

# Energy Frontier Program and Program Funding Opportunity Announcements and Reviews

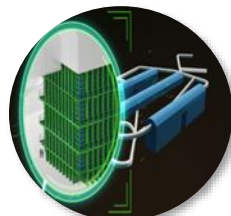
DOE-HEP Principal Investigator Meeting  
APS/DPF - Pheno Meeting Pittsburgh · May 13-17, 2024  
<https://indico.cern.ch/event/1358339/>

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U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



- DOE and HEP Program: Planning and Budgets
- DOE Energy Frontier Program Overview
- DOE/HEP University 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 an overview for preparing proposals for the next FY 2025 HEP university comparative review process. But prior to submission of any proposal, please refer to the issued funding opportunity.

# 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

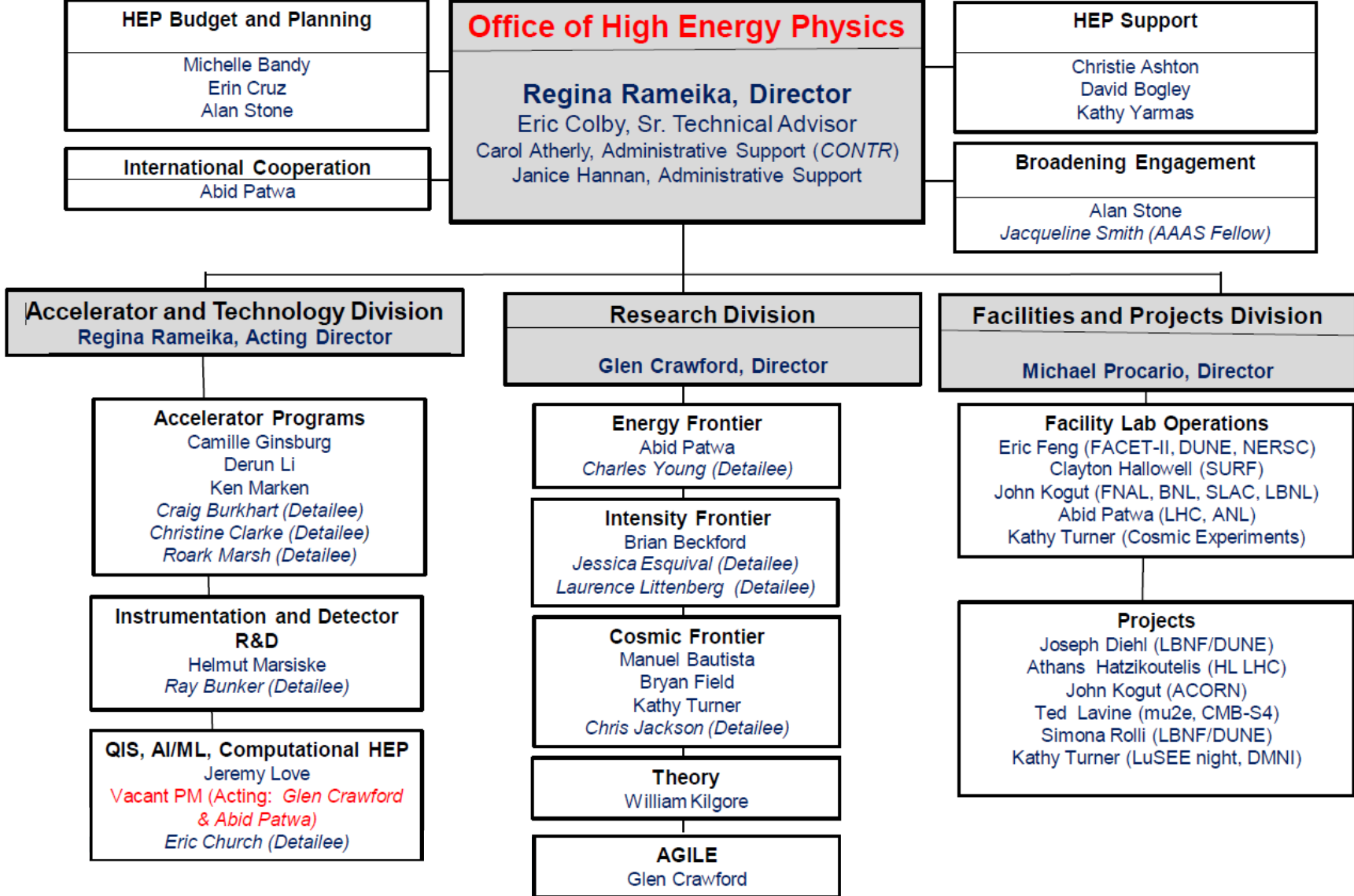
## How do we do this?

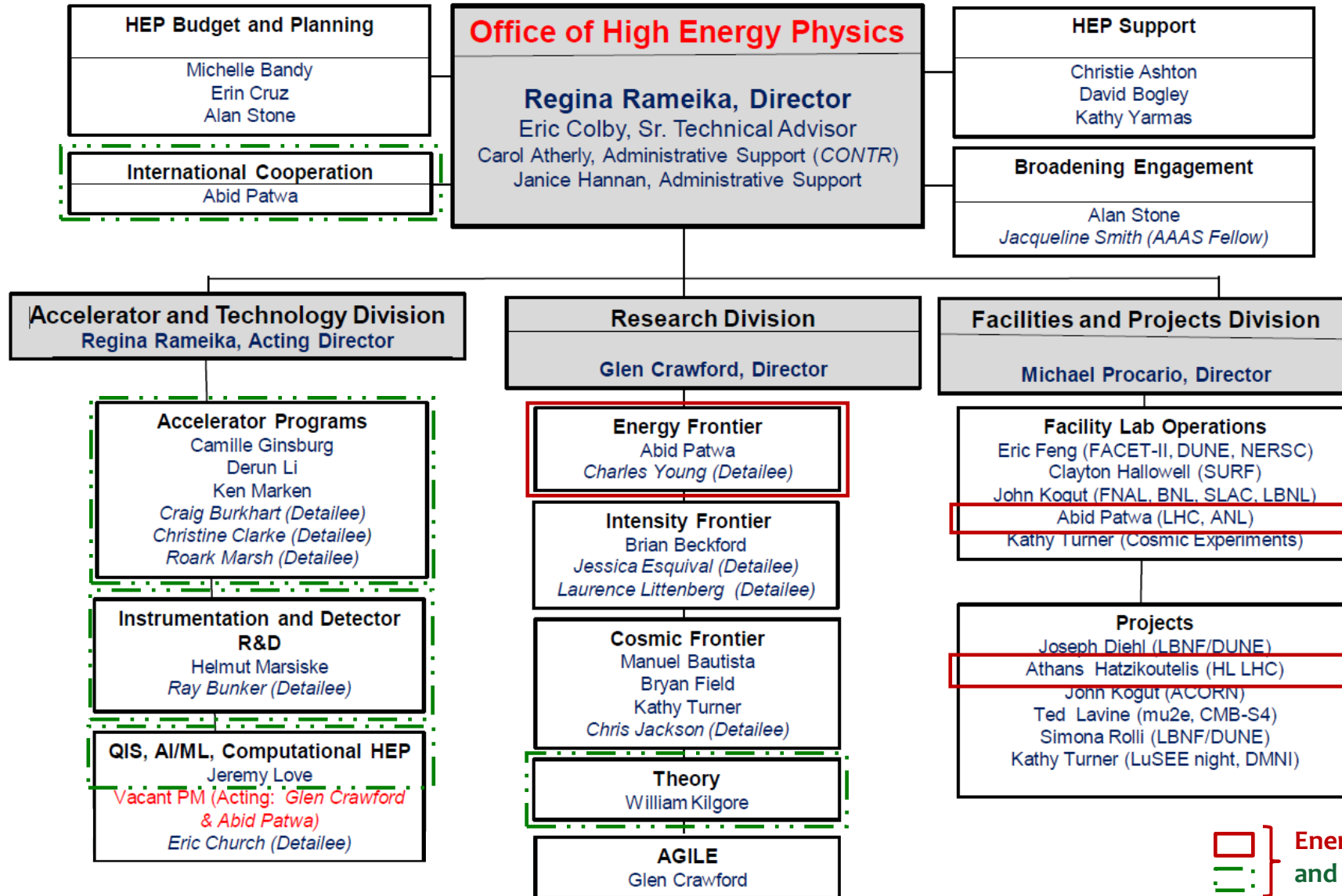
- Make significant, coherent contributions to global facilities/experiments (e.g., LHC/CMS and ATLAS, Rubin/LSST, ...), including project management under DOE project system
- Support science collaborations in all stages, leading to the best possible science results
- Support technology R&D to advance state-of-the-art particle accelerators and detectors leading to new capable facilities
- Form partnerships with other agencies (e.g., NSF, NASA) and organizations (e.g., CERN) 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., P5 subpanel, HEPAP’s “International Benchmarking Study” subpanel)





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



# U.S. and DOE High Energy Physics Budgets

# The U.S. Federal Budget Cycle

- The President submits a Budget Request (“PBR”)

----- For the next fiscal year, FY 2025, we are here;  
and await the release of the House and Senate Marks -----

- Each house of U.S. Congress passes their vision of a draft budget called a “Senate or House 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 30<sup>th</sup>), Congress may pass a “continuing resolution” (or CR), or without any action, the U.S. Government can [partially] “shutdown”

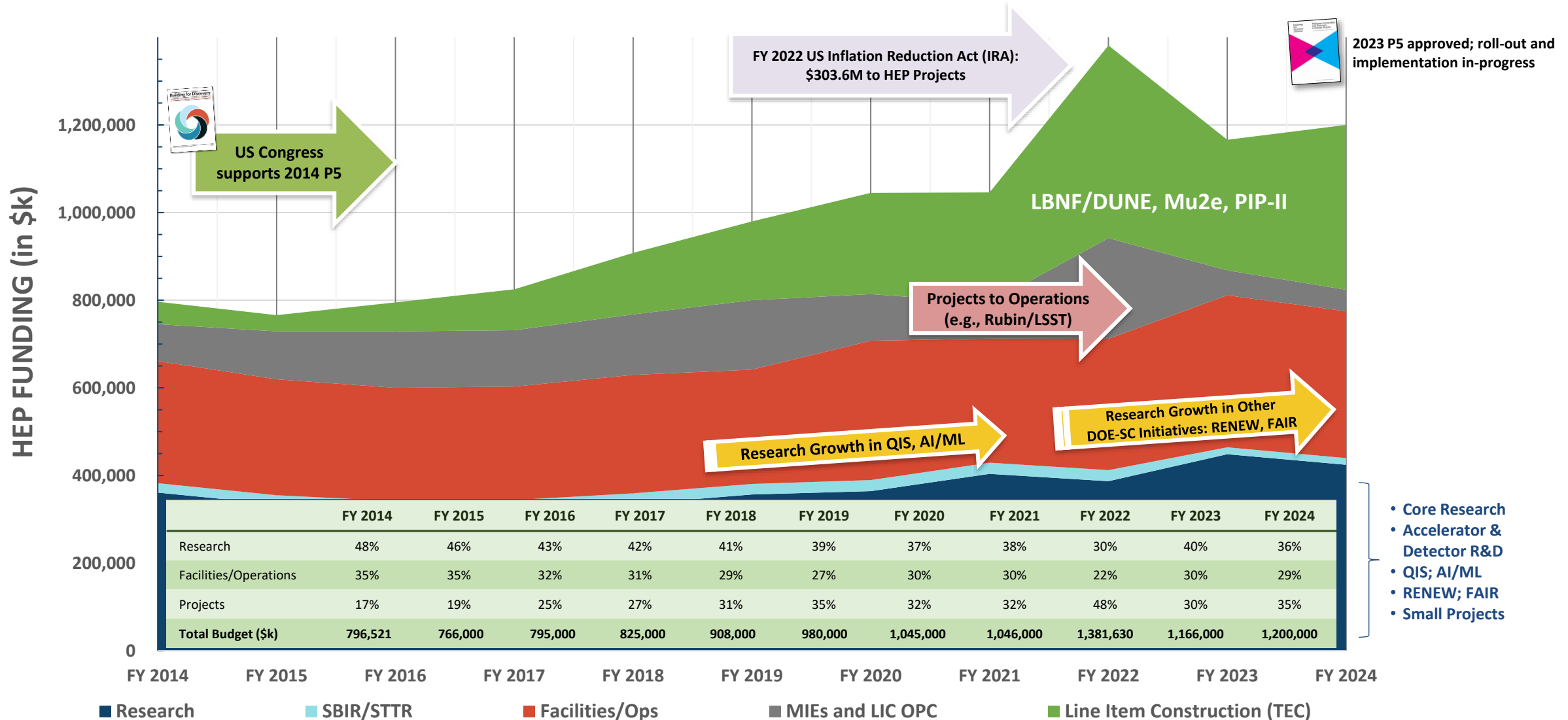


*“I’m Just a Bill”*

Credit: America Rocks, 1976.  
3<sup>rd</sup> season, Schoolhouse Rock.

# DOE-HEP Budget (\$k): FY 2014-2024

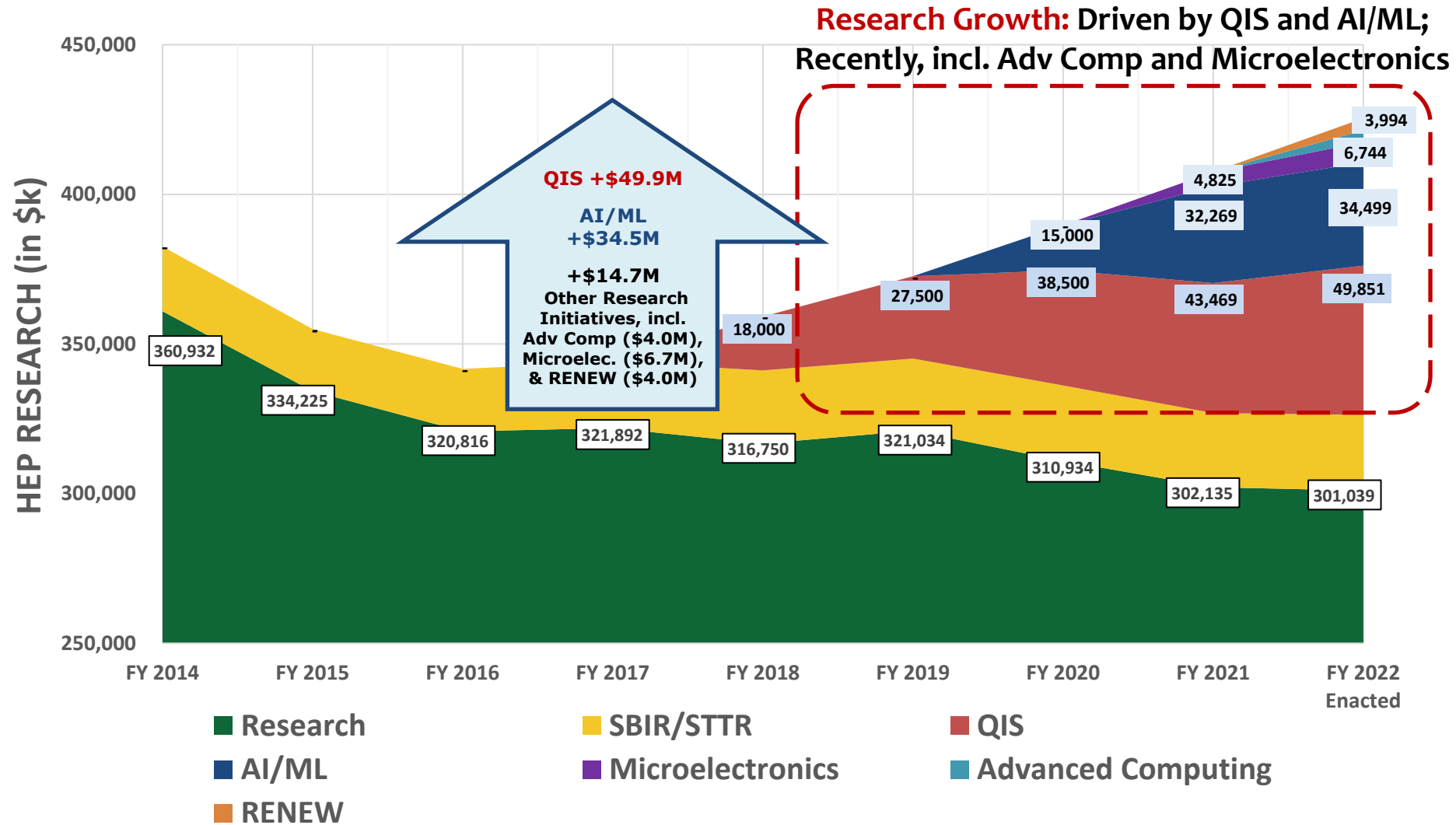
## Research, Operations, Projects (Construction and MIEs)

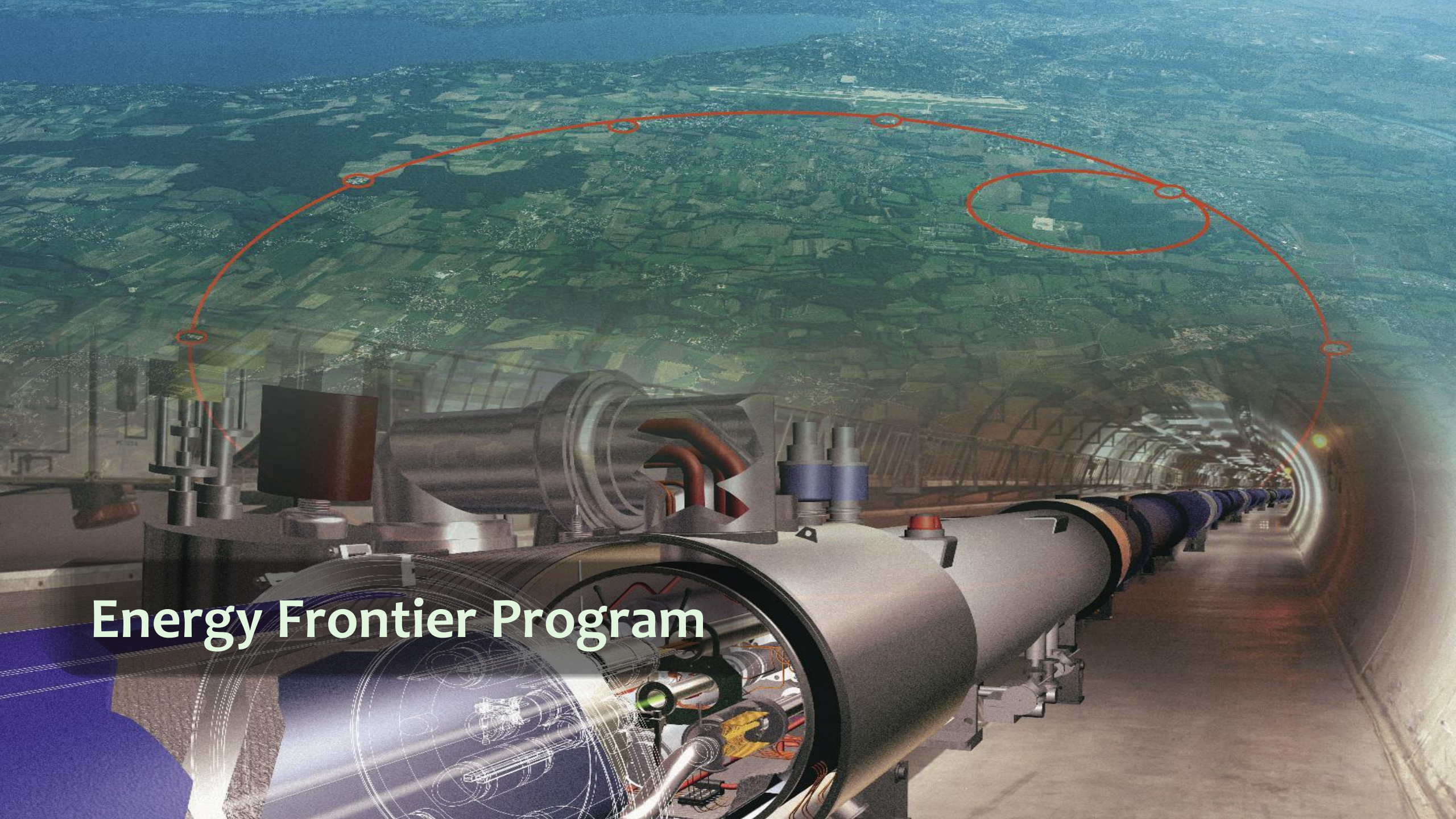




# DOE-HEP Research (\$k): FY 2014-2022

- Distinguishing HEP Research into: HEP “Core” Research, QIS, AI/ML, and Other Research Initiatives
- HEP “Core” Research ≈ Energy, Intensity, and Cosmic Frontiers; Detector and Accel R&D; and HEP Theory
- In recent years, dedicated AI/ML, Adv Comp, and Microelectronics funds have helped offset some fraction of reductions to “Core” Research
- FY 2022 IRA funds to projects – including to HL-LHC upgrades, LBNF, and PIP-II – allowed for some modest increases in the FY 2023 appropriated budget to “Core” Research





# Energy Frontier Program

# Enabling the Next Discovery

## U.S. Particle Physics Project Prioritization Panel – “P5” – Long-range Planning Process

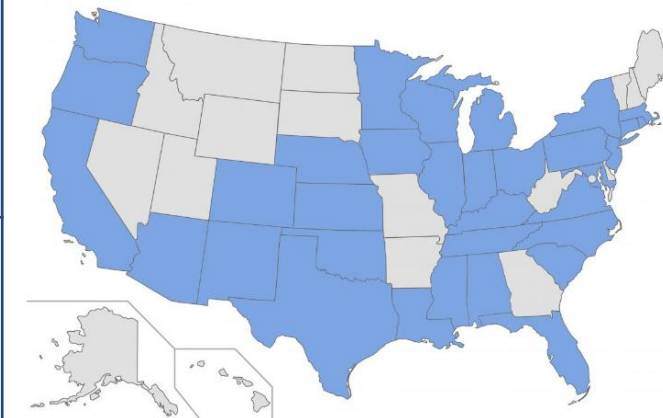
- 2023 P5 identified **6 Science Drivers** to address the scientific motivation of particle physics
- **Research Frontier** are useful categorization of experimental techniques ⇒ a basis of the U.S. budget process
- **Energy Frontier**
  - Explore science of the **Higgs**, **Dark Matter**, **Direct Evidence of New Particles**, and **Quantum Imprints of New Phenomena**
- **Research Frontiers are complementary**
  - No one Frontier addresses all science drivers
  - Each Frontier provides a different approach to address a science driver and enables cross-checking of scientific results
- **The U.S. is now transitioning from the 2014 P5 to the updated 2023 P5 strategy, which is to be executed over the next 10-year timeframe in the context of a 20-year, globally aware strategy for the field**
  - For Energy Frontier, the 2023 P5 re-affirmed 2014 P5’s recommendation for the LHC and HL-LHC (Ref., Rec. 1a of the 2023 P5 report)
  - DOE-HEP developing plans to implement the future Higgs factory portfolio (Rec. 2c and 6a; *more later...*); as well as R&D plans that chart a path to a future 10 TeV pCM collider (Rec. 4 and 6b; *more details anticipated later this year...*)



# DOE/HEP Energy Frontier

Experiment	Location	Center-of-Mass Energy; Status	Science Topics	# Institutions; # Countries	# U.S. Institutions	#U.S. Collab.
<b>ATLAS</b> (A Toroidal LHC Apparatus)	<b>CERN, Large Hadron Collider</b> [LHC; Geneva, Switzerland / Meyrin, Switzerland]	<b>7-8 TeV; 13-14 TeV</b> 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	<b>185 Institutions; 42 Countries</b>	<b>30 DOE Universities, 4 DOE National Labs; [11 NSF Universities]</b>	<b>605</b>
<b>CMS</b> (Compact Muon Solenoid)	<b>CERN, Large Hadron Collider</b> [LHC; Geneva, Switzerland / Cessy, France]	<b>7-8 TeV; 13-14 TeV</b> 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	<b>257 Institutions; 58 Countries</b>	<b>33 DOE Universities, 1 DOE National Lab; [18 NSF Universities]</b>	<b>645</b>

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

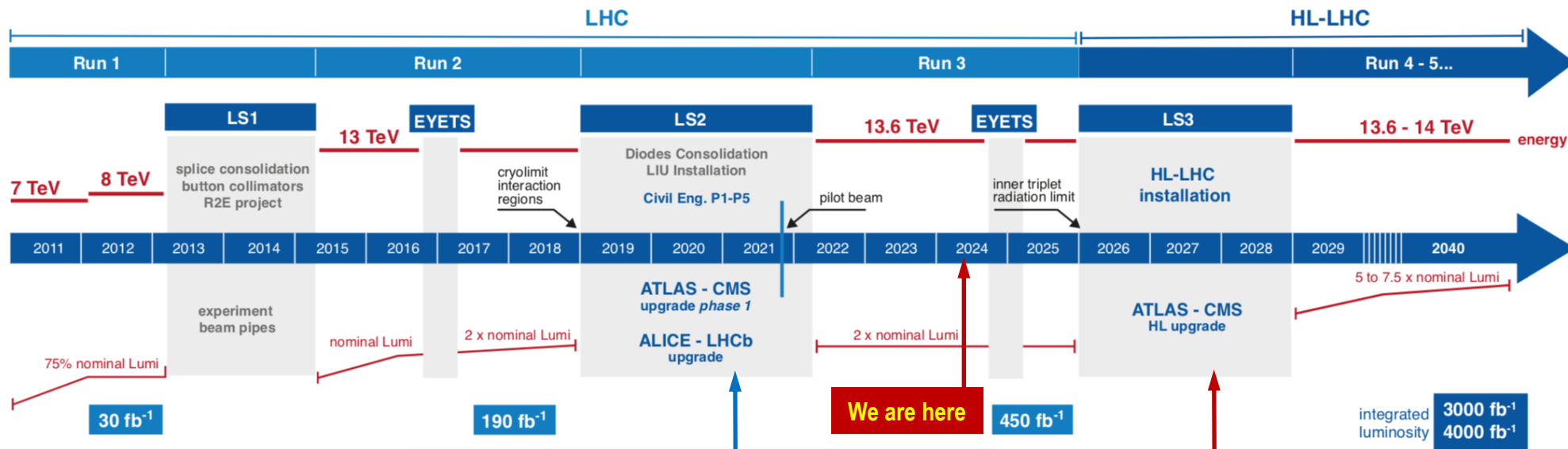
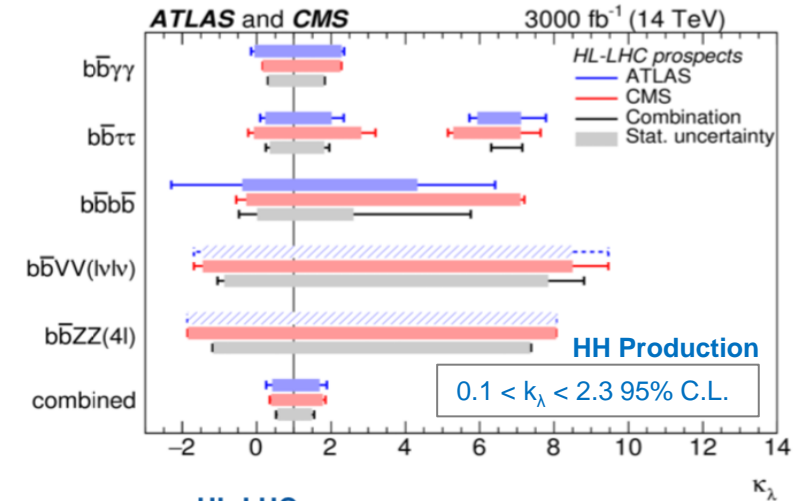


LHC data provided by the U.S. LHC collaborations, as of April 2024.

- **Main scientific thrust: LHC at CERN ( $pp$  collider) – ATLAS and CMS Collaborations**
- **Modest support for studies on future collider initiatives**
  - An off-shore Higgs factory: physics studies, conceptual and pre-project R&D for experiment detectors
  - or up to 25% of DOE grant for LHC may work on such future collider activities – past examples incl. Snowmass or inputs for 2023 P5
- **Key focus of Energy Frontier program: collaborate on the ATLAS and CMS experiments**
  - U.S. ATLAS: ~19.5% of ATLAS collaboration (~15.9% DOE + ~3.6% NSF); 4 DOE labs: BNL (U.S. host lab), ANL, LBNL, and SLAC
  - U.S. CMS: ~29% of CMS collaboration (~23.7% 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



**2<sup>nd</sup> LHC shutdown (2019-2021; extended due to COVID)**

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

**3<sup>rd</sup> LHC shutdown (2026 to end-2028)**

- HL-LHC installation, including accelerator upgrade's Nb<sub>3</sub>Sn focusing magnets near interaction regions;
- Install CMS and ATLAS HL-LHC detector upgrades

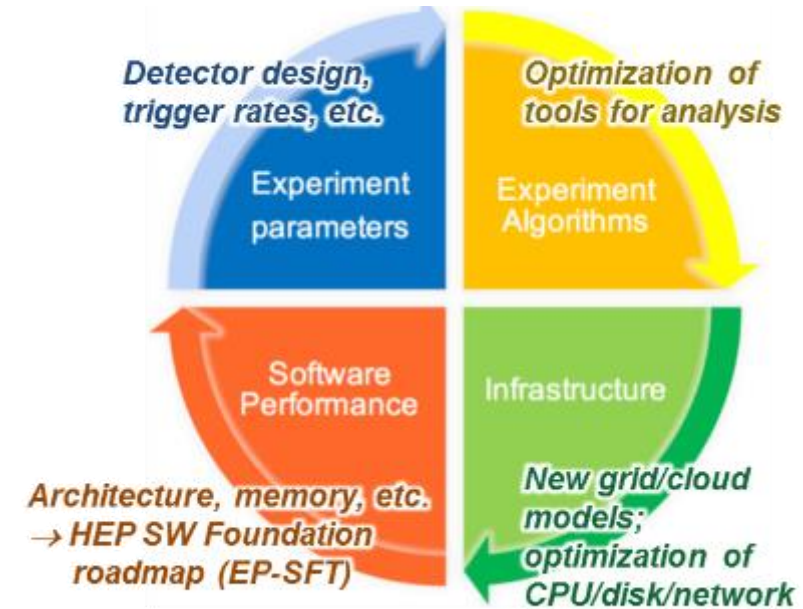
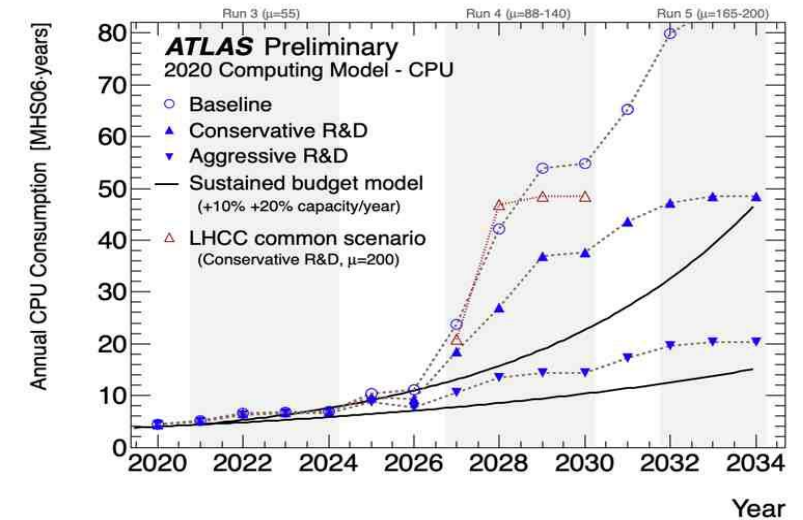
# U.S. LHC Detector Operations Program

- **U.S. ATLAS and U.S. CMS Operations is a jointly coordinated program by DOE and NSF; program scope funded separately**
- **Supports**
  - Each experiment's Operations Program Management Office in the U.S.
  - 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
    - Detector consolidation activities at CERN requested by the experiment during LHC long shutdowns or year-end technical stops
  - 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 ⇒ 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 original current software and computing approach is applied, costs can quickly exceed the entire U.S. HEP budget (“\$1B problem”)
- The 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 15-20 years ago
    - needs 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> (2017)**
  - Additional documentation prepared by the LHC experiments during last few years



# CMS HL-LHC (Phase-II) 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 and interests 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



## 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



## Muon systems

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

- DT & CSC new FE/BE readout
- RPC back-end electronics
- New GEM/RPC 1.6 < η < 2.4
- Extended coverage to η ≈ 3



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

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

All Funding Agencies



## 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 η ≈ 3.8

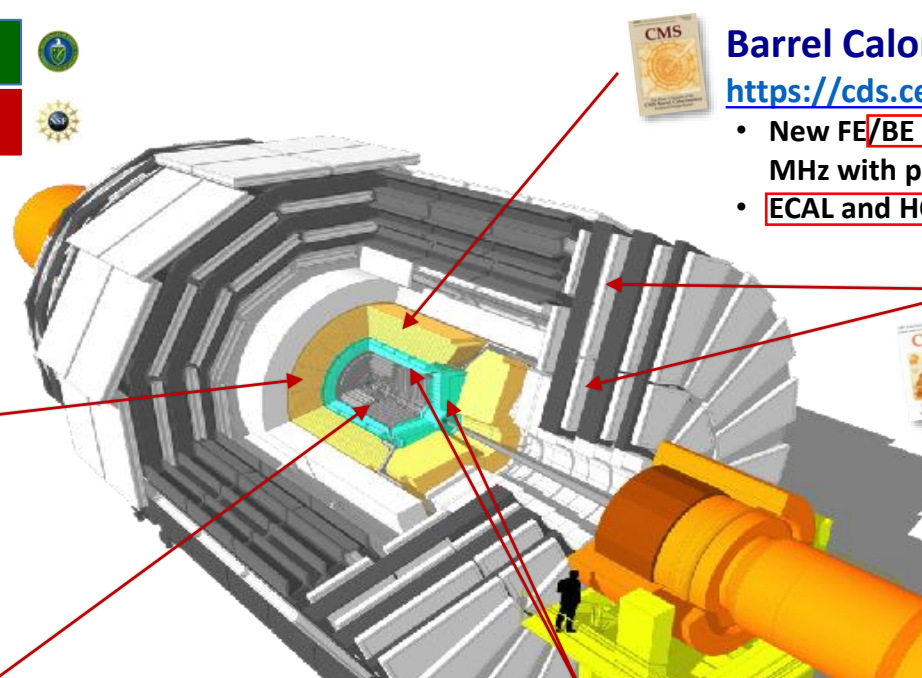


## MIP Timing Detector

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

Precision timing with:

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





# ATLAS HL-LHC (Phase-II) Upgrade

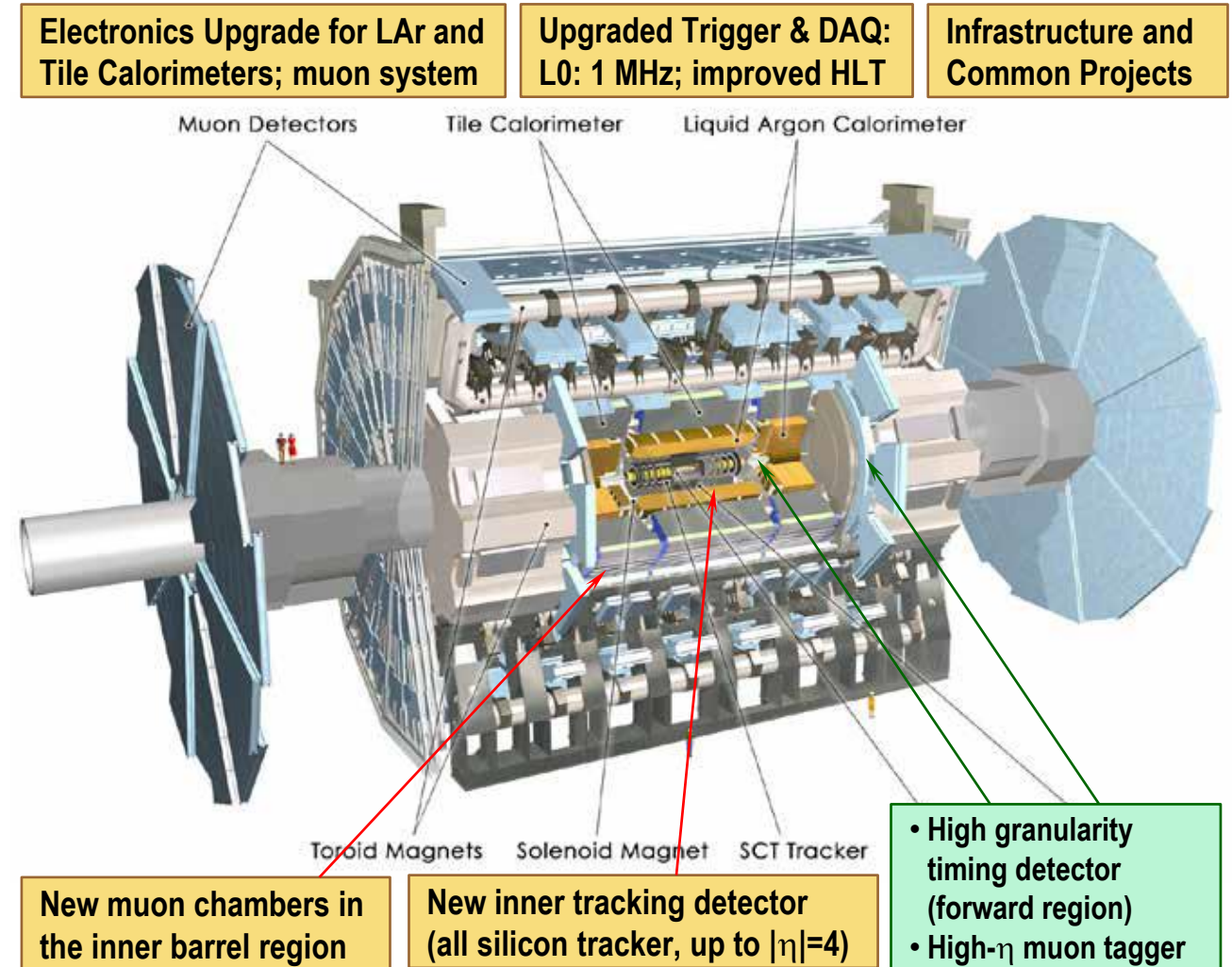
- Similarly, U.S. ATLAS, DOE, and NSF have defined the scope of our HL-LHC contributions by leveraging interests and experience of U.S. groups, coordinating with global partners and ATLAS collaboration and CERN

## 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 ⇒ initiated the ‘project’
- DOE approved CD-1/CD-3a [long-lead procurement for Nb<sub>3</sub>Sn conductor for quadrupole magnets] in 2017; DOE CD-2 [Project Baseline] and CD-3b [RF crab cavities] in 2019; Full CD-3 [full production] in 2020
- Project re-baselined in Jan 2023 to include CERN’s update in 2022 for the LHC Long-Shutdown 3 (LS3) schedule
- MOU between CERN and Fermilab, the host U.S. laboratory for HL-LHC AUP, signed in Mar 2021
- Delivery to CERN of first U.S.-built magnet assembly in Nov 2023

## ■ DOE HL-LHC ATLAS and CMS Detector Upgrades

- DOE CD-0 approved in Apr 2016 ⇒ initiated each ‘project’ ⇒ approved CD-1 for U.S. ATLAS in 2018; U.S. CMS in 2019
- DOE CD-2 [Project Baseline] for U.S. ATLAS in Jan 2023 and U.S. CMS in Mar 2023 ⇒ *inter alia*, included LS3 schedule update, impacts from pandemic & supply-chain, and fractional sharing of originally-planned Russian contributions
- Series of DOE CD-3a and CD-3b for U.S. ATLAS and U.S. CMS during 2019-2022 to procure silicon for trackers, and, for CMS, the end calorimeter; CD-3 approval for U.S. ATLAS in Jan 2023 and U.S. CMS in Jan 2024

## ■ 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 ⇒ both projects funded since FY 2020 by MREFC
- MREFC re-baselined both U.S. ATLAS and U.S. CMS projects in calendar year 2023

# Proposals for Energy Frontier: LHC Research

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

- Physics analyses that support the P5 strategy
- 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 with Run 2 data + those now progressing during the current Run 3 program

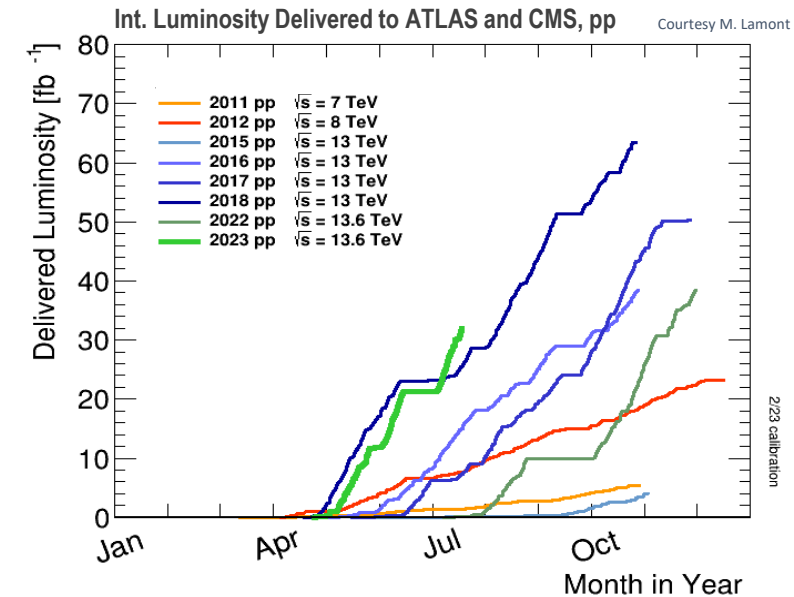
## ...and over the next ~4-5 years with the HL-LHC (Phase-II) detector upgrades

- 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
  - Upgrade efforts should be *aligned* with respect to the U.S. CMS or U.S. ATLAS HL-LHC upgrade projects

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

## General considerations

- Those undertaking HL-LHC upgrade efforts, consider impact to the program now that the projects are baselined
- In addition to activities at CERN, encourage university community to exploit the CMS LHC Physics Center (LPC) or the ATLAS Centers (ATCs)



# Off-shore Higgs Factory: 2023 P5 Strategic Report



## From 2023 P5:

- **Recommendation 2, Priority #3 out of 5:** An *off-shore Higgs factory*, realized in collaboration with international partners, in order to reveal the secrets of the Higgs boson. The current designs of FCC-ee and ILC meet our scientific requirements. The U.S. should actively **engage in feasibility and design studies**. Once a specific project is deemed feasible and well-defined (see also P5 Recommendation 6), the U.S. should aim for a contribution at funding levels commensurate to that of the U.S. involvement in the LHC and HL-LHC, while maintaining a healthy U.S. on-shore program in particle physics (P5 section 3.2).
- **Recommendation 6:** Convene *a targeted panel* with broad membership across particle physics later this decade that makes decisions on the U.S. accelerator-based program *at the time when major decisions concerning an off-shore Higgs factory are expected*, and/or significant adjustments within the accelerator-based R&D portfolio are likely to be needed. A plan for the Fermilab accelerator complex consistent with the long-term vision in this report should also be reviewed. The panel would consider the following:
  - a) The level and nature of U.S. contributions in a specific *Higgs factory* including an evaluation of the associated schedule, budget, and risks once crucial information becomes available.
  - b) Mid- and large *test and demonstrator facilities* in the accelerator and collider R&D portfolios.
  - c) A plan for the *evolution of the Fermilab accelerator complex* consistent with the long-term vision in this report, which may commence construction in the event of a more favorable budget situation.

DOE does not envision a single panel to address Recommendation 6; rather we plan to work with NSF, the DOE national labs, and community-at-large to convene three separate panels that each will address one of the topics

## DOE's response and actions (thus far):

- In Feb 2024, we presented our approach to MEXT (Japan) to be “observers” in the ILC Technology Network while considering, at some fraction, associated R&D efforts particularly in advancing workforce development under the existing U.S.-Japan Cooperation Program in HEP
- In Mar 2024, we presented DOE's view on participating in any potential FCC-ee to CERN Council
- Through interagency coordination, led by The White House Office of Science and Technology Policy (OSTP) and which included the U.S. Department of State, DOE, NSF, and NASA, a Statement of Intent was signed in Apr 2024 between the U.S. Government and CERN
  - Statement expresses an intent for the United States to collaborate on the FCC-ee should the CERN Member States determine it is likely to be CERN's next research facility following the HL-LHC (*more next slide*)
- Jointly with NSF, we've initiated forming a U.S.-based organization for Higgs Factory development efforts for the Physics, Experiment, and Detectors that is nationally coordinated (*more info expected in the next few weeks...*)
- At DOE, we are also beginning to develop a similar approach for the accelerator side

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## Joint Statement of Intent between The United States of America and The European Organization for Nuclear Research concerning Future Planning for Large Research Infrastructure Facilities, Advanced Scientific Computing, and Open Science

OTHER RELEASE

BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS

APRIL 26, 2024

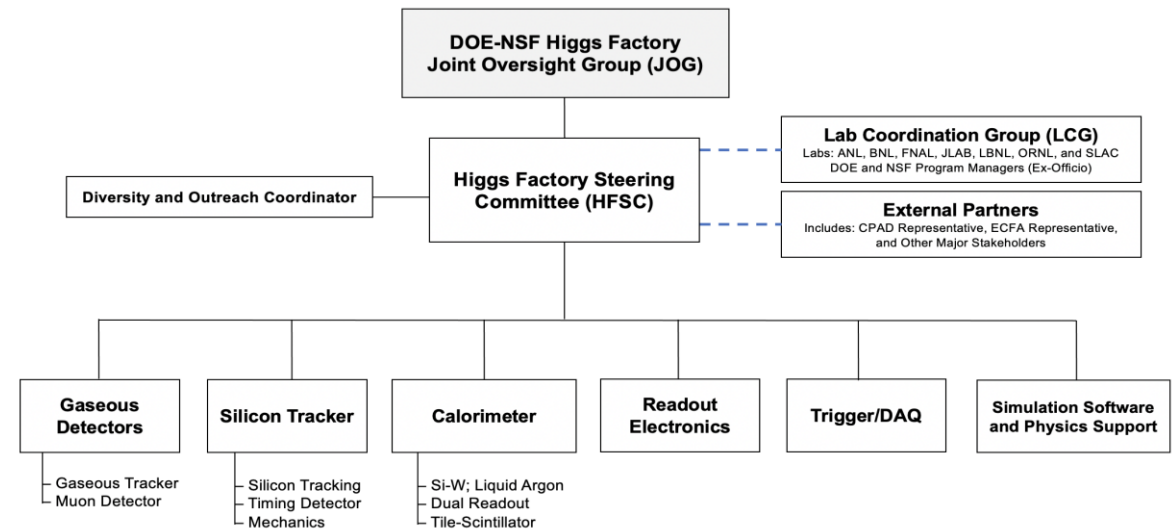


The text of the following statement was released by the Government of the United States of America and the European Organization for Nuclear Research (CERN), an Intergovernmental Organization having its seat at Geneva, Switzerland. White House Office of Science and Technology Policy Principal Deputy U.S. Chief Technology Officer Deirdre Mulligan signed for the United States while Director-General Fabiola Gianotti signed for CERN.

- Text available at: [U.S. Department of State Remarks & Releases site](#)
- Among the topics in the Statement,
  - Expresses intentions by the U.S. and CERN to continue collaborating in the FCC Higgs Factory feasibility study
  - Subject to appropriate processes, the intention for the U.S. to collaborate on the FCC-ee, should the CERN Member States determine the FCC-ee is likely to be CERN’s next research facility following the HL-LHC
- Statement aligned with P5: should FCC-ee receive a “green-light” following the next update of the European Strategy, U.S. intends to collaborate; and nature of the contributions to be discussed by the targeted panel prescribed in 6.a

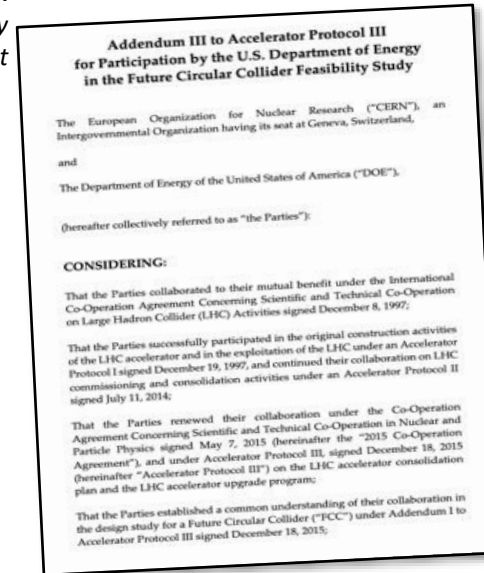
# U.S. Organization for Higgs Factory Development

- Jointly with NSF, DOE-HEP is preparing a charge that forms a nationally coordinated U.S. Higgs Factory Coordination Consortium (HFCC) for developing the Physics, Experiment, and Detector (PED) program
  - A similar approach by DOE is envisioned for developing the Higgs factory accelerator program
- The proposed U.S. HFCC plans to include: 1) Higgs Factory Steering Committee (HFSC); 2) a Lab Coordination Group (LCG); and 3) various detector systems that report to the HFSC and naturally map onto CERN Detector R&D (DRD) initiative
  - Ensure collaborations by the U.S. with our partners are cost-effectively carried out for Higgs factory initiatives
- The LCG forms an integral part of the U.S. HFCC and includes reps from: ANL, BNL, FNAL, JLAB, LBNL, ORNL, and SLAC
- Additional collaborative partners include representatives from U.S. CPAD (Coordinating Panel for Advanced Detectors) and from ECFA (European Committee for Future Accelerators)
- Charge to available soon; example tasks and goals could include:
  - Physics and technical feasibility studies
  - Pre-project R&D
  - Software and computing framework to advance the physics and R&D



# Some additional words on future colliders ...

December 30, 2020:  
DOE-CERN FCC Feasibility Study  
Agreement



- **Advancing colliders of the proposed size, scale, and complexity requires intergovernmental discussions and global coordination**
  - Continuing concerted U.S. Government interagency effort initiated ~8 years to support moving forward and advance a future collider
- **Following the 2020 European Strategy for Particle Physics update, DOE and CERN signed an FCC agreement to collaborate in the FCC feasibility study for the proposed 80-100 km collider in Swiss-French area**
- **DOE is coordinating with the ILC International Development Team, formed by ICFA in 2020, that is guiding the future of the ILC**
- **In the near-term – *i.e.*, this fiscal year and next – as DOE develops plans to support nationally-coordinated R&D efforts towards future collider initiatives**
  - Key constraint is the FY 2024 and [foreseen] 2025 fiscal budgets, which currently are heavily constrained
  - Priority is to support LHC and HL-LHC efforts (*i.e.*, 2023 P5's Rec. #1a)
- **While DOE/HEP develops plans for R&D efforts that 2023 P5 recommended, DOE PIs with LHC grants can continue to apply up to 25% of funds for development and studies for experiments/detectors for the proposed future colliders**
  - PIs and their group must ensure that existing LHC efforts, under which the grant is funded, are not impacted





# HEP University Comparative Reviews

[also please refer to the “General HEP FOAs and Review Processes” talk  
by William Kilgore, at this DPF-Pheno & DOE/HEP PI Meeting, May 13, 2024]

# University HEP Comparative Reviews

- Since FY 2012, DOE/HEP has been using a process of comparative reviews for university research proposals and grants — those scheduled for renewal or any new proposals
  - Upcoming FY 2025 Funding Opportunity FOA will mark 14<sup>th</sup> 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
  - Ref. 2024 COV for HEP facilities (operations & projects): ensure coordination between facilities and research

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

- **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” is not 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: Plan for “Promoting Inclusivity and Equity in Research” (PIER)**
  - Supporting narrative in the proposal’s appendix that aims to address a PIER plan (*more later in this talk...*)
- **Each FOA has different eligibility, technical requirements, page limits, etc.**
  - **Prior to any proposal submission, please read the specific FOA carefully for these guidelines and/or requirements**

- **Data Management Plan (DMP) involves all stages of the digital data life cycle including collection, analysis, sharing, and preservation.**
- **Focus of the DOE 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 the explicit subsection in the FOA for the Appendix on the “Data Management Plan’ for the requirements pertaining to DMPs that must be included in the overall application
- **International CMS and ATLAS have developed the 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 the respective HEP collaborations and have key roles and responsibilities on those experiments
- “Generic” or “blue-sky” R&D that is not to be carried out as part of a targeted HEP experimental initiative or collaboration should be directed to the Detector R&D program, as appropriate
- Read each FOA carefully and follow the requirements on content, length, etc.
  - Several requirements in the FOA are set from outside the DOE/HEP office. Non-compliant proposals that do not address FOA guidelines or requirements may not get merit reviewed.
  - In past years, ~3-5% of incoming proposals have been 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/Key Person”**
  - Senior ≡ an Investigator ≡ Active tenured or tenure-track faculty member at sponsoring institution
  - Key Person ≡ a non-tenure track faculty (e.g., research scientists) or other senior-level research staff with term appointments is also provided 9-pages each – *i.e., a new feature under this “open” FOA process*
  - Faculty members at collaborating institutions that may be listed in the proposal (if any) are not included
- **Investigators encouraged to refer to Section I.5 [under “HEP” program subsection] and Section IV of the FOA**
  - Includes useful information to guide research groups 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 for DOE/HEP support should be adjusted according to %-time the faculty is on research effort

## ■ Research Scientists (*... also more details in the 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 tenured or tenure-track 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) ...

- **Panel is 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) to operational and/or project activities for an experiment will not be supported by the respective frontier's research area
  - If RS conducting physics research-related activities, requests [scaled to % time on such efforts] can be included
  - **RS encouraged to narrate their plans in the 9-pages allotted to Key Persons + include a 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**
- **Two categories typically 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
- **Investigators encouraged to narrate any of the group's AI/ML efforts, where applicable, in the proposal**
  - 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, the review committee has been encouraged to provide input on any AI/ML activities of a group on an experiment**

- 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
  - FY 2025 review process continues to encourage investigators to include a level-of-effort table in the proposal's appendix related to the **budget material** for such cross-cut or transitions of effort planned in the project period
- As part of their overview of the subprogram and review process, DOE PMs will provide the respective review 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

[A set of criteria elements listed in Section V of FOA: for both Investigators and Merit Reviewers to evaluate proposals]

MERIT REVIEW CRITERIA	REVIEW CRITERIA SUB-QUESTIONS FOR MERIT REVIEWER'S EVALUATIONS
<b>SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROJECT</b>	<ul style="list-style-type: none"> <li>• What is the scientific innovation of the proposed research?</li> <li>• What is the likelihood of achieving valuable results?</li> <li>• How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?</li> <li>• How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality?</li> <li>• 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?</li> <li>• For renewal applications only: Is the proposed work an appropriate outgrowth of, continuation to, or successor of the currently supported research?</li> </ul>
<b>APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH</b>	<ul style="list-style-type: none"> <li>• How logical and feasible are the research approaches?</li> <li>• Does the proposed research employ innovative concepts or methods?</li> <li>• Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions?</li> <li>• Does the applicant recognize significant potential problems and consider alternative strategies?</li> <li>• Is the proposed research aligned with the published priorities identified or incorporated by reference in Section I of the FOA such as program strategic plans? <i>I.e., for HEP, the <a href="#">2023 P5 strategic plan</a>.</i></li> </ul>
<b>COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES</b>	<ul style="list-style-type: none"> <li>• What is the past performance and potential of the research team?</li> <li>• How well qualified is the research team to carry out the proposed research?</li> <li>• Are the research environment and facilities adequate for performing the research?</li> <li>• Does the proposed work take advantage of unique facilities and capabilities?</li> </ul>
<b>REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET</b>	<ul style="list-style-type: none"> <li>• Are the proposed budget and staffing levels adequate to carry out the proposed research?</li> <li>• Is the budget reasonable and appropriate for the scope?</li> </ul>
<b>QUALITY AND EFFICACY OF THE PROMOTING INCLUSIVE AND EQUITABLE (PIER) RESEARCH PLAN</b>	<ul style="list-style-type: none"> <li>• Is the proposed PIER Plan suitable for the size and complexity of the proposed project and an integral component of the proposed project?</li> <li>• To what extent is the PIER Plan likely to lead to participation of individuals from diverse backgrounds, including individuals historically underrepresented in the research community?</li> <li>• What aspects of the PIER Plan are likely to contribute to the goal of creating and maintaining an equitable, inclusive, encouraging, and professional training and research environment and supporting a sense of belonging among project personnel?</li> <li>• How does the proposed plan include intentional mentorship and are the associated mentoring resources reasonable and appropriate?</li> </ul>

# PIER: Promoting Inclusive and Equitable Research

- **DOE Office of Science (SC) is deeply committed to supporting diverse, equitable, inclusive, and accessible (DEI&A) work, research, and funding environments that value mutual respect and personal integrity**
- **PIER Plans:** since FY 2023, all DOE SC Funding Opportunity Announcements (FOAs) and DOE National Lab Announcements and other funding solicitations require applicants to submit a PIER plan as an appendix to their proposal narrative.
  - Additional information about the PIER Plan, including 1) FAQs for applicants and reviewers and 2) link to the DOE's public webinar, available at: <https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans>
- **At-a-glance, PIER Plans:**
  - Should describe the activities and strategies proposed by the PI/project team to promote equity and inclusion integral to the research project
  - Should be included as an Appendix to the proposal narrative not exceeding 3 pages
  - Are to be evaluated as part of the merit review process that is used to inform funding decisions by DOE
- **General guidance language for applicants is provided in Section IV of the FOA:**
  - Plans may include, but are not limited to, strategies of your institution (and collaborating institutions, if applicable) for enhanced recruitment of undergraduate students, graduate students, and early-stage investigators (postdoctoral researchers and others), including individuals from diverse backgrounds and historically underrepresented groups
  - Strategies for creating and sustaining a positive, inclusive, safe, and professional research and training environment that fosters a sense of belong among all researchers
  - Plans may incorporate or build upon existing DEI&A efforts but should not re-state the standard institutional and broad principles. The complexity and detail of a PIER Plan is expected to increase with size of research team and the # of personnel supported

- Generally, very useful to have head-to-head reviews of PIs working in similar areas, particularly for large grants
- Panels discuss 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 in the context of a longer-term program
    - ✓ Interesting? Novel? Significant? Plausibly achievable?
    - ⊗ Incremental? Implausibility 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

## 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 for the 2024 Fall term, applications due May 22, 2024
- **Visiting Faculty Program (VFP)**
  - Summer research support for faculty/students from historically underrepresented institutions
  - Now open for 2024 Fall term, applications due May 22, 2024
- **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 for the 2024 Fall term, applications due May 22, 2024

## 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”** – [for FY 2024: DE-FOA-00003177]: <https://science.osti.gov/grants/FOAs/Open>
  - DOE-HEP uses this FOA primarily for supplemental proposals, experimental [non-LHC] operations support, and conferences/workshops



**Early Career  
Research Program**



# How to Prepare for an Early Career Proposal (I)

- For FY 2024, proposals have been submitted and merit review process now underway
- Plan to issue the FY 2025 FOA later this year (*i.e.*, early-Fall 2024) for the next round of Early Career applicants
  - Stay tuned for further updates at: <https://science.osti.gov/early-career>
- In addition to merit review criteria in the FOA, following should be considered while preparing proposal narrative:
  - What challenges/problems are you trying to solve? Communicate these in the proposal.
  - Is someone else doing the activities already?
    - Alternatively, aren't such 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? Indicate what facilities exist at your institution to carryout 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?
    - **Important: update your CV (bio-sketch)** that is part of the overall proposal

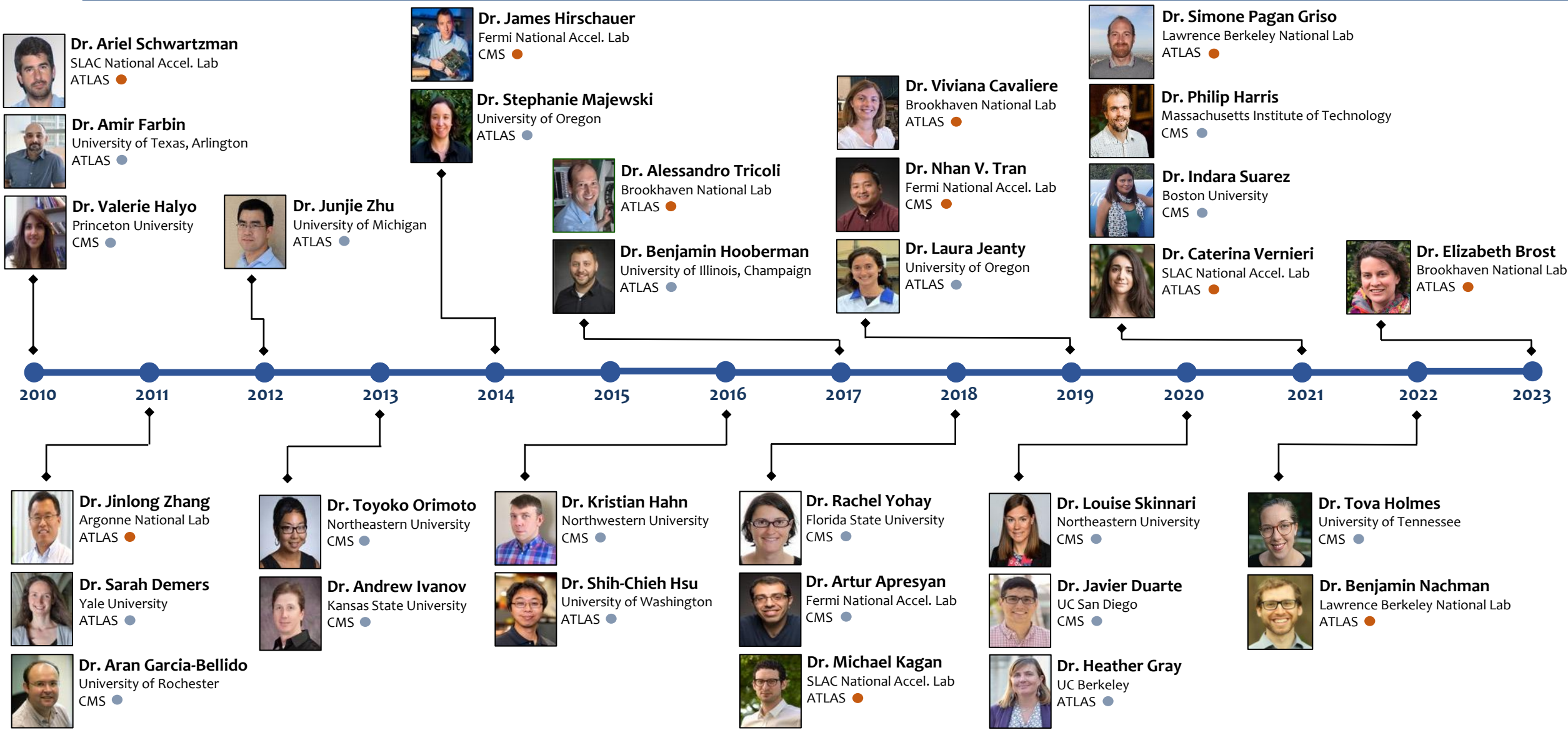
# How to Prepare for an Early Career Proposal (II)

- **Some additional guidance for LHC (ATLAS, CMS) research proposals – based on past submissions and reviews**
  - Tell a story ... propose a **compelling, innovative research plan!**
  - 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, **be quantitative, where possible**: show any simulation results, trigger efficiency studies, or other projections **that you have completed on the activity; include any figures/plots/tables!**
  - Energy Frontier proposals typically include a strong physics effort + a hardware effort, where the PI takes a lead in both
  - Hardware effort can include, for instance:
    - A U.S. HL-LHC upgrade scope or a LHC (ATLAS, CMS) experiments’ operations component
    - Targeted physics, experiment, and detector R&D effort towards a proposed future collider that is aligned with P5 priorities
  - Budget justifications in the appendix are important: 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”**
    - Avoid too many acronyms and 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 Program

## DOE/HEP Early Career Research Awardees: 2010-2023



# 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.

- **HEP continues to maintain the core of its DOE science mission**
  - We continue to deliver exciting discoveries, important scientific knowledge, and technological advances
  - Now transitioning from [2014 P5](#) to [2023 P5](#) to begin advancing the next long-range program for particle physics
- **DOE/HEP funding opportunities**
  - Issued FOAs are available at: [Grants.gov](https://www.grants.gov) or <https://science.osti.gov/hep/Funding-Opportunities>
  - Your research proposals should provide a plan for activities to be undertaken; and prepare the accompanying budget material, **including any description in the budget justifications, with the same care as the narrative**
- **FY 2025 President's Budget Request released earlier this year**
  - Now awaiting FY 2025 House and Senate Marks, which generally are 'budget indicators' in the overall 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 P5-recommended projects as well as the core research and operations programs

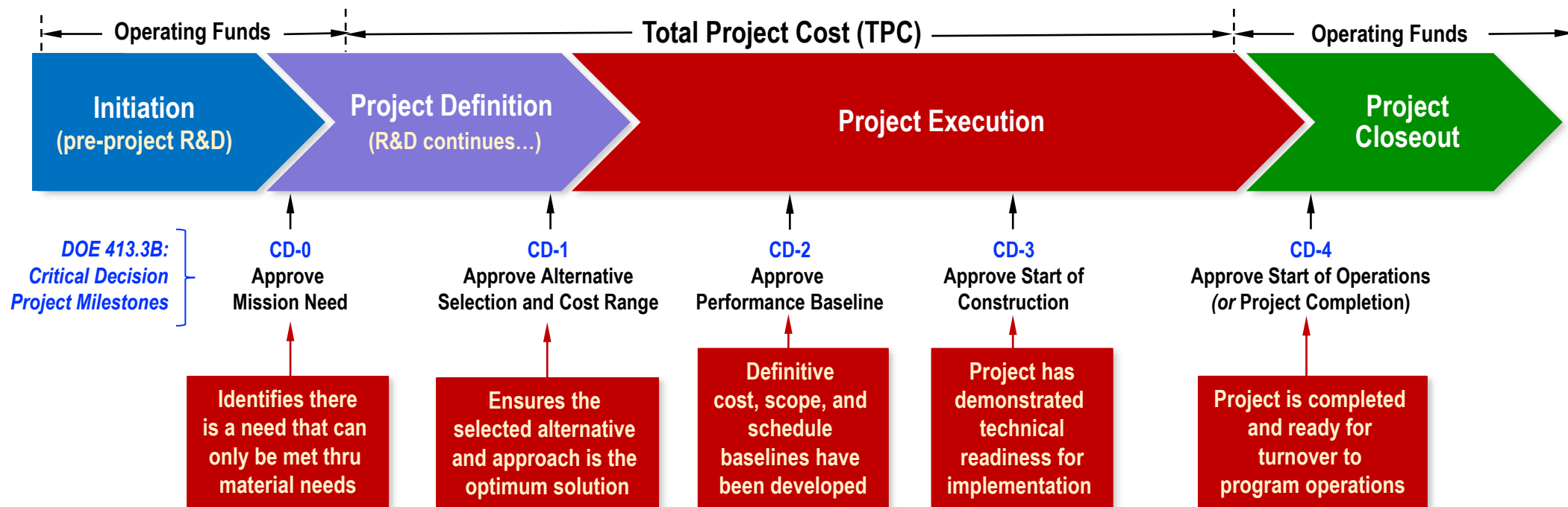


U.S. DEPARTMENT OF  
**ENERGY**

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 from FY 2014 through FY 2023, 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.
  - Requirements have continued for such awards since FY 2015.
- **Congress updated threshold from \$1 million to \$1.1 million in FY 2024.**
- **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 \$1.1 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.**