

Energy Frontier Program and Program Funding Opportunity Announcements and Reviews

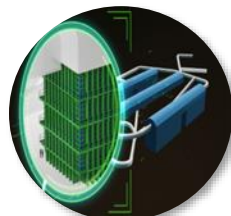
DOE-HEP Principal Investigator Meeting
Snowmass 2022 · July 17-26, 2022

Abid Patwa
U.S. Department of Energy
Office of High Energy Physics



U.S. DEPARTMENT OF
ENERGY

Office of
Science



- DOE and HEP Program: Planning and Budgets
- DOE Energy Frontier Program Overview
- DOE/HEP Comparative Review Process
- DOE Early Career Research Program
- Closing Remarks

This talk will (1) emphasize the Energy Frontier program — which includes the science programs at the LHC and proposed future particle colliders — within the broader context of the overall HEP program; and
(2) Provide a planned overview of the upcoming FY 2023 HEP comparative review funding opportunity announcement. But please refer to the issued announcement prior to any submission of a proposal.

What is the DOE HEP Program

DOE Program Model Science Mission-driven

DOE develops and supports a specific portfolio of projects ⇒ emphasis placed on planning, R&D, building experiments, operating, and publishing results

DOE High Energy Physics Mission

- **Discover** the fundamental constituents of matter and energy
- **Probe** the interactions between them
- **Explore** the basic nature of space and time

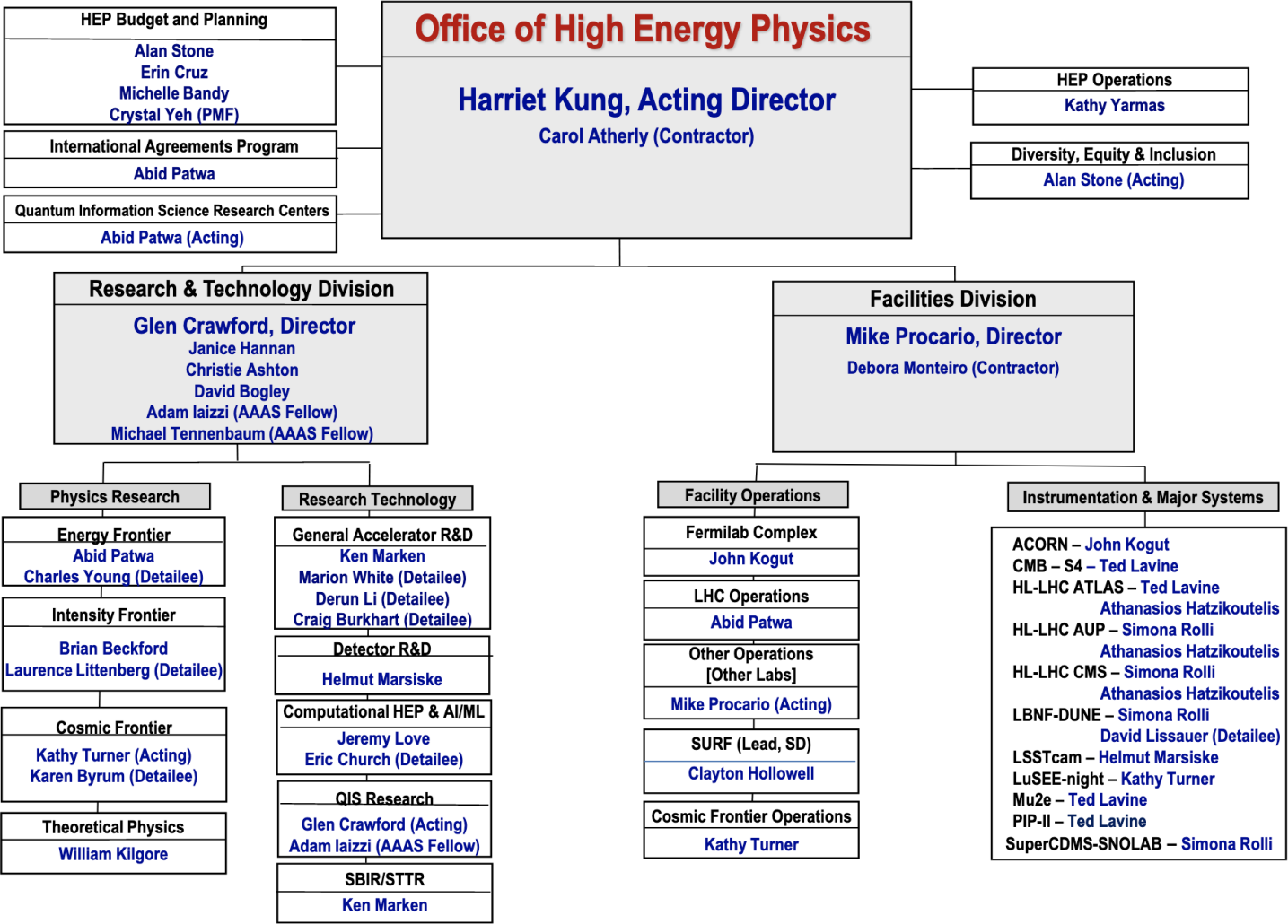
How do we do this?

- Make significant, coherent contributions to global facilities/experiments (e.g., LHC/CMS and ATLAS, Rubin/LSST, ...), including project management under DOE project system
- Support science collaborations in all stages, leading to the best possible science results
- Support technology R&D to advance state-of-the-art particle accelerators and detectors leading to new capable facilities
- Form partnerships with other agencies (e.g., NSF, NASA) to help deliver our mission

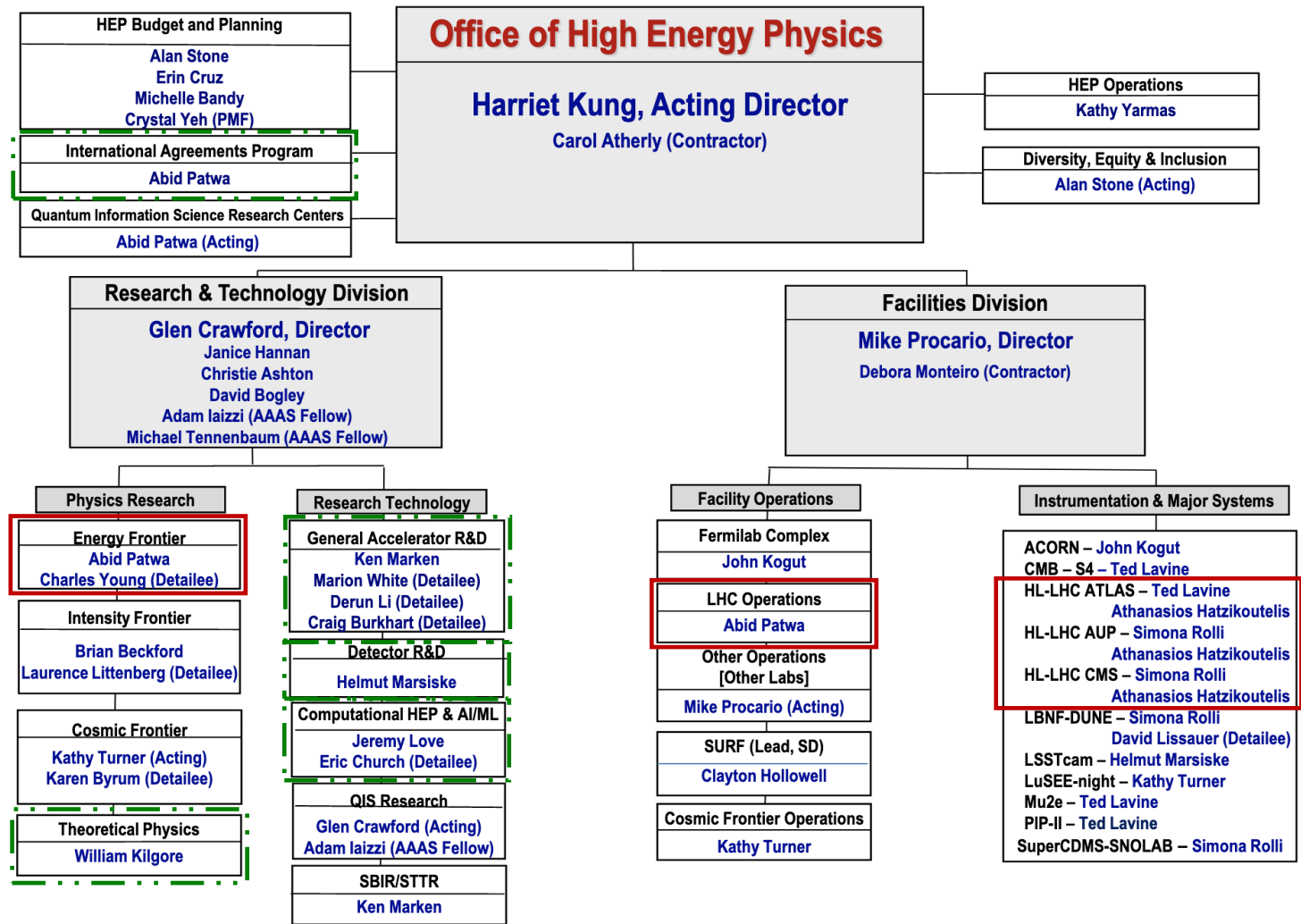
DOE supports about 80-85% of the U.S. HEP effort (in \$), including the U.S. national laboratories

HEP Program Guidance

- Federal Advisory Committee Act (FACA) panels – official advisory bodies to the U.S. government
- for e.g., High Energy Physics Advisory Panel (HEPAP) provides the primary advice for HEP program to DOE and NSF and includes subpanels for detailed studies (e.g., HEPAP “International Benchmarking” subpanel, P5)



HEP advances DOE’s missions and objectives through a balanced portfolio of scientific **research**, facilities’ **operations** and **projects**, and by developing **key technologies** and the **trained person-power** needed to work at the cutting edge of science.



 Energy Frontier / LHC; HL-LHC
 and related cross-cut programs

HEP advances DOE’s missions and objectives through a balanced portfolio of scientific **research**, facilities’ **operations** and **projects**, and by developing **key technologies** and the **trained person-power** needed to work at the cutting edge of science.

The background of the slide is a Cosmic Microwave Background (CMB) fluctuation map. It features a complex pattern of blue and white lines and swirls against a dark blue background, representing the distribution of matter and energy in the early universe. The pattern is dense and intricate, with many small, bright spots and larger, more diffuse regions. The overall effect is one of a highly detailed and complex scientific visualization.

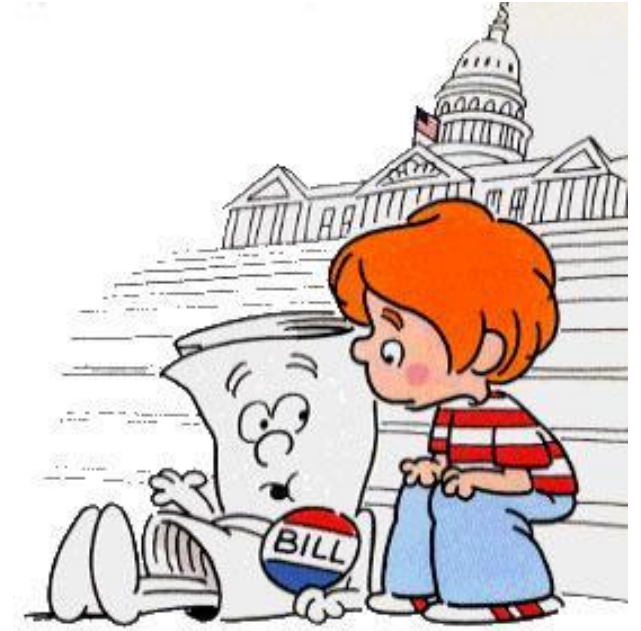
DOE High Energy Physics Budget

The U.S. Federal Budget Cycle

- The President submits a Budget Request (“PBR”)
- Each house of U.S. Congress passes their vision of a draft budget called a “Senate or House Mark”

— — — — — For the next fiscal year, FY 2023, we are here — — — — —
with a House Mark but await the Senate Mark

- Both houses agree on a single bill (a process through “reconciliation”)
 - No amendments are allowed beyond this point ⇒ ensures that the process converges
- Congress passes this legislation
- The President signs it and it becomes law
- If this process is not completed by the end of a fiscal year (September 30th), Congress may pass a “continuing resolution” (or CR), or without any action, the U.S. Government can [partially] “shutdown”



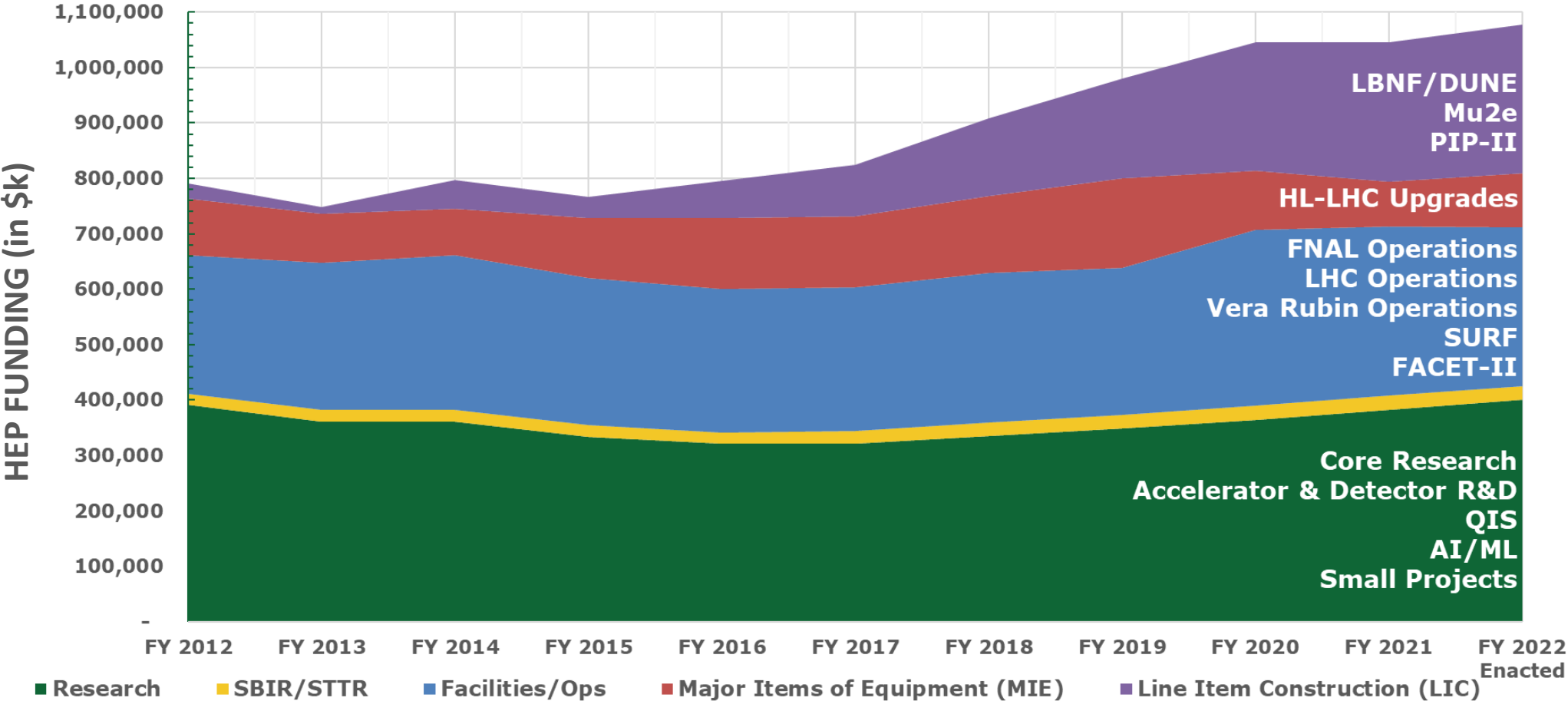
“I’m Just a Bill”

*Credit: America Rocks, 1976.
3rd season, Schoolhouse Rock.*

DOE-HEP Budget (\$k): FY 2011-2022

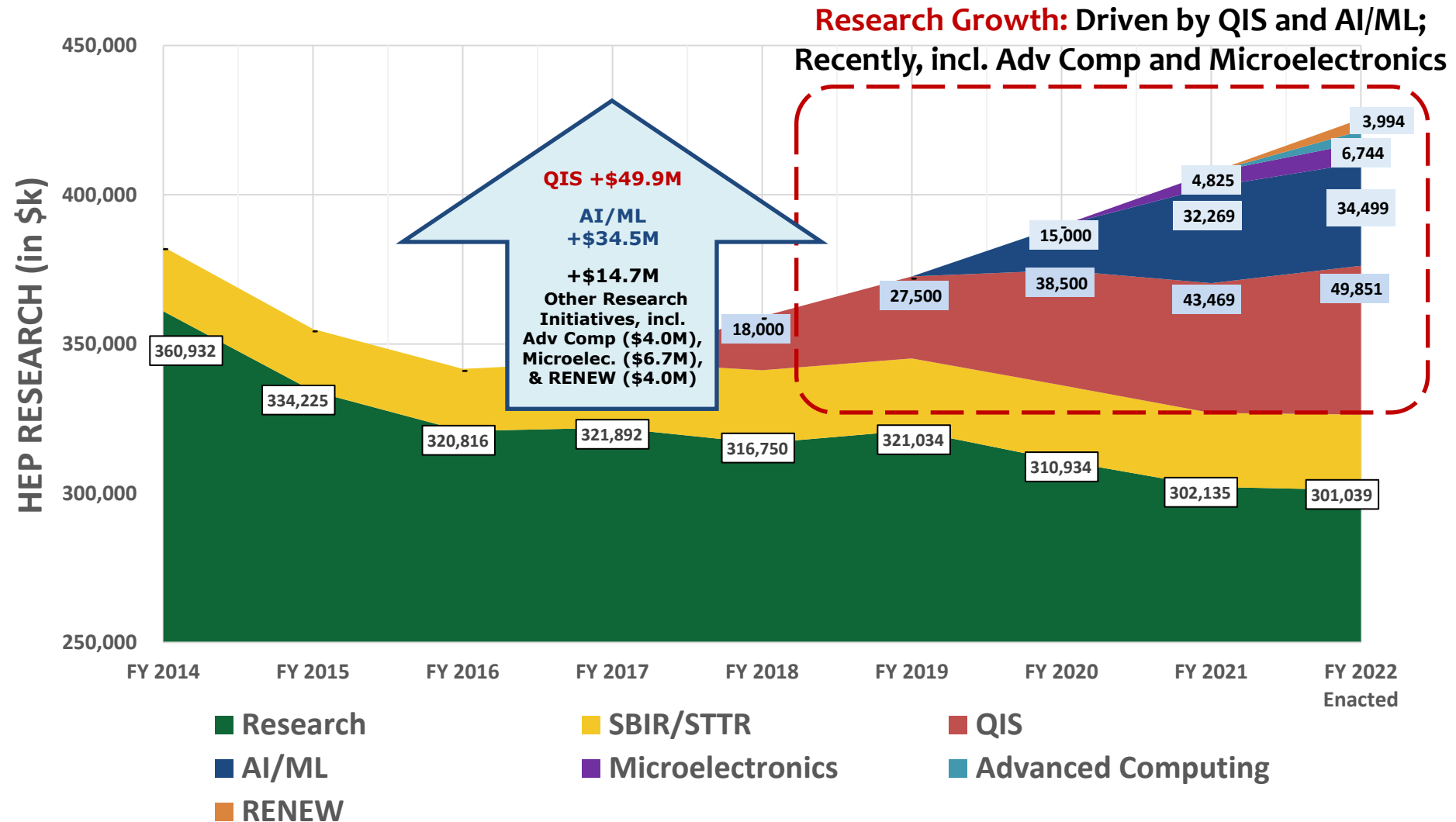
Research, Operations, Projects (Construction and MIEs)

HEP Funding (\$ in k)	FY 2017 Actual	FY 2018 Actual	FY 2019 Actual	FY 2020 Actual	FY 2021 Actual	FY 2022 Enacted	FY 2023 President's Request <i>(for Reference)</i>	FY 2023 House Mark <i>(for Reference)</i>
TOTAL	825,000	908,000	980,000	1,045,000	1,046,000	1,078,000	1,122,020	1,158,000



DOE-HEP Research (\$k): FY 2014-2022

- Distinguishing HEP Research into: HEP “Core” Research, QIS, AI/ML, and Other Research Initiatives
- HEP “Core” Research \approx Energy, Intensity, and Cosmic Frontiers; Detector and Accelerator R&D; and HEP Theory
- In recent years, incl. FY 2022, dedicated AI/ML, Adv Computing, and Microelectronics funds have helped offset some fraction of reductions in “Core” Research




A composite image showing a long, brightly lit tunnel with a series of large, cylindrical, metallic structures on the left side, receding into the distance. The structures have various pipes and components attached. Above the tunnel, a red line with several small circles connects different points across a green, textured landscape, suggesting a path or trajectory. The overall scene is a blend of industrial technology and natural landscape.

Energy Frontier Program

Enabling the Next Discovery

- 2014 P5 [U.S. Particle Physics Project Prioritization Panel] identified 5 Science Drivers to address the scientific motivation of particle physics
- Research Frontier are useful categorization of experimental techniques ⇒ a basis of the budget process
- Energy Frontier**
 - 3 out the 5 drivers: pursue science of the Higgs, Dark Matter, and Exploring the Unknown
- Research Frontiers are complementary
 - No one Frontier addresses all science drivers
 - Each Frontier provides a different approach to address a science driver
 - Enables cross-checking of scientific results

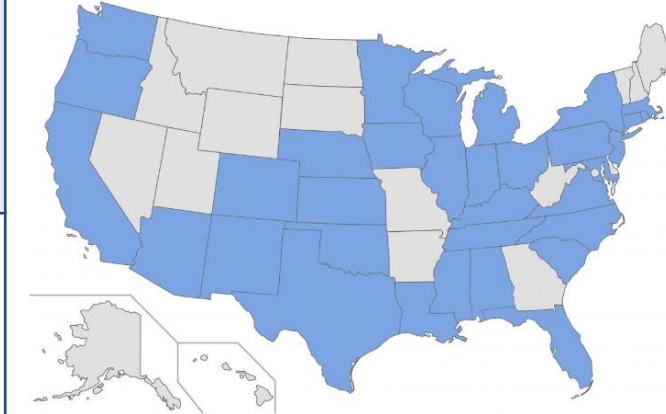
Research Frontiers				
Particle Physics Science Drivers		Energy Frontier	Intensity Frontier	Cosmic Frontier
	Higgs Boson	●		
	Neutrino Mass		●	●
	Dark Matter	●	●	●
	Cosmic Acceleration			●
	Explore the Unknown	●	●	●

DOE/HEP Energy Frontier

Experiment	Location	Center-of-Mass Energy; Status	Science Topics	# Institutions; # Countries	# U.S. Institutions	#U.S. Collab.
ATLAS (A Toroidal LHC Apparatus)	CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Meyrin, Switzerland]	7-8 TeV; 13-14 TeV Run 1: 2009-2012 Run 2: 2015-2018 Run 3: 2022-2025 Run 4 to begin: 2029	Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics	181 Institutions; 42 Countries	30 DOE Universities, 4 DOE National Labs; [11 NSF Universities]	604
CMS (Compact Muon Solenoid)	CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Cessy, France]	7-8 TeV; 13-14 TeV Run 1: 2009-2012 Run 2: 2015-2018 Run 3: 2022-2025 Run 4 to begin: 2029	Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics	241 Institutions; 55 Countries	32 DOE Universities, 1 DOE National Lab; [18 NSF Universities]	642

LHC data provided by U.S. LHC collaborations, as of April 2022.

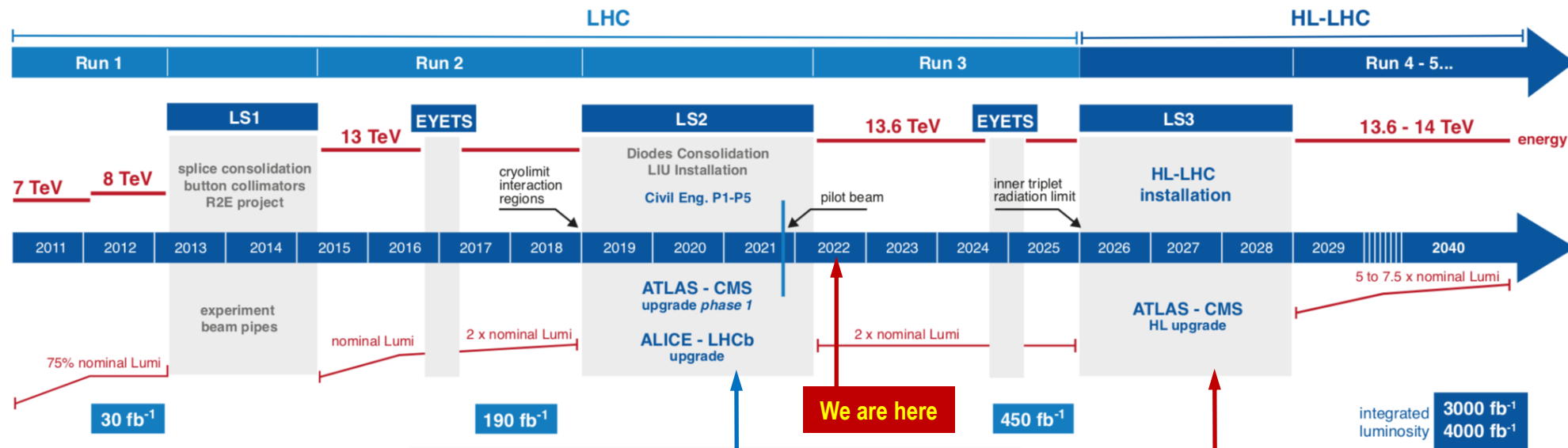
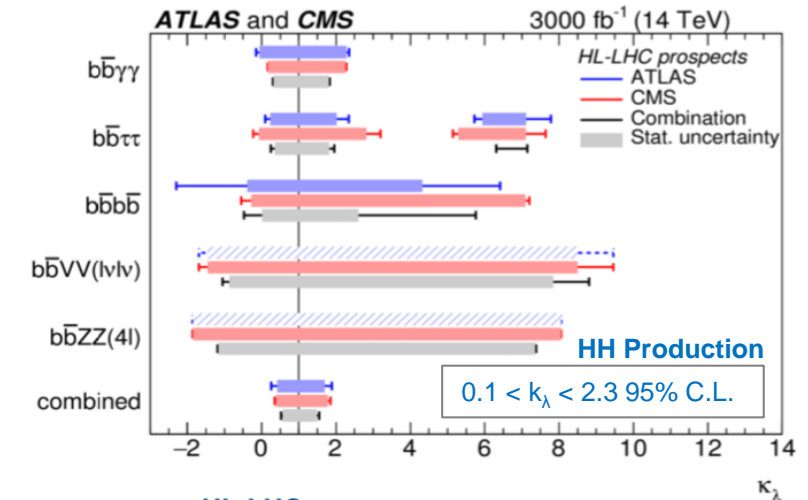
States hosting members of the U.S. LHC experimental program



- **Main scientific thrust: LHC at CERN (pp collider) – ATLAS and CMS Collaborations**
- **Modest support for studies on future collider initiatives**
 - Dedicated ILC/Japan support; and efforts on FCC/CERN R&D and physics studies
 - or up to 25% of a DOE grant for the LHC may work on such future colliders and/or Snowmass-related activities
- **Key focus of Energy Frontier program: collaborate on the ATLAS and CMS experiments**
 - U.S. ATLAS: ~19% of ATLAS collaboration (~15.3% DOE + ~3.6% NSF); 4 DOE labs: BNL (U.S. host lab), ANL, LBNL, and SLAC
 - U.S. CMS: ~27% of CMS collaboration (~21.5% DOE + ~5.7% NSF); 1 DOE lab: Fermilab (U.S. host lab)
- **DOE Nuclear Physics supports heavy-ion research at ALICE, CMS, and ATLAS; NSF supports LHCb, CMS, and ATLAS**

LHC and HL-LHC Timeline

- During next decade, LHC will be the only means to produce and characterize the Higgs boson
 - Precision measurements of its properties leading to any deviations at the few %-level
 - Expanded sensitivity to rare processes and decay modes – e.g., extend the present Higgs decay to $\mu\mu$ results; searches for additional H, ...
- Up to 40% larger discovery potential for new physics than that accessible prior to the upgrades



2nd LHC shutdown (2019-2021; extended due to COVID-19)

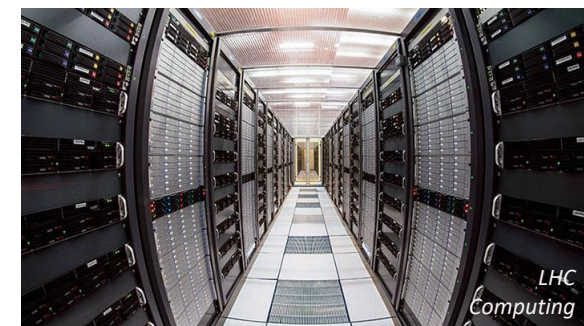
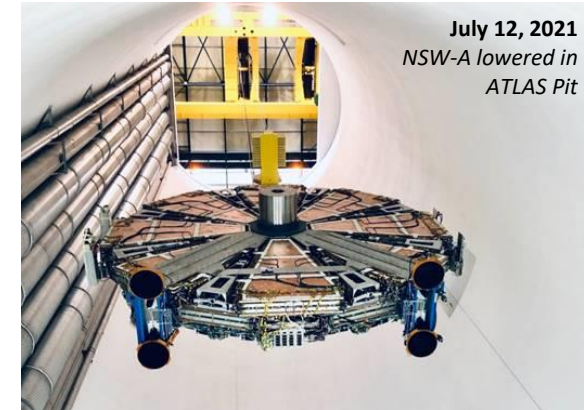
- LHC Injectors Upgrade (to deliver brighter bunches)
- LHC consolidation activities
- Install initial [Phase-1] LHC experiments upgrades

3rd LHC shutdown (2026 to end-2028)

- HL-LHC installation, including accelerator upgrade's Nb₃Sn focusing magnets near interaction regions;
- Install CMS and ATLAS HL-LHC detector upgrades

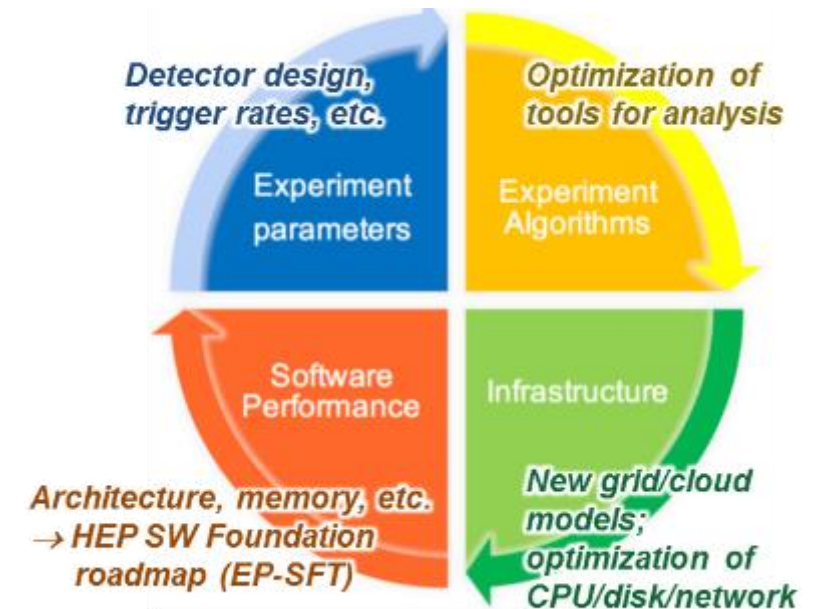
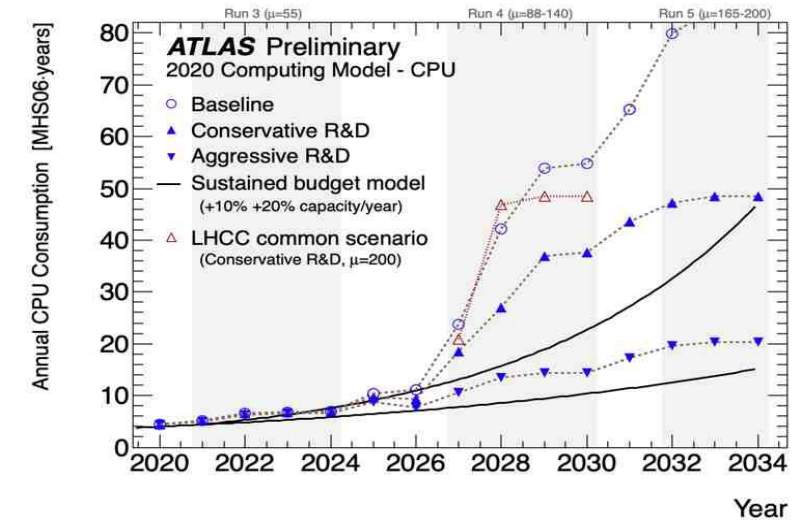
U.S. LHC Detector Operations Program

- **U.S. ATLAS and U.S. CMS Operations** is a jointly coordinated program by DOE and NSF; program scope funded separately
- **Supports**
 - Operations Program Management
 - Detector Maintenance and Operations (M&O)
 - M&O of U.S.-built detectors or detector components
 - Meet U.S. obligations to CMS and ATLAS collaboration via common funds contributions
 - Install and commission U.S.-built detector components at CERN after completing fabrication and delivery of initial [Phase-1] ATLAS and CMS detector upgrades
 - Software and Computing (S&C)
 - Support U.S. Tier-1 (DOE) and Tier-2 (NSF) computing facilities
 - Support computing hardware, core software, tools and provisions \Rightarrow enable physics
 - DOE support of ESnet transatlantic network for data transfer from Tier-0 to U.S. Tier-1s
 - Since FY 2017, each program tasked to spearhead HL-LHC S&C planning and R&D
- **U.S. agencies' review of operations held every ~24-28 months for above scope; and resources are coordinated through the CERN LHC Resources Review Boards (RRB)**



Computing in the HL-LHC Era

- **Simple extrapolation leads to an unsustainable place**
 - If the current software and computing approach is applied, costs can quickly exceed the entire U.S. HEP budget (“\$1B problem”)
- **Our goal is to match demonstrable experiment needs with a realistic funding profile — we want the science to succeed**
 - How do the software and computing models evolve?
 - much was developed beginning 15 years ago
 - they need to function 15 years from now
 - To what extent can we leverage HPC capabilities?
 - What is the optimum balance between CPU, disk, and networking?
 - R&D investments: what activities are being done or planned to address the HL-LHC software and computing challenges?
- **What is the optimum balance between people and hardware?**
 - Goal: assess computing resources and needs early enough to help inform experiments and funding agencies for successful operations during the HL-LHC era
- **For efforts towards a strategic plan, HEP Software Foundation prepared Community White Paper: <https://arxiv.org/pdf/1712.06982.pdf> (Dec. 2017)**
 - Additional documentation prepared by the LHC experiments during last few years



CMS HL-LHC Upgrade

- U.S. CMS, DOE, and NSF coordinated U.S. contributions with international partners and CMS at CERN
- Scope of the U.S. deliverables leverages expertise by U.S. scientists

L1-Trigger/HLT/DAQ

<https://cds.cern.ch/record/2283192>

<https://cds.cern.ch/record/2283193>

- Tracks in L1-Trigger at 40 MHz
- Particle Flow-like selection 750 kHz output
- HLT output 7.5 kHz

DOE

NSF



DOE



New Calorimeter Endcap

<https://cds.cern.ch/record/2293646>

- Referred to as HGCAL, EC, CE
- 3D showers and precise timing
- Si, Scintillator + SiPM in Pb/W-SS



Tracker

<https://cds.cern.ch/record/2272264>

- Si-Strip and Pixels increased granularity
- Design for tracking in L1-Trigger
- Extended coverage to $\eta \approx 3.8$

DOE

NSF



Barrel Calorimeters

<https://cds.cern.ch/record/2283187>

- New FE/BE electronics for full granularity readout at 40 MHz with precise timing for e/ γ at 30 GeV
- ECAL and HCAL new Back-End boards

NSF



Muon systems

<https://cds.cern.ch/record/2283189>

- DT & CSC new FE/BE readout
- RPC back-end electronics
- New GEM/RPC $1.6 < \eta < 2.4$
- Extended coverage to $\eta \approx 3$

NSF



Beam Radiation Instr. and Luminosity, and Common Systems and Infrastructure

<https://cds.cern.ch/record/2020886>

All Funding
Agencies

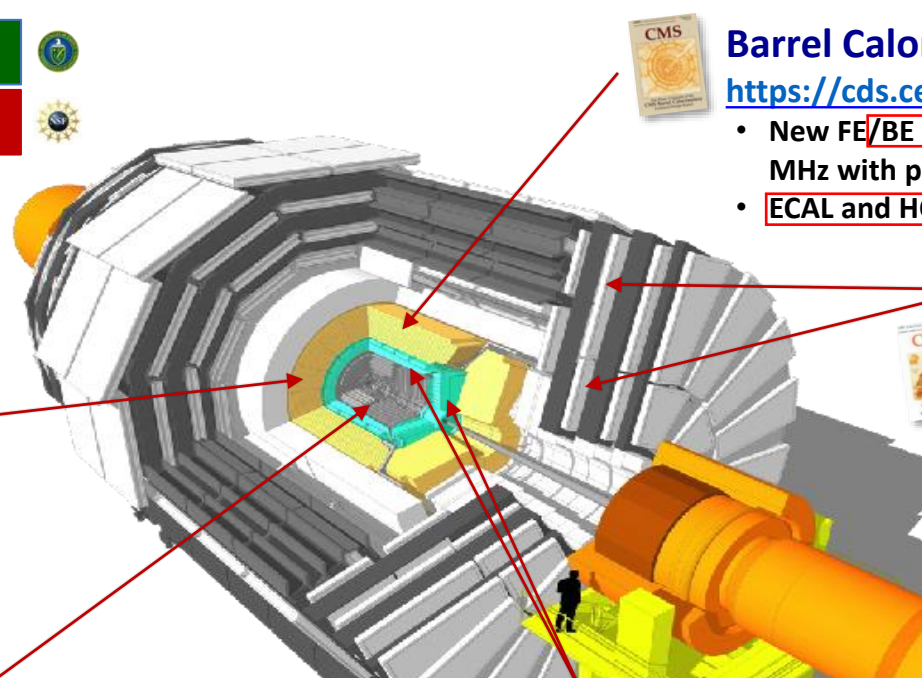
MIP Timing Detector

<https://cds.cern.ch/record/2296612>

Precision timing with:

- Barrel layer: Crystals + SiPMs
- Endcap layer: Low Gain Avalanche Diodes

DOE



ATLAS HL-LHC Upgrade

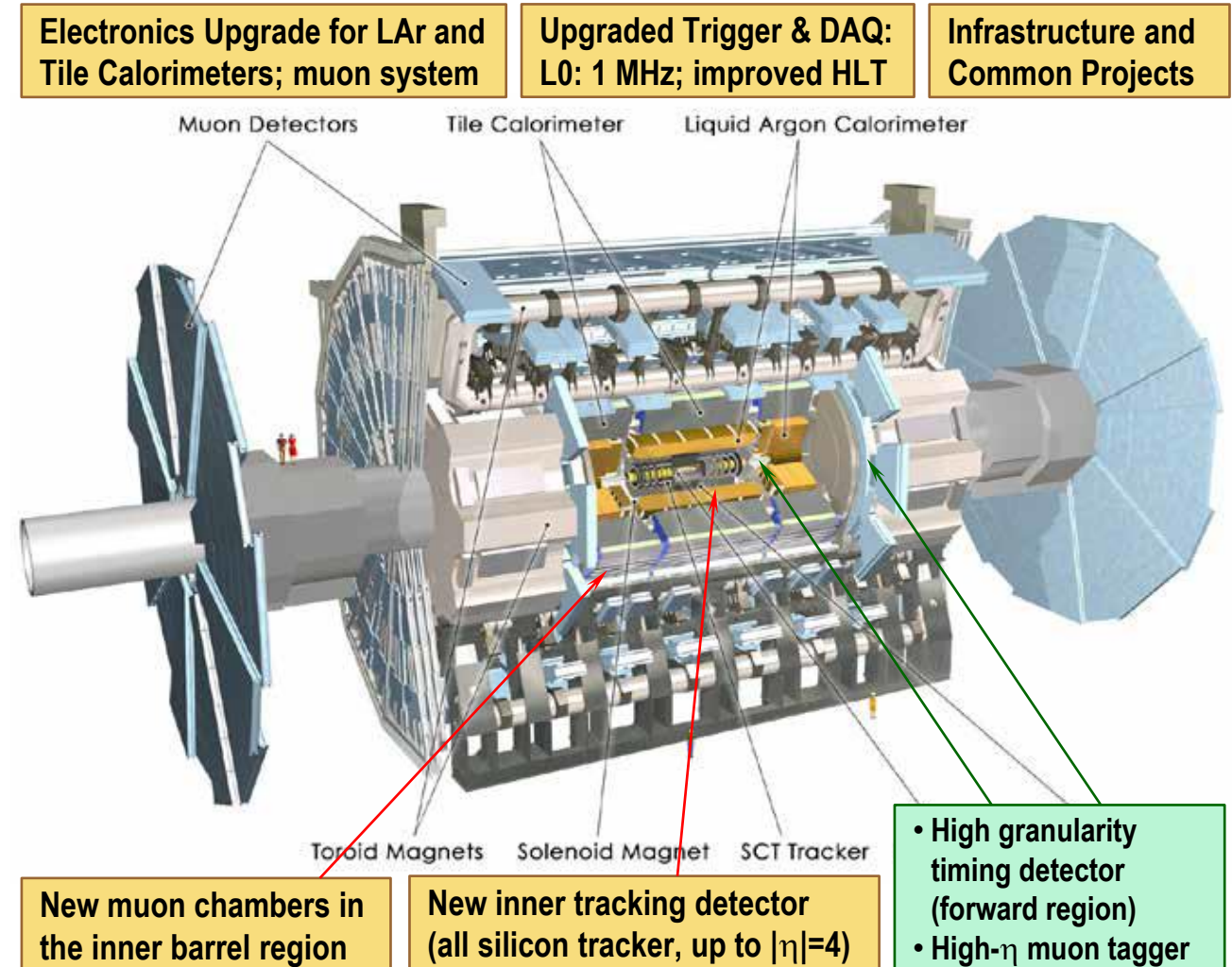
- Similarly, U.S. ATLAS, DOE, and NSF have defined the scope of our HL-LHC contributions by leveraging interests and experience of U.S. groups, coordinating with global partners and ATLAS collaboration and CERN

DOE Scope

- Barrel Inner Tracker (pixel & strip detectors)
- LAr Calorimeter front-end analog chip development
- DAQ hardware (data flow elements)
- Common systems and infrastructure projects

NSF Scope

- ‘Triggering’ at high luminosities
- Readout electronics for LAr, Tile, Muons
- Common systems and infrastructure projects



U.S. HL-LHC/Phase-II Upgrade Project Status

■ DOE HL-LHC Accelerator Upgrade Project (AUP)

- DOE Critical Decision (CD)-0 [Mission Need] approved in Apr 2016 \Rightarrow initiated the DOE ‘project’
- DOE approved CD-1/CD-3a [long-lead procurement for Nb₃Sn conductor for quadrupole magnets] in Oct 2017; DOE CD-2 [Project Baseline] and CD-3b [RF crab cavities] in Feb 2019; Full CD-3 [full production] in Dec 2020
- MOU between CERN and Fermilab, host laboratory for HL-LHC AUP, signed in Mar 2021
- **Planning to re-baseline project in 2022**, which includes the schedule update by CERN for LHC’s 3rd shutdown (LS3)

■ DOE HL-LHC ATLAS and CMS Detector Upgrades

- DOE CD-0 approved in Apr 2016 \Rightarrow initiated each DOE ‘project’
- DOE approved CD-1 for U.S. ATLAS in Sept 2018; U.S. CMS in Dec 2019
- DOE CD-3a for U.S. ATLAS and U.S. CMS in Sept 2019 and June 2020, respectively, to procure silicon for trackers, and, for CMS, the end calorimeter;
- DOE CD-3b for U.S. CMS in June 2022 for outer tracker and remaining end-cap calorimeter procurements
- **DOE CD-2 [Project Baseline] planned in Fall 2022** \Rightarrow *inter alia*, will include LS3 schedule update and COVID impacts

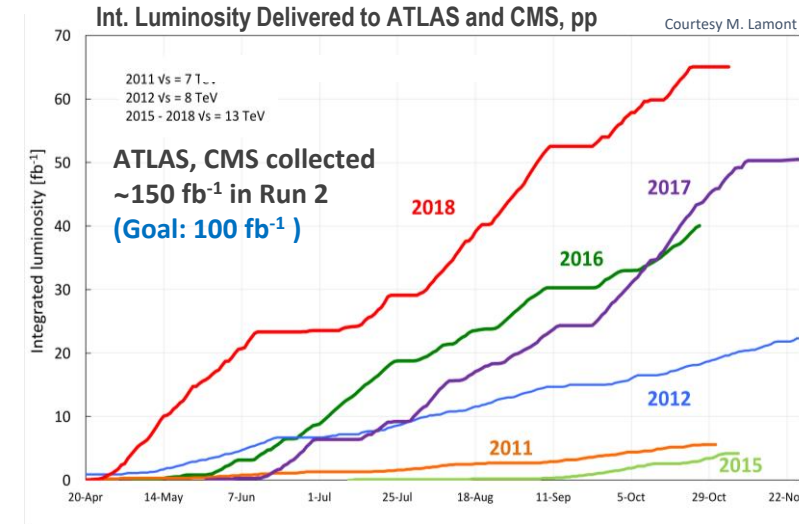
■ NSF HL-LHC ATLAS and CMS Detector Upgrades are under a Major Research Equipment and Facilities Construction (MREFC) project

- NSF National Science Board approved MREFC in Feb 2020 \Rightarrow both projects funded since FY 2020 by MREFC

Proposals for Energy Frontier: LHC Research

■ Energy Frontier Research supports data analysis efforts on ATLAS and CMS

- Physics analyses that supports P5 science drivers
- Activities that support analyses — e.g., calibration and reconstruction, object-ID, triggers, ...
- Within the topical areas, DOE reviews evaluate
 - Scientific output, impact and accomplishments by each PI and overall group
 - Group's research plans and any completed deliverables for LS2 (post-Run 2) + the now-ongoing Run 3 program



■ ...and over the next ~5-6 years with the HL-LHC (Phase-II) detector upgrades

- Contributions to upgrade activities in addition to physics research-related efforts
 - PIs are encouraged to provide an appropriately *balanced* proposal demonstrating that the group conducts activities across: research + operations + upgrade
 - HL-LHC plans should be *aligned* with respect to the U.S. CMS or U.S. ATLAS upgrade projects

■ ...and/or a research program *balanced* with responsibilities in U.S. CMS or U.S. ATLAS operations

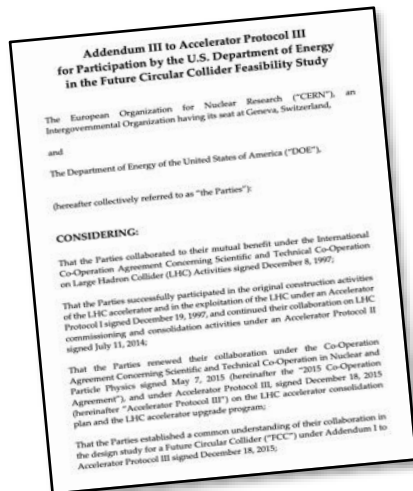
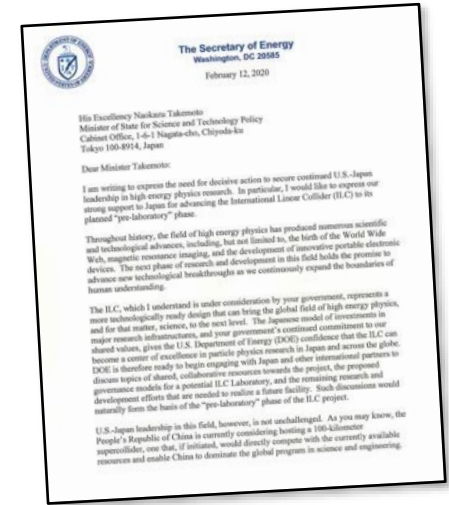
■ Other general considerations

- In addition to activities at CERN, encourage university community to exploit the CMS LHC Physics Center (LPC) or the ATLAS Centers (ATCs)

Seeding the Future: Energy Frontier Planning

- **Future collider strategy in the 2014 P5 plan**
 - Support development and realization of the ILC
 - R&D towards a very high-energy proton-proton collider
- **Advancing colliders of the proposed size, scale, and complexity requires intergovernmental discussions and global coordination**
 - Concerted U.S. Government interagency effort during the last ~5-6 years to support moving forward with a proposed ILC in Japan and collaborate with CERN on a proposed FCC
- **DOE coordinating with the ILC International Development Team, formed by ICFA in 2020, on the next phase of ILC in Japan; and plans to participate in any future intergovernmental meeting with Japan and global partners on the ILC**

February 12, 2020: Letter from the former U.S. Secretary of Energy Brouillette to Japan Cabinet S&T Policy Minister Takemoto conveying DOE's support to advance the ILC



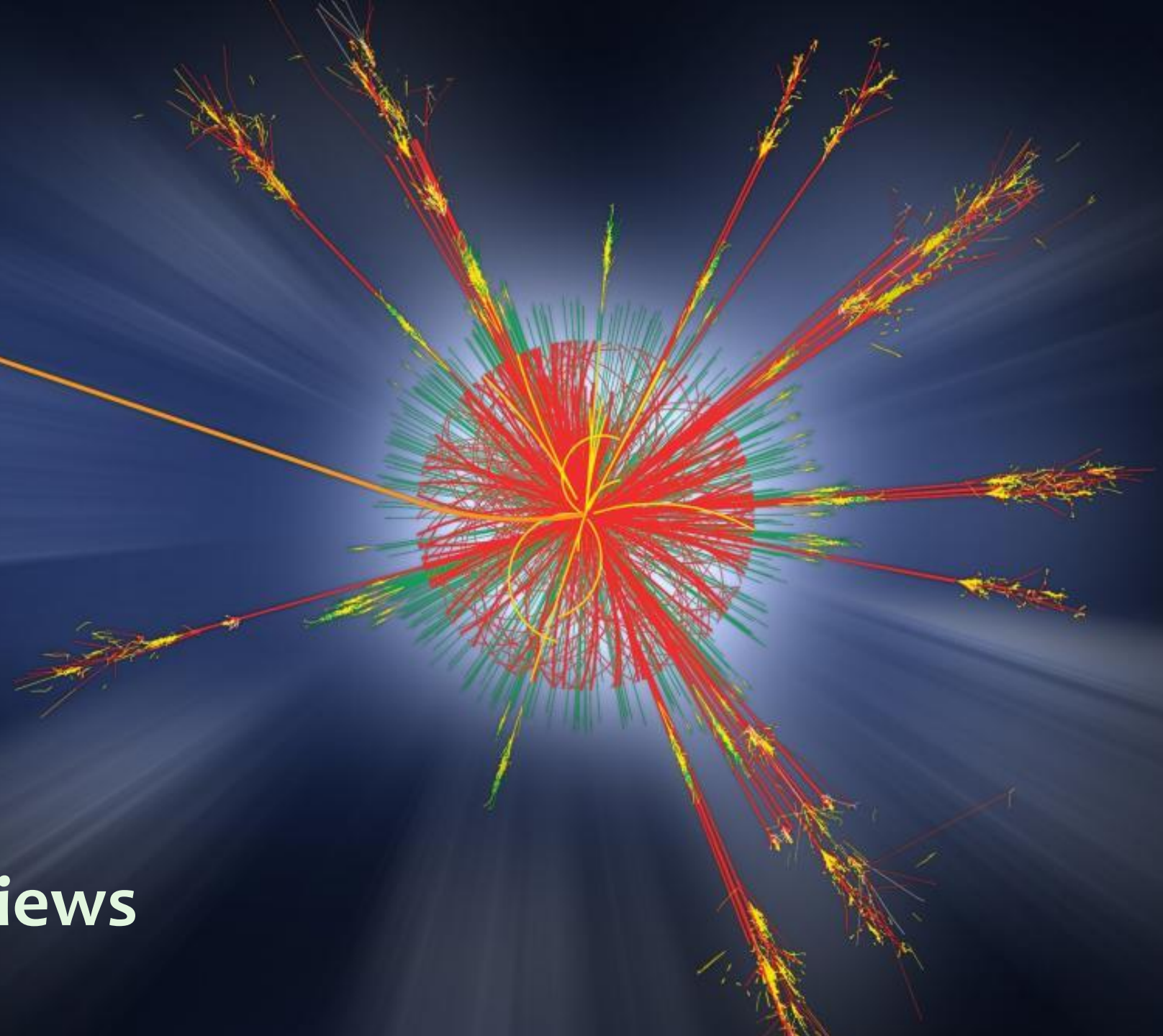
December 30, 2020: DOE-CERN FCC Agreement

- **Following the 2020 update of the European Strategy for Particle Physics, DOE and CERN signed an FCC agreement to continue R&D and collaborate in the FCC feasibility study for the proposed 80-100 km collider in the Swiss-French area**

Current efforts on future colliders primarily focused on accelerator R&D; but DOE grants for the LHC may apply up to 25% funds for development and studies for experiments for future colliders;

Look forward to the upcoming P5 process in developing the roadmap for future DOE investments for the currently proposed future colliders, concepts, and related technology R&D

HEP University Comparative Reviews



University HEP Comparative Reviews

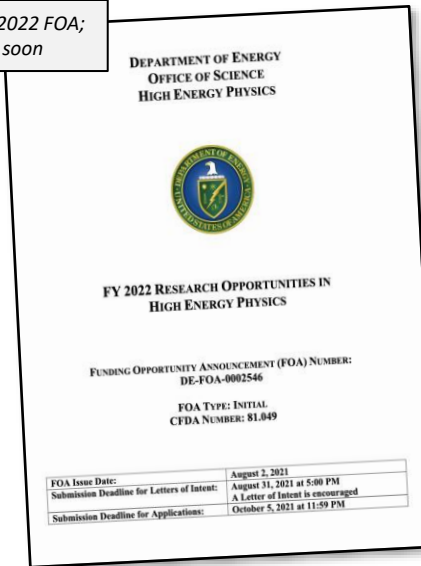
- Since FY 2012, DOE/HEP has been using a process of comparative reviews for university research grants — those scheduled for renewal or any new proposals
 - FY 2023 Funding Opportunity Announcement (FOA) marks 12th year of the process
 - Each HEP subprogram at the DOE national laboratories is also reviewed approximately every 4-6 years
- Process supported by several DOE advisory committees, including the 2010, 2013, 2016, and 2020 HEP Committee of Visitors (COV)
 - 2010 COV: *“In several of [past] cases ... grants are being evaluated based on the historical strength of the group rather than the current strength or productivity of the group. This is of particular concern when considering whether new investigators, new science, or high-risk projects can be competitive. Comparative reviews can be a powerful tool for keeping the program in peak form.”*
 - Recommend the use comparative review panels on a regular basis
 - 2013 COV: Continue comparative reviews.
 - 2016 and 2020 COV: Continue comparative reviews; and DOE/HEP continue communicating with PIs the program priorities in HEP and the overall process at annual DOE/HEP PI Meetings

Goal: improve overall quality and efficacy of the HEP research program by identifying the best proposals with highest scientific impact and potential

FY 2023 HEP Comparative Review FOA and FAQ

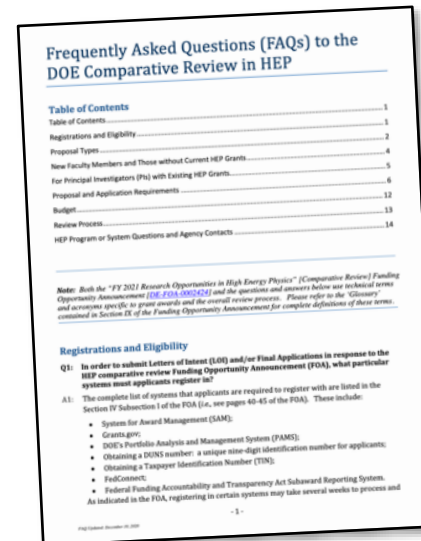
- **DE-FOA-000xxxxx** planned to be issued ~late-summer or early-fall
- Six HEP research subprograms
 - Energy, Intensity, and Cosmic Frontiers
 - HEP Theory, Accelerator R&D, and Detector R&D
- Letters of Intent are not planned to be required but are strongly encouraged
- Review and Selection processes planned to take place from this Fall into early-Spring

Shown: Last year's FY 2022 FOA;
FY 2023 FOA expected soon



Request institutions and PIs to comply with all FOA requirements prior to submitting a proposal.

- In addition to the FOA, a FAQ is planned to be available and addresses topics such as:
 - Registration and eligibility requirements
 - Proposal types and requirements; Letter of Intent
 - Guidance for new faculty and those without current grants; for PIs with HEP grants
 - Budget information and guidance on scope of requests
 - Information on overall scientific merit review process



Both the FOA and FAQ are planned to be available at: <https://science.osti.gov/hep/Funding-Opportunities>

Some ‘Quasi-Recent’ Updates in the FOA

- **All Research proposals submitted to DOE Office of Science (SC) must have a Data Management Plan (DMP)**
 - Includes HEP comparative review and Early Career but not proposals for conferences, workshops, operations, or projects
 - Any thrust in a proposal without a DMP will **be declined without review**
 - A DMP that is blank or states “not applicable” will not be accepted
- **All Renewal proposals must submit “proposal products” (publications, etc.) after the application is submitted**
 - PIs are notified via PAMS and typically have about 7-10 days to respond
 - We cannot review incoming renewal proposals until this step is completed
 - These ‘products’ are captured with your annual Progress Report, but for this review process, applicants can update their entries prior to merit review process
- **Explicit merit review criterion: quality and efficacy of recruitment and mentoring plan**
 - Supports an Appendix 9 narrative that aims to address similar subject matter (*more later in this talk...*)
- **Recurring submissions of research applications (*initiated in FY 2018*)**
 - “A previously declined application may be resubmitted to this FOA, but **only after it has undergone substantial revision**. An application submitted to this FOA that has not clearly taken into account the major concerns from prior DOE reviews may be **declined without review and will not be considered for funding**.”
- **Each FOA has different eligibility, technical requirements, page limits, etc.**
 - **Prior to any proposal submission, please read the specific FOA carefully**

Data Management Plan

- **Data Management Plan (DMP) involves all stages of the digital data life cycle including collection, analysis, sharing, and preservation.**
- **Focus of the DOE Office of Science (SC) DMPs is the sharing and preservation of digital research data.**
 - See Dr. Laura Biven's September 2014 HEPAP presentation: <https://science.osti.gov/hep/hepap/Meetings/201409>
 - FOAs issued after October 1, 2014 require a DMP and compliance with the associated SC statement
 - Available at: <https://science.osti.gov/Funding-Opportunities/Digital-Data-Management>
 - In research proposals, DMPs are included as an appendix of the proposal
 - See also Section IV of the comparative review FOA, subsection for 'Appendix – Data Management Plan', for the requirements pertaining to DMPs that must be included in an application
- **International CMS and ATLAS have developed DMPs for their collaboration**
 - **These plans meet the SC digital data management requirement**
 - Those seeking financial assistance grants [universities] or submitting FWPs [labs] for HEP Research support can cite the DMPs for the respective experiment with the appropriate links:
 - CMS Data Policy Document 6032-v1.2 (2018): <https://cms-docdb.cern.ch/cgi-bin/PublicDocDB/ShowDocument?docid=6032>
 - ATLAS Data Policy - ATLAS-CB-PUB-2015-001 (2015): <https://po.usatlas.bnl.gov/programoffice/datamanagementpolicy.php>

Other Key Items to Keep in Mind

- Proposed research reviews best if closely aligned with the DOE/HEP mission, its program, and current P5 strategy
- Investigators in experimental HEP research frontiers [Energy, Intensity, Cosmic] review best if they are closely integrated into HEP collaborations and have key roles and responsibilities on those experiments
- “Generic” research that is not to be carried out as part of a specific HEP experimental collaboration should be directed to the Detector R&D or HEP Theory programs, as appropriate
- Read the FOA carefully and follow the requirements on content, length, etc.
 - Several requirements in the FOA are set from outside the DOE/HEP office, and there is little to no flexibility to modify. Non-compliant proposals submitted to the FOA will not be reviewed.
 - In recent years, ~3-5% of incoming proposals are declined without review. Requirements most often missed or overlooked include:
 - DMPs, page limits, separate budget sheets (if needed) for each research subprogram or thrust, and inclusion of Personally Identifiable Information (PII)
- During and prior to the proposal submission, work with your university sponsored research/program office to ensure all FOA requirements are met

Proposal: Project Narrative

- **Project Narrative comprises the group's *research plan* for the project**
 - Should contain enough background material in the introduction to demonstrate sufficient knowledge of the plan
 - Devote main portion describing and justifying the proposed project, including detailing methods to be used to obtain relevant results
 - Indicate which personnel will be responsible for which activities
 - Include timeline for the major activities of the proposed project
- **Must not exceed 9-pages per senior investigator**
 - Senior investigator \equiv active tenured or tenure-track faculty member at sponsoring institution
 - Non-tenure track faculty (e.g., research scientists) or senior research staff with term appointments are not included in the 9-page limit per senior investigator unless they are the sole investigator on the application
 - Faculty members at collaborating institutions listed on the proposal (if any) are not included
- **PIs encouraged to refer to Section IV of the FOA**
 - Includes useful information to guide PIs to prepare better narratives — *for e.g.:*
 - Info for background and introduction; Multiple investigators and/or multiple research subprograms or thrusts
 - Common narrative discussing any synergies and connections among any group in different research areas
 - Proposed project objectives and the research methods and resources to accomplish each objective
 - Timetable and level of effort of different activities, ...

HEP Research Activities Supported

■ What DOE supports

- Efforts that are in direct support of our programs; depend on merit reviews, programmatic factors, and available funds
- Research efforts (mainly scientists) on R&D, experiment design, data taking, analysis-related activities
- Some engineering support may be provided through the DOE/HEP Detector R&D subprogram
- Theory, simulations, phenomenology, computational studies

■ Faculty support

- Based on merit reviews and/or optimizing the number of research personnel supported by financial assistance awards, support of up to 2-months faculty summer salary
- Summer support should be adjusted according to %-time the faculty is on research effort

■ Research Scientists (*...also more details on next slide*)

- Support may be provided, but due to long-term expectations, are considered on case-by-case basis on merits
- Determine whether roles and responsibilities are well-matched with individual capabilities and cannot be fulfilled by a term term position
- Efforts for ‘research’ support should be related to research; not *long-term* operations and/or project activities

× What’s not supported by ‘Research’ grants

- Any significant HEP operations and/or project-related activities, including equipment or consumables for DOE projects
- Non-HEP related efforts — for e.g.: gravity waves (LIGO); heavy-ion research (RHIC or at the LHC)

More about Research Scientists (RS) ...

- The Energy Frontier review panel plans to evaluate RS efforts where support is requested in a proposal
- **Guidance to PIs given in Q&A of the FAQ...**
 - Requests to support RS dedicated full-time (and long-term) for operational and/or HL-LHC detector upgrade project activities are typically not supported through Energy Frontier Research
 - If RS conducting physics research-related activities, requests [scaled to % time on such efforts] can be included
 - **RS encouraged to narrate complete plans in 2-page “Appendix 2 Narrative” + provide 1-page bio-sketch**
- **What are “physics research-related activities”?**
 - Object reconstruction/algorithm development, performance studies, data taking and analysis, ...
 - Mentorship of students and postdocs in these areas
 - Scientific activities in support of detector/hardware design and development
- **Common [past] reviewer comments that may result in unfavorable merit reviews:**
 - ‘RS conducting scope of work typically commensurate at the postdoctoral-level ...’
 - ‘RS involved in long-term operations/project activities with minimum physics research efforts ...’
 - such efforts may review well in a DOE review of the operations/project programs but not as well in a review of the experimental research program
- **From the research program, cases become an issue when operations/projects become the *dominant* activity**
 - A well-balanced portfolio that includes physics research-related activities is encouraged

- **AI/ML continues to be a priority in the Administration and the U.S. Congress**
 - Dedicated funds since the FY 2020 appropriation for DOE/HEP Research Program to advance AI/ML initiatives
- **Development and implementation of machine (or deep) learning tools, techniques, and algorithms are part of most, if not all, LHC-based analyses as well as components for the LHC/HL-LHC trigger development efforts**
- **Typically two categories in a proposal narrative for AI/ML-based activities**
 1. PIs and research team explicitly lead efforts to develop ML tools and algorithms for the collaboration to enhance sensitivity in physics studies, improve triggers, etc.
 2. End-user: PIs and research team are implementing ML-based algorithms in an analysis, which was developed by other collaborators on the experiment
- **FY 2023 FOA plans to continue encouraging investigators to narrate in the proposal any of the research group's AI/ML efforts, where applicable**
 - Prefer a proposal's narrative to describe aspects of the above category #1 in research proposals
 - Identify any personnel and resources (e.g., students, postdocs, etc.) devoted to efforts
- **During panel deliberations, panelists are encouraged to provide any input on AI/ML activities of a group on an experiment**

Cross-cut, Multi-thrust, or Transitional Proposals

- Applications where an investigator is proposing to conduct research across multiple HEP research subprograms during the project period are planned to be considered
- PIs are encouraged to submit only one application describing:
 - Overall research activity, including fractional time planned in each subprogram
 - **Plan to continue for the FY 2023 FOA:** in proposal's budget material (*i.e.*, a dedicated Appendix), include a level-of-effort table for any transitions of efforts during the next project period
- As part of their overview of the subprogram and review process, DOE PMs will provide the panel with details regarding such research plans across multiple HEP thrusts
- Reviewers with appropriate topical expertise in the research area(s) will assess the full scope, relevance, and impact of the proposed research in the merit review process — *e.g.*, merit review questions consider:
 - Are plans for such cross-cutting efforts reasonably developed and balanced?
 - Does the scope of the full proposed program provide synergy or additional benefits to the HEP mission beyond the individual thrusts?
 - Will PI's overall efforts across multiple thrusts add value to HEP program goals and mission and have impact?

Comparative Merit Review Criteria

[Planned Criteria Questions provided to Investigators via Section V of FOA; and to Merit Reviewers/Panel to evaluate a proposal/PIs]

MERIT REVIEW CRITERIA	REVIEW CRITERIA SUB-QUESTIONS FOR MERIT REVIEWER'S EVALUATIONS
SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROJECT	<ul style="list-style-type: none">• What is the scientific innovation of the proposed research?• What is the likelihood of achieving valuable results?• How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?• How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality?• Is the Data Management Plan (DMP) suitable for the proposed research? To what extent does it support the validation of research results? To what extent will research products, including data, be made available and reusable to advance the field of research?
APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH	<ul style="list-style-type: none">• How logical and feasible are the research approaches?• Does the proposed research employ innovative concepts and methods?• Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions?• Does the applicant recognize significant potential problems and consider alternative strategies?• Is the proposed research aligned with the published priorities in the 2014 P5 strategic plan?• How does the proposed research of each senior investigator specifically contribute to the mission, science goals, and programmatic priorities of the subprogram in which the application is being evaluated?• How likely is the research to impact the direction of the overall HEP program?• Does the proposed plan to recruit and retain students and early-stage investigators provide sufficient mentorship?
COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES	<ul style="list-style-type: none">• What is the past performance and potential of the research team?• How well qualified is the research team to carry out the proposed research?• Are the research environment and facilities adequate for performing the research?• Does the proposed work take advantage of unique facilities and capabilities?• Are the senior investigator(s) or any members of the research group that are being reviewed leaders with the proposed effort(s) and/or potential future leaders in the field?• For senior investigator(s) proposing to work across multiple research thrusts, are plans for such cross-cutting efforts reasonably developed and will the proposed activities have impact?
REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET	<ul style="list-style-type: none">• Are the proposed budget and staffing levels adequate to carry out the proposed research?• Is the budget reasonable and appropriate for the scope?• If multiple research thrusts are proposed, is the balance of proposed efforts reasonable and well-matched to the proposed research goals?
QUALITY AND EFFICACY OF RECRUITMENT AND MENTORING PLAN	<ul style="list-style-type: none">• What is the past performance of the investigator(s) for mentoring and advancing career opportunities of students and other early-stage personnel in the research team?• Does the proposed plan to recruit and retain students and early-stage investigators provide sufficient mentorship, either towards completion of a degree or advancing their career?• Are the plans proposed for recruiting additional scientific and/or technical personnel including new senior staff, students, and postdocs reasonable, justified, and appropriate?• Is the proposed plan likely to lead to satisfactory outcomes and an advancement in career opportunities for students and other early-stage personnel?• Does the proposed plan by the team help ensure a diverse, equitable, and inclusive research environment?

Recruitment and Mentoring

- DOE-HEP introduced a new Merit Criterion into last year's review process and plans to include this year
- **Quality and Efficacy of Recruitment and Mentoring Plan – i.e., see the 5th criteria listed in previous slide**
 - Evaluate the past performance of the investigator(s) for mentoring and advancing career opportunities of students and other early-stage personnel in their research team
 - Evaluate any proposed plan for future recruitments and whether the plan will lead to successful outcomes – e.g., passing forward the scientific training and developing the critical thinking skills needed in the workforce
 - Evaluate whether the proposed plan helps ensure a diverse, equitable, and inclusive research environment
- **PIs encouraged to include a dedicated **Appendix 9 Narrative** in the proposal to address this criterion**
 - PIs may also describe such plans in their 9-page research narrative
 - Panelists are encouraged to comment on the plan during this review as well as provide their knowledge about the performance of the group's recruitment and mentoring efforts
- **Such plans need not be limited to personnel currently on-board or planned to be supported by any grant. A more inclusive or comprehensive plan is welcome, including mentorship activities with other early-stage members of their scientific collaboration(s) or the broader community.**
- **A large fraction of HEP Research funding is devoted to students and postdocs. It is appropriate that we consider the effectiveness of the applicants' record and plans in the allocation of research funds.**

- Generally very useful to have head-to-head reviews of PIs working in similar areas, particularly for large grants
- Panels discuss the relative strengths and weaknesses of individual proposals and PIs
- Many factors weigh into final funding decisions
 - Compelling research proposal [plan] for *next* ~3-4 years
 - ✓ Interesting? Novel? Significant? Plausibly achievable?
 - ⊗ Incremental? Implausibly ambitious? Poorly presented?
 - Significant *recent* contributions in last ~3-4 years
 - Synergy and collaboration within group (as appropriate)
 - Contributions to the research infrastructure of experiments
 - *Alignment* with programmatic priorities
 - *Availability* of funds
- **Supportive of excellent people, including excellent new people, even when times are tough!**
- **Corollary: Some proposals or personnel ranked below average may not be funded.**

For Investigators [You]

- Merit review criteria and corresponding questions are given in Section V of the FOA
- Program Policy Factors, which are also used in selections for an award – including those pertaining to the availability of funds – are given in Section V of the FOA
- These serve as an additional guide for PIs to address in their proposal's project narratives
 - **Provide a plan!** Do not just write paragraphs explicitly answering each [sub-]question.
 - Instead, integrate and adapt these, as appropriate, when narrating the group's activities and research plans.

For Reviewers/Panelists

- The same merit review criteria and corresponding sub-questions are given to all reviewers to input reviews in DOE's Portfolio Analysis and Management System (PAMS)
 - Serves as a guide for reviewers to address each review criteria for written reviews
 - Presented and discussed by individual panelists for each proposal
- Other Program Policy Factors are also encouraged to be considered
 - For e.g., program alignment with respect to the P5 strategic plan, fostering development of diverse cadre of supported researchers, and opportunity for early-stage investigators and/or early-stage scientific personnel

Guidance Checklist for the FY 2023 Comp Review

- **Non-compliant proposals will not be reviewed, and therefore, cannot be considered for funding**
- **As a convenience and courtesy, DOE/HEP plans to provide general checklist in the FY 2023 FOA**
 - The list, found in the opening pages of the FOA, is not intended to be complete ⇒ applicants should carefully review the FOA and follow all instructions

HEP Comparative Review FOA – GUIDELINE FOR APPLICATION REQUIREMENTS	COMPLETED
Is the proposed research scope aligned with the mission and programmatic priorities of DOE/HEP?	<input checked="" type="checkbox"/>
Personally Identifiable Information (PII): Do not supply any information, such as birth date or place, citizenship, home address, personal phone nos., etc., that should not enter into the merit review.	<input checked="" type="checkbox"/>
Is Appendix for a Data Management Plan (DMP) submitted? Does it comply with the page-limit requirements for DMPs specified in the FOA?	<input checked="" type="checkbox"/>
Project Summary/Abstract Page: contains the name(s) of the applicant, the project director/principal investigator(s) and the PD/PI's institutional affiliation, and any Co-Investigators and their affiliations.	<input checked="" type="checkbox"/>
DOE Cover Page: list each HEP research subprogram (e.g., Energy Frontier, HEP Theory, etc.) for which funding is requested. If there is more than one, be sure to attach the Cover Page Supplement, as specified in the FOA.	<input checked="" type="checkbox"/>
Page limits for each section comply with the FOA requirements (as defined in Section IV of the FOA).	<input checked="" type="checkbox"/>
Biographical sketches carefully follow the FOA instructions, including page limits, and avoid PII.	<input checked="" type="checkbox"/>
Current and Pending Support information completed, including period and an abstract of the scope of work.	<input checked="" type="checkbox"/>
In addition to the budget information for the full proposal: separate budget and budget justification narratives for each HEP research subprogram in the proposal for each year in which funding is being requested and for the cumulative funding period has been provided in Appendix 7.	<input checked="" type="checkbox"/>
Level-of-Effort Tables completed in Budget Justifications in Appendix 7: for each person for whom funding is requested in a research thrust, on the scope of activities during proposed project period.	<input checked="" type="checkbox"/>
Include Appendix 9 narrative addressing recruitment and retention of students and early-stage investigators.	<input checked="" type="checkbox"/>
Post-submission of a 'renewal' application, timely submitted the Renewal Proposal Products (RPP) in PAMS.	<input checked="" type="checkbox"/>

Workforce Development for Teachers and Scientists (WDTs) programs: <https://science.osti.gov/wdts/>

- **Office of Science (SC) Graduate Student Research (SCGSR)**

- Supports graduate student research at a DOE national laboratory; 3 to 12 months
- Two calls per year, usually opens in February/August; applications typically due May/Nov, respectively, for following Fall or Summer start

- **Science Undergraduate Laboratory Internships (SULI)**

- Supports undergraduate research in a DOE national laboratory; 10 to 16 weeks
- Three calls per year, for following Spring, Summer, Fall terms – opened recently on July 14, 2022, for the 2023 Spring term

- **Visiting Faculty Program (VFP)**

- Summer research support for faculty/students from historically underrepresented institutions
- One call per year, usually opens in October; Applications typically due the following January

- **Community College Internships (CCI)**

- Provides technical training for community college students at DOE laboratories; 10 weeks
- Three separate internship terms: Summer, Fall, Spring – call opened recently on July 14, 2022, for the 2023 Spring term

DOE-SC programs: <https://science.osti.gov/Funding-Opportunities>

- **Early Career Research (more in next few slides...):** <https://science.osti.gov/early-career/>

- **General SC “open call” – [DE-FOA-00002562]:** <https://science.osti.gov/grants/FOAs/Open>

- DOE-HEP uses this FOA primarily for supplemental proposals, experimental [non-LHC] operations support, and conferences/workshops

A complex network graph visualization on a black background. A dense, bright yellow and white central cluster of nodes is the focal point. From this center, numerous lines radiate outwards, mostly in red and white, connecting to smaller, dimmer nodes scattered across the frame. Some lines are straight, while others are curved, creating a dynamic, web-like structure. The overall effect is one of intense connectivity and energy.

Early Career Research Program

How to Prepare for an Early Career Proposal (I)

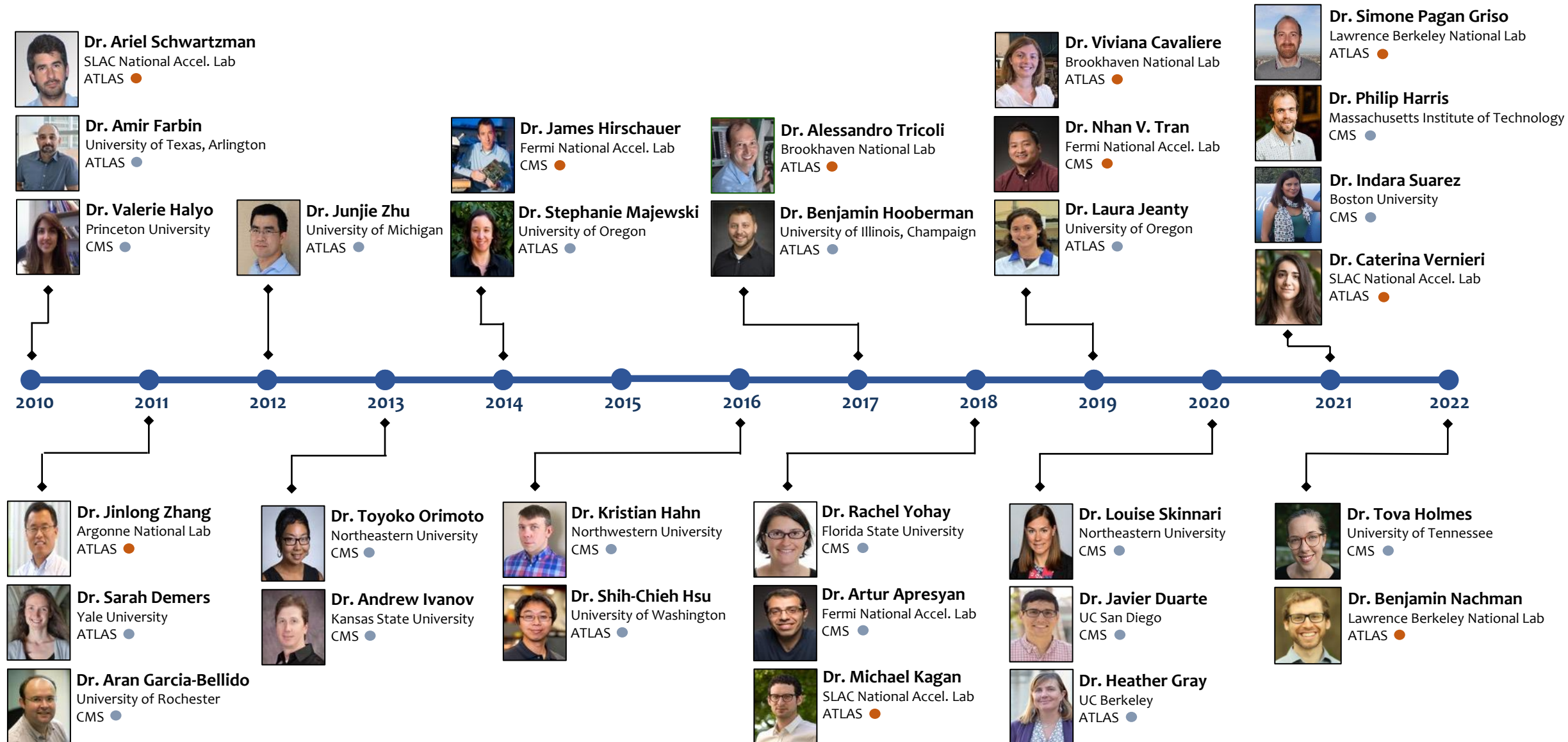
- **Plan to issue a FY 2023 FOA around the Fall of 2022 for the next round of Early Career applicants**
 - Stay tuned for further updates at: <https://science.osti.gov/early-career>
- **In addition to the merit review criteria in the FOA, the following guidance should be considered while preparing the proposal narrative:**
 - What challenges/problems are you trying to solve? Communicate this in the proposal.
 - Is someone else doing it already?
 - Alternatively, aren't those research activities already being funded elsewhere?
 - *i.e.*, if you carry-out these efforts, discuss why are they unique and require “you”?
 - How does your research plan exploit/engage the unique capabilities of your institution?
 - What resources are needed to complete the project?
 - Does your proposal address a **5-year timeline** with key deliverables and personnel profiled during this project period?
 - If funded, what will be the **outcome after 5-years**?
 - Leadership:
 - Have you **led the activities** that you are proposing?
 - Why are you a **future leader in HEP**? For e.g., identify past & present leadership activities in the Collaboration; any in HEP, your institution, or the broader scientific community?
 - **Update your CV** (bio-sketch) that is part of the overall proposal

How to Prepare for an Early Career Proposal (II)

- **General guidance based on LHC (ATLAS, CMS) research proposals submitted in the past**
 - Tell a story ...
 - Provide *unique* capabilities. Impact: what does not get done, if not funded?
 - During proposal preparation, address “why is it critical that I carry-out this research?”
 - How does your work impact the efforts within the international collaboration?
 - To make the point, show any simulation results, trigger efficiency studies, or other quantitative projections that *you have completed* on the activity; *include any figures/plots/tables!*
 - Identify, where appropriate, innovative approaches to the analysis method
 - A balanced program: strong physics effort + a hardware effort for the U.S. HL-LHC upgrade scope or an operations component, where the PI takes a lead
 - For searches, discuss the *discovery reach*.
 - Do not just state: “in the absence of a signal, a 95% C.L. limit will be set.”
 - Budget justifications in the appendix matter: reviewers consider what is being requested
 - You may submit proposals of similar scope to Early Career and the HEP comparative review
 - Don’t just copy / paste one narrative into the other: check the FOA instructions (e.g., page limits, appendices, ...)
 - Align the proposal with the process: for Early Career, develop a “5-year plan”
 - Spell out certain details for reviewers from the non-LHC community

Prior to submission, applicants may want to seek guidance from members within the international collaboration and/or appropriate senior faculty and staff while preparing proposals, including a critique of the narrative and appendices

Energy Frontier Early Career Research Awardees: 2010-2022



Proposals: What to Do

Do Follow the Instructions and Guidelines

Read the current FOA thoroughly, as well as any supporting materials – e.g., FAQ, HEP PI meeting slides.

SC rules and procedures as well as HEP program requirements are regularly updated.

Do seek out advice & support from trusted colleagues & mentors

Your institution has invested a lot of time and money hiring you. They want you to succeed. Let them help you.

Request a pre-review of the proposal.
There are resources at most institutions; and/or seek guidance from collaborators.

Do learn the rules, regulations, and costs of your institution

Funds are awarded to the institution. Understand direct and indirect rates, benefits, and restrictions.

Establish a relationship with your budget office and/or sponsored research/ program office;
Remember they submit the proposal for you!

Do follow through on any past reviewer feedback

Give weight to the critical reviews
Arguing with HEP that 3 out of 5 reviewers thought your proposal was excellent does not address the 2 reviewers who had a different opinion

Read the Panel Summaries from past reviews. These contain the panel discussions of your proposal, including any strengths and weaknesses.

Do be clear and follow proper English grammar and composition

Be clear: avoid reviewers having to guess about your research plans;
Careless editing will annoy or confuse reviewers.

Hire someone to proof-read your proposal.

Do ask for what you reasonably need

Standard research requests include:

- Salary (PI and co-PIs)
- Other Personnel including post-docs, students, etc.
- Travel (domestic and foreign)
- M&S, Tuition remission
- Indirect Costs, Rates

Realistic funding expectations

- Early Career >\$150k Univ. & >\$500k Lab
- ~50% FTE to proposal
- Stagger personnel

Proposals: What Not to Do

Do Not submit a proposal late

You should assume that applications received after the deadline will not be reviewed or considered for award.

Use the weeks or months after the FOA is made public to prepare and then submit your proposal early.

Do Not brag or exaggerate

Be professional and objective.

Fully list your accomplishments in the bio-sketch; Include your mentoring and leadership roles.

Accurately and reasonably describe the research plan

Do Not bury the message

The narrative should be accessible to a review panel with a wide range of expertise.

Avoid jargon when possible. Same with acronyms.

Describe in clear and concise language. Tell a story...

Do Not overly dwell on the past

General rule of thumb (1/3:2/3).

No more than one-third of proposal devoted to past efforts;

Discuss future since DOE investments are meant for the next period.

Majority of proposal narrative should be forward looking.

Do Not submit a sloppy budget or budget justification

The budget sheets and justification should be prepared with the same care as the narrative.

Reviewers will call out any:

- Excessive or inappropriate requests
- Arithmetic errors
- Poorly justified expenses
- Start guessing if not adequately explained

Do Not be discouraged

Competition is strong.

Some very good proposals are declined due to limited resources.

That first feedback is so valuable.

Closing Remarks

- **HEP is maintaining the core of the DOE science mission**
 - We continue to deliver exciting discoveries, important scientific knowledge, and technological advances
 - Look forward to the Snowmass studies and the upcoming P5 process to begin advancing the next long-range program for particle physics
- **DOE/HEP funding opportunities**
 - FY 2023 FOAs are (or will be) available at: [Grants.gov](https://grants.gov) or <https://science.osti.gov/hep/Funding-Opportunities>
 - Provide a plan for activities to be undertaken and prepare the accompanying budget material, **including the budget justifications with the same care as the narrative**
- **FY 2023 House and Senate Marks are generally ‘budget indicators’ in the overall fiscal budget process**
 - Fiscal budget is only known when Congress passes an appropriation and the President signs the bill
 - DOE continues to work within the process to emphasize the importance of the 2014 P5-recommended projects as well as the core research and operations programs

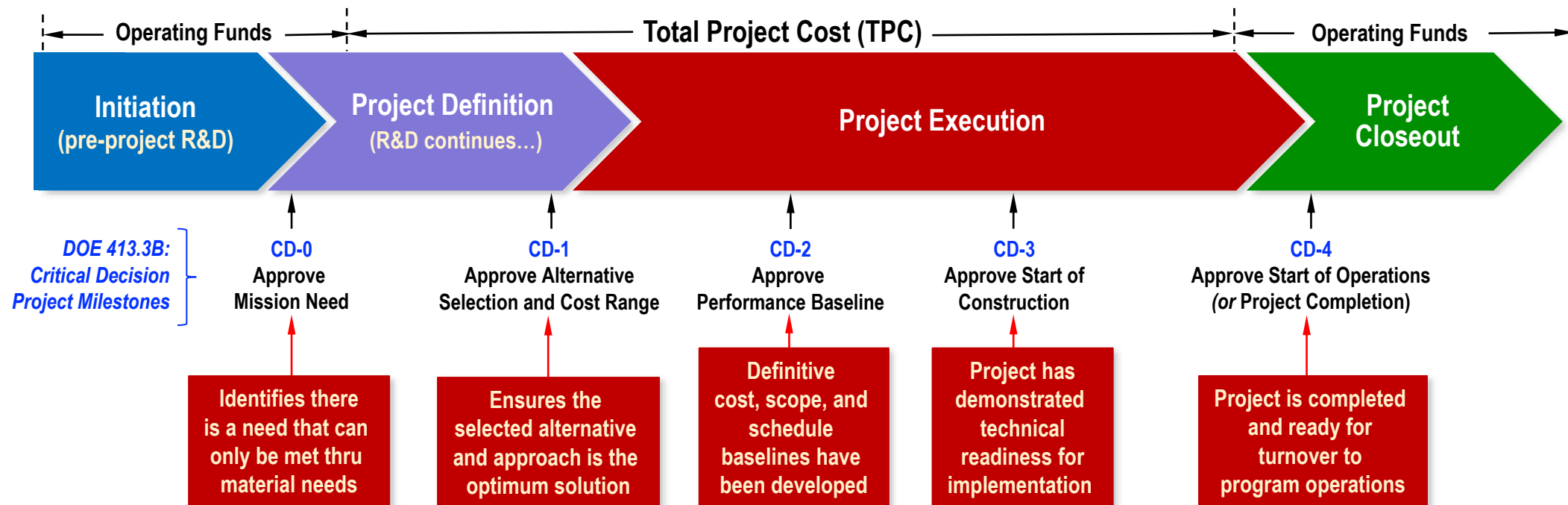


U.S. DEPARTMENT OF
ENERGY

Office of
Science

DOE Project Management

- Construction projects and fabrication of large pieces of equipment costing over \$5 million are managed through a series of “Critical Decision” (CD) milestones under DOE Order 413.3B
- The CD process ensures successful project execution and scientific return on the agency’s investment, but funding must still be appropriated
 - Projects reaching CD-3 may have technical readiness, but they must be supported in the President’s Budget Request and receive funding from U.S. Congress before they can begin
- DOE projects require the use of U.S. accounting (*i.e.*, M&S, contingency, labor, etc.) vs. CORE (M&S only)



Full Funding of Multi-Year DOE Grants

- Section 301(D) of the 2014 Consolidated Appropriations Act (CAA), passed by U.S. Congress on January 17, 2014, and subsequent legislations enacted thereafter, requires full funding of multi-year grants and/or cooperative agreements received from academic institutions with total cost less than \$1 million.
 - “Full funding” implies *funds for the entire award* for the proposal’s project period is *obligated at the time the award is made*, instead of funding year-by-year.
 - Requirement continues for such awards since FY 2015.
- **Logistics of full funding:**
 - Process applies to new, renewal, or supplemental grant awards made after merit review.
 - No other exemptions from this provision apply other than grants are of total cost less than \$1 million – integrated over the project period *approved by DOE after a proposal’s selection for a grant*.
- **During submission of a proposal along with conducting its merit review and making decisions on the award:**
 - There is no change to how an applicant applies for a grant or cooperative agreement.
 - There is no change to the merit review process.
 - There is no change to DOE Program Managers (PM) requesting revised budgets from PIs/institutions.
- **DOE PMs continue to have oversight of the program by requiring PIs to submit an annual research progress report that must be approved by the PM prior to any funds accessed by the PI the following year.**