



U.S. DEPARTMENT OF
ENERGY

Office of
Science

High Energy Physics Project Status

HEPAP Meeting
November 2, 2021

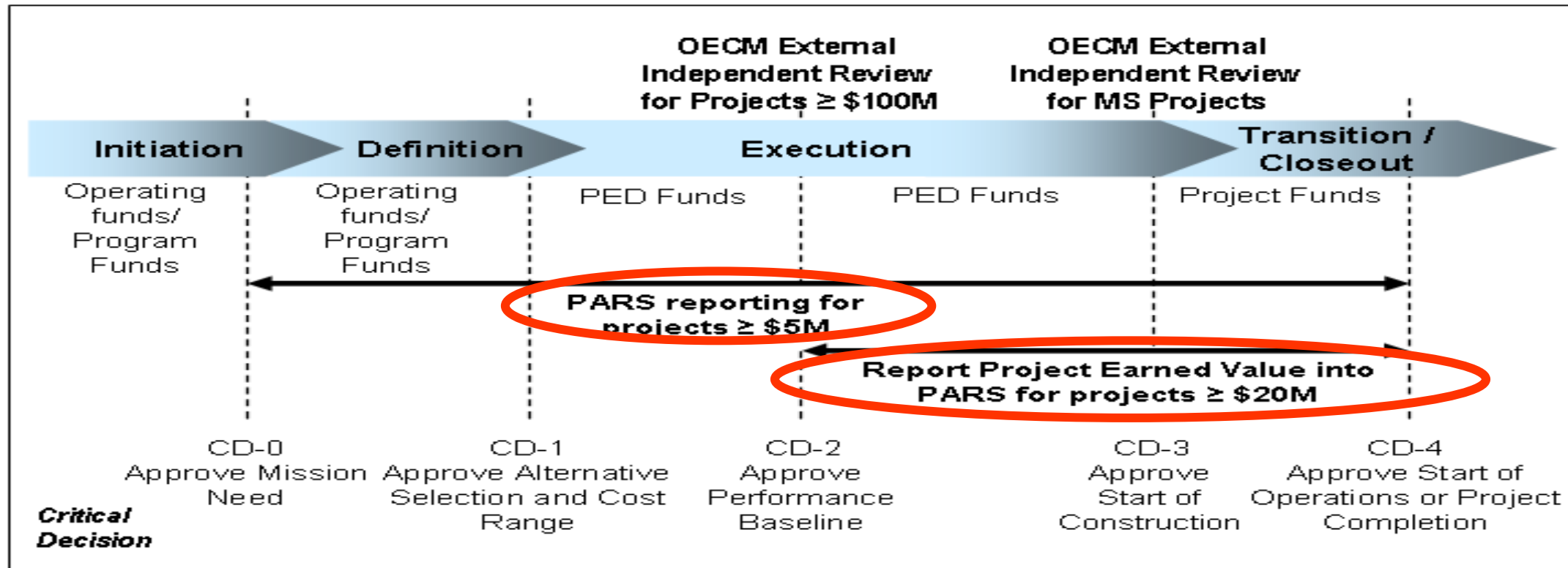
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Outline

- ▶ Introduction to DOE/SC project management
- ▶ Recently Completed Projects
- ▶ COVID 19 impacts
- ▶ HL-LHC Projects
- ▶ PIP II
- ▶ LBNF/DUNE
- ▶ Newest Projects
- ▶ Summary

DOE/SC Project Management

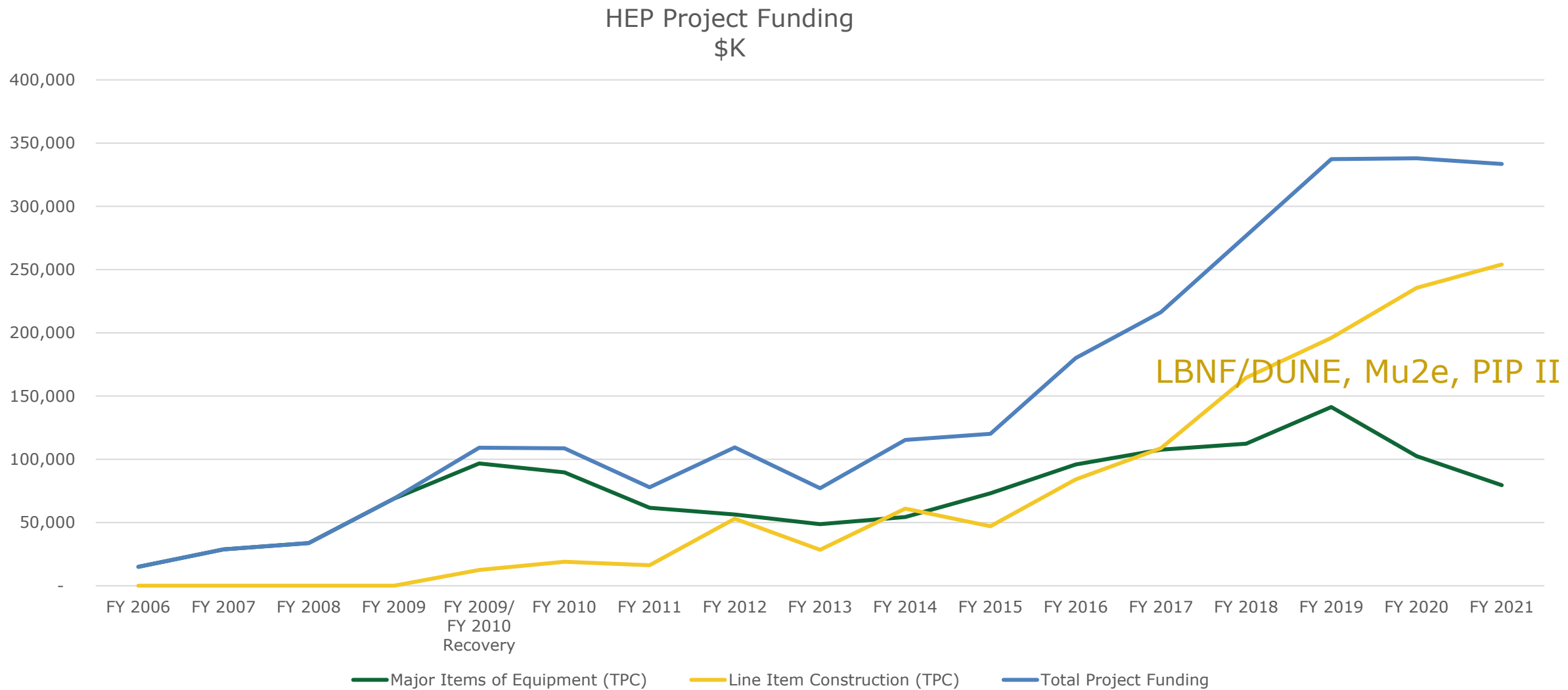
- ▶ Projects with TPC < \$5 million don't fall under O413.3; those <\$10 million don't have to be called out in the budget.
 - Small projects are managed by the HEP Research Division
- ▶ The Office of Science has delegated oversight of project with TPC < \$50 million to the labs.
 - Of current projects this applies to SuperCDMS and FACET II



Project Reviews

- ▶ A key to the Office of Science project management system is peer reviews of the project.
- ▶ Before any critical decision, the project is reviewed by a committee of experts.
 - ▶ The experts come from both HEP and other fields within the Office of Science.
 - ▶ The review is run by the Office of Science's Office of Project Assessment (OPA).
- ▶ The project is also reviewed as least once a year after CD-3 to monitor progress. These are also run by OPA.
- ▶ If a project cannot complete on time and within budget, SC will request a proposal to correct the problems and have OPA do a "rebaseline" review.

Project Funding



Project Management Awards

- ▶ Every year DOE runs a competition among completed projects to see which projects performed best.
- ▶ DESI completed their project in May 2020 and in FY 2021 we nominated DESI for an award. The awards were just announced.

Project Management Excellence Award

Presented to

The Office of Science's Dark Energy Spectroscopic Instrument Project

In recognition of the successful delivery of the Dark Energy Spectroscopic Instrument (DESI) project at Lawrence Berkeley National Laboratory. This \$56 million project delivered a state-of-the-art instrument to the Mayall Telescope at Kitt Peak, Arizona, transforming it into the most powerful multi-object spectrographs in existence...

Recently Completed Projects

- ▶ **The LSSTcam Project received CD-4 in September 2021.**
 - ▶ All of the Key Performance Parameters (KPP) were met, but final assembly of the components were moved to operations.
 - ▶ This protected us from COVID impacts pushing the project over cost and make it late.
 - ▶ The NSF Rubin Observatory Project is being rebaselined to deal with the delays created by COVID 19.
 - ▶ DOE and NSF are still coordinating their work to bring the entire work to a successful completion.
- ▶ **The FACET II Project also completed in September 2021.**
 - ▶ Oversight of this small project (TPC < \$50M) was delegated to SLAC.
 - ▶ All KPP were met. FACET II is now running.
- ▶ **There are now 9 HEP O413.3b projects with 4 beyond CD-2.**

List of Current Projects

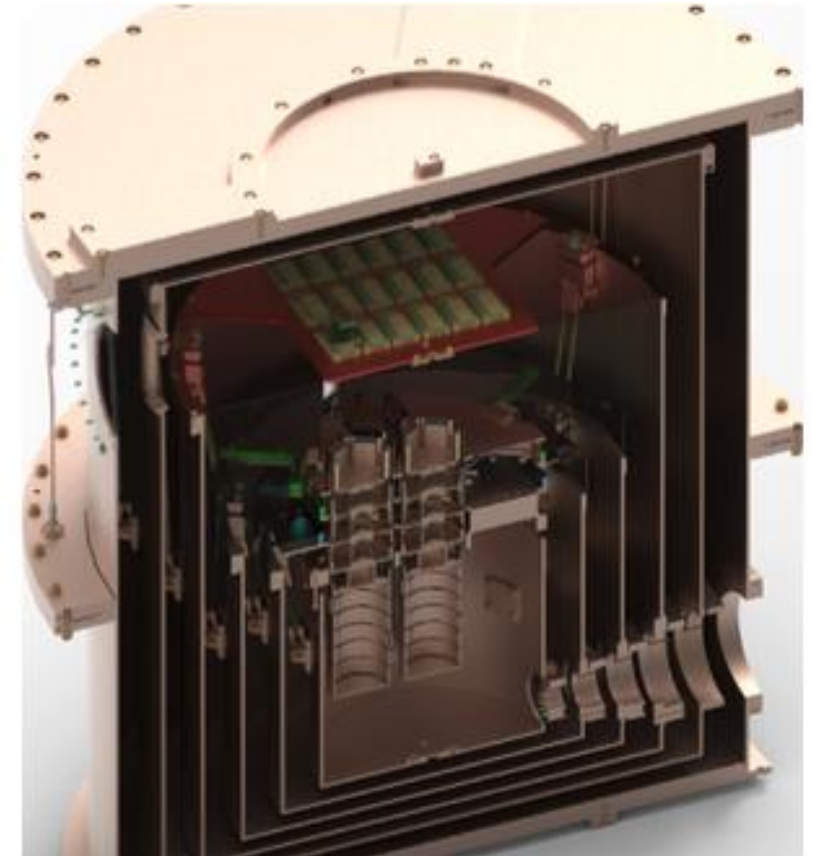
- ▶ HEP now has 9 projects with 4 projects after CD-2.
- ▶ SuperCDMS CD-3
- ▶ Mu2e CD-3
- ▶ HL-LHC Accelerator Upgrade Project CD-3
- ▶ HL-LHC ATLAS CD-3A (before CD-2)
- ▶ HL-LHC CMS CD-3A (before CD-2)
- ▶ LBNF/DUNE CD-3A (before CD-2)
- ▶ Proton Improvement Plan II (PIP II) CD-3A (after CD-2)
- ▶ CMB-S4 CD-0
- ▶ Accelerator Control & Research Network (ACORN) CD-0

COVID 19 Impacts on Projects

- ▶ COVID has had different impacts on projects depending on the stage of the project.
- ▶ DESI, LZ, LSSTCam, and FACET II were close to completion and were able to finish without rebaselining.
 - ▶ On LZ and LSSTcam the KPP were met, but some final work was moved to operations.
- ▶ SuperCDMS-SNOLAB, Mu2e, and HL-LHC Accelerator Upgrade Project are all past CD-3 and had large enough impacts that rebaselining is necessary.
- ▶ PIP II, HL-LHC ATLAS, and HL-LHC had impacts that required additional funds to be added in order to maintain their planned scope.

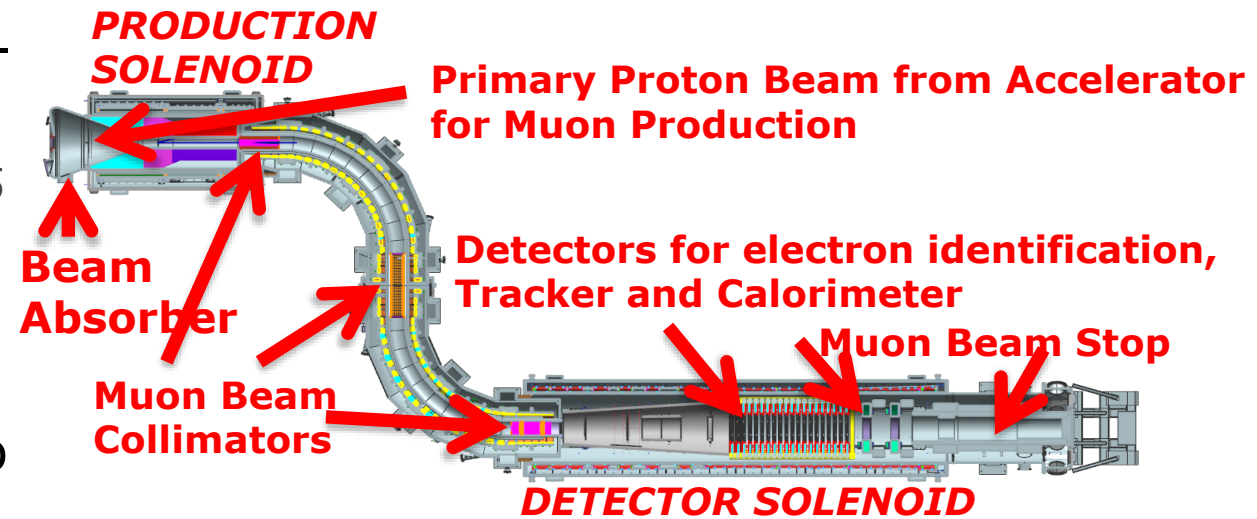
SuperCDMS-SNOLAB

- ▶ The project was past CD-3 when COVID hit but far from completion.
- ▶ The shutdowns at the labs due to COVID stopped work for several months.
- ▶ The project also had a problem finding a vendor to fabricate the multiple containers in the cryostat.
 - ▶ The time needed and cost to fabricate these “cans” were significantly longer and more expensive than planned.
 - ▶ The new project team simplified the design and brought in JLAB to produce some of the cans.
- ▶ The project successfully passed a rebaseline review in September 2021 with a \$6.4M increase in the TPC. DOE will provide \$5.3M, and NSF has been asked for \$1.1M.



Mu2e Project

- ▶ Like SuperCMDS, Mu2e was well past CD-3 but not near CD-4 when COVID hit.
- ▶ The project's estimate of the cost of COVID is \$8.5 million.
- ▶ Work was shutdown at Fermilab and the University of Minnesota where the tracker is being built.
- ▶ COVID was not the only problem, the two magnets being built by General Atomics (GA) were significantly behind schedule.
- ▶ Fermilab is currently negotiating with GA to get a new schedule that can be relied on.
- ▶ Understanding the total cost of the rebaseline depends on concluding these negotiations.
- ▶ The goal is to conclude these negotiations this year.
- ▶ We plan to have a rebaseline review in May 2022.



Mu2e Status

- ▶ The transport solenoid built by ASG has been delivered to Fermilab.



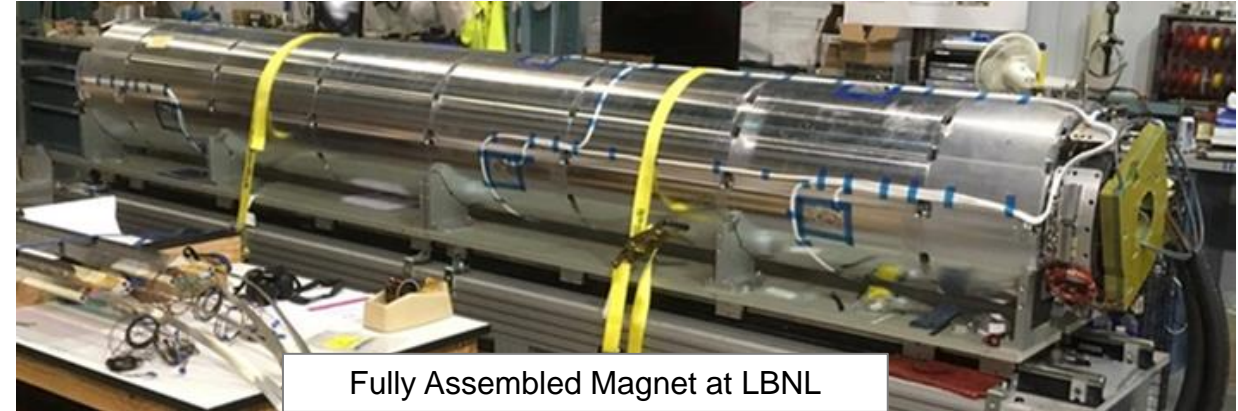
The TSu outer thermal shield was delivered to Fermilab in March (left). The thermal shield is a clam shell that will be installed around the outside of the TSu coldmass (right).



Dry fit of TSu outer thermal shield to look for interference issues. A few were identified and can be easily resolved.

HL-LHC Accelerator Upgrade Project (HL-LHC AUP)

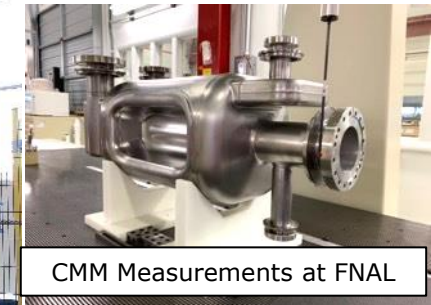
- ▶ Like the previous two projects, HL-LHC AUP is beyond CD-3 but far from CD-4.
- ▶ The bulk of the work for this project is being done at national labs: BNL, FNAL, and LBNL.
- ▶ The project has completed more 50% of the coils needed for the magnets.
- ▶ The lab shutdowns due to COVID had a very dramatic effect on the project.
 - ▶ Work has returned to near normal at the labs. The labs have gone through stages of return to work.
 - ▶ The labs have prioritized letting projects bring people back into the lab.
- ▶ We plan to rebaseline with \$18 million increase due to COVID only.
- ▶ The rebaseline review is scheduled for April 2022.



Fully Assembled Magnet at LBNL



Cryostat and Insertion tooling from CERN installed at FNAL



CMM Measurements at FNAL

HL-LHC Funding

- ▶ The funding for the HL-LHC projects in the FY 22 President's Budget request were lower than the projects expected.

	ATLAS	CMS	AUP
FY 22 PRB	\$10 M	\$10 M	\$20 M
Prior Guidance	~\$27M	\$28M	\$33.9M

- ▶ This change was made very late in the budget process and was justified by counting on the reconciliation bill to fully fund the projects.
- ▶ We have developed a strategy to mitigate the impacts should there not be a reconciliation bill.



HL-LHC Funding

- ▶ Proposed stop gap in FY 22.
 - ▶ +\$10 million each for CMS and ATLAS and +\$5 million for AUP.
 - ▶ Not a complete restoration but should prevent the worst impacts.
 - ▶ Needs SC and Congressional approval.
 - ▶ This has already been discussed with SC management and they are agreement with our plan.
 - ▶ We have maintained regular contact with CERN on this topic.
- ▶ New guidance reflecting this have been given to the projects for their CD-2 reviews or rebaseline review.
 - ▶ Funds have been added to cover the COVID impact.

New Guidance

Project Name	BRN	FY 2019 and Prior	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	Total	Previous TPC
HL-LHC AUP	TEC	71,572	52,025	43,000	25,000	35,000	20,855	6,500		253,952	
	OPC	6,048	-	-	-	-				6,048	
	TPC	77,620	52,025	43,000	25,000	35,000	20,855	6,500		260,000	242,720
HL-LHC ATLAS	TEC	27,500	24,500	16,000	20,000	28,000	15,700	17,000	5,785	154,485	
	OPC	16,515	-	-	-	1,000	3,900	3,050	2,050	26,515	
	TPC	44,015	24,500	16,000	20,000	29,000	19,600	20,050	7,835	181,000	162,515
HL-LHC CMS	TEC	13,750	20,988	13,500	20,000	33,000	19,000	18,487	8,725	147,450	
	OPC	30,250	-	-	-	-	2,000	800	500	33,550	
	TPC	44,000	20,988	13,500	20,000	33,000	21,000	19,287	9,225	181,000	162,050

TPC increases due to COVID



HL-LHC Reviews

- ▶ We plan to have CD-2 reviews of the ATLAS and CMS detector projects in 2022.
- ▶ By March 2022, CERN is expected to provide an updated schedule for the start of LHC's 3rd shutdown to allow for installation of the upgrades.
- ▶ This is key information to develop credible baselines for the projects
- ▶ We now plan to have
 - ▶ January 2022 HL-LHC ATLAS Status review
 - ▶ April 2022 HL-LHC AUP Re-baseline review
 - ▶ April 2022 HL-LHC CMS CD-3b review (before CD-2)
 - ▶ Q4 22 HL-LHC ATLAS CD-2/3 review

PIP II

- ▶ A new SC linac to replace the current Fermilab linac that will raise the power of the complex to 1.2 MW.
- ▶ PIP II received CD-2 approval on December 14, 2020, and CD-3A approval for long lead procurements on March 16, 2021.
- ▶ This project has significant in-kind contributions from France, India, Italy, Poland, and the UK worth nearly \$310 million in US accounting.

Artist's rendering of the PIP II complex



Prototype of the single spoke resonator cryomodule

PIP II

- ▶ The project has successfully completed a major prototype testing program called PIP2IT.
 - ▶ Beam was accelerated from the injector through the warm section and through 2 prototype cryomodules.
 - ▶ The beam behaved consistent with simulations.
- ▶ The cryoplant building was split off into its own subproject.
 - ▶ This subproject was approved in July 2020.
 - ▶ The building is well advanced and will be ready to accept the cryoplant when it arrives from India.
- ▶ We are planning a CD-3 review for March 2022.
- ▶ More details in Lia Merminga's talk.



PIP II Integration Test Facility (PIP2IT)

LBNF/DUNE

- ▶ The highest priority domestic project per P5 will produce a new neutrino beam at Fermilab pointed to Lead, SD.
- ▶ New liquid argon detectors in the Sanford Underground Research Facility (SURF) and a near detector at Fermilab.
- ▶ The project has CD-1R and CD-3A, which allows the start of excavation the caverns for the detectors at SURF.
- ▶ LBNF/DUNE has arranged \$570M of international contributions.
- ▶ The cost estimate is about \$3 billion for DOE.



Yates Shaft Headframe at Sanford Underground Research Facility

LBNF/DUNE Current Status

- ▶ Excavation has started and is proceeding well under a CD-3A.
- ▶ The DOE Project Management Office has recommended breaking the project up into subprojects.
- ▶ This will allow various parts of the project to be baselined as they technically mature.

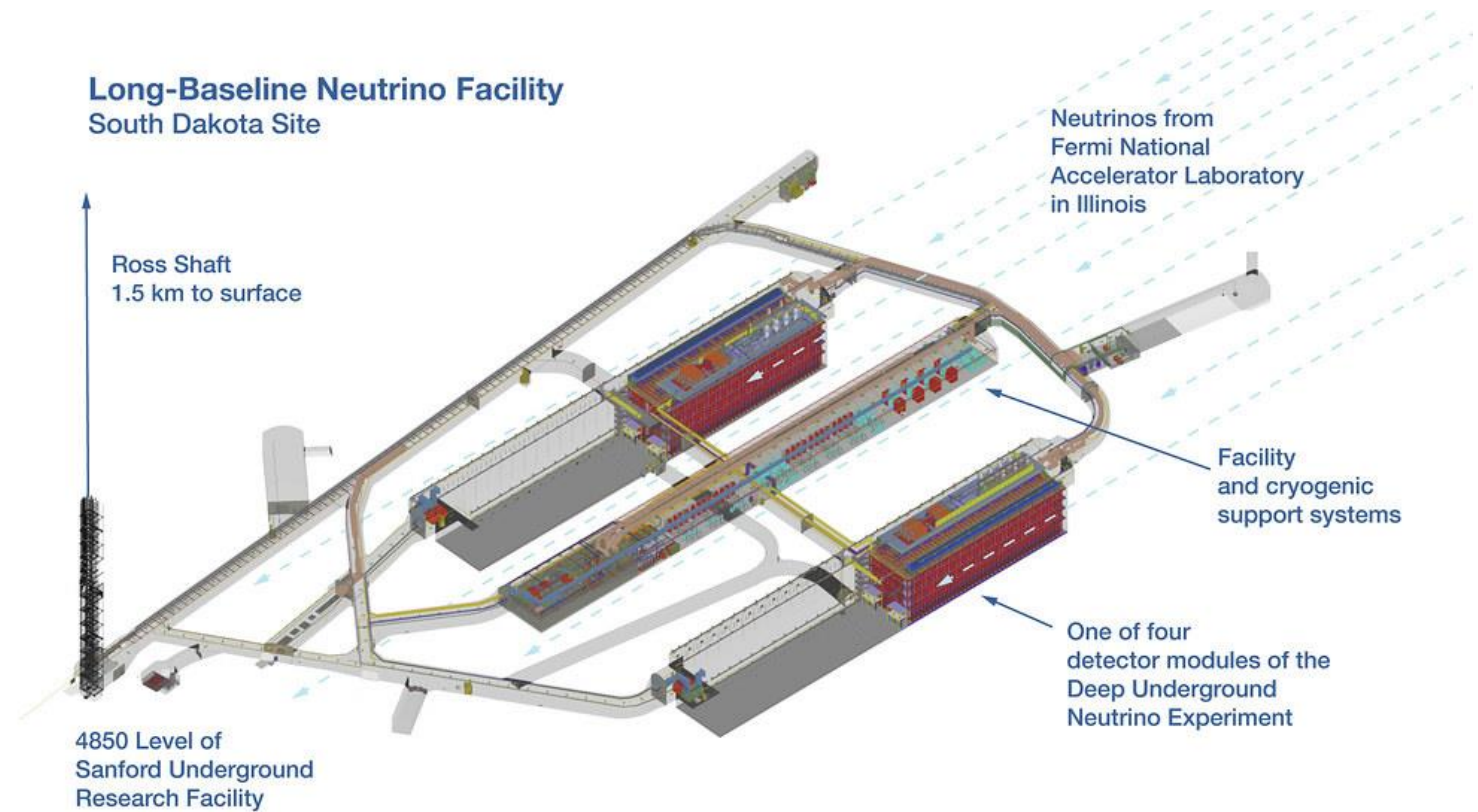


Diagram of the detector and utility caverns at SURF

DOE Independent Project Reviews

- ▶ Reviews were held in January 2021 and June 2021.
 - ▶ The committee did not see any way that the TPC could be held under \$2.75 billion with the two far detectors and the near detector.
 - ▶ Exceeding \$2.75 billion would exceed a DOE threshold for cost growth and require CD-1R to be reaffirmed.
 - ▶ The committee recommended that the project prepare for a review to reaffirm CD-1R, which we have been calling CD-1RR.
- ▶ The project is planning for a review in January to evaluate CD2/3 for the far site excavation and to look at progress towards CD-1RR.
- ▶ The project is planning for its CD-1RR in the spring.
- ▶ The CD-1RR process will establish a new cost range.
- ▶ There will be more details in Chris Mossey's talk.

LBNF/DUNE Funding Profile

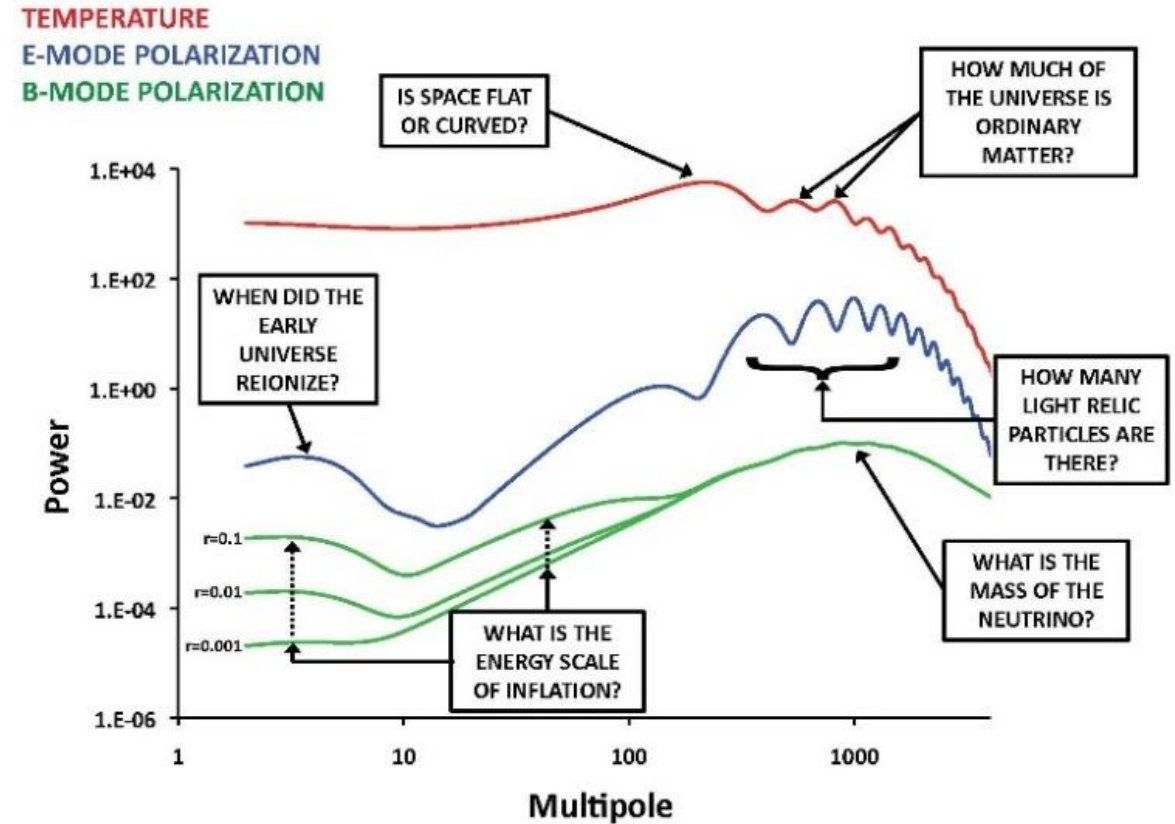
- ▶ Congress has not appropriated the amount that the project was planning in recent years.
- ▶ HEP has developed a new conservative profile that the Office of Science can support.

	Prior	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	FY 32	Total
TPC	772	180	180	200	225	250	250	250	250	250	250	102	3159

- ▶ The flat funding in FY 23 is due to a need to increase HL-LHC funding.
- ▶ Impacts will be explained by Chris Mossey.

CMB-S4

- ▶ This project will measure the CMB B-mode polarization to the precision needed to definitively test the theory of inflation.
- ▶ The current design concept has telescopes in Chile and at the South Pole.
- ▶ NSF is expected to participate if the ASTRO2020 decadal survey gives CMB-S4 a strong recommendation.
- ▶ The project received CD-0 in July 2019 with a DOE cost range of \$300–400 million.
- ▶ LBNL has been assigned to be the DOE host lab for the project.
- ▶ A status review to look at progress towards CD-1 is planned for Feb 2022.



Science beyond inflation can be done, including neutrino mass, and light relic particles, etc.

ACORN

- ▶ The accelerator control system at Fermilab was built in the 1980's.
- ▶ Both the hardware and software components are out of date.
- ▶ A modern control system will increase the efficiency and reliability of the complex.
- ▶ This is not a P5 project. It is a stewardship responsibility of HEP to keep the complex viable for future physics.
- ▶ CD-0 was approved in August 2020.

Summary

- ▶ Many of the small P5 projects have been completed.
- ▶ We have seen COVID impacts for several projects.
 - ▶ We have committed to at least \$60 million to deal with this so far but have gotten no help from Congress.
 - ▶ Several projects will need to be rebaselined due to COVID.
- ▶ LBNF/DUNE has two major reviews in 2022 that they need to pass.



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Potential Upgrades to LBNF/DUNE

- ▶ The P5 vision was for 40 tons of detector mass and a 2.4MW beam.
- ▶ This requires two more large far detectors and an upgrade to the Fermilab Booster.
- ▶ The DUNE collaboration believes that the near detector will need to be more capable after several years of data taking.
- ▶ HEP has asked Fermilab to help organize the case for these upgrades to go to Snowmass and P5.