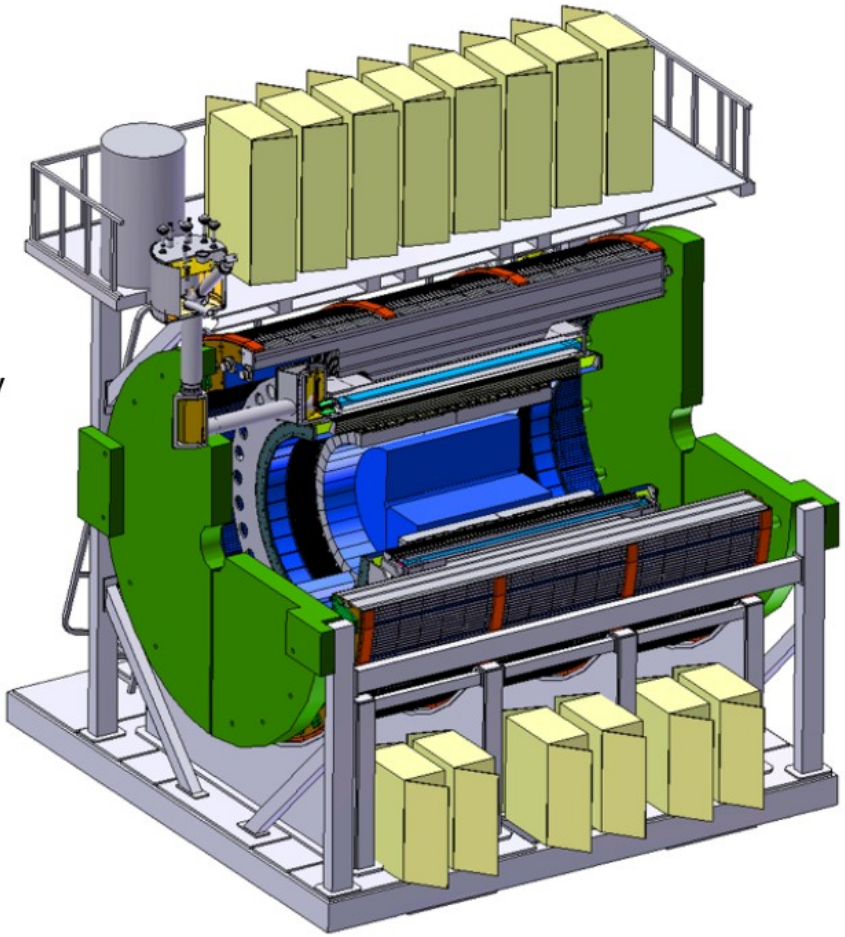
sPHENIX IB Meeting

August 26, 2015

sPHENIX Design



- Uniform acceptance $-1<\eta<1$ and $0<\varphi<2\pi$
- Superconducting solenoid enabling high resolution tracking
- Hadronic calorimeter doubling as flux return
- Compact electromagnetic calorimeter to allowing fine segmentation at a small radius
- Solid state photodetectors that work in a magnetic field, have low cost, do not require high voltage
- Common readout electronics in the calorimeters
- High rate 15 kHz in AA allows for large unbiased MB data sample
- Utilization of existing 1008 Infrastructure
- Potential re-use of PHENIX silicon vertex detector plus additional silicon tracking layers.

Recent sPHENIX Calendar

- sPHENIX Simulations workshop Jul 27-31 at SBU. 41 Participants from 18 inst
- EMCal Workshop at UIUC Aug 13-14
- Discussions w/ FNAL scintilltor production facility wk Aug 17
- Internal Review of sPHENIX EMCal at BNL Aug 20 at BNL
  - 5th Internal review of sPHENIX subsystems
  - Previously we reviewed the Magnet, Decommissioning and Installation, HCal, Calorimeter Electronics
- Si Tracker Workshop UNM Aug 21
- 1st meeting of new IB Aug 26
- Meetings with Vladimir, Ru scintillator production facility wk Aug 31
- sPHENIX Tracker Workshop at Santa Fe Oct 27
- sPHENIX Cost and Schedule Review Nov 9 – 10 at BNL
- sPHENIX Test Beam at FNAL April 2016
- sPHENIX Test Beam at FNAL Fall 2016

Review Charge

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Managed by Brookhaven Science Associates for the U.S. Department of Energy

Associate Laboratory Director's Cost and Schedule Status Review of the sPHENIX Project

Charge to the Review Committee
August 5, 2014

The sPHENIX detector, currently under development, is designed to facilitate large acceptance, ultra-high rate measurements of fully reconstructed jets and high resolution spectroscopy of upsilon states at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL). The experiment is being proposed with an eye toward enhancing the physics reach afforded by the RHIC complex prior to the possible construction of an Electron Ion Collider (EIC), which is currently under consideration by both the nuclear physics community and the Office of Nuclear Physics (ONP) in the Department of Energy. A review of the sPHENIX science program conducted by ONP in April 2015 resulted in a strong endorsement of the physics capabilities enabled by such a detector.

This review is being undertaken in order to provide an independent evaluation of the maturity and status of the sPHENIX project plan, which will inform Laboratory and ONP program planning. The committee is being asked to assess the current plan, focusing primarily on the cost and schedule, and taking into consideration the pre-conceptual stage of the planning and design. The project is currently planning to begin construction in CY2018. In the event that deficiencies are identified in the project plan, the committee is asked, to the extent possible, to recommend or outline a corrective path forward that is consistent with such a target.

The review will include an examination of the following specific items:

1. Design: Do the technical designs as described in the Pre-Conceptual Design Report (PCDR) adequately address the scientific goals and requirements? Is the pre-conceptual design sound, and does it provide an adequate basis for establishing the project's technical performance requirements efficiently and effectively, given the current stage of the project? Have the technical design choices been adequately justified? Have design alternatives, and any design decisions still in process, been adequately identified and integrated into the project plan, including decision branch points? Do the PCDR and supporting documentation adequately justify the stated preliminary cost range and project duration at this stage?

2. Scope: Are the project's scope and specifications sufficiently defined to support the preliminary cost and schedule estimates? If not, where are improvements called for, and what additional time and effort will be required to bring these to resolution?

3. Cost and Schedule: Are the preliminary cost and schedule estimates credible and realistic for this stage of the project? Do the estimates include adequate scope, cost and schedule contingency? Does the contingency adequately bound the design alternatives being considered, or that are still outstanding?

4. Risk: Have risks been adequately identified for this stage in the project? Have they been adequately taken into consideration in the determination of the preliminary cost and schedule contingency?

5. Management and ES&H: Is the project being appropriately managed at this stage? Does the proposed project team have adequate strength, management experience, design skills and Laboratory support to produce a credible technical, cost and schedule baseline on the time scales under consideration? If not, which specific areas need to be addressed or strengthened? Are ES&H aspects being properly addressed, and are future plans sufficient given the project's current stage of development?

6. Documentation: Is the documentation currently in place adequate to support the project plan being presented? If not, where are the deficiencies? Does the project team have an adequate plan for generating the required material for future reviews?

The review will take place on Monday and Tuesday, November 9-10, 2015, at BNL. A closeout will be presented to the Laboratory and the project team at the end of the second day. It is requested that the committee submit its final report to me by Friday, November 20.

I very much appreciate your willingness to lend your time and expertise to this highly significant step in the sPHENIX review process, and look forward to receiving your assessment.

Sincerely,

Berndt Mueller
Associate Laboratory Director for Nuclear and Particle Physics
Brookhaven National Laboratory

Documents to Prepare for the November Cost and Schedule Review

- **Revised WBS and WBS Dictionary (PM team)**
- **Preliminary CDR (Brant Johnson)**
- **Draft Basis of Estimate documents (Jim Mills and Don Lynch)**
- **Contingency Estimate – Bottoms up and risked based (Irina Sourikova)**
- **Draft Safety and Hazard Analysis (Paul Giannotti)**
- **Draft Quality Assurance Plan (Jack Eng)**
- **Draft Acquisition Strategy (Bob Ernst)**
- **Draft Risk Analysis and Mitigation document (Irina Sourikova)**
- **Draft Alternative Options document (PM team)**

We have people assigned to each document

Considerations for the November Review

It will be important for the review committee to note:

- **The project is ~ 18 months from a OPA CD-1 review**
- **All designs are pre-conceptual**
- **We have chosen technologies for the reference design and that allows us to do initial schedule, resource, costing and contingency estimations**
- **We're in the 1st round of prototyping**
- **There are a number of unresolved questions and in the case of Tracker multiple options to consider.**
- **The earliest we will begin final fabrication is 4QFY18. 3 years from now**
- **We have ~ 2.5 years before we need to make all final technology choices.**
  - **Of course we would like to make the choices earlier but that will require us to retire all technical risk as quickly as possible – rapid R&D and prototyping.**

November Cost and Schedule Review Agenda

Associate Laboratory Director's Cost and Schedule Status Review
of the sPHENIX Project
November 9-10, 2015
Draft Agenda

Monday, November 9, 2015 – Rooms TBD

8:00 am	Executive Session……Kotcher
8:45 am	Welcome……Mueller
8:55 am	Project Overview, Cost and Schedule……O'Brien
9:40 am	Detector Design and Performance……Haggerty
10:10 am	Magnet and Infrastructure……Mills
10:35 am	Break
10:50 am	Integration, Installation and Decommissioning……Lynch
11:15 am	Hadronic Calorimetry……Lajoie
11:40 am	Electromagnetic Calorimetry……Sickles
12:05 pm	Tracking……Hemmick or Nakagawa
12:30 pm	sPHENIX Collaboration……Harris
12:45 pm	Lunch
1:45 pm	Subcommittee Breakout Sessions • Management, Cost and Schedule • Calorimetry (EM and HAD) • Tracking, Trigger and Data Acquisition • Installation, Integration and Installation
3:45 pm	Break
4:00 pm	Subcommittee Executive Sessions
5:00 pm	Full Committee Executive Session……Kotcher
6:30 pm	Adjourn

Tuesday, November 10, 2015 – Rooms TBD

8:00 am	Subcommittee Breakout Sessions Drill Downs and Project Interviews: 8:00 am Calorimeter 9:00 am Tracking 10:00 am TDAQ
11:00 am	Responses to Questions
11:30 am	Executive Session/Committee Report Writing
12:30 pm	Working Lunch
2:00 pm	Full Committee Dry Run……Kotcher
3:00 pm	Closeout Presentation
4:00 pm	Adjourn

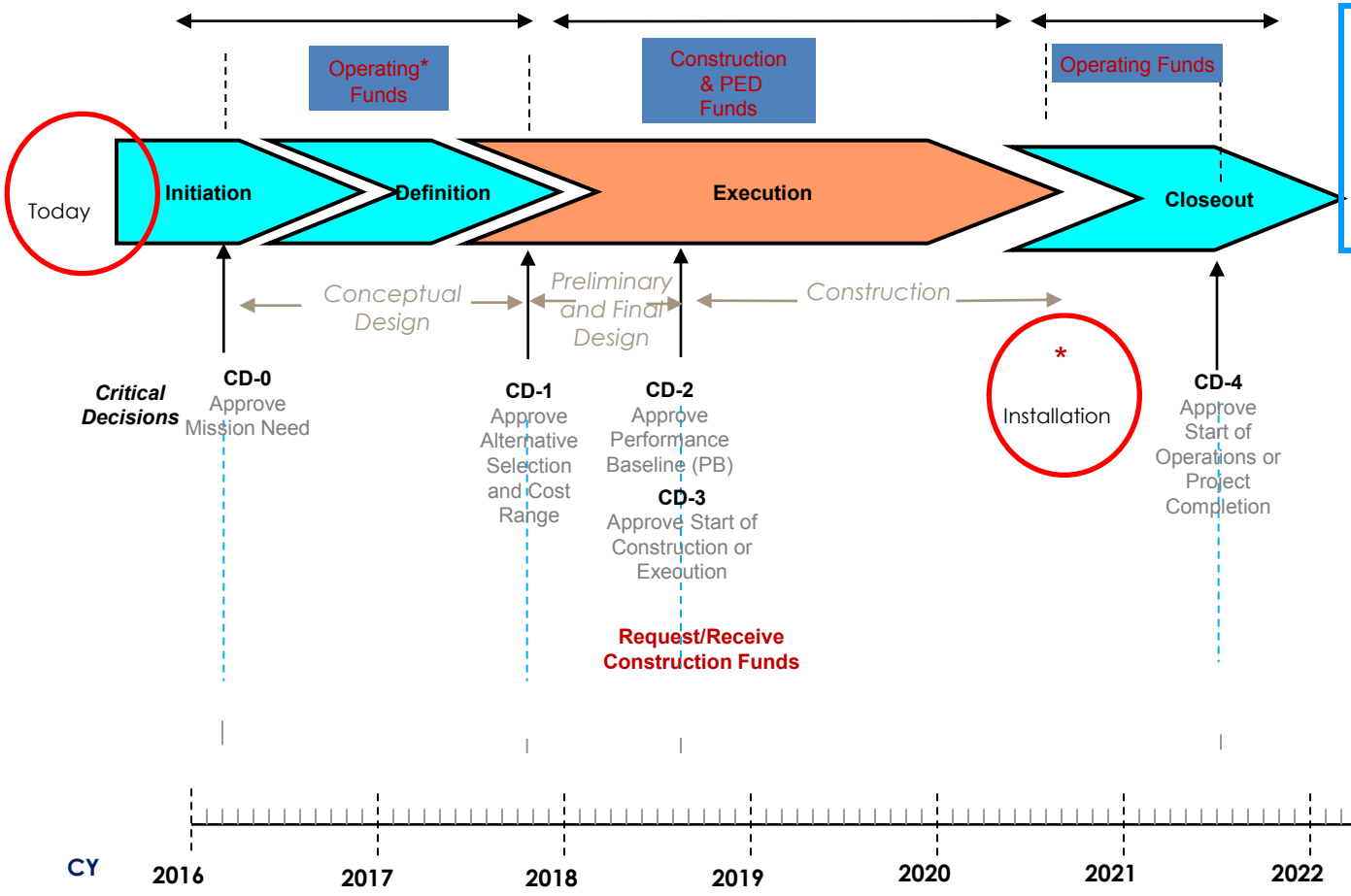
We also need to schedule breakout talks. Prepare and rehearse them.

Draft Cost and Schedule Review Break Out Agenda

	Parallel Session A					
		Project Management - Cost and Schedule				
A1	Management and Organization	0:20	0:05	13:35	14:00	Ed O'Brien
A2	Schedule Overview	0:20	0:05	14:00	14:25	Jim MIlls
A3	Cost & Schedule Methodology and summary	0:15	0:05	14:25	14:45	Irina Sourikova
A4	Had Cal Cost	0:15	0:05	14:45	15:05	Ed O'Brien
A5	EM Cost	0:20	0:05	15:05	15:30	Ed O'Brien
A6	Tracker Cost	0:15	0:05	15:30	15:50	Ed O'Brien
A7	Electronics/DAQ/Trigger Cost	0:15	0:05	15:50	16:10	Ed O'Brien
A8	Installation/Integration/Infrastructure Cost	0:15	0:05	16:10	16:30	Jim MIlls
A9	ES&H	0:15	0:05	16:30	16:50	Paul Giannotti
A10	QA	0:15	0:05	16:50	17:10	Jack Eng
	Coffee Break &Sub-committee Executive Session	0:30		17:10	17:40	
	Parallel Session B					
		Calorimenters : Had and EM				
B1	Calorimenter Overview - specification, design optimization	0:15	0:05	13:35	13:55	John Haggerty
	Calorimeter Simulations	0:20	0:10	13:55	14:25	Jin Huang
B2	R&D Plan - Had	0:15	0:05	14:25	14:45	John Lajoie
B3	R&D Plan EM	0:20	0:05	14:45	15:10	Anne Sickles
B4	R&D Plan Calorimeter Readout	0:20	0:05	15:10	15:35	Eric Mannel
B5	HCal Production and Assembly	0:20	0:05	15:35	16:00	Anatoli Gordeev
B7	EMCal Production and Assembly	0:20	0:05	16:00	16:25	Chris Cullen
B9	Calorimeter Electronics Production	0:20	0:05	16:25	16:50	Eric Mannel
	Coffee Break &Sub-committee Executive Session	0:30		16:50	17:20	

		Duration	Discussion	Start	End	
	Parallel Session C					
		Tracking/DAQ/Trigger				
C1	Tracker Overview - specification, design optimization	0:15	0:05	13:35	13:55	Itaru Nakagawa
	Tracker Simulations	0:20	0:10	13:55	14:25	Tony Frawley
C2	R&D Plan - Silicon	0:20	0:05	14:25	14:50	Itaru Nakagawa
C3	R&D Plan TPC	0:20	0:05	14:50	15:15	Tom Hemmick
C4	R&D Plan DAQ/Trigger	0:20	0:05	15:15	15:40	Martin Purschke
C5	Silicon Production and Assembly	0:20	0:05	15:40	16:05	Yasuyuki Akiba ??
C6	TPC Production and Assembly	0:20	0:05	16:05	16:30	Tom Hemmick ??
C7	DAQ/Trigger Production	0:15	0:05	16:30	16:50	Martin Purschke
	Coffee Break &Sub-committee Executive Session	0:30		16:50	17:20	
	Parallel Session D					
		Infrastructure, Integration and Installation				
	Overview of Integration/Installation/Infrastructure	0:15	0:05	13:35	13:55	Don Lynch
D1	Decommissioning	0:20	0:10	13:55	14:25	Dave Phillips
D2	Magnet	0:20	0:10	14:25	14:55	Kin Yip
D3	Integration	0:20	0:10	14:55	15:25	Rich Ruggiero
D4	Installation	0:20	0:10	15:25	15:55	Don Lynch or Dave Phillips
D5	Infrastructure	0:15	0:05	15:55	16:15	Paul Giannotti
	Coffee Break &Sub-committee Executive Session	0:30		16:15	16:45	
	Executive Session with full Committee	0:45		17:40	18:25	

Possible sPHENIX Project Scenario



Authorization Dates
CD-0 Apr 2016
CD-1 Dec 2017
CD-2/3 Jul 2018

Assumption:
•3 Months CR
•Will receive 1/12 per month during CR

•Operating Funds are used for conceptual design between CD-0 and CD-1. Operating funds may also be used prior to CD-4 for R&D, NEPA, D&D, ES&H, transition, startup, and training costs. Non-federal funds from other sources that are considered capital funds and are included in the "Total line item cost" as OPC.

•Good Practice—For the first year that TEC is requested, ensure that OPC is also requested for that year. The OPC will allow the project to continue in a long CR until TEC is available and new starts are allowed.

•MIE funds are more flexible than Line Items. Moving OPC to TEC or vice versa is much easier than for Line-Item reprogramming since MIE funds are "batched."

•New Start is defined as the first use/appropriation of any TEC funds (including TEC PED) for both line items and MIEs project.

Revision to WBS Structure

1 sPHENIX Design, Production, Commissioning

1.1 Project Management

1.2 Magnet

1.3 Tracker

1.4 EMCal

1.5 HCal

1.6 Calorimeter Electronics

1.7 DAQ/Trigger

1.8 Infrastructure

1.9 Installation/Integration

2 sPHENIX Preconceptual Activities

2.1 Decommissioning

2.2 Magnet Acceptance Testing

2.3 Tracker Generic R&D and Preconceptual Design

2.4 EMCal Generic R&D and Preconceptual Design

2.5 HCal Generic R&D and Preconceptual Design

2.6 Calorimeter Electronics R&D and Preconceptual Design

2.7 DAQ/Trigger generic R&D and Preconceptual Design

2.8 Infrastructure Preconceptual

2.9 Installation and Integration Preconceptual

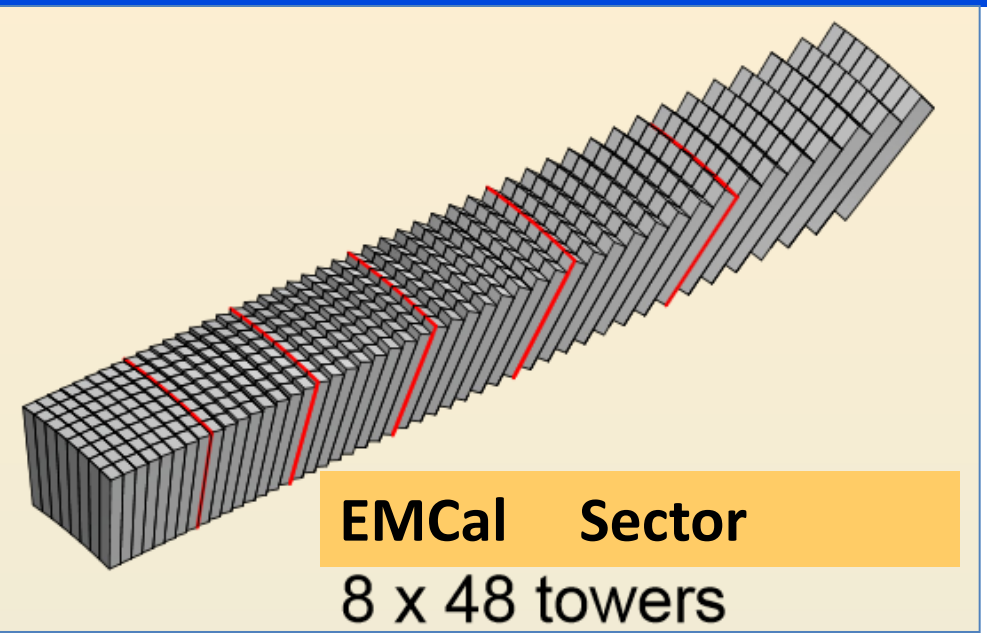
The revised WBS structure has a few advantages:

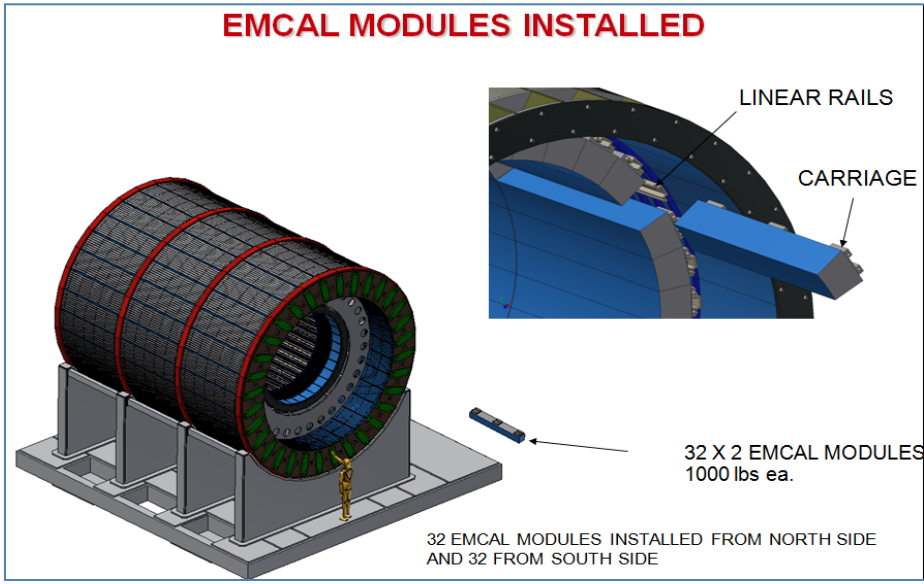
- Straight-forward evolution from the existing WBS scheme
- Natural separation of on-project and off-project costs and resources
- Allows one to balance resources and link tasks between on-project and off-project WBS elements
- Shouldn't require major changes to WBS structure once we get CD-1

Based on discussions with projects experts at BNL & ORNL

R&D and Design Update

EMCal Engineering Design

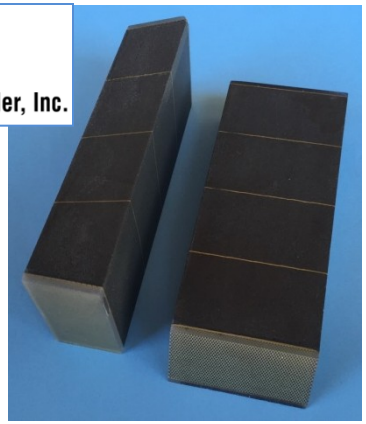




- **EMCAL Tungsten-scintillating fiber**
  - **$\Delta\eta \times \Delta\varphi \approx 0.025 \times 0.025$**
  - **96 x 256 towers**
  - **4 SiPM/tower (~ 100k SiPMs total)**
  - **384 towers/sector**
  - **32x2 sector in the full detector**
  - **EMCal $\Delta E/E < 12\%/\sqrt{E}$ (single particle)**

EMCal Towers and Modules

THP- 1-D projective

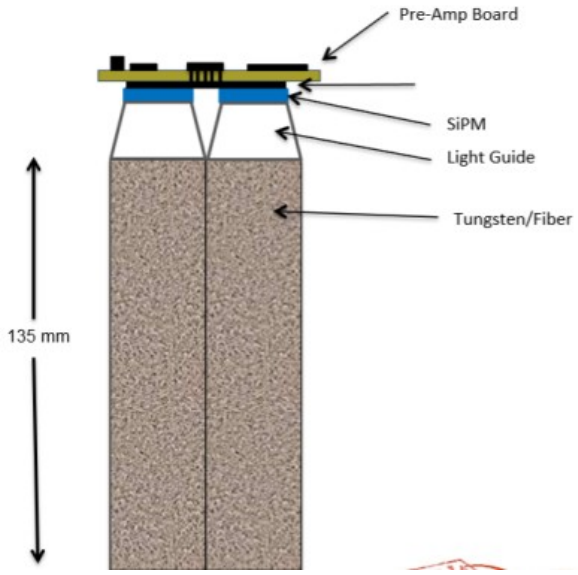


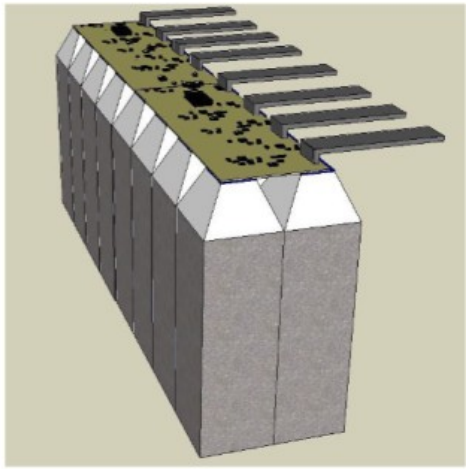
UIUC 1-D projective

Development of 2x8 module

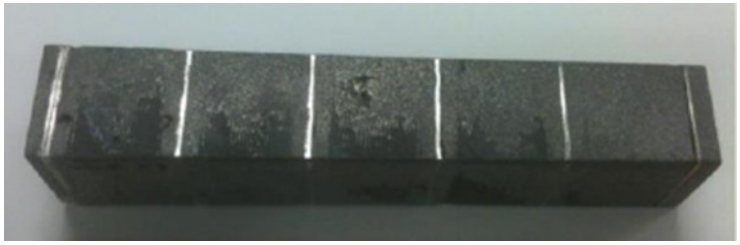
Towers based on UCLA-developed technology

4 SiPMs/tower





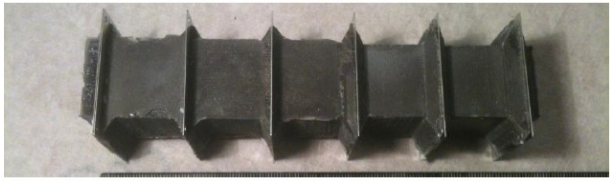
BNL 2-D Projective

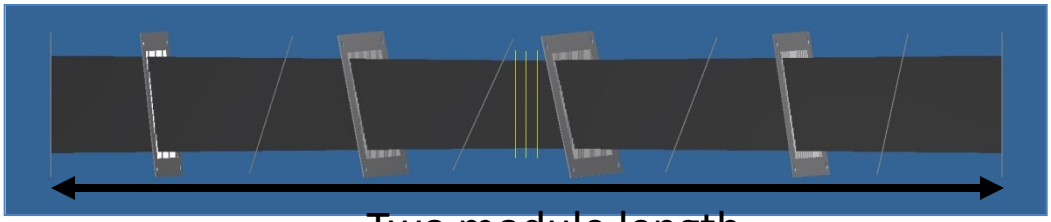


EMCal R&D

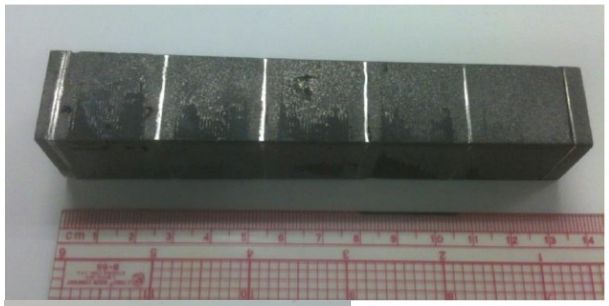
Two, 2-D projective towers made at BNL to date

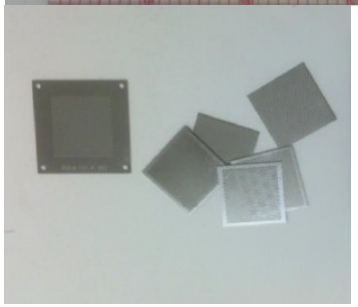
Sean Stoll (BNL), Spencer Locks (SBU), Dan Cacace(SBU), Jin Huang (BNL) and others

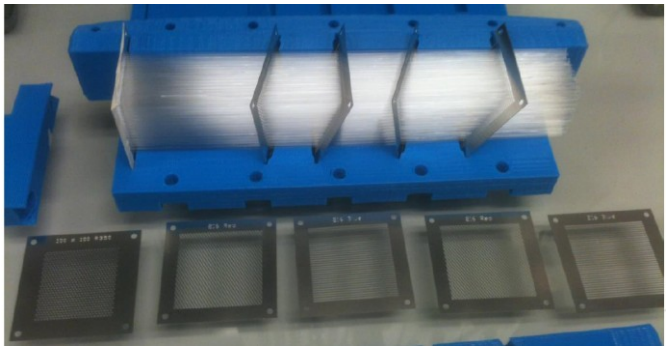




Two module length





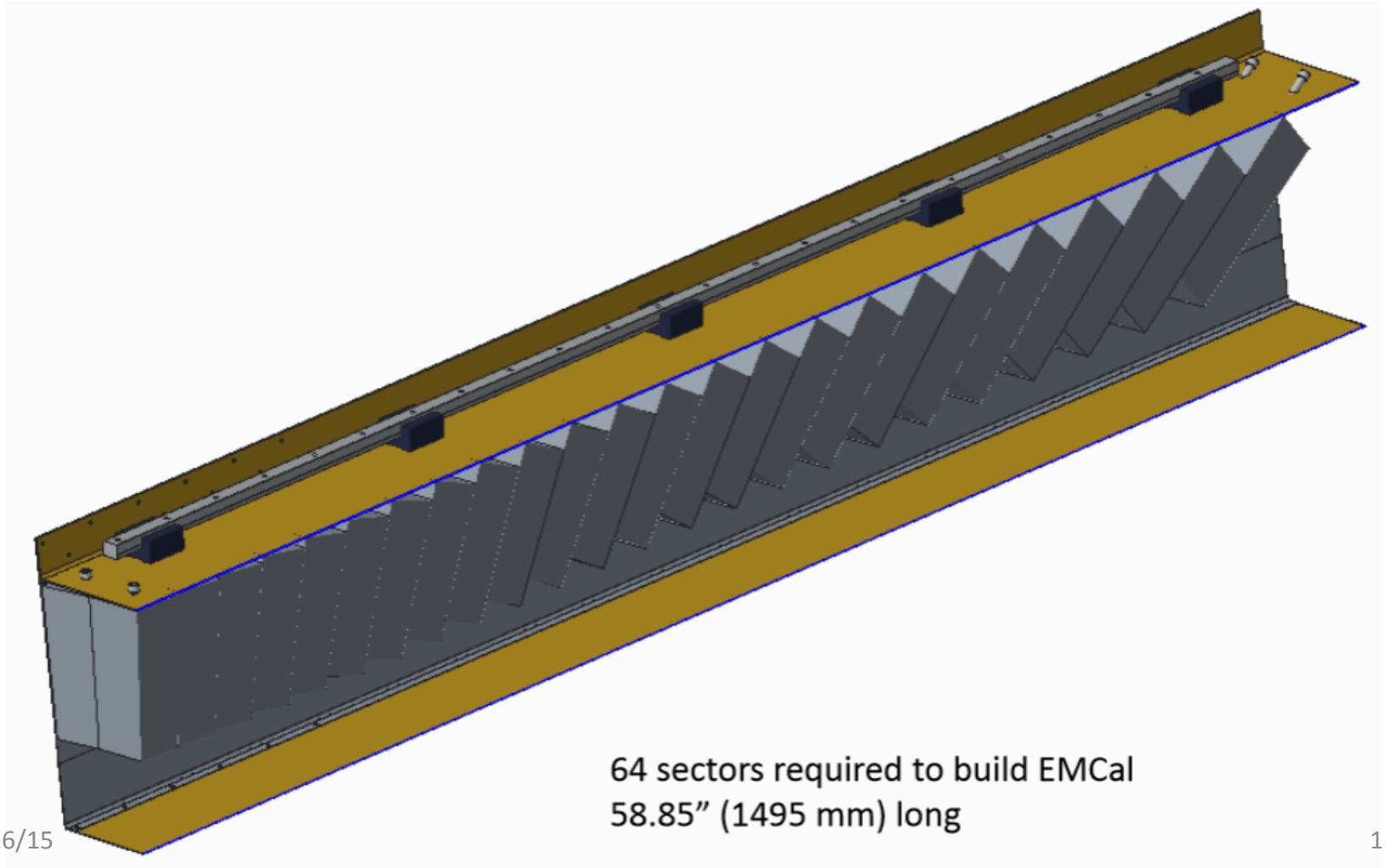


R&D Direction 1:
Tapered step screens

R&D Direction 2:
Tilting Wireframes

EMCal Engineering Design

Sector Section



64 sectors required to build EMCal
58.85” (1495 mm) long

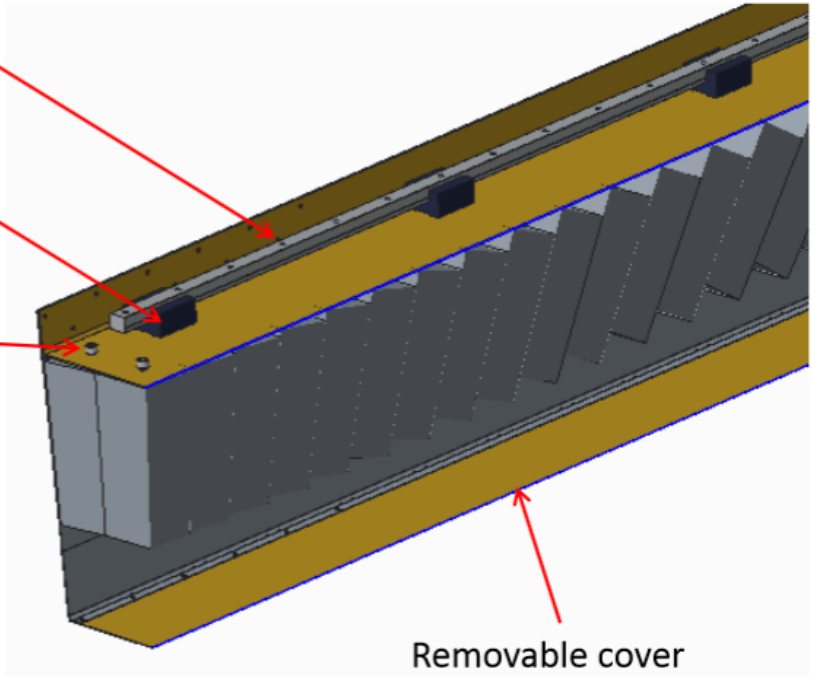
EMCal Engineering Design

Sector Load Path

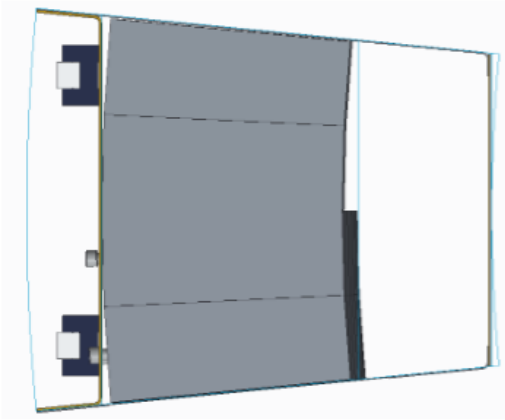
Rails are bolted to inner HCal

Multiple bearing blocks are bolted to the strongback

Each module is bolted to the stainless steel strongback



Removable cover for in-situ access



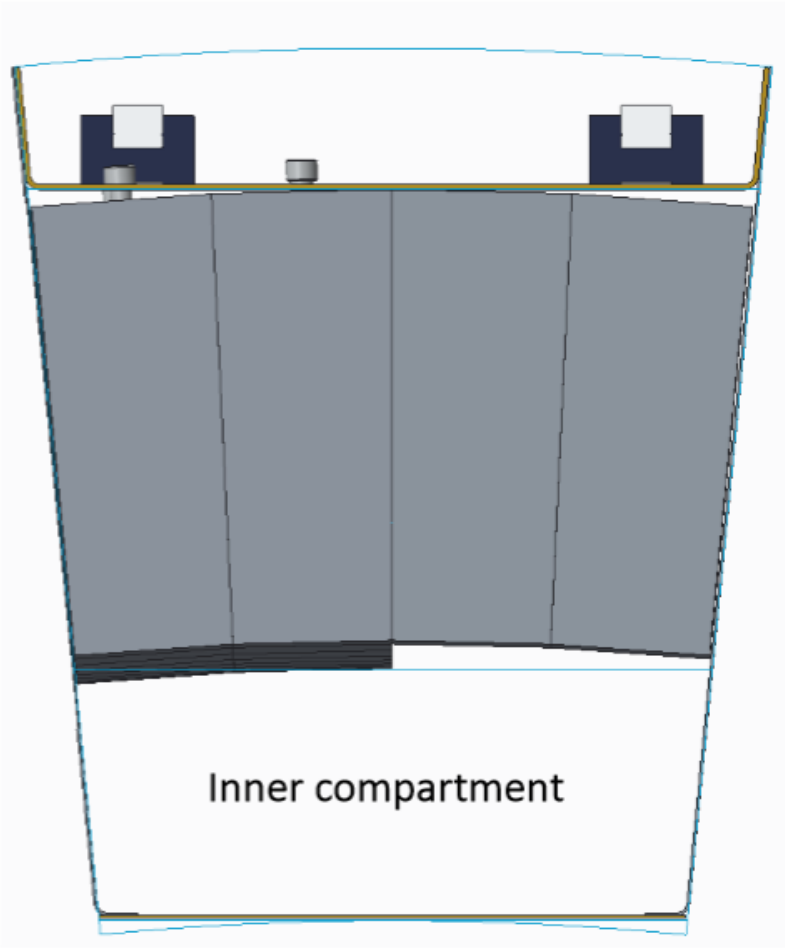
Sheet metal shroud & end covers (not shown) are not part of the structural load path

Load path from modules to HCal is direct!

EMCal Engineering Design

Inner Compartment

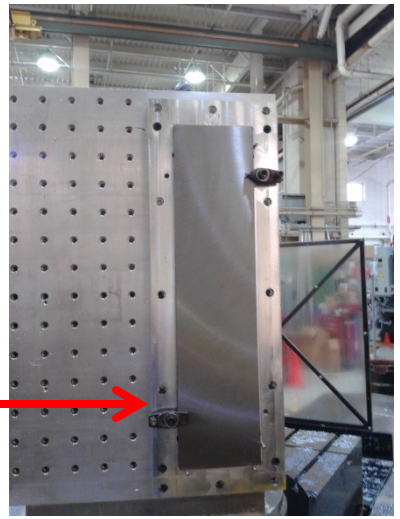
- Houses light guides, front end electronics & cables
- Cooled, preferably by air
- Cooling enters and exits from external end of EMCal
- Several cooling configurations under consideration

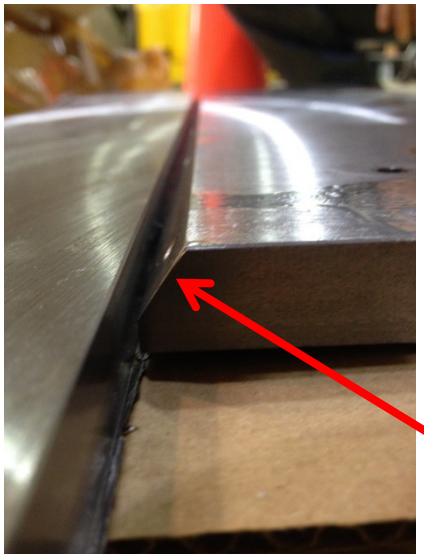


Inner & Outer HCAL Prototype Updates

- Central Shops is currently machining the Inner HCAL Absorber Plates
- All the holes will be drilled and chamfers made before they taper all of the plates
- Currently have 4 plates awaiting tapering(as of 8/20)

Backing Plate used to hold down steel plates during machining process





Chamfer on bottom of absorber plate

Inner HCAL Absorber Plates

Inner & Outer HCAL Prototype Updates

- Outer HCAL plates being machined at Strecks facility.

Outer HCAL Absorber Plate

Summary

- **R&D, design and simulations are all making good progress. Pace seems to have pick-up in the last couple of months**
- **Important technical cost and schedule review Nov 9-10 at BNL**
  - **Many are contributing**
- **Much work needed to prepare for FNAL test beam in Apr 2016**