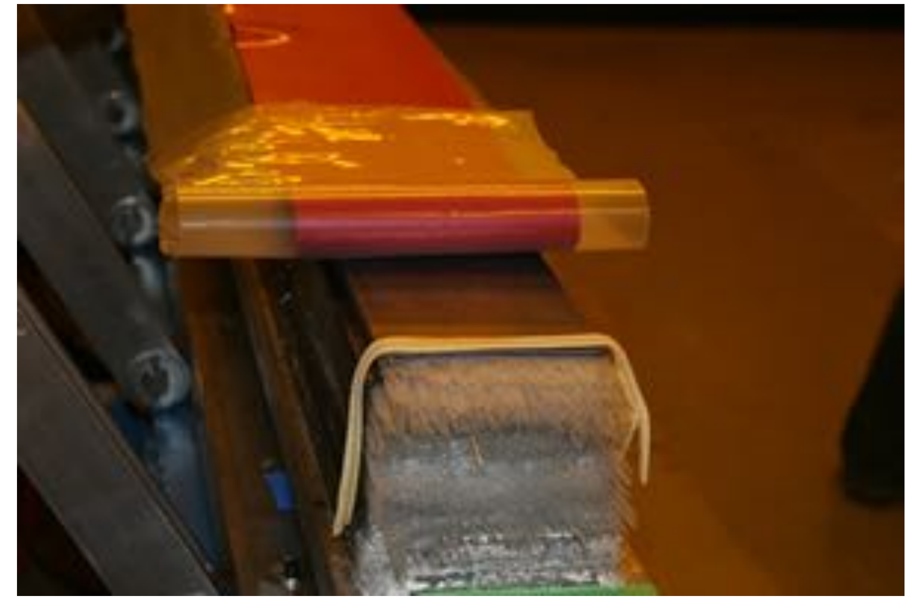
Matrix construction progress - panoramic



Construction Facility @ Regina

ROLLING

GLUING



QUALITY CONTROL AT EVERY STEP

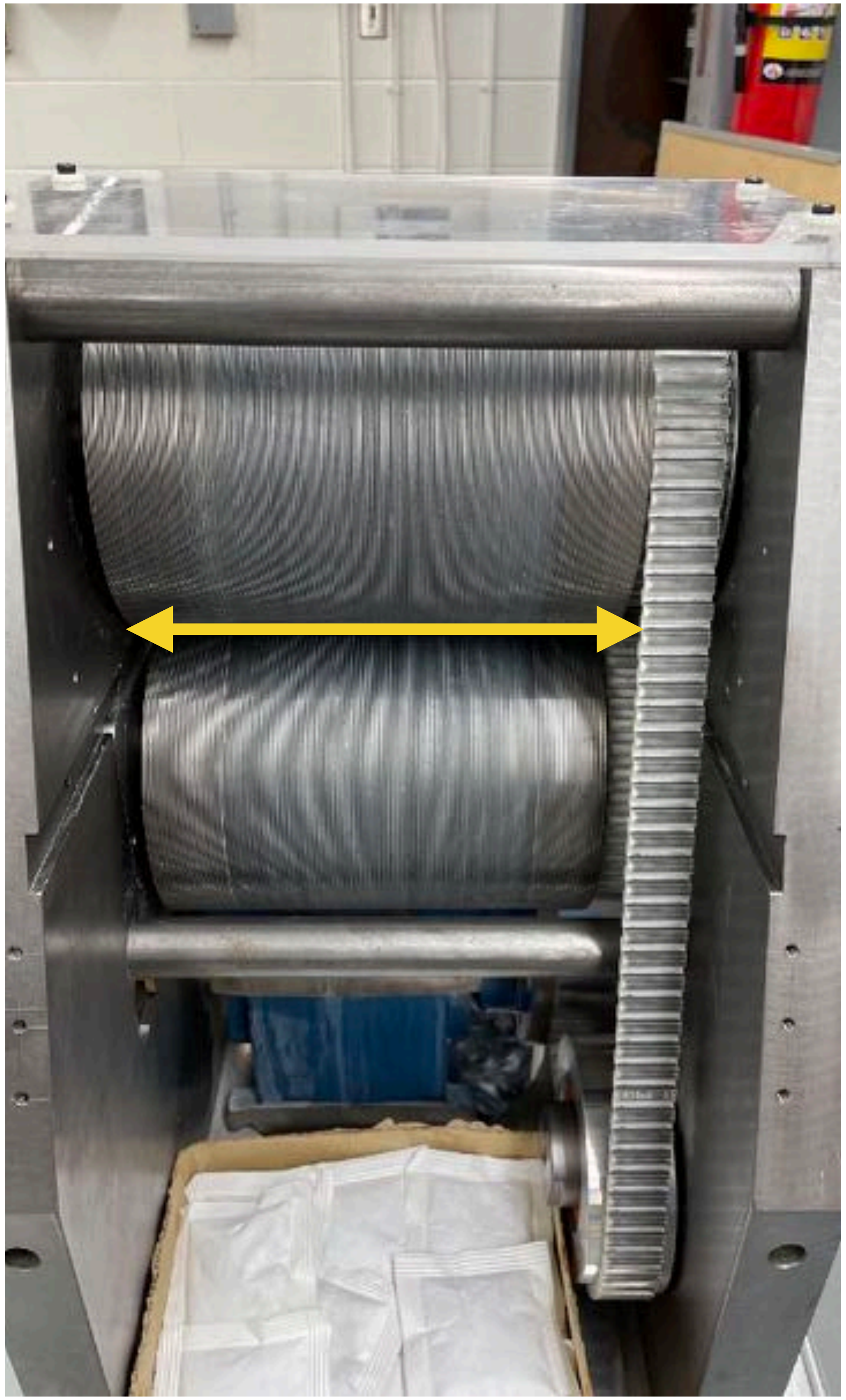
SWAGGING

PRESSING

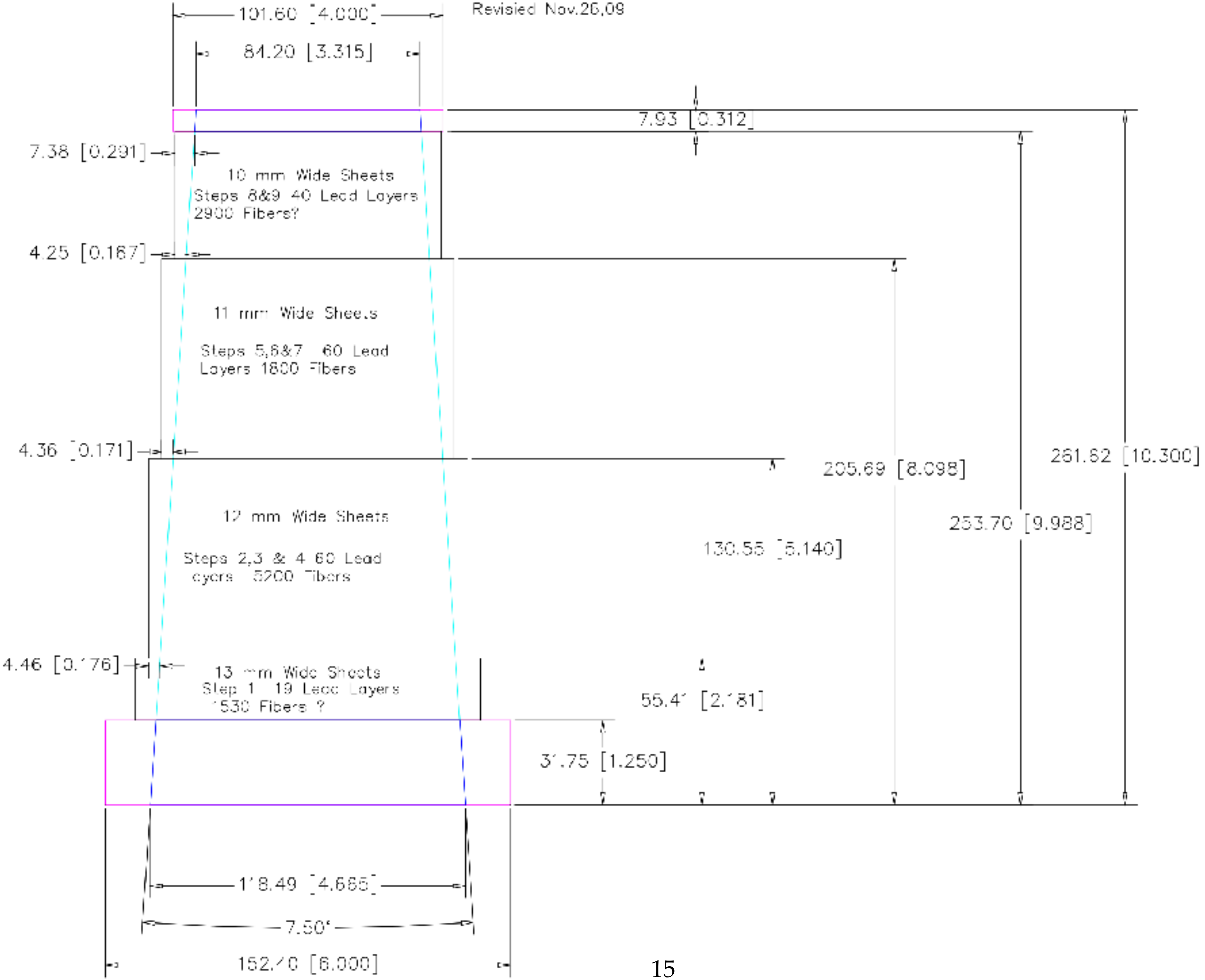
Swager

Roller width
19.5 cm

BCAL widest
sheet was 13cm



Mayan Pyramid



Fiber Preparation

1. Make sure the copper covered fiber table is grounded.
2. Take a box of fibers from the crate onto the fiber table.
3. Open the box at one end. There are two large bags of fibers in each box. One person holds the bags and keeps the fibers on the table, while another person pulls the box out.
4. Cut the end of the large bags. There are 12 small bags of fibers in each large bag. One person holds the small bags, while another person pulls the large bag out.
5. Cut one end of the small bag. Be careful not to damage the fibers.

13cm – 96-97 fibers
12cm – 88 -89 fibers
11cm – 80-81 fibers
10cm – 73-74 fibers

Construction Procedure

- 19-page step-by-step manual
- Extensive photo gallery

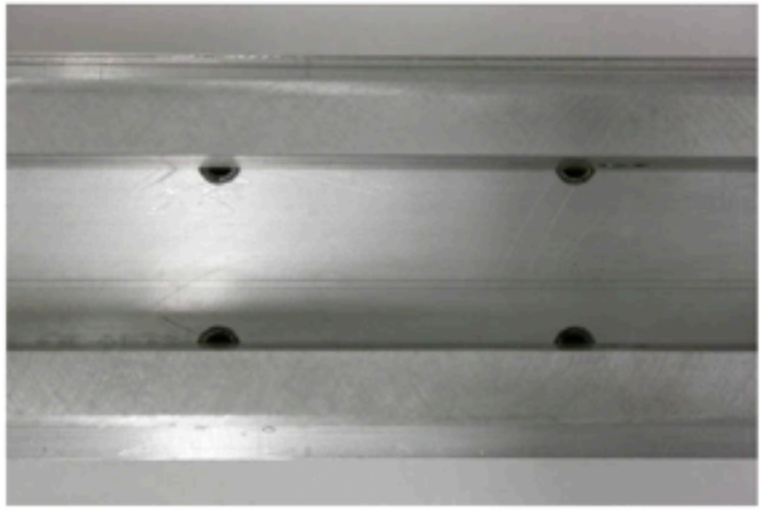
University of Regina
DRAFT ONLY
Barrel Calorimeter Module Construction Procedure Manual

Proper Safety Procedures, Clothing, Equipment, and Materials Must be Used During the entire construction and all measuring equipment must be properly calibrated before use.

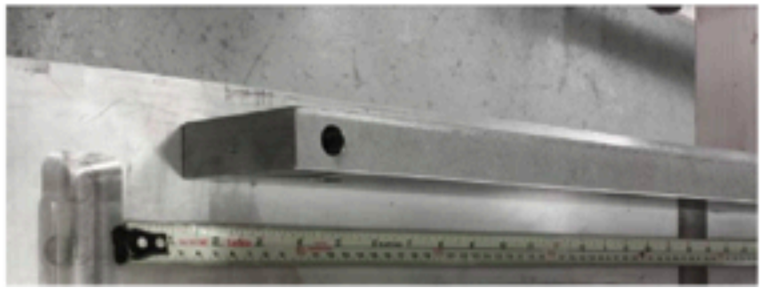
Preparing Base Plate

1. Clean the bottom of base plate with a water soluble degreaser followed by ethanol.

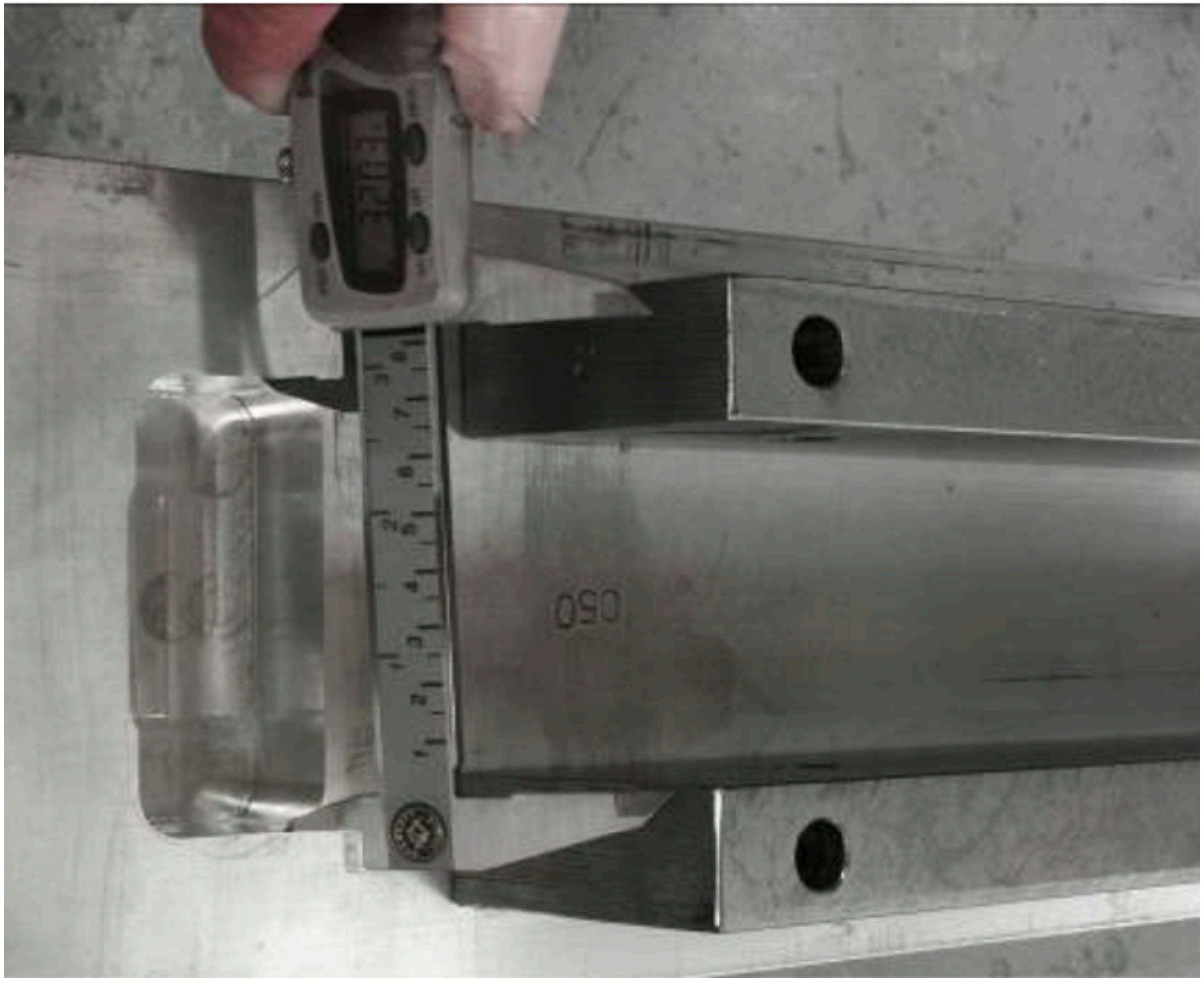
2. Check that the inserts (two sets of four) have been properly installed. Position is checked at Ross Machine Shop using the gauges that we provided.



3. Using a calibrated tape measure check the position, of the bolt hole pockets, report only out of specification measurements on the traveler for that specific base plate.



Base plates



Verify Pockets, Holes

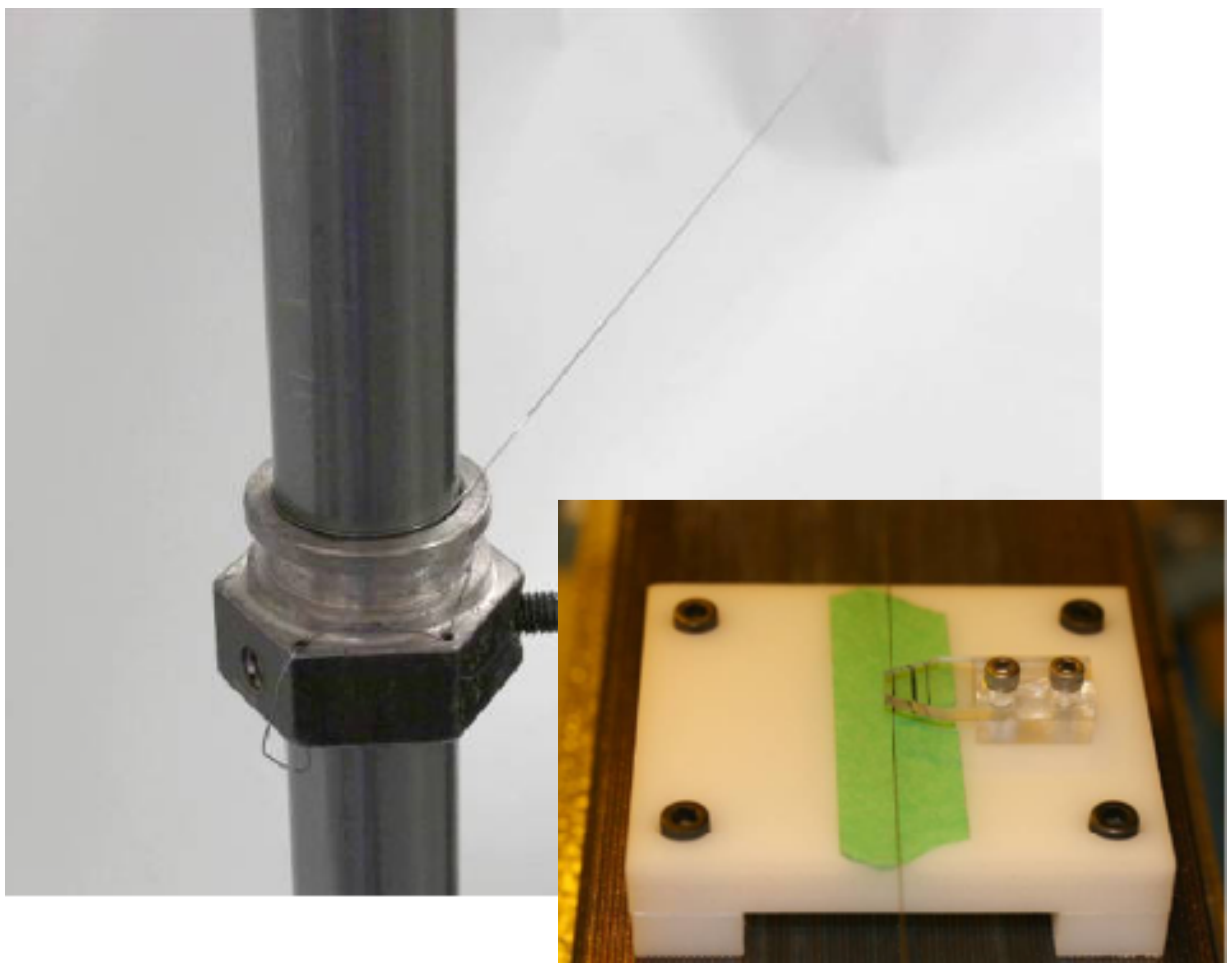
6. Measure the depth of each bolt hole pocket with calibrated digital depth gauge, report only out of specification measurements on the traveler for that specific base plate.

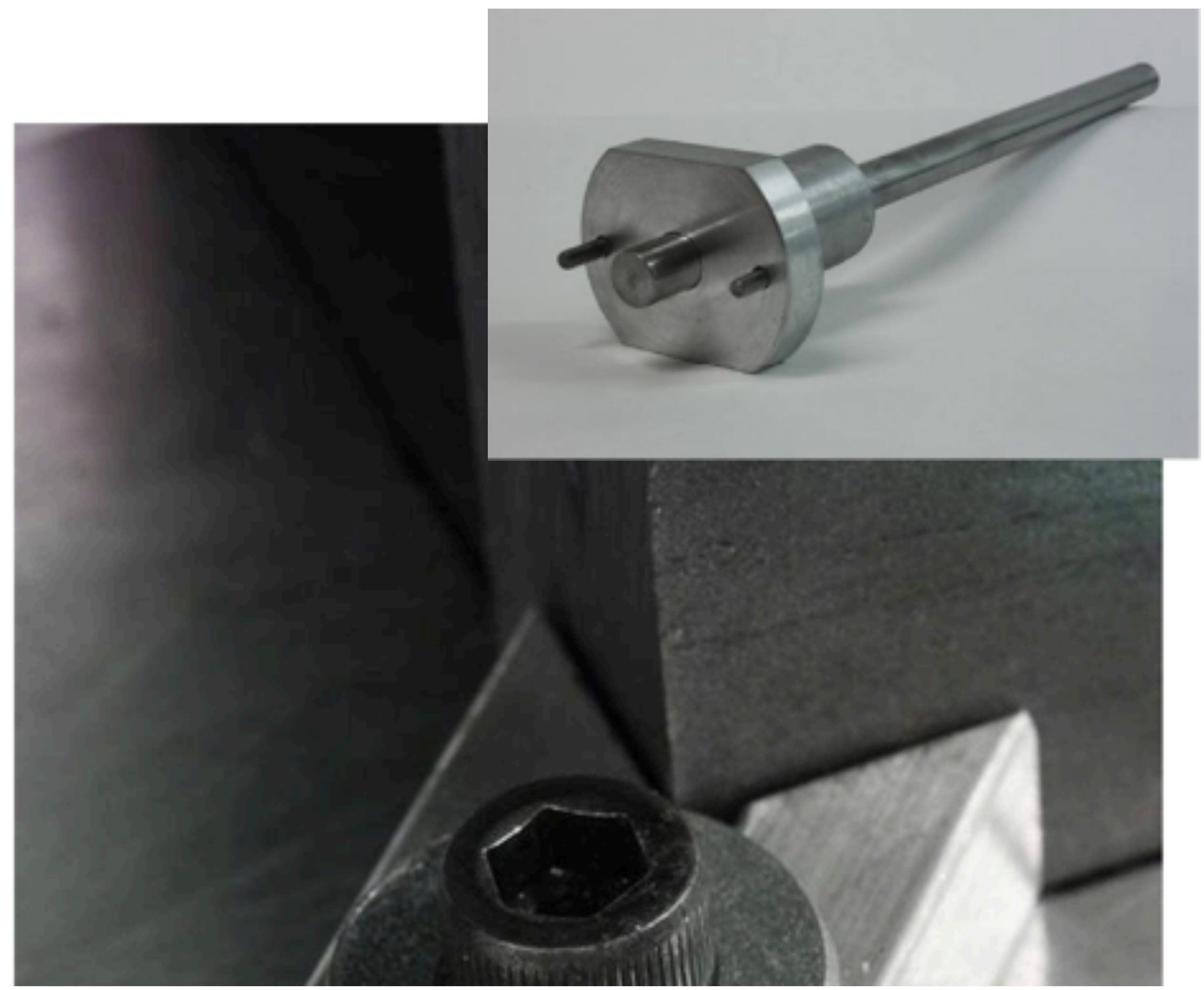
8. Label 16 points on the side of the plate:
   Facing the machine side (front side), point 1 is on the left; stamp is near point 16. Either use the drill holes on a top plate as a guide, transferring them to the base plate

QC Press Attachments

12. Set up posts and wire, and set guides .5 mm above the top of the plate.

13. Move the base plate with rails attached on to the press, level, shim if necessary, center and align the groove parallel to the wire.





Prepare Building Surface

10. Using an orbital sander, abrade the top of the plate using 80 grit sand paper to improve epoxy bonding characteristics.

Single-fiber guiding groove

First Build

- Layer 0 using industrial epoxy
- “Roll” lead over surface

Epoxy (St. Gobain BC-600)

Preparing Epoxy

1. Check and recalibrate the scale if necessary using the 100g weight.
2. Cover the scale with plastic wrap.
3. Put a plastic cup on the scale. Zero (tare) the scale.
4. Measure the resin and hardener separately in clean new 10 ml. plastic cups:
5. The ratios are as follows:

Bicron Optical Epoxy:	100.0g resin
	28.0g hardener
Arldtite 2011 Industry Epoxy:	100.0g resin
	80.0g hardener

6. **Do not mix** the epoxy until it is ready to be used. Cover the resin and hardener with plastic wrap until such time.
7. When the epoxy is ready to be used, add the hardener to the resin. Stir and fold with a mixing stick for one minute in the original cup and then transfer mixed contents to the center of a clean new cup and continuing mixing for a total minimum time of 4 minutes.

Epoxy Tracking

Build #	2	3	4	5	6	7	8	9	10
Day	Dec 15/09	Dec 15/09	Dec 16/09	Dec 16/09	Dec 17/09	Dec 18/09	Dec 21/09	Dec 21/09	Dec 22/09
Pb layers	7	6	6	7	8	7	8	10	8
SciFi lost	0	2	0	0	0	0	0	0	0
Start Time	9:50	18:45	9:00	18:45	8:45	8:48	8:50	18:47	9:06
End Time	12:36	20:59	11:28	21:14	11:08	11:11	11:11	21:03	11:25
Time/Layer	0:23	0:22	[illegible]	[illegible]	[illegible]	0:20	0:17	0:13	0:17
Time Mixed	9:50	18:45	[illegible]	[illegible]	[illegible]	8:48	8:50	18:47	9:06
1 resin (g)	99.9	100.0	[illegible]	[illegible]	[illegible]	100.1	100.0	100.1	100.0
1 Hardener (g)	28.1	28.0	[illegible]	[illegible]	[illegible]	28.0	28.0	28.0	28.0
Time Mixed	10:11	19:04	[illegible]	[illegible]	[illegible]	9:07	9:08	18:57	9:27
2 resin (g)	99.9	100.0	[illegible]	[illegible]	[illegible]	37.1	100.2	100.1	99.9
2 hardener (g)	28	28.0	[illegible]	[illegible]	[illegible]	10.4	28.1	28.1	28.0
Time Mixed	10:46	19:43	[illegible]	[illegible]	[illegible]	9:22	9:38	19:24	9:45
3 Resin (g)	100.1	100.0	[illegible]	[illegible]	[illegible]	100.0	100.0	100.0	100.1
3 Hardener (g)	28	28.0	[illegible]	[illegible]	[illegible]	28.1	28.0	28.0	28.0
Time	11:17	20:19	[illegible]	[illegible]	[illegible]	9:56	10:09	19:43	10:17
4 Resin (g)	50.1	50.0	[illegible]	[illegible]	[illegible]	100.1	99.9	100.1	100.1
4 Hardener (g)	14	14.0	[illegible]	[illegible]	[illegible]	28.0	28.0	28.0	27.9
Time	11:41		[illegible]	[illegible]	[illegible]	10:29	10:47	20:06	10:46
5 Resin (g)	50		[illegible]	[illegible]	[illegible]	100.0	50.0	100.0	100.0
5 Hardener (g)	14		[illegible]	[illegible]	[illegible]	28.1	14.0	28.0	28.0
Time			[illegible]	[illegible]	[illegible]			20:40	
6 Resin (g)			[illegible]	[illegible]	[illegible]			50.2	
6 Hardener (g)			[illegible]	[illegible]	[illegible]			14.1	
Time			[illegible]	[illegible]	[illegible]				
7 Resin (g)			[illegible]	[illegible]	[illegible]				
7 Hardener (g)			[illegible]	[illegible]	[illegible]				
total Resin (g)	400.0	350.0	400.0	399.8	450.2	437.3	450.1	550.5	500.1
Total Herdener (g)	112.1	98.0	112.0	112.1	126.1	122.6	126.1	154.2	139.9
sample	10.5	10.0	10.5	8.0	13.5	18.6	12.8	11.3	8.7
left	0.0	0.0	0.0	33.0	0.0	32.3	0.0	6.1	21.7

25 builds per module

Fiber Laying - Lead Rolling

1. Two people paint optical epoxy evenly on the top lead layer of the module.
2. One person with clean gloves (no epoxy) should lift one end of a bundle of fibers from the grounded copper covered fiber sorting table so that another person can hold the fibers from that end. Repeat this at the middle of the bundle and at the other end. Three people

Lead Tracking

Module #1			
	used	wast	total
13 cm	21	1	22
12 cm	61	3	64
11 cm	65	1	66
10 cm	38	2	40
Total	185	7	192

Module #2			
	used	wast	total
13 cm	21	1	22
12 cm	62	0	62
11 cm	62	1	63
10 cm	38	0	38
Total	183	2	185

Module #3			
	used	wast	total
13 cm	21	0	21
12 cm	60	1	61
11 cm	61	2	63
10 cm	40	0	40
Total	182	3	185

	Sheets	Lead Coils
Total 13 cm lead	65	7
Total 12 cm lead	187	19
Total 11 cm lead	192	20
Total 10 cm lead	118	12
Total	562	57

Press Retracted

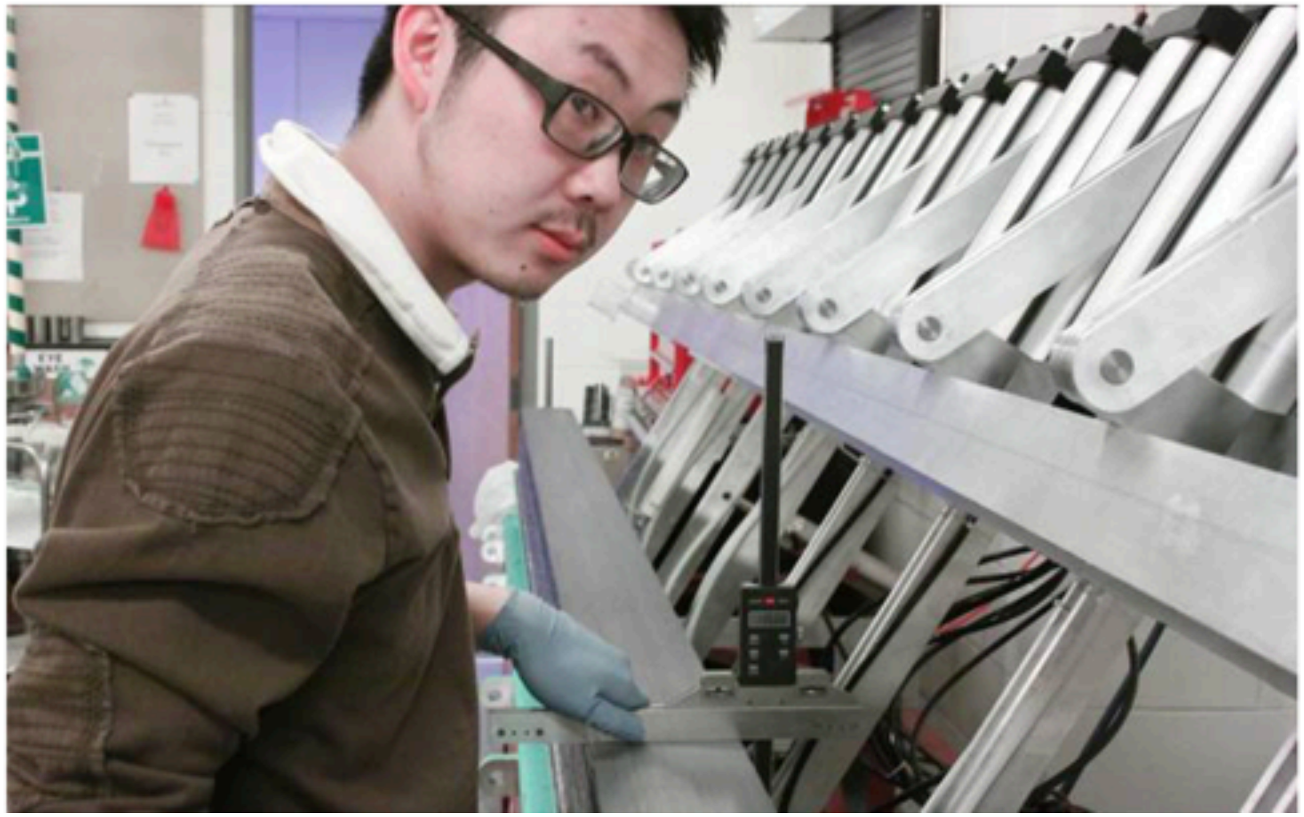
"Growing" Process Check

Work on each press 1/2 day: then press for 20 hrs

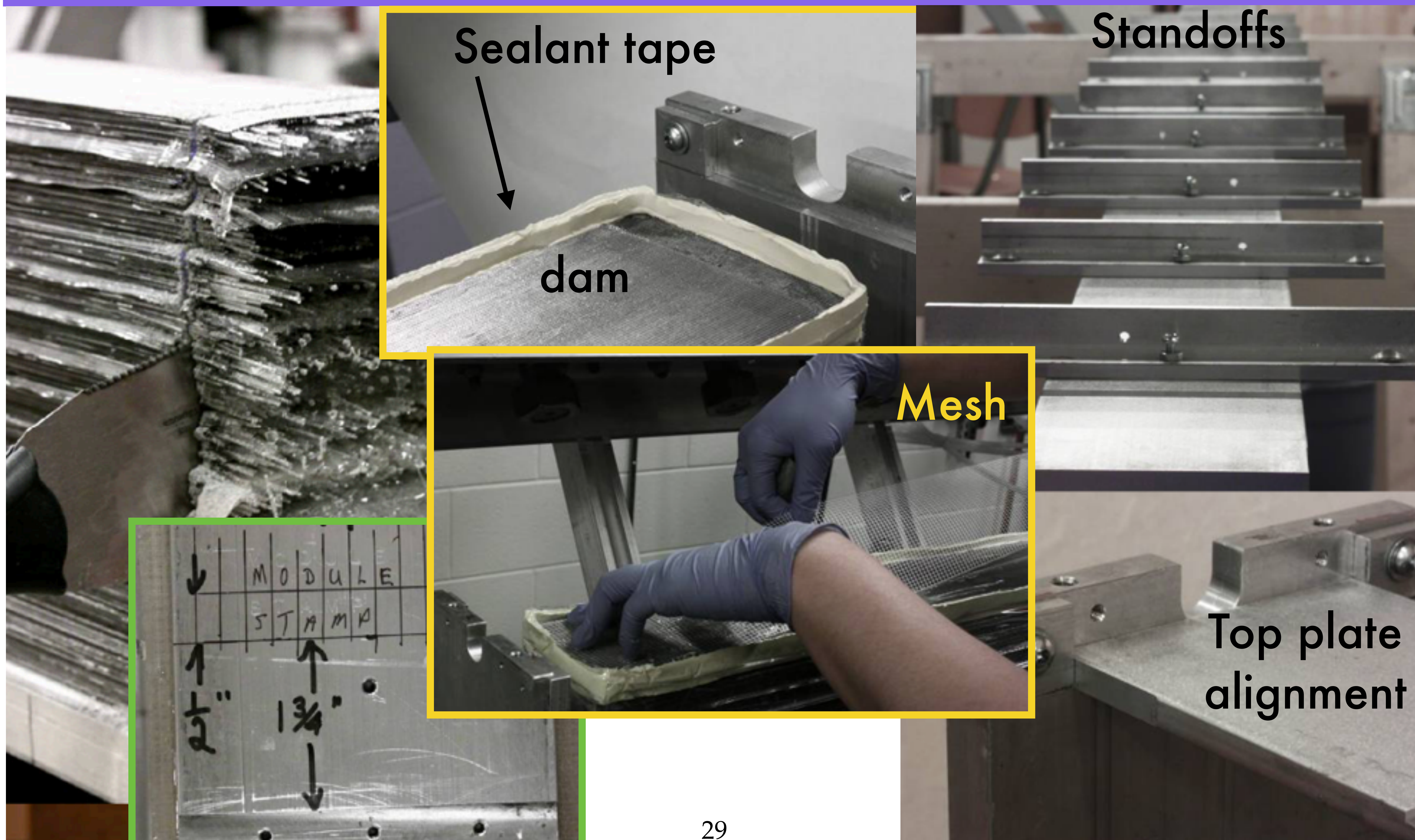
Last Build of Each Step

1 Reference drawing Stepwedge.pdf to determine the minimum height needed to complete the step.

2 Using a digital depth gauge measure the height of the build from the top of lead sheet to the top of base plate step at positions 1-16, front and back. Enter

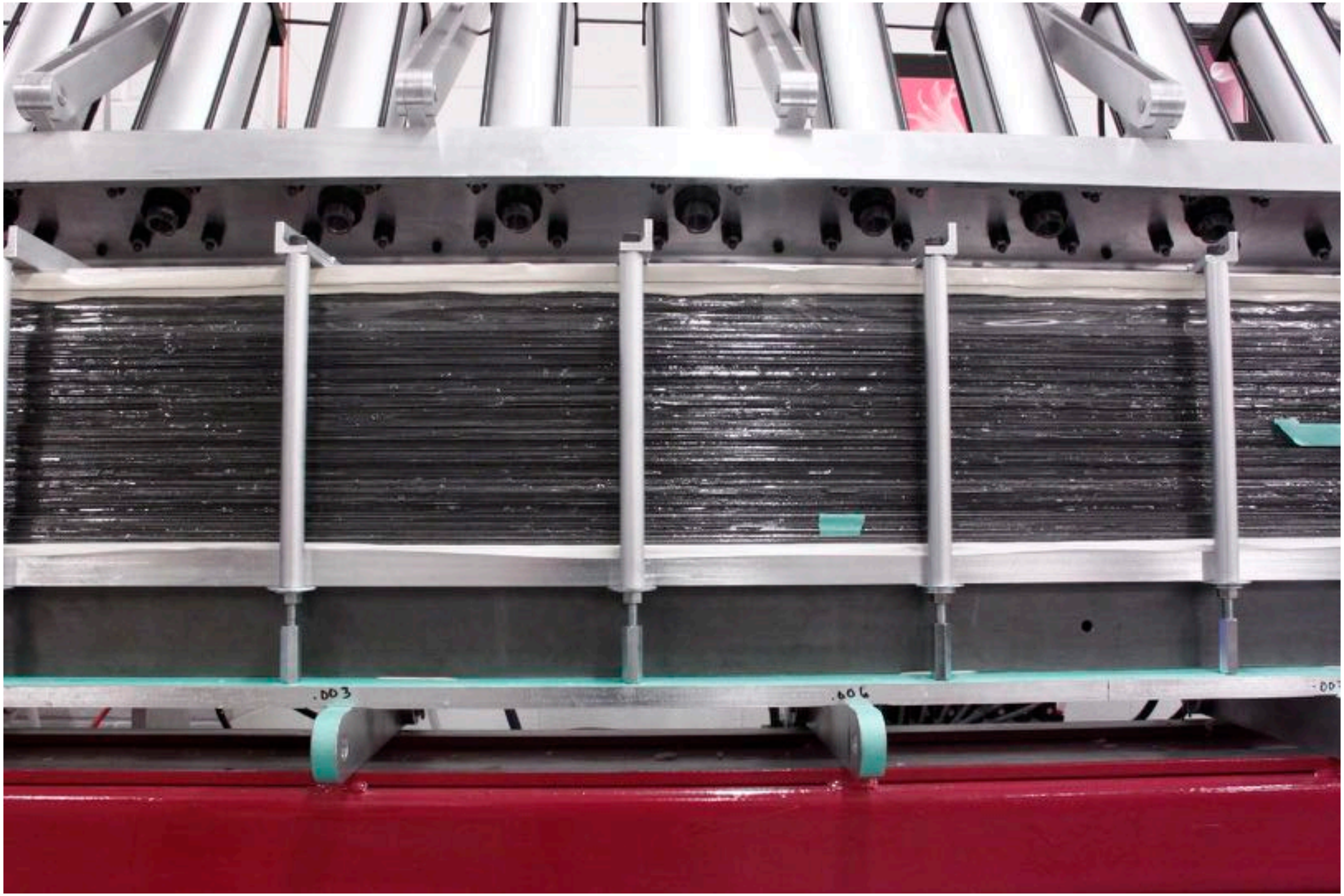


Top Plate Gluing



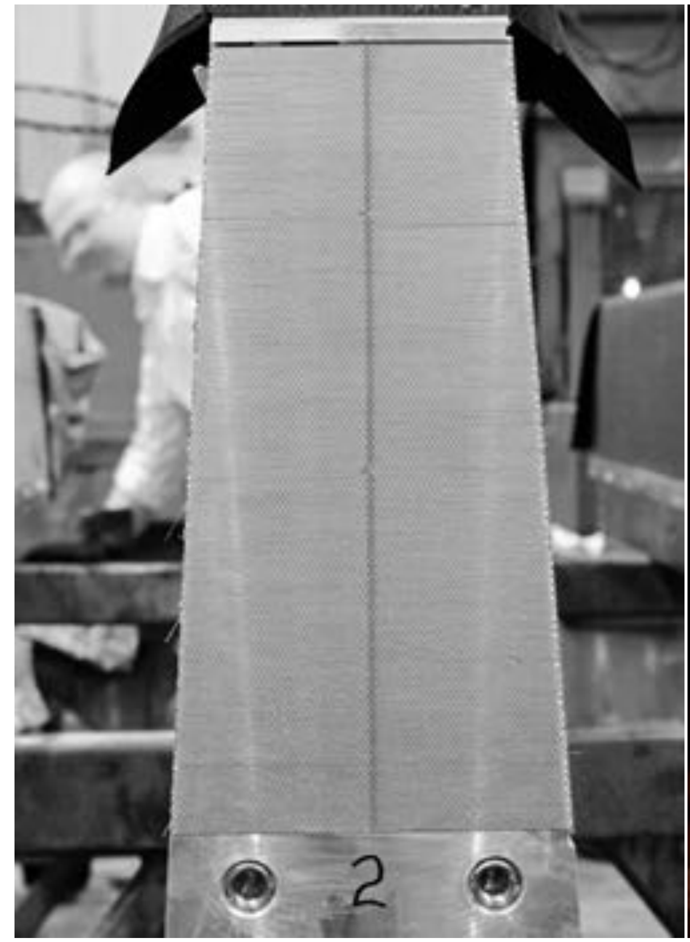
Blue Press

Red Press



Machined Modules

Prototype



02

04

- Excellent finish of end faces & transmission uniformity
- 52 modules have been built & machined (3 prototypes, 48 production, 1 spare)

Travellers

BCAL Construction Traveller

BCAL Construction — Traveller version 1.0

Module No.	**01**	**Nonconformities:**	Build & Machining	Fibres

Base Plate

Stamp/Segment No.	005	Drawing	RMS Traveller

Matrix Build

Date Start	09/11/09	Fibre Shipment	02	Epoxy Used (g)	14576.9
Date End	02/12/09	Fibre Lots (JS-)	32-34, 37-39,	Epoxy Lost (g)	899.6
No. of Layers	187		41,42,45,46,49,	Pb Sheets Lost	4
No. of Builds	23		51,52,59,60,63		
Temp Range	20-22C	AttenLen Means	334-387cm	Build Stats	
Humid Range	20-22%	Npe Means	6.5-7.6	Epoxy Stats	
		Fibres Used	15468	Procedures	
		Fibres Lost	3	Photos	

Top Plate

Stamp No.	01	Drawing	DC Rails:	No

Machined Module

Module/Segment No.	01	Drawing	RMS Traveller

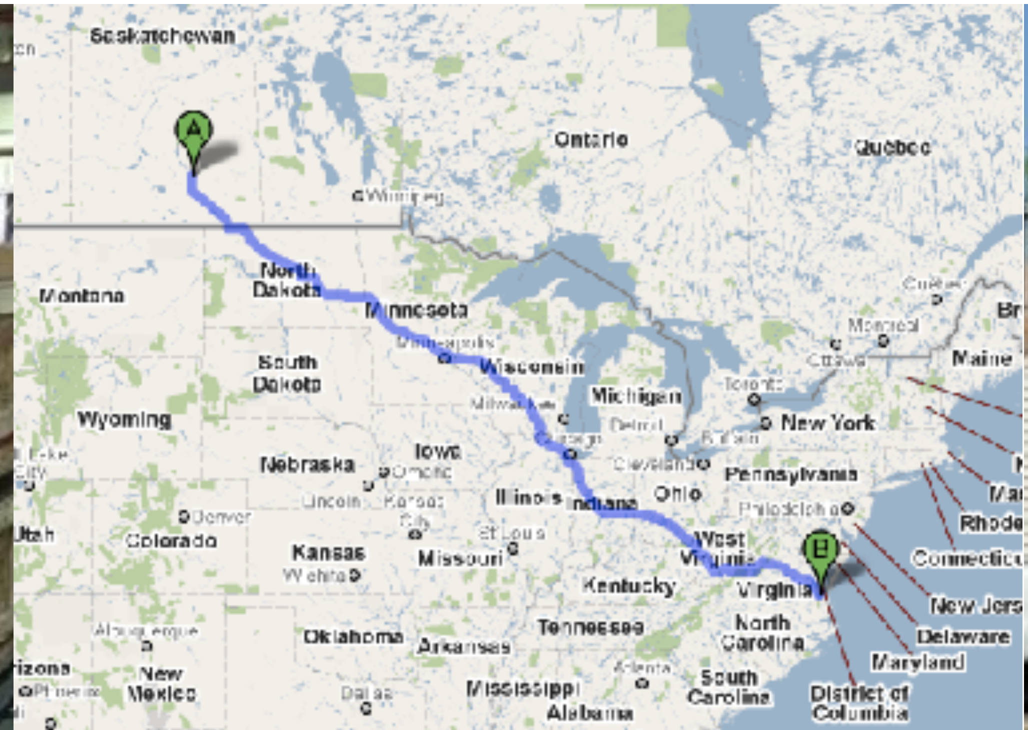
Transmission Uniformity

Light Source:	UV-LED	**Coupling:**	Air gap	Uniformity Results
Coupler:	Winston Cone	**Readout:**	Winston Cone	End 1 Image
				End 2 Image

Last Updated: 05/08/10 13:17

BCAL Construction — University of Regina - GlueX Team — Author: Zisis Papandreou

Module Delivery to JLab



~3,255 km
in refrigerated truck

Left Regina
(April 22, 2023)

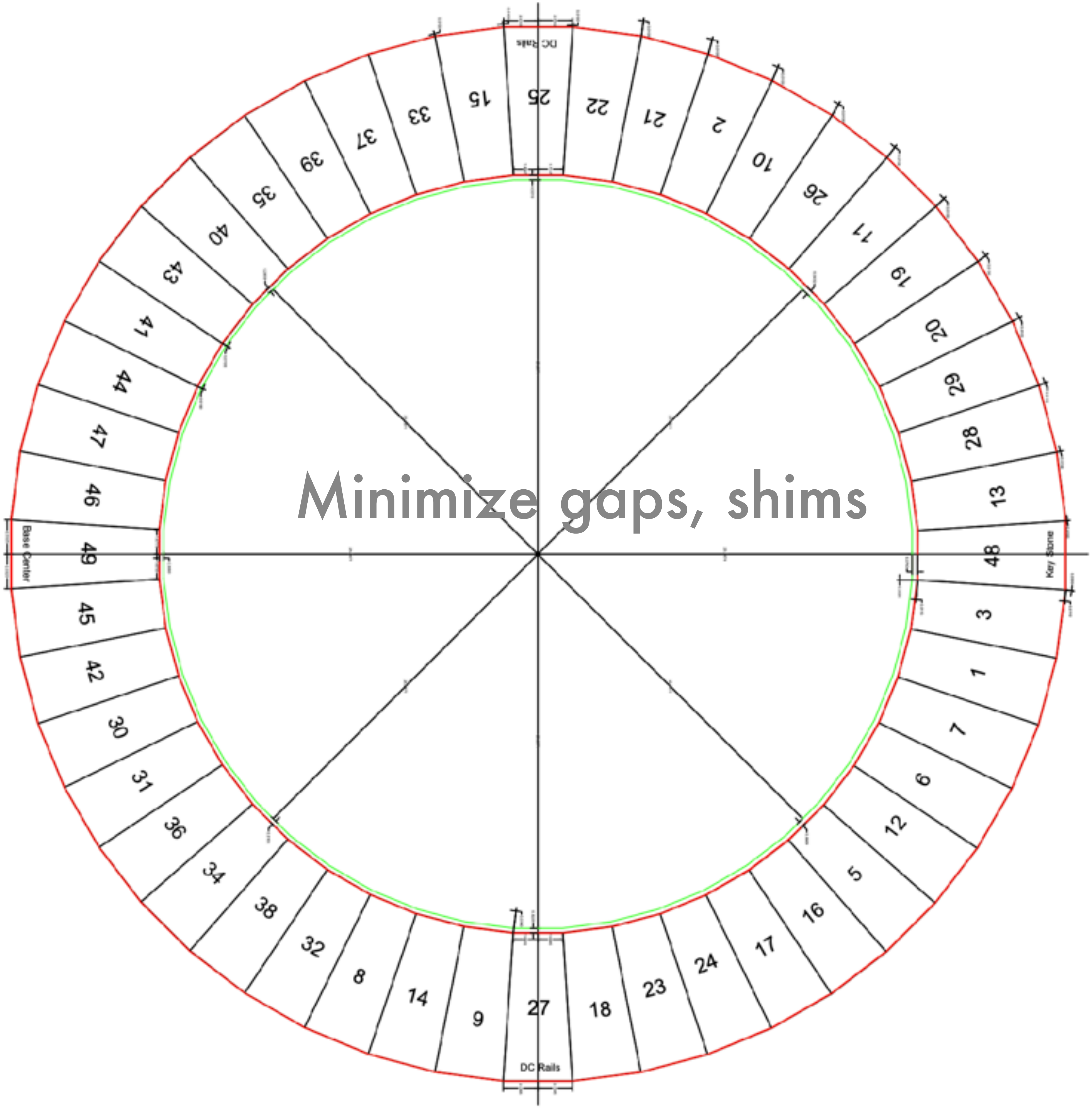
~3,226 km
to BNL

Arrived at JLab
(April 26, 2010)

Modules 01-04: 1st detector delivery for 12 GeV program!

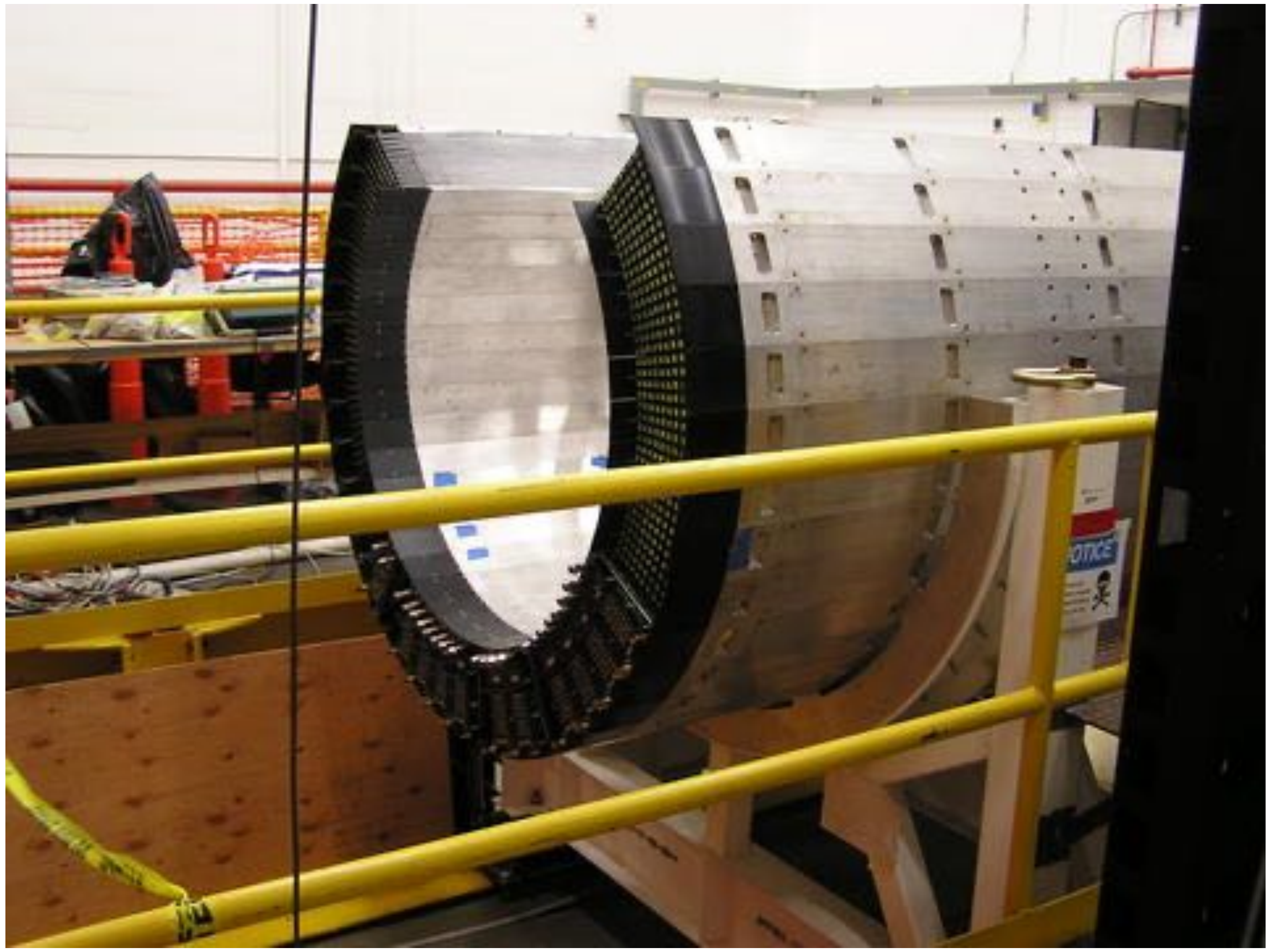
Module Arrangement

Minimize gaps, shims



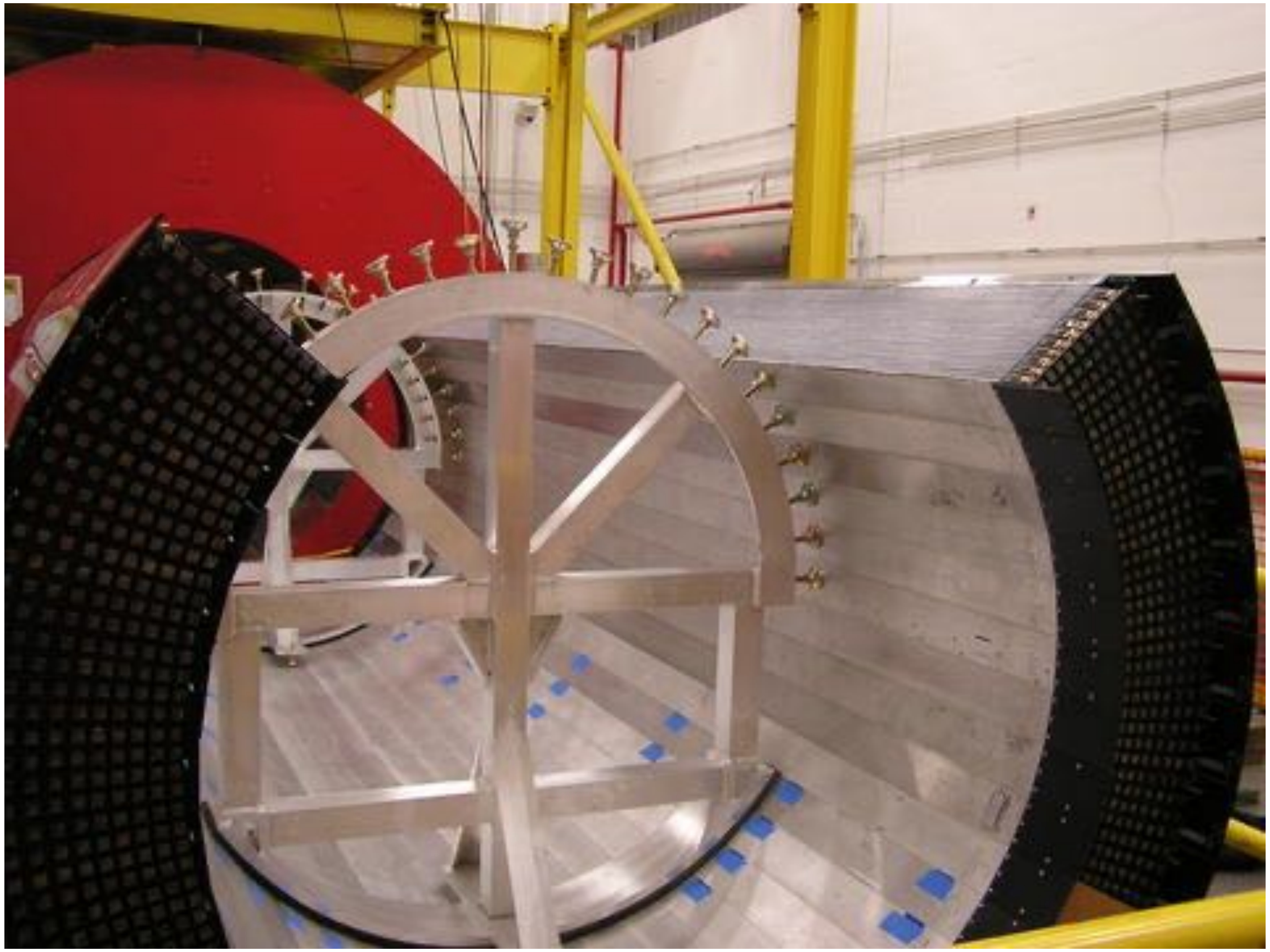
Assembly

Cradle

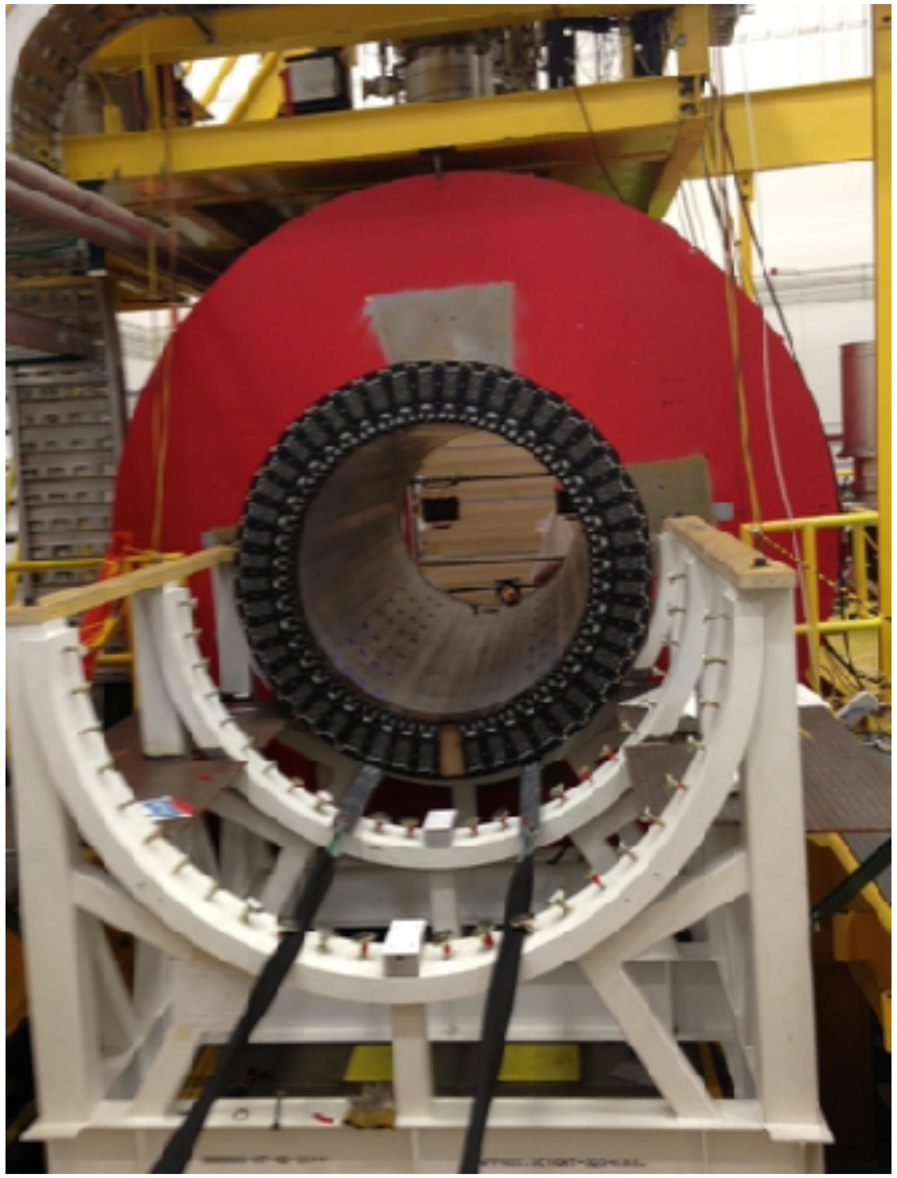


Assembly on floor
then upstream platform

Assembly & Installation

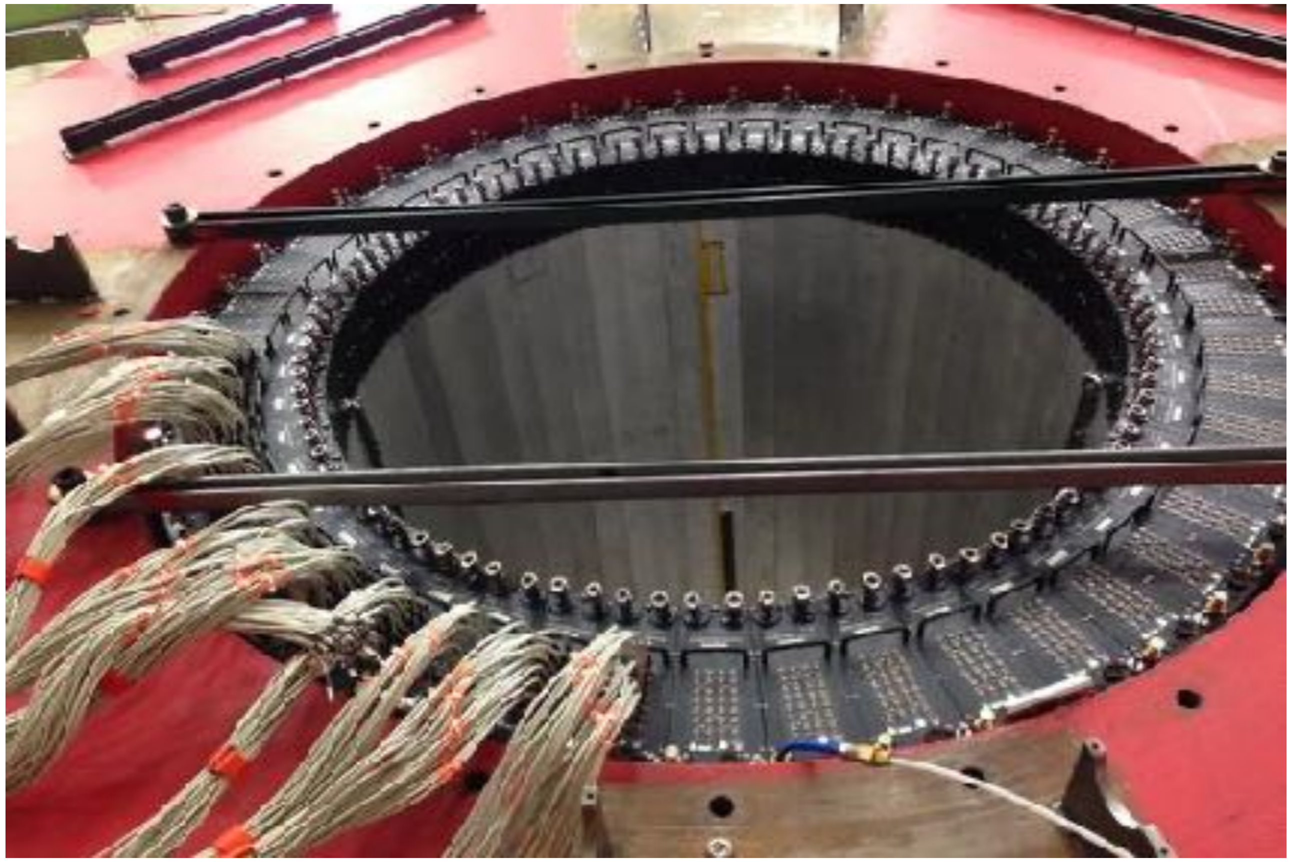


fixture to support top modules



into the solenoid

Cables, Cooling, N2



Cabling starts

Before tracker installation

Memorandum of Understanding
between

Jefferson Science Associates, LLC.,
Thomas Jefferson National Accelerator Facility

and the

UNIVERSITY OF REGINA, as represented by
the Subatomic Physics at Regina with Research Offsh
(SPARRO) Group

Pursuant to the 12 GeV Upgrade Project

WBS 1.5.2.2.1
The Hall D/GlueX Barrel Calorimeter

March 9, 2009

Jefferson Lab

STATEMENT OF WORK

12000 Jefferson Avenue
Newport News, VA 23606

D00000-01-07-S003

TITLE: Hall D Barrel Calorimeter Module Fabrication Statement Of Work
WBS 1.5.2.2.1

DATE: March 12, 2009

BY: Elton Smith

APP: ____________ ________
E. S. Smith Date
SOTR

APP: ____________ ________
E. Chudakov Date
Hall D Group Leader

APP: ____________ ________
T. Whitlatch Date
Hall D Engineer

Jefferson Lab
Thomas Jefferson National Accelerator Facility

COST REIMBURSEMENT SUBCONTRACT

[FOR EDUCATIONAL INSTITUTIONS AND NONPROFIT ORGANIZATIONS]

JEFFERSON SCIENCE ASSOCIATES, LLC
628 HOFSTADTER ROAD SUITE 5
NEWPORT NEWS, VA 23606

Subcontractor: University of Regina Office of Research Services	**JSA Subcontract No.: JSA 09-C1744**
Attention: Lucille Legare	**Subcontracts Manager: Teresa Danforth**
Street Address: 3737 Wascana Parkway, Rm 109	**Phone #: (757) 269-7364**
City, State, Zip: Regina, SK S4S0A2	**Fax #: (757) 269-7057**
Phone:306-585-4775 Fax: 396-585-4893	**E-Mail: danforth@jlab.org**
E-Mail: Lucille.legare@uregina.ca	

Introduction

This is a cost-reimbursement (no-fee) subcontract for production of 48 Barrel Calorimeters (BCAL) as further described Article I. Statement of Work.

This Subcontract is between *Jefferson Science Associates, LLC, (hereinafter called "JSA" or "Contractor")* and University of Regina (hereinafter called "*Subcontractor*"). The Subcontract is issued under Prime Contract No. DE-AC05-06OR23177 between JSA and the United States Department of Energy (hereinafter called "DOE").

Agreement

The parties agree to perform their respective obligations in accordance with the terms and conditions of TC-9 Section I- Schedule of Articles rev. April 2008 and TC-9 Section II- General Provisions rev April 2008, and other documents included in the appendices, attachments or incorporated by reference, which together constitute the entire Subcontract and supercede all prior discussions, negotiations, representations, and agreements.

UNIVERSITY OF REGINA

By: [signature]

Name: D.C. Malloy

Title: Director

Date: July 15, 2009

JEFFERSON SCIENCE ASSOCIATES, LLC

By: Teresa Danforth

Name: Teresa Danforth

Title: Subcontracts Manager

Date: August 6, 2009

JLab-Regina Contract

- Quotes/costs:
  - Materials
  - Machining
  - Shipping
  - Customs

BCAL Construction Budget

1. Salaries (Labour)

The table below lists the salaries for students and the Construction Manager in US$. Cost to JLab includes the UofR overhead, which is 15% for students and 10% for the Construction Manager. For more details, please see Appendix 2.

All amounts include benefits.

Personnel	#	Task	Salary (US$/m)	Duration (months)	Cost (US$)	Cost to JLab (US$)
Students	4	BCAL Construction	2,000	28	224,000	257,600
Students	2	SciFi & BCAL Optical QA	2,000	24*	96,000	110,400
Construction Manager	1	BCAL Construction and QA	6,666.67	36	240,000	264,000
Total Labour					**560,000**	**632,000**

* If longer duration is needed, it will be contributed manpower by the UofR.

2. BCAL Materials and Machining (Ross Machine Shop)

The table below lists the costs of materials (Al plates, inner and outer and steel support base plates) and the machining as per drawings and specifications. The UofR overhead rate of 15% is included as cost to JLab. For more details, please see Appendix 2.

PST and/or GST are included in the estimates, where it applies.

Description	#	Unit Price (US$)	Cost (US$)	Cost to JLab (US$)
Al base (outer) plate	48	1,175	56,400	64,860
Al top (inner) plate	48	349	16,752	19,265
Module machining	48	2,465	118,320	136,068

QUALITY ASSURANCE PLAN FOR THE CONSTRUCTION OF THE BCAL

George J. Lolos

JUNE 3, 2009

1. SCOPE

The quality of a finished BCAL module is judged on two separate criteria. One is dimensional uniformity in meeting the stated objectives of all the geometric characteristics of the BCAL. Second is the optical quality of the BCAL, which reflects the quality controls of the SciFi's, including response to cosmic rays, and the machining and polishing of the BCAL read-out ends. The controls on the SciFi quality will be the subject of a separate document and will only be touched upon briefly here.

The UofR group has constructed a series of prototype modules, including two full-scale modules, and personnel that participated in the construction is still available to act as the instructor core for the student labour that will be employed for the construction of the 48 (+1) modules. In addition, both written and video material is available to further assist in the training of the students and illustrating the continuous testing of the modules as they are being constructed.

1.1 Key components to control and the methodology to be followed

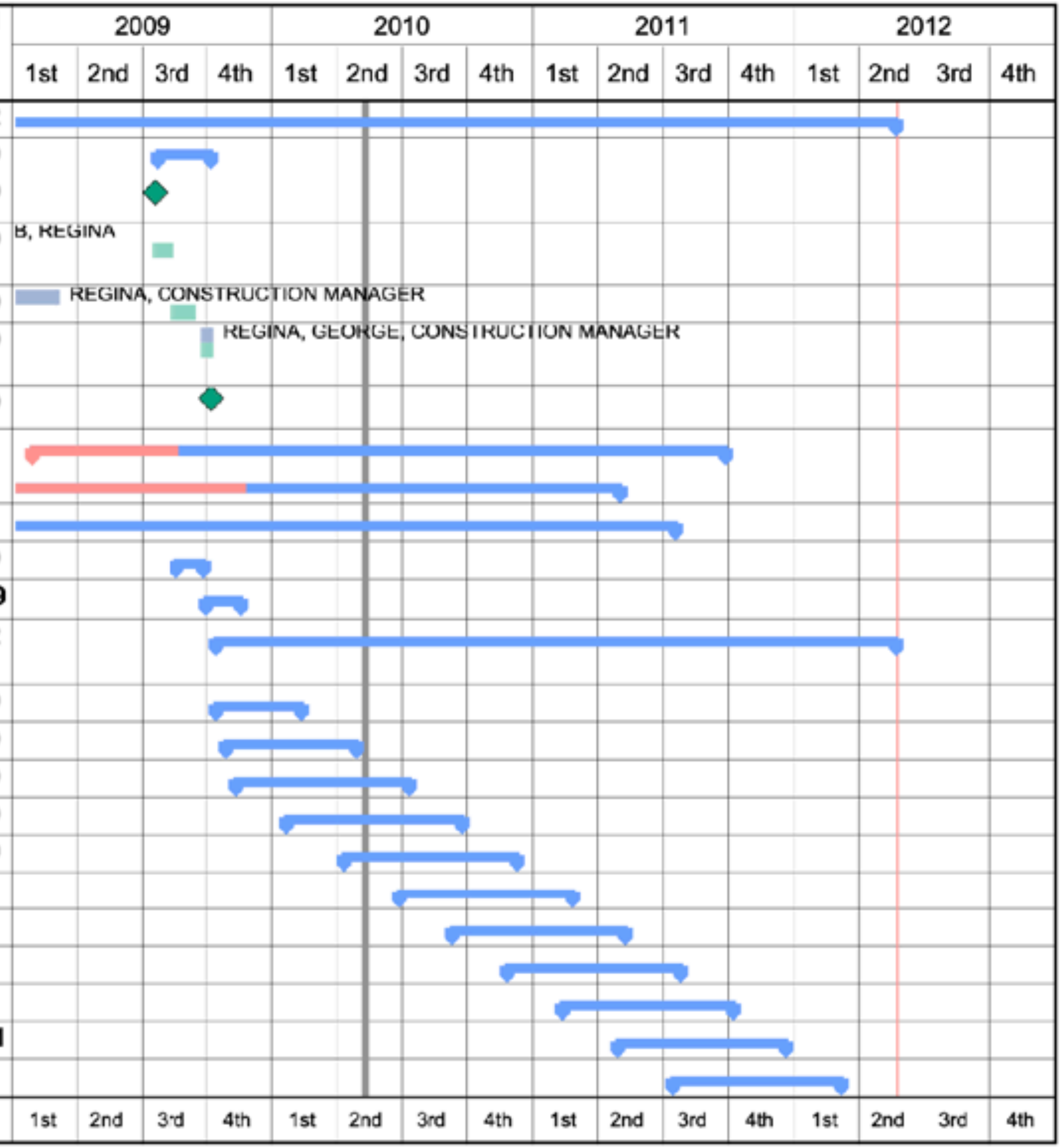
The methods of lead swaging and epoxy curing, which have been developed as part of the extensive R&D, have resulted in excellent uniformity of construction. Specifically, starting with a high quality base of pure Pb of uniform thickness, the swaging process results in further improvements in thickness uniformity of the now grooved Pb sheets. Furthermore, the final thickness can be adjusted, within ~ 150 μm, by the gap between the two grooved rollers. In addition, the new wider rollers in the swaging machine, which was designed and built at the UofR, compared to the original swaging machine on loan from INFN-LNF, result in more even distribution of pressure on the Pb sheets by placing the latter away from the ends of the rollers.

Earned-Value Management System

University of Regina					
Barrel Calorimeter				dollar value	
1.5.2.2.1					
		Planned		Budgeted Total	Original
Activity ID	Activity Name	Start	Finish	Cost	Duration
	PHASE 1			$220,407.00	
15221050	Proc 2nd press/Frame (BarCal)	8-31-09	3-1-10	$30,655.00	24.00
15221195LOE	Bcal Module Construction Manager Phase 1	8-31-09	3-1-10	$50,160.00	16.20
15221200	Module #1 Matrix Fabrication	8-31-09	12-01-09	$12,842.00	12.80
15221205	Module #1 Machining and Shipping	8-31-09	02-10-10	$4,607.00	21.60
15221210	Module #2 Matrix Fabrication	8-31-09	12-01-09	$12,842.00	12.80
15221215	Module #2 Machining and Shipping	8-31-09	02-10-10	$4,607.00	21.60
15221220	Module #3 Matrix Fabrication	8-31-09	01-07-10	$12,842.00	17.00
15221225	Module #3 Machining and Shipping	8-31-09	02-10-10	$4,607.00	21.60
15221230	Module #4 Matrix Fabrication	8-31-09	01-07-10	$12,842.00	17.00
15221235	Module #4 Machining and Shipping	8-31-09	02-10-10	$4,607.00	21.60
15221240	Module #5 Matrix Fabrication	8-31-09	02-12-10	$12,842.00	5.80
15221245	Module #5 Machining and Shipping	8-31-09	04-27-10	$4,607.00	16.00
15221250	Module #6 Matrix Fabrication	8-31-09	02-12-10	$12,842.00	5.80
15221255	Module #6 Machining and Shipping	8-31-09	04-27-10	$4,607.00	16.00
15221260	Module #7 Matrix Fabrication	8-31-09	03-24-10	$12,842.00	11.20
15221265	Module #7 Machining and Shipping	8-31-09	04-27-10	$4,607.00	16.00
15221270	Module #8 Matrix Fabrication	8-31-09	03-24-10	$12,842.00	11.20
15221275	Module #8 Machining and Shipping	8-31-09	04-27-10	$4,607.00	16.00

Timetable

	Name	Revised Duration (Work Days)	Revised Start Date	Revised Finish Date
1	**BCAL FABRICATION**	**972.00**	**9/1/08**	**5/22/12**
2	**PREPARATIONS**	**61.00**	**7/17/09**	**10/9/09**
3	CONTRACT AWARD	0.00	7/17/09	7/17/09
4	HIRE CONSTRUCTION MANAGER	20.00	7/17/09	8/13/09
5	QA PLAN WRITTEN	21.00	8/14/09	9/11/09
6	PREPARE FOR READINESS REVIEW	10.00	9/28/09	10/9/09
7	READINESS REVIEW	0.00	10/9/09	10/9/09
8	**LEAD...**	**696.00**	**1/26/09**	**9/26/11**
35	**FIBERS...**	**696.00**	**9/1/08**	**5/2/11**
64	**ALUMINUM PLATES...**	**700.00**	**11/12/08**	**7/19/11**
76	**PRODUCTION SETUP...**	**31.00**	**8/14/09**	**9/25/09**
87	**CONSTR PROTOTYPE...**	**38.00**	**9/28/09**	**11/18/09**
96	**PRODUCTION MODULE CONSTRUCTION**	**682.00**	**10/12/09**	**5/22/12**
97	**MODULES 1-4...**	**88.00**	**10/12/09**	**2/10/10**
115	**MODULES 5-8...**	**132.00**	**10/26/09**	**4/27/10**
133	**MODULES 9-12...**	**176.00**	**11/9/09**	**7/12/10**
151	**MODULES 13-16...**	**179.00**	**1/19/10**	**9/24/10**
169	**MODULES 17-20...**	**178.00**	**4/6/10**	**12/9/10**
187	**MODULES 21-24...**	**177.00**	**6/22/10**	**2/23/11**
205	**MODULES 25-28...**	**176.00**	**9/7/10**	**5/10/11**
223	**MODULES 29-32...**	**175.00**	**11/23/10**	**7/25/11**
241	**MODULES 33-36...**	**174.00**	**2/8/11**	**10/7/11**
259	**MODULES 37-40...**	**173.00**	**4/26/11**	**12/22/11**
277	**MODULES 41-44...**	**172.00**	**7/12/11**	**3/7/12**



Thursday, December 1, 2011

UNIVERSITY OF REGINA

DEPARTMENT OF PHYSICS

Dr. Z. Papandreou, Ph.D., P.Phys.
Professor

Regina, Saskatchewan
Canada S4S 0A2
Phone: (306) 585-5379
Fax (306) 585-5659
Email: zisis@uregina.ca
www.phys.uregina.ca

Thursday, December 1, 2011
To: Customs and/or Carriers
Re: Packing List/Description for Shipment of four (6) Calorimeter modules

To Whom It May Concern:

This shipment consists of four (5) wooden crates with gross weight 7500 lbs (1500 lbs per crate), plus one (1) smaller crate with gross weight 350 lbs, destined to the Thomas Jefferson National Accelerator Facility (Jefferson Lab), 12000 Jefferson Avenue, Newport News, Virginia, USA, 23606. The Jefferson Science Associates consortium operates Jefferson Lab on behalf of the Department of Energy.

Item description: Each of the large crates contains one (1) Calorimeter module, consisting of a rows of optical fibres bonded in to thin, corrugated lead sheets in a stack, forming a single unit between top and bottom aluminum plates. This device will be used in basic physics research experiments at Jefferson Lab to detect cosmic rays and other particles. The small crate contains a one (1) Calorimeter sample module as well as its mechanical and positioning support structure.

Item ownership: The equipment is property of JSA/Jefferson Lab. The equipment is used only for research purposes and has no commercial value. However, for purposes of insurance, the total estimated value of the shipment is USD$695,600 (USD$135,000 per large module and USD$20,600 for the sample module).

NAFTA/Duty Free Status: The Calorimeter modules were assembled/constructed at the University of Regina, from materials purchased and provided by JSA/Jefferson Lab; JSA/Jefferson Lab also paid for the labour.

- For questions related to Customs Clearance please contact Eastport Customs Brokers, 757-873-2215, fax 757-873-2130).
- Upon arrival of the shipment at the U.S. port of entry, the U.S. Customs Office is requested to release the shipment under 19 CFR 142 and request the Jefferson Lab subcontracting officer (Mitch Laney, 757-269-5338, fax 757-269-7057) and property administrator (Joan Holloway, fax 757-269-5825) to furnish duty-free status documentation if required.

For any questions or clarifications please do not hesitate to contact our Construction Manager, Mr. Dan Kolybaba, at (306) 585-4264 or me directly.

Sincerely,

Dr. Zisis Papandreou
Professor of Physics
Calorimeter Construction Principal Investigator

Last shipment

PbSciFi Decisions & Discussion

- Technical: fiber types, SiPM (sensors)
- Construction sites? 1 or 2
- Financial, Political
- Labour
- Mechanical, installation