

Project Update

John Corlett (LBNL) Interim Project Director August 9, 2021



Who Am I

- 30 years at LBNL
- Involved in scientific contributions and project management of DOE projects for last 30 years
 - Advanced Light Source
 - PEP-II B-Factory
 - Linear Colliders
 - LCLS-II
 - LCLS-II HE
- LBNL projects portfolio since 2018
 - Diverse science and facility construction projects



Outline

- Key Project Goals Over the Next Year
- Project Organization
- Project Reviews
- Preliminary Baseline Design
- Detectors Request for Information
- Cost & Schedule Update Plans
- Project Tools
- MOUs/MOAs/SOWs
- Timeline
- Conclusion

Key Near-term Project Goals

- Obtain Funding
 - DOE
 - FY21 funding \$5M + carry-forward from FY20 has been distributed
 - Made FY22 request. Overall DOE->SC->OHEP->CMB-S4 funding not known
 - House and Senate appropriations both have \$20M for CMB-S4
 - NSF
 - MSIP & MSRI-1 supplemental funds support ongoing work through CY21
 - Proposal for Final Design work, CY22-24, to be submitted in August
 - Anticipating an MREFC award that will fund construction starting in CY25
 - The ASTRO 2020 report, due in August, will inform NSF priorities including CMB-S4
- Complete Status and Gate Reviews
 - Director's Status Review November 16-19
 - DOE-led Status review February 15-17 (planning to extend to 4 days) 2022
 - NSF Preliminary Design Review CRITICAL milestone
 - Will be informed by ASTRO2020
 - DOE Critical Decision 1 (CD-1) Review CRITICAL milestone, target Q4FY22

Org Chart

- Developed to L3
- Approved by L1
- Appropriate for this stage of the project
- Several interim roles to be filled when funds are available





Agency and Director's Reviews

- MSRI-1 status review held May 18-19, charged to assess path to Preliminary Design Review for NSF scope
 - "... team is excellent and includes many leaders in this scientific field..."
 - "... team is on a credible path to deliver a draft Preliminary Project Execution Plan and proposal for review..."
 - The review addressed only the MSRI-1 scope and highlighted the need to present a coherent integrated DOE/NSF project overview in future
- DOE Project Status review by the Office of Science, Office of Project Assurance
 - February 15-19, 2022 (plan to extend to 4 days)
- LBNL Director's Review November 16-19, 2021
- An NSF review of the Preliminary Design is required before an MREFC award can be initiated
 - Tentatively scheduled to align with the DOE Status Review, February 2022
 - \circ $\,$ Coordination to be initiated by the NSF after ASTRO2020 report is released



L2 technical reviews mostly completed

- Each L2 subsystem is being reviewed at the Conceptual Design level
- 7 reviews completed, 2 scheduled for September
- Highly expert review committees for each, predominantly external to CMB-S4
- Provide documentation of technical readiness and refine plans using comments and recommendations from subject matter expert reviewers
- Design Reviews and Reports:
 - South Pole and Chile Sites: <u>CMBS4-doc-741</u>
 - South Pole and Chile Large Aperture Telescopes (LATs): <u>CMBS4-doc-746</u>
 - Data Management (DM): <u>CMBS4-doc-742</u>
 - Small Aperture Telescopes (SATs): <u>CMBS4-doc-749</u>
 - Readout: <u>CMBS4-doc-762</u>
 - Module Assembly and Testing: <u>CMBS4-doc-756</u>
 - Large Aperture Telescopes Receivers (LATR): CMBS4-doc-(tbd)
 - Detectors: CMBS4-doc-(tbd)
 - Data Acquisition and Controls (DAQ): CMBS4-doc-(tbd)



Preliminary Baseline Design

- The Preliminary Baseline Design Report (PBDR) captures the science goals and technical requirements that lead to a scope and design for the experiment
- Draft posted May 2021 <u>CMBS4-doc-716</u>
 - 1. Science Case
 - 2. Science and Measurement Requirements
 - 3. Preliminary Baseline Design
 - 4. Science Analysis
 - 5. Project Overview
 - (6) Appendices
- Working with the Science Council and L2s on revisions to restructure with clearly defined flowdown, and updates where necessary
- Update to be provided to the Director's Review committee in November
- Goal of published version by early CY2022

Detectors Request For Information (RFI)

- Detectors are a major cost driver and critical technology to develop into production •
- Three detector layout workshops completed in May
- Resolved issues in the way of production detector wafer layouts
 - ¹/₂ day workshops held in March, April, May Ο
 - Darks, RF coupling, interfaces
 - Specifications, layout, and fabrication capabilities
- Each potential fabrication site has presented resources and capabilities
- RFI distributed to SLAC, ANL, NIST, Caltech, UC Marvell, and LBNL (for SeeQC)
 - Gather information from each potential fabrication site Ο
 - Update detector cost and input to next iteration of fabrication schedule Ο
 - Interplay among requirements flowdown, detectors, readout and modules Ο
 - Keep costs (including risks) at forefront of technical development Ο
 - Manufacturability, minimize complexity of detectors/readout ... think cheap

Brenna Flaugher, Technical Integration Scientist John Joseph, Detectors L2 CAM q



CMB-S4





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Integrated Project Schedule Captures Scope And Forms The Basis For Cost Development

Includes all production details

lumbe Waters

12 SAT 30/40GHz

48 LAT 30/40GHz

27 LAT 20GHz

147 SAT 85/145

147 SAT 95/155

432 LAT 90/150

SATs

LATS

469 SAT/LAT 225/278

name

24 SAT LF

4 LAT ULF

25 LAT LF

72 SAT MF1

72 SAT MF2 162 LAT MF

112 SAT/LAT HE

471

216

255 Yield Assumption - Need to produce 6 wa NCLUDE OVERAGES - EXPEC

REFERENCE DETECTOR TASK FORCE PI 4 batchs of 4 wafers/ year/line = 16 science v batchs come out every 12 weeks from each li

Assume max production lines/site, AS LIST

8 waters/ half year for one line

- Based on a nominal fabrication plan based on
 - Six detector fabrication sites
 - Two module assembly and testing sites
 - One readout assembly site
 - Two SAT receiver and two LAT receiver assembly sites
 - Two Northern Hemisphere telescope test assembly sites
 - Chile and South Pole Installation and Commissioning

REVISIONS DEC. 2020 ANL = 1 LINE, based of carecoardiners of	11, WW, IW, MI 1999-11, 2020	_	_	_	_	_	_	_	_	_	_		_	_	_	
WL = 1 LINE based on discussion, MAX 20 wafers/year RY, SH, C	CC, TC, BF Dec. 11, 2020															Design Modifications For Production - Detector Waters NonLabor
MB-S4 will use 4 lines at SLAC DMF for SQUID and Detector pro	oduction. The number of SQUID and detector lines will be optim	nized in FY2	3, the year p	nor to Prepr	oduction. D	iscussed wit	h JH, KI, BI	Dec. 15,	2020							
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IPL 2 wafers/person in 2 months, Have 4 people now so could produ	duce 8 wafers every 8 weeks, pl PRODUCTION	Finish C	yostats Pla	n	Split yea	rs into part A	A and B for t	ransition to	new dete	ctor type						Test & Ship SAT1 LF Water: NIST 01-03
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FY22 demonstrate capabilities of 5 sites	Site 1		1	1000000	2	8	8	10	10	10	10	10	10	10	88	Test & Ship SAT1 LF Waters NIST 04:06
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	Site 3				2	8	10	10	14	11	11	11	11	8	96	Test & Ship SATTLE Waters NIST 07-10
	Site 4				2	8	10	12	10	8	8	10	12	12	92	
FY24 optimize detector fab plan: more than 2 lines/s	site?, less sites? CD3, P Site 5								11	11	8	10	14	14	68	
FY25-27 full production	Site 6				2	4	2	4	4	4	4	3	4	4	35	
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FY22 demonstrate capabilities of 5 sites Site 1 2 8 9 10	JPL'2 waters/persor	n in 2 months, Have 4 p	people now so could	produce 8 waters every 8 weeks	L P PRODUCTION	Finish Cryostats Plan St	23.8 EY24A EY248	EY25B EY264	EY268 EY22	A EY278 Total	test & Snip SATT LF Waters NIST 01-03 Fabricate SATT LF Waters NIST 04-06	
FY23: start producing science grade wafers, ramp to full production rate, r/sine 2 2 8 10 12 10 11 11 11 11 11 11 11 11 11 11 13 13 11 10 11 10 11 10 11 10 11 10 11 10 11 11 11 11 11 11 11 11 11 10 11 10 11 10 11 10 11 10 11 10 11 10 11 10 11 10 11 11	FY22 demonstr	rate capabilities of	f 5 sites		Site 1	2	8 8 10	10 10	10 10	10 10	88 Test & Ship SAT1 LF Waless NIST 04:06	
Step 3 2 8 10 11	FY23: start pro	ducing science g	rade wafers, ra	mp to full production rate	, ri Site 2	2	8 10 10	12 10	10 12	8 10	92 Fabricale SATLLF Waters NIST 07-10 Test & Shin S&TLLF Waters NIST 07-10	
FY24 optimize detector fab plan: more than 2 lines/site?, less sites? CD3, PSne5 2 4 2 4 4 3 4 4 FY25-27 full production Ste 6 2 4 2 4 4 3 4 4 3 Image: Ste 7 Ste 6 2 4 4 4 3 4 4 3 Image: Ste 7 Ste 6 2 4 4 4 3 4 4 3 Image: Ste 7 Ste 6 0 0 10 36 40 46 61 54 55 59 58 471 Image: Ste 7 Numerion: water modules to water module					Site 3	2	8 10 10	14 11	11 11	11 8		2
Fr28-27 full production Step 5 2 4 4 4 3 4 3 4 3 4 3 4 3 4 3 4 4	FY24 optimize	detector fab plan	more than 2 lie	es/site? less sites? CD	Stef	2	0 10 12	11 11	o 10	14 14	32	-
Total Science Grade 0 10 36 40 46 61 54 51 56 59 58 471 Project CMBS4-WP - Number of water modules to test (inc. 12% overage and - - - - - - 13	FY25-27 full pro	oduction			Site 6	2	4 2 4	4 4	4 3	4 4	35	
- Number of water modules to test (inc. 12% overage and					Total Science Grade	0 0 10	36 40 46	61 54	51 56	59 58 4	Project CMBS4-WF	
to test (inc. 12% overage and					~ Number of wafer modules						10	,
67% vield 0 0 17 60 67 77 100 85 94 99 97 787					to test (inc. 12% overage and 67% yield)		60 67 77	102 90	85 04	99 97 7	"	,

Cost Estimate in Progress

CMB-S4

CASH360	Cost Estimat	ting Form	n @											
M. Dashboard	Project: CMB-S4 > Last Updated: 6/30/2	021 7:23:30 PN	WBS: 1.01.01. - By Kevin Long	02 Project Office - DOE 🕨			Work Pa Start Da	ckage: DOE-PMC te: 07/01/2019	D-MGT-1000	000 Project Management Project Office - DOE + End Date: 03/31/2030				
@ titlimating -	Details 👻													
O Work Package Report O Cost Estimating Reports		САМ	Matthaeus Leitner		•	Earned	Value Technique (EVT	Level of El	ffort	~				
o Suffing Pain Report ○ Will's Fire ○ Will's Destonary E Reporting → O Matthaeus ~	WP Stateme	ent of Work	З д п п Маладе the CMB-S4 ко resources. Maintain offices for Di Covers all Recruiting a Manage the Headquar Construction Phase, as includes: Managing softw Procuring, config softw 	Indulies, budgets, plans, organization, procedures, poli rector, Project Manager, and all key staff in the Organiz and staff relocation. ters physical assets (hardware, software, facilities, doct, well as preparing for the same activities during the Op are and document repositories guing administering and maintaining computing, con urrangedocumentics fab for a dimensional and and con-	cies, partnering, and action. uments) during the berations Phase. This umunications and horizon		WP Basis of Effort		 First Iteration of WBS Dictionary Implemented Cost and BoE Updates Initiated Cost Estimate Training held June 30 					
		OBS	configurations) Configurations control and asset management for all physical assets. A. Infrastructure for PMCS and EVMS systems. Somestic and international travel expenses for all key staff not covered in focused activities. Gomestic and international travel expenses for all key staff not covered in focused activities. Gomestic and international travel expenses for all key staff not covered in focused activities. Gomestic and international travel expenses for all key staff not covered in focused activities. Gomestic and international travel expenses for all key staff not covered in focused activities. Communications service for Project Management office. LIBNE - Leavence Berkeley National Lab			Save				 Cost Drill-Down Training held Aug 4 Implemented Dash360 to collect input Basis of Estimate Estimate Uncertainty Factors WBS Dictionary 				
	Labor Estimate													
	10 0	Re	iource ID	Oescription	O Start O	Finish 🗘	Hours 🗘	Cost	•	Upcoming: Risk workshop planned Aug 26				
	29322-Budget	A40.3 - LBN	L Administrator - Sr	PM_3400 Management - CD0103A to FY23 - DOE	04/01/2021 0	9/30/2022	Hours: 9,041.00	\$ 962,847.0		5 · · · · · · · · · · · · · · · · · · ·				
	29323-Budget	A40.3 - LBN	L Administrator - Sr	PM_3500 Project Controls - CD0103A and beyond	04/01/2021 1	0/31/2028	Hours: 45,384.00	\$ 5,481,164.38	null	0 0 0				
	29324-Budget	A40.3 - LBN	L Administrator - Sr	PM_4100 QA/Safety Support - DOE	10/01/2022 0	3/31/2030	Hours: 7,564.00	\$ 965,154.55	null	© Ø ®				
	29325-Budget	A40.3 - LBN	L Administrator - Sr	PM_4200 Management - FY23 and beyond - DOE	10/01/2022 1	1/30/2028	Hours: 18,168.00	\$ 2,262,026.23	null	00				
	29326-Budget	\$13.4 - LBNL 5	ci/Engr - Physicist Staff	PM_3400 Management - CD0103A to FY23 - DOE	04/01/2021 0	9/30/2022	Hours: 3,014.00	\$ 533,056.68	nult	• © Ø ®				
	29327-Budget	\$13.4 - LBNL 5	ci/Engr - Physicist Staff	PM_4200 Management - FY23 and beyond - DOE	10/01/2022 1	1/30/2028	Hours: 3,028.00	\$ 626,088.43	nult	© ⊘				

CMB-S4 Matthaeus Leitner, Jeff Zivick, Project Managers 14

Cost Estimate in Progress



Suite of Project Tools Implemented

10X.582 U

- Single-Sign-On capability implemented through cmb-s4.org domain
- Confluence cloud-based wiki
- Jira cloud-based project tracking tool (e.g. risk register, • recommendation tracker, event tracker, milestone tracker)
- cmb-s4.org Indico meeting and review database •
- cmb-s4.org **DocDB** document management system
- Primavera scheduling software •
- Cobra cost aggregating tool

CMB-S4 Q. toject . | Change projet

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CMB-S4

1 103 Detector Assembly w 104 Readout Assemble 1 05 Module Assembly

1 1 06 LAT 1.07 SAT

040 80.1 B H 1.09 DM H TI 10 CH State IS B 1 11 SP StellC

Defects

- Acumen Fuse for schedule quality control
- Acumen Risk for Monte Carlo contingency simulation
- Dash360 cost estimating tool (incl. basis of estimate database, WBS Dictionary, reporting functionality)
- Hammer tool for EVMS reporting (future) •
- Windchill and Workgroup Manager for CAD data •

Learn more = 4 Dastaboard CMB-SA

CMB-S4 Ves

Relationship rule diagram

Jama requirements management tool PROJECTS REVIEWS



MOUs/MOAs/SOWs

MOU: Memorandum of Understanding MOA: Memorandum of Agreement SOW: Statement of Work IPMP: Intellectual Property Management Plan

• MOUs (standard format)

- Legal framework for work in Chile. U of Chicago: completed
- Framework for potential in-kind contributions to CMB-S4
 - Harvard-Smithsonian: completed
 - CCAT Prime Observatory, Inc. and U. Chicago: completed
 - Simons Observatory and U. Chicago: in progress
- MOAs (bespoke format)
 - Detector fab sites MOA completed, IPMP in progress
 - Institutional MOAs (signed once) + FY Appendix (update each FY):
 - LBNL, ANL, FNAL, SLAC completed
 - Caltech and CfA | Harvard in progress
- SOWs (key part of contracts between LBNL and DOE funded institutions)
 - Complete for FY21
 - To be renewed for FY22, based on budget and capabilities







Conclusions

- CMB-S4 Project structure is in place and will be developed over time
- Project "machinery" is in place and is being used to prepare for agency status (one completed) and gate reviews in the coming year
- Most major elements have undergone formal technical design reviews, remainder to be completed this summer
- Cost and schedule are being updated this summer
- Preliminary Baseline Design Report revisions under way, next draft by November 1
- Preparations for agency reviews are well under way