

# sPHENIX Director's Review EMCal Block Production

Anne Sickles
August 2-4, 2017
BNL



# EMCal Blocks

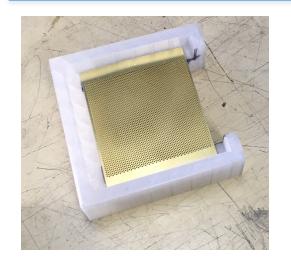


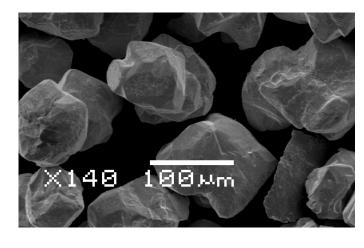
- this covers the absorber blocks for the EMCal
- density and block uniformity to achieve
   15% / \( \subseteq \text{E energy resolution} \)
- block dimensional tolerances to enable blocks to fit together with minimal gaps



## EMCal blocks technical overview











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

density ~10 g/cm<sup>3</sup>

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

each block has 4 towers

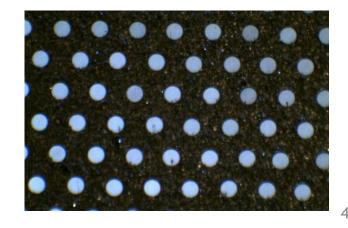
# EMCal block scope



### Illinois:

- block production
- block light testing and QA
- ship to BNL





# EMCal block production manpower





- 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)
- Nuclear Physics group has also built: COMPASS DC5, PHENIX RPCs, nEDM at ORNL (in progress), Seaquest Hodoscopes, ...
- 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 Fite)

WBS	Task Name	Duration	Start	Finish	Total Cost	Fixed Cost	Labor
1.3.1	EMCAL Management	645 days	Wed 2/1/17	Fri 8/30/19	\$0	\$0	\$0
1.3.2	EMCAL Block Production	1096 days	Fri 3/31/17	Mon 8/23/21	\$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	144 days	Fri 3/31/17	Tue 10/24/17	\$220,681	\$167,745	\$52,936
1.3.2.3	EMCAL Final Block Production	1057 days	Thu 5/25/17	Mon 8/23/21	\$4,574,474	\$3,900,324	\$674,150
1.3.3	EMCAL Module Production and Sector Assembly	1168 days	Wed 3/1/17	Tue 11/2/21	\$3,574,881	\$1,048,728	\$2,526,153
1.3.3.1	Set up module production, sector assembly and test area	50 days	Fri 6/9/17	Mon 8/21/17	\$67,043	\$29,500	\$37,543
1.3.3.2	EMCAL Module Production	1143 days	Wed 3/1/17	Tue 9/28/21	\$1,013,259	\$221,343	\$791,916
1.3.3.3	EMCAL Sector Assembly	1145 days	Mon 4/3/17	Tue 11/2/21	\$2,494,579	\$797,885	\$1,696,694
1.3.4	Install sectors into sPHENIX	0 days	Tue 11/2/21	Tue 11/2/21	\$0	\$0	\$0

Main Schedule Driver:

Production of absorber blocks at UIUC

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

Aug 2-4, 2017

### 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 ( $\sim \frac{1}{2}$  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 Start of block production (2/3/20) 1,590 blocks 1,590 blocks summer 2019 winter 2019/2020 Filling fiber assemblies summer 2020

**Total: \$816K** 

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

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

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

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

### **BOE Block Production Overview**



							oor			Materials	
						total	Tot w/ contin		total	Tot w/ co	
1.3.2		ock Production									
1.3.2.1	EMCAL Pr	MCAL Prototype V2.1 Block Production MCAL Pre-Prod Prototype Block Productio			1	\$18,316			\$23,250	\$23	
1.3.2.2	EMCAL Pr				ction	\$52,938			\$167,745	\$184	
1.3.2.3	EMCAL Fi	nal Block I	Production	1		\$676,167			\$3,900,325		
			(0.4	1 (2017)							
	from Bob	Summary pages (8/1/2017)					E. al Carl Dil				
	WBS	Task Nam	e				Fixed_Cost_sPH ENIX	Net Labor			
	1.3.2	EMC Bloc	k Producti	on		\$4,838,741	\$4,091,320	\$747,421			
	1.3.2.1	Prototy	pe V2.1 B	lock Produ	ction	\$41,566	\$23,250	\$18,316			
	1.3.2.2	Pre pro	d Prototyp	e Block Produc		\$220,683	\$167,745	\$52,938			
	1.3.2.3	Final B	lock Produ	ction		\$4,576,492	\$3,900,325	\$676,167			
	from Dire	inst file (7	1/26/2047	\							
	HOIH Pro	ject file (7 1	/ 20/ 201/	)			Fixed_Cost_sPH				
	WBS	Task Nam	ie			Cost	ENIX	Net Labor			
	1.3.2	EMC Bloc	ock Production type V2.1 Block Produc			\$4,836,685	\$4,091,319	\$745,366			
	1.3.2.1	Prototy			ction	\$41,530		•			
	1.3.2.2	Pre pro	Pre prod Prototype Block Pro Final Block Production				\$167,745				
	1.3.2.3	Final B				\$4,574,474	\$3,900,324	\$674,150			

### **BOE Cost Breakdown**



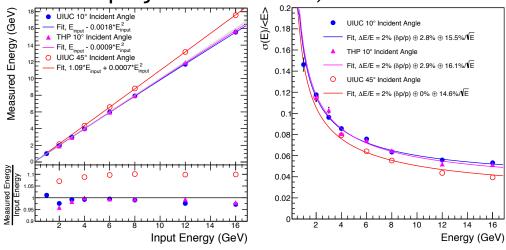
Example: EMCAL Block Production - Materials

WBS	Description	Item	Vendor	Total	Status	Basis of Estimate	Contingency	Item Contingency	Wt Continge	Total	Contingenc	Total w/ Contingend	Grand Total	Grand Total w/ Contingen
1.3.2.3	EMCAL Final Block Production			\$3,900,325						\$5,712,464		\$5,712,464	\$2,702,530	\$5,717,744
1.3.2.3.3	Order & deliver W	Tungsten	Tungsten Heavy Powder http://www.tungstenheavypowder.co	\$2,250,000		quote	0.20	\$450,000	0.03	\$2,700,000	\$87,440			
1.3.2.3.5	Order & deliver fibers #1	Optical fibers	Saint Gobain http://www.saint-gobain-northamerica.com	\$640,000		quote	1.00	\$640,000		\$1,280,000				
1.3.2.3.6	Order & deliver fibers #2	Optical fibers	Saint Gobain http://www.saint-gobain-northamerica.com	\$640,000		quote	1.00	\$640,000		\$1,280,000				
1.3.2.3.7	Order & deliver screens	Etched metal plates	TechEtch http://www.tech-etch.com	\$176,262		extrapolation, waiting for quot	0.40	\$70,505		\$246,767	\$0			
1.3.2.3.8	Order & deliver expoxy	Epoxy glue	Epoxy Technology http://www.epotek.com	\$156,420		quote		\$0		\$156,420				
1.3.2.3.9	Order & deliver mold parts	Sum of mold costs:	subtotal	\$29,613				\$8,884		\$38,497				
		Delrin plates	McMaster-Car https://www.mcmaster.com/	\$7,128		webpage	0.30	\$2,138		\$9,266				
		Vacuum hose	McMaster-Car https://www.mcmaster.com/	\$650		webpage	0.30	\$195		\$845				
		Fitings for vacuum	McMaster-Car https://www.mcmaster.com/	\$9,200		webpage	0.30	\$2,760		\$11,960				
		Potting tools (various)	McMaster-Car https://www.mcmaster.com/	\$300		webpage	0.30	\$90		\$390				
		Hardware [packs of 100]	McMaster-Car https://www.mcmaster.com/	\$416		webpage	0.3	\$125		\$541				
		Silicone grease	McMaster-Car https://www.mcmaster.com/	\$1,015		webpage	0.30	\$305		\$1,320				
		Vibrating tables	McMaster-Car https://www.mcmaster.com/	\$3,984		webpage	0.30	\$1,195		\$5,179				
		Digital scales	McMaster-Car https://www.mcmaster.com/	\$445		webpage	0.30	\$134		\$579				
		Solo cups [cases of 1000]	Solo Cup http://www.solocup.com/	\$1,450		webpage	0.30			\$1,885				
		Stiring tools [boxes of 500]	McMaster-Car https://www.mcmaster.com/	\$250		webpage	0.3	\$75		\$325				
		Cleaning supplies	do-it-best hardware https://www.doitbest.com	\$2,000		webpage	0.30	\$600		\$2,600				
		Gloves	Local MRL store room	\$1,525		catalog	0.30	\$458		\$1,983				
		Safety gear	Local MRL store room	\$1,250		catalog	0.30	\$375		\$1,625				
1.3.2.3.10	Set up factory for final blocks	Sum of factory set up:	subtotal	\$2,530						\$2,530	\$2,750	\$5,280		
	(costs indicated are 25% of act		UIUC campus		delivered		0.00			\$0				
	because items will be used als	Charger for fork truck	Bahrns Equipment http://www.bahrns.com	\$600	delivered		0.00			\$600				
		Battery packages for fork tru	Bahrns Equipment http://www.bahrns.com	\$1,367	delivered		0.00	\$0		\$1,367				
		Shelves	Bahrns Equipment http://www.bahrns.com	\$563	delivered		0.00	\$0		\$563				
1.3.2.3.14	8x ship 8 block for 64 sectors to	Shipping	tbd	\$5,500		Estimate	0.50	\$2,750		\$8,250				

# Status and Highlights



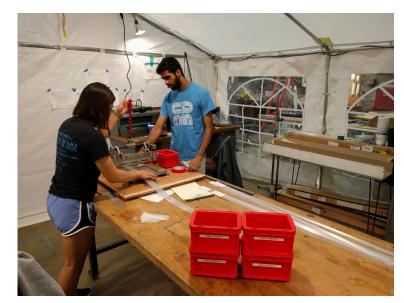
### 1D projective modules, 1704.01461



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