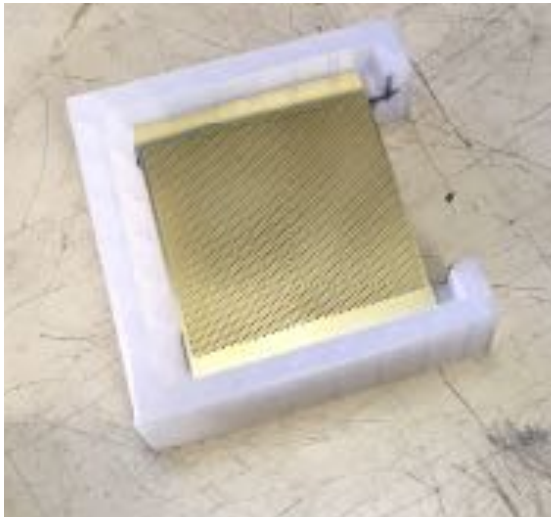
sPHENIX Director's Review

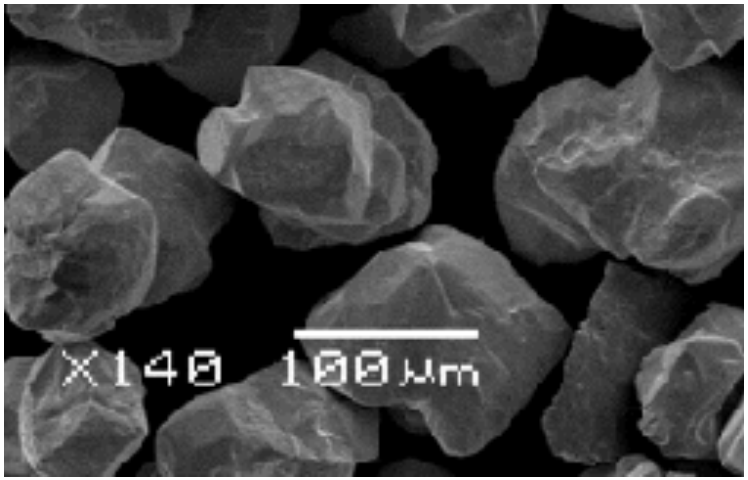
August 2-4, 2017
BNL

EMCal Blocks

- this covers the absorber blocks for the EMCal
- density and block uniformity to achieve 15% / √E energy resolution
- block dimensional tolerances to enable blocks to fit together with minimal gaps

EMCal blocks technical overview





blocks made from mesh/fiber assemblies and tungsten powder cast with epoxy

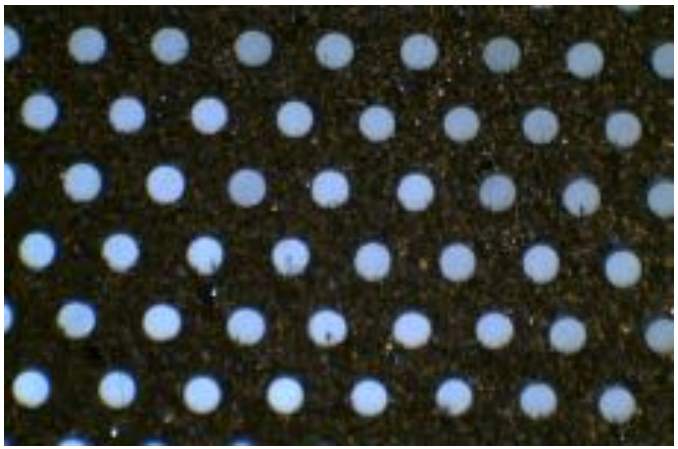
density ~10 g/cm^3

blocks have diamond fly cut end for optical transmission to read out

each block has 4 towers

EMCal block scope

- filling meshes with fibers
- casting of blocks from raw materials
- finishing the block outsides
  - filing away mesh edges
  - diamond cutting front and back for light transmission
- tests of dimensional tolerances
- check of block light transmission
- packing and shipping blocks to BNL



EMCal block production manpower

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

- CAM/L3: Anne Sickles assistant professor
- scientific supervision: Caroline Reidl (research scientist)
  - supervised factory for COMPASS DC production in Urbana,
  - currently technical coordinator for COMPASS
  - will return to Urbana in ~1 year for this project
- postdoc: Yongsun Kim scientific supervision and record keeping setup
- technical supervision: Eric Thorsland
  - lead technician for Nuclear Physics Lab in Urbana
  - ~30 years experience in wide variety of physics instrumentation including calorimeters for g-2 (BNL and Fermilab both)
- additional technical and student labor
- group has built 2 W/SciFi prototypes for sPHENIX test beams including first 2D projective blocks over the last ~3 years

Resource Loaded Schedule (EMCAL Project File)

					Total Cost	Fixed Cost	Labor
1.3.1	EMCAL Management	641 days	Wed 7/1/17	Fri 8/30/19	$0	$0	$0
1.3.2	EMCAL Block Production	1095 days	Fri 3/31/17	Fri 8/20/21	$4,836,685	$4,091,318	$745,366
1.3.2.1	EMCAL Prototype V2.1 Block Production	100 days	Thu 4/6/17	Mon 8/28/17	$41,530	$23,250	$18,280
1.3.2.2	EMCAL Preproduction Prototype Block Production	141 days	Fri 3/31/17	Tue 10/24/17	$220,681	$167,745	$52,936
1.3.2.3	EMCAL Final Block Production	1056 days	Thu 5/25/17	Fri 8/20/21	$4,574,474	$3,900,324	$674,150
1.3.3	EMCAL Module Production and Sector Assembly	1167 days	Wed 8/1/17	Mon 11/1/21	$3,253,278	$1,048,728	$2,204,550
1.3.3.1	Set up module production, sector assembly and test area	50 days	Fri 6/9/17	Mon 8/21/17	$37,847	$29,500	$8,347
1.3.3.2	EMCAL Module Production	1142 days	Wed 8/1/17	Mon 9/27/21	$1,011,189	$221,348	$789,840
1.3.3.3	EMCAL Sector Assembly	1144 days	Mon 4/3/17	Mon 11/1/21	$2,204,248	$797,885	$1,406,363
1.3.4	Install Sectors into sPHENIX	0 days	Mon 11/1/21	Mon 11/1/21	$0	$0	$0

Block production drives the EMCal assembly schedule and is on the critical path

Main Cost Drivers:

W-Powder: $2.225M

Scintillating Fiber: $1.28M

Fixed Costs	$K
UIUC	
Materials	4091
Paid Labor	745
Total UIUC	4836
BNL	
Materials	1049
Total Fixed Costs	5885

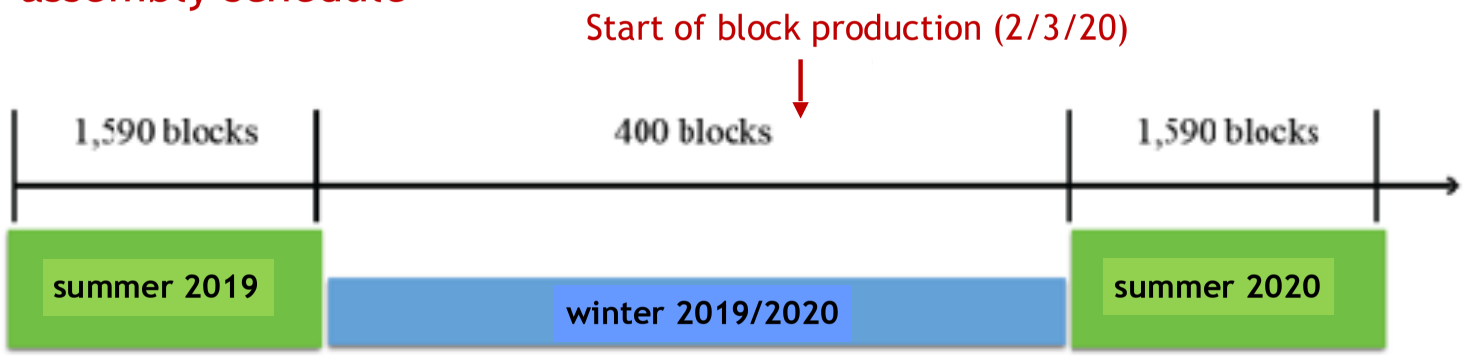
Key Milestones

1.3.3.3.1.11	Completion of v2.1 prototype	Tue 4/10/18
1.3.3.3.2.20	Completion of preproduction prototype	Fri 5/25/18
1.3.2.3.2	Readiness and Safety Review for final block production	Wed 8/12/19
1.3.3.2.3.2	Readiness Review for final module production	Thu 8/12/19
1.3.3.3.3.5	Readiness Review for final sector production	Thu 8/12/19
1.3.4	Install Emcal sectors into sPHENIX	Mon 11/1/21

CD-3a Procurement

- Schedule is being driven by the production of absorber blocks at UIUC.
- This is in turn being driven by the filling of the fiber assemblies. This will be done by students that are mainly available during the summer academic break.
- We must make use of the summer break period in 2019 to create a stockpile of fiber assemblies so that full scale production can begin in early February 2020.
- This requires ordering sufficient fiber and screens (~ ½ the total order) in early 2019 such that they will be delivered by spring of 2019 and available for making fiber assemblies in the summer of 2019.

Fiber assembly schedule



Filling fiber assemblies

- 2.2 hrs/block
- 7 hrs/day, 5 days/week
- 10 students
- 10 weeks over summer

CD-3a Procurement (1/23/19)

- ½ fiber order - $640K
- Screens - $176K

Total: $816K

preproduction prototype construction in FY18 will decrease the the uncertainty time estimate

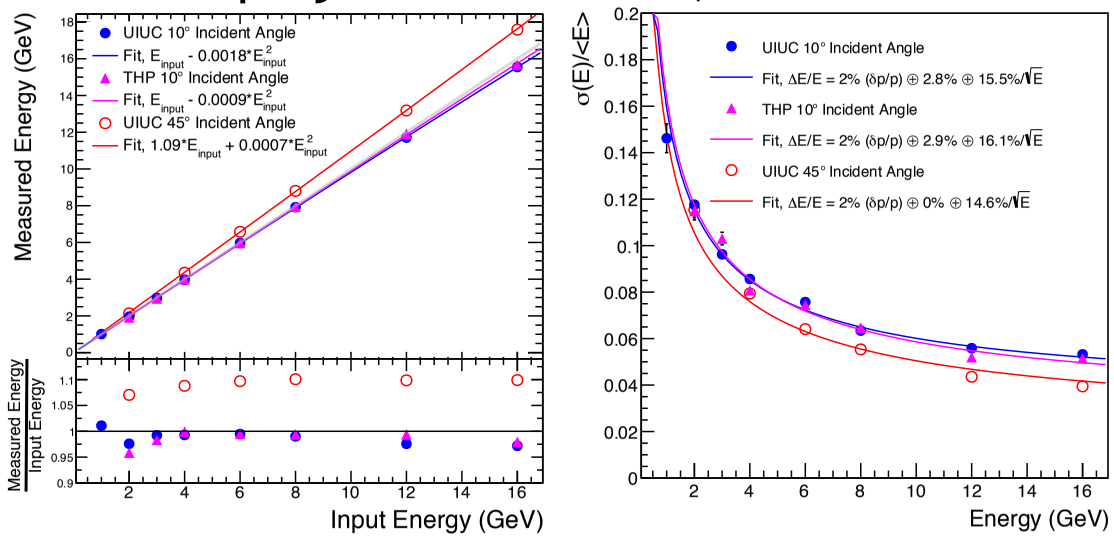
BOE Cost Breakdown

Example: EMCAL Module Production - Materials

WBS	Description	Item	Vendor	Total	Status	Basis of Estimate	Contingency	Item Contingency	Wt Contingency	Total'	Contingency	Total w/ Contingency
		per part $ 6.83 x 1000		$6,830		quote	0.25	$1,708				
1.3.3.2.1.1	Procure Mechanical parts for v1.1 prototype blocks	subtotal		$218				$44		$211		
		3M 2216 epoxy	McMaster	$25		catalog/web	0.20	$5.00				
		1/4" spherical washers	McMaster	$68		catalog/web	0.20	$13.60				
		10-32 ss nuts and washers	McMaster	$9		catalog/web	0.20	$1.88				
		2-56 set screws and nuts	McMaster	$15		catalog/web	0.20	$3.00				
	design & produce 15 gluing fixtures	light guide gluing fixtures	BNL	$100		3D printed	0.20	$20.00				
	modify V2.0 enclosure for V1.1											
1.3.3.2.1.8	Install light guides on v2.1 prototype blocks	Saint Gobain BC600 optical epoxy	Saint Gobain	$65		catalog	0.20	$13.00				
1.3.3.2.1.9	Install reflectors and glue v1.1 prototype blocks	Vikuiti Mirror film	Vikuity	$52		catalog	0.20	$10.40				
		Saint Gobain BC600 optical epoxy	Saint Gobain	$65		catalog	0.20	$13.00				
1.3.3.2.1.10	Install SiPMs & daughterboards on v2.1 prototype blocks	Momentive RTV615 couplant	Momentive	$350		catalog	0.20	$70.00				
1.3.3.2.2	EMCAL PreProduction Prototype Module Production			$6,085				$1,521	#DIV/0!			$7,924
1.3.3.2.2.1	Procure light guides for preproduction prototype modules	subtotal		$5,000				$1,000		$5,300		$6,000
	(assuming v2.1 design is OK, we don't need additional [illegible])	mold cost (reusable?)	NN Inc			quote	0.20	$0.00				
		part cost - use remainder from Y2.1	NN Inc	$5,000		quote	0.20	$1,000.00				
1.3.3.2.2.5	Procure mechanical parts for preproduction prototype modules	subtotal		$925				$185		$923		$1,098
		set screw 10-32 ss 1.15" mounting stud	McMaster	$40		catalog	0.20	$8.00	0.00		$0	$40
		10-32 ss nuts and washers	McMaster	$72		catalog/web	0.20	$14.40				
		3M 2216 epoxy	McMaster	$200		catalog	0.20	$40.00				
		1/4" spherical washers	McMaster	$544		catalog	0.20	$108.80				
		set screws 2-56 ss	McMaster	$48		catalog/web	0.20	$9.60				
		nuts 2-56 ss	McMaster	$11		catalog/web	0.20	$2.20				
1.3.3.2.2.8	Install light guides on preproduction prototype blocks	subtotal		$130				$26		$130		$156
		light guide gluing fixtures	BNL									
		Saint Gobain BC600 optical epoxy	Saint Gobain	$130		catalog/web	0.20	$26.00				
1.3.3.2.2.9	Install reflectors and glue preproduction prototype blocks	Vikuiti Mirror film	Vikuity	$208		catalog/web	0.20	$41.60				
		Saint Gobain BC600 optical epoxy										
1.3.3.2.2.10	Install SiPMs & daughterboards on preproduction prototype blocks	2-56 set screws and nuts										
		Momentive RTV615 couplant	Momentive	$350		catalog	0.20	$70.00		$420		
1.3.3.2.2.11	Glue preproduction blocks together into modules											
1.3.3.2.3	EMCAL Final Module Production			$151,355				$71,751	0.00	$153,355		$225,106
1.3.3.2.3.1	Revise module production procedure based on preproduction prototype											
1.3.3.2.3.2	Readiness Review for Final module production											
1.3.3.2.3.3	Procure mechanical parts for final modules	subtotal		$31,455				$14,001		$30,455		$45,446

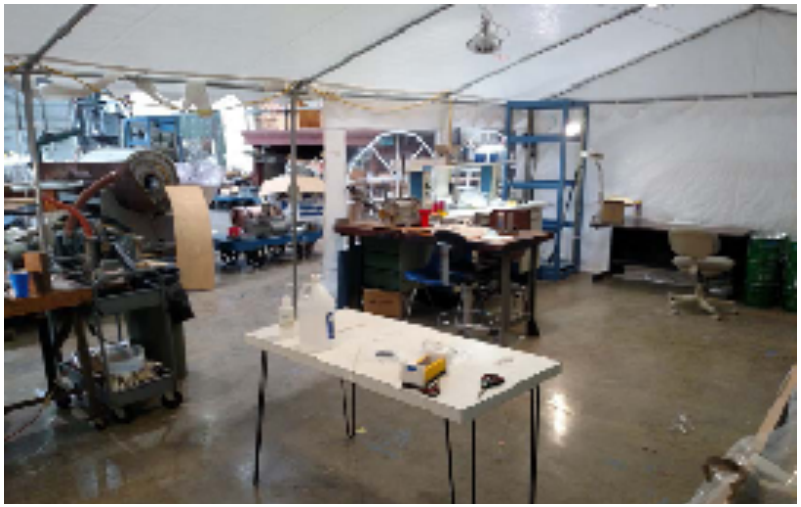
Status and Highlights

1D projective modules, 1704.01461



2D projective modules tested in February, analysis ongoing!

factory in Urbana taking shape



Issues and Concerns

- EMCal block production is on the critical path
  - preproduction prototype experience will improve labor estimates
- procurement delays an issue
  - schedule relies on CD3A funding for fibers and meshes $800k in early 2019 to use student labor in the summer 2019

Back Up