U.S. DEPARTMENT OF ENERGY | Office of Science

HEP Theory

2022 Snowmass Community Summer Study

July 22, 2022

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Seattle, Washington

Outline

- HEP Program Planning
- HEP Theory Program Overview
- DOE/HEP Comparative Reviews
- DOE Early Career Research Program
- Other Funding Opportunities
- Closing Remarks

This talk will:
(1) Emphasize the HEP Theory program within the broader context of the overall HEP program; *and*
(2) Provide an overview of the FY 2023 comparative review funding opportunity announcement (FOA). But please refer to slides from my talk of July 19 and the FOA document prior to any submission of an application.

What is the DOE HEP Program?

DOE Program Model
Mission-driven Science

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

DOE HEP Mission

- **Discover** the most elementary 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 facilities/experiments (*e.g.,* LHC/CMS and ATLAS, LBNF/DUNE, …), 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 that will lead to new and more capable facilities
- Form partnerships with other agencies (*e.g.,* NSF, NASA) to help deliver our mission

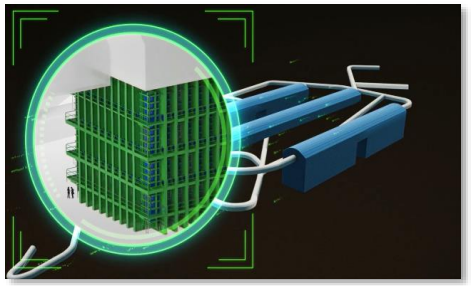
DOE supports about 85% of the U.S. HEP effort (in $), including U.S. national laboratories

HEP Program Guidance

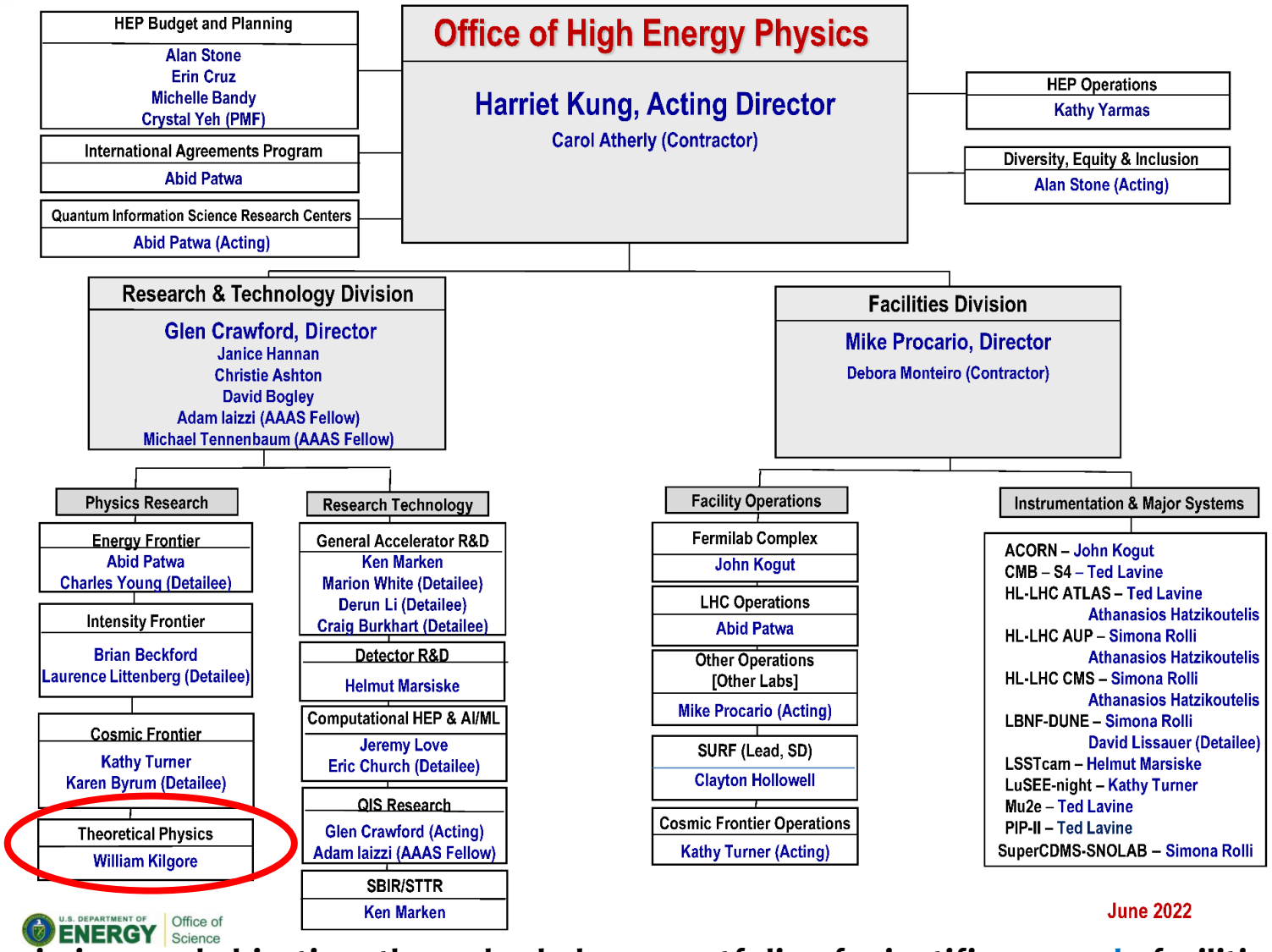
- FACA panels are the official advisory bodies to U.S. government agencies.
- The High Energy Physics Advisory Panel (HEPAP) provides the primary advice for HEP program to DOE and NSF and includes subpanels for detailed studies (*e.g.,* P5)

A Global Vision for Particle Physics

- The global vision presented in the 2014 P5 report addresses the five Science Drivers with a balanced program that deeply intertwines U.S. efforts with international partners
  - "The United States and major players in other regions can together address the full breadth of the field's most urgent scientific questions if each hosts a unique world-class facility at home and partners in high-priority facilities hosted elsewhere."
- CERN is an important partner in achieving this vision
  - The LHC and its upgrades are a core part of the U.S. program
  - CERN is a key partner in the U.S.-hosted international neutrino program (Short- and Long-Baseline)
  - R&D on advanced accelerator and detector technologies lays the foundation for enabling future collider facilities
- DOE execution of the P5 strategy requires navigating many factors, including:
  - Balancing HEP program for projects, operations, research
  - U.S. budget formulation and execution
  - Coordination among U.S. and international partners

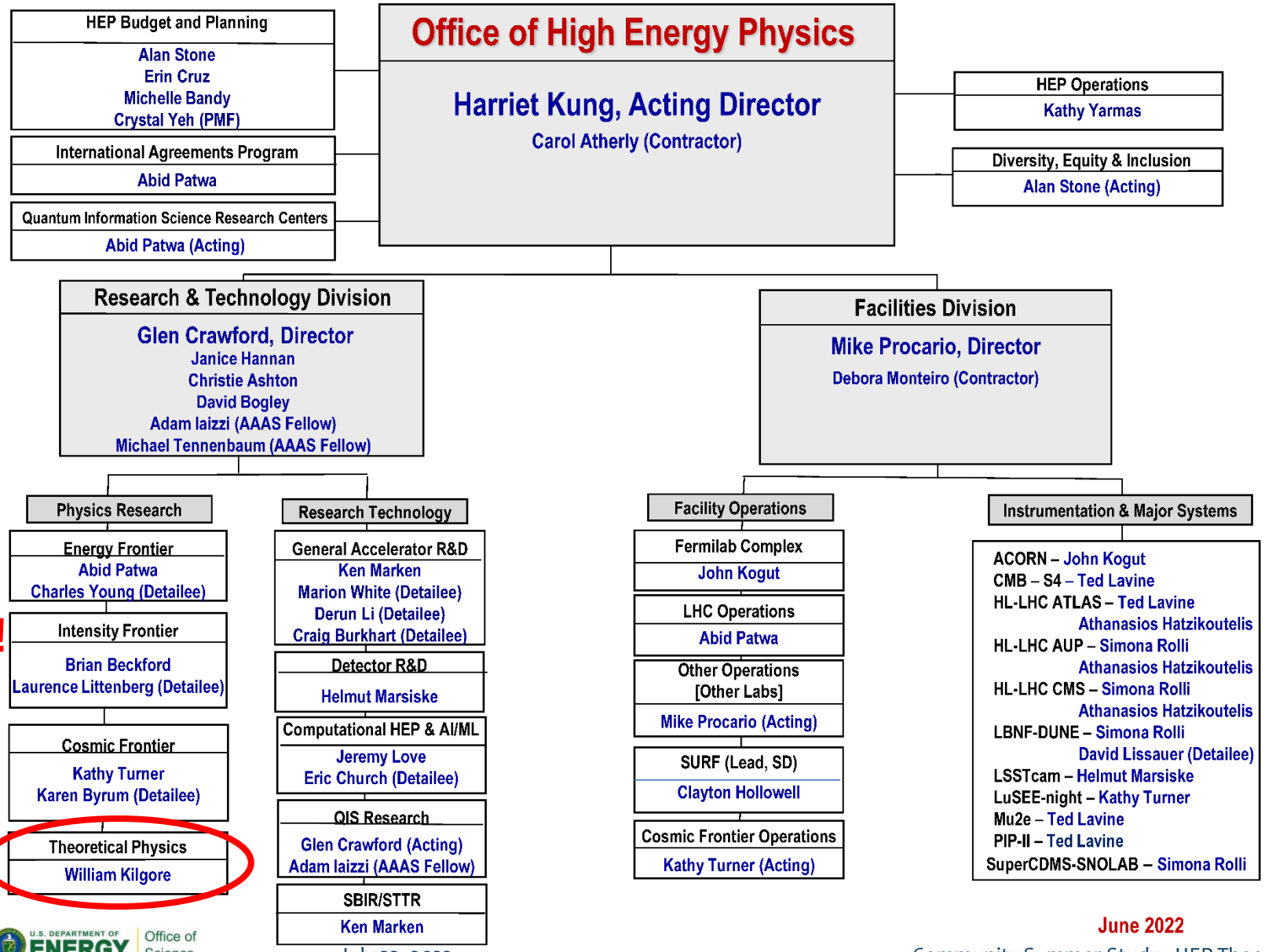


DOE Office of High Energy Physics



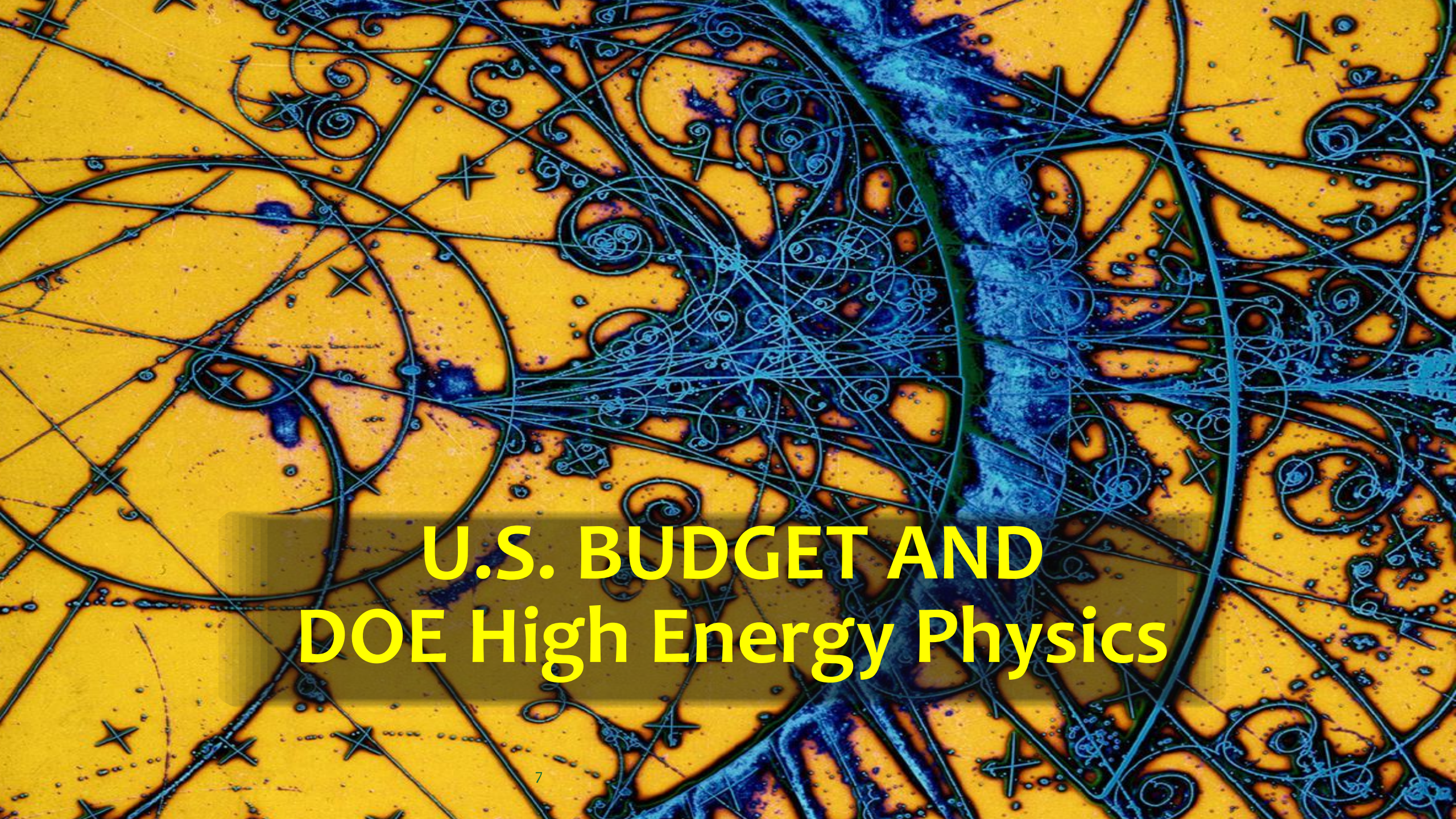
HEP advances the DOE missions and objectives through a balance portfolio of scientific research, facilities operations and projects, and by the development of key technologies and trained person-power needed to work at the cutting edge of science.

DOE Office of High Energy Physics



Help Wanted:
IPAs Welcome!

June 2022



U.S. BUDGET AND DOE High Energy Physics

The U.S. Federal Budget Cycle

- The President submits a Budget Request (PBR)
- Each house of Congress passes their vision of a draft budget

We are almost here (House Only)

- Both houses agree on a single bill (through "reconciliation")
  - No amendments are allowed beyond this point, to ensure the process converges
- Congress passes this legislation
- The President signs it and it becomes law

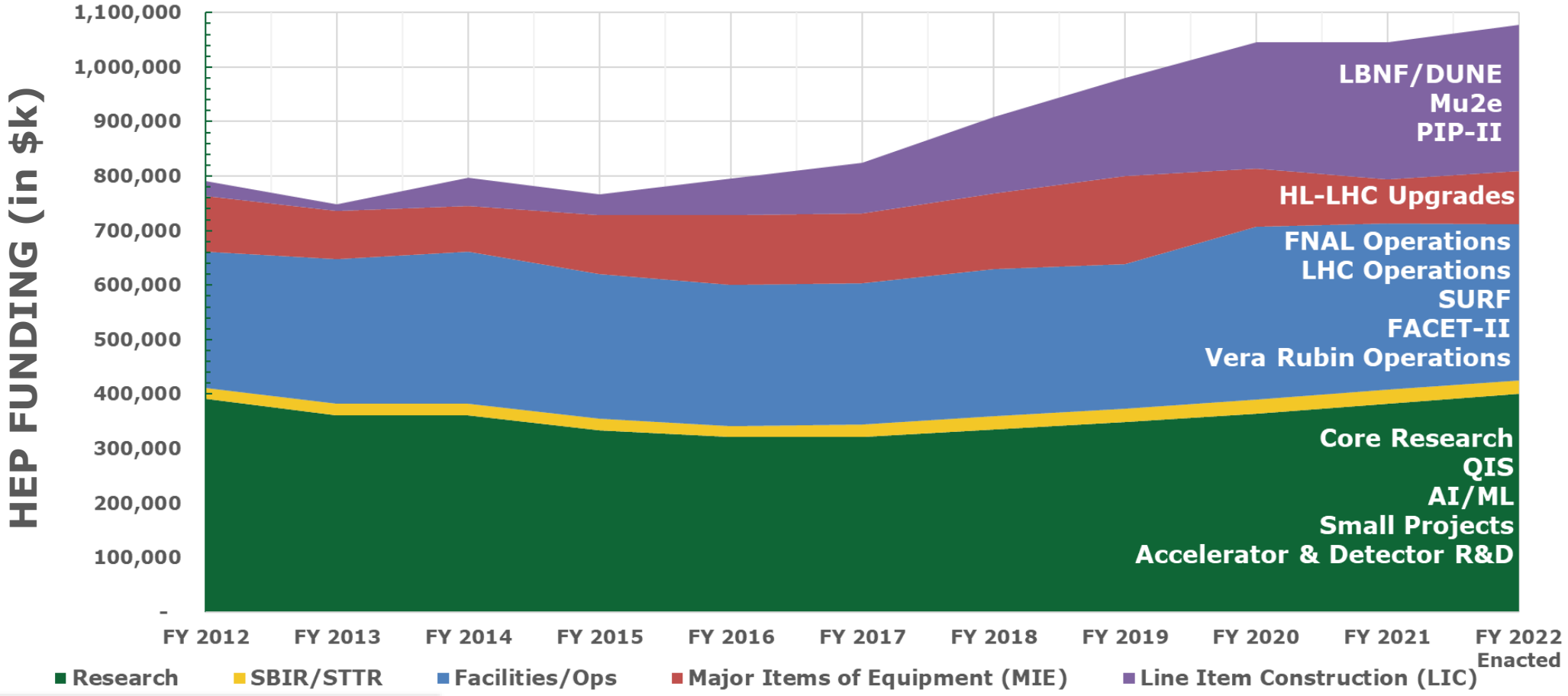
Credit: "I'm Just a Bill", America Rocks, 1976. 3rd season, Schoolhouse Rock.

- If this process does not complete by the end of the fiscal year (September 30th), Congress may pass a "continuing resolution," or without any action, U.S. Government can [partially] "shutdown"

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

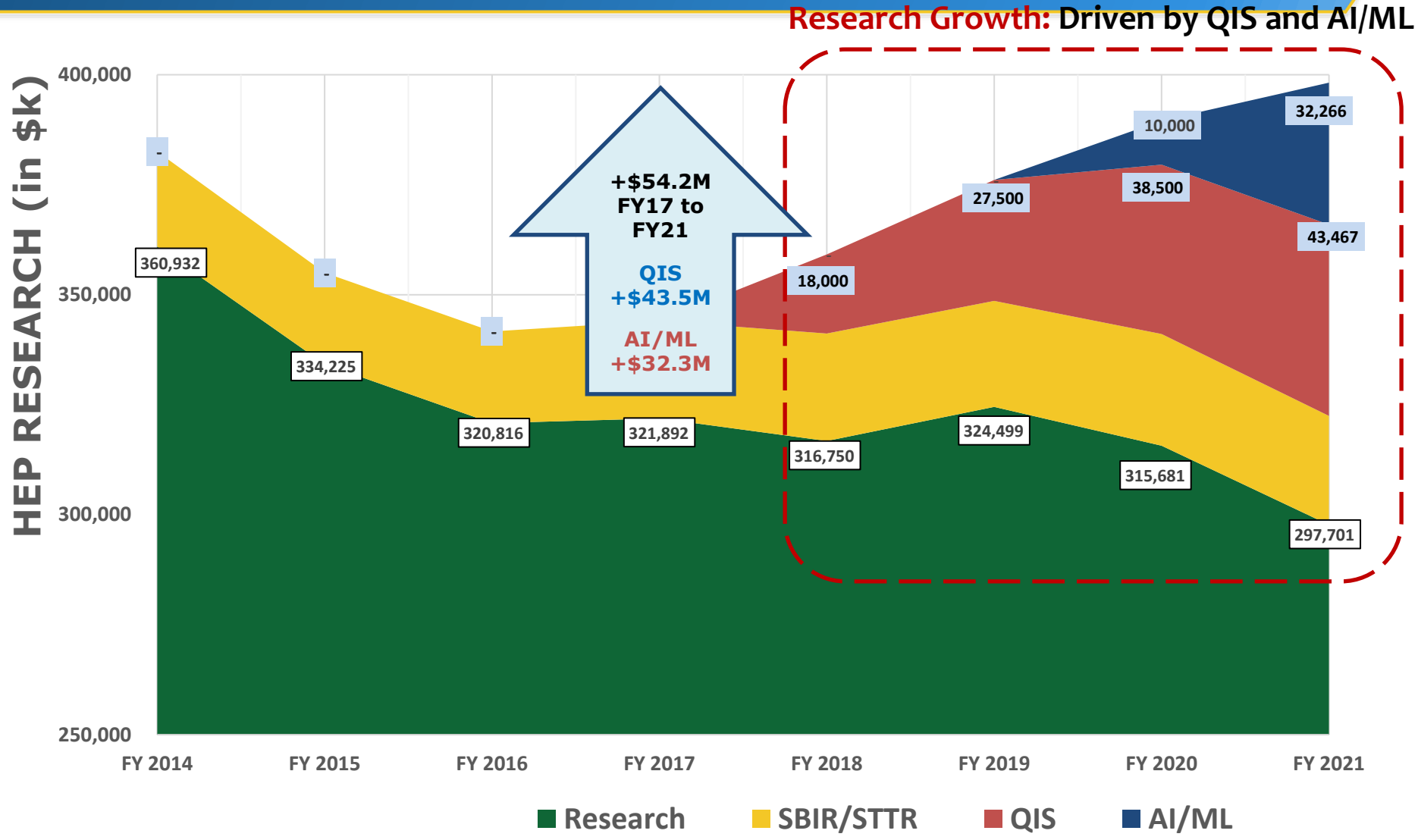
Research, Operations, Projects (Construction and MIEs)

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 (for Reference)	FY 2023 House Mark (for Reference)
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 2014-2021

- **Distinguishing HEP Research into HEP "Core" Research, QIS, and AI/ML**
- **HEP "Core" Research ≈ Energy, Intensity, and Cosmic Frontiers; Detector and Accelerator R&D; and HEP Theory**
- **In recent years, dedicated AI/ML funds have helped offset some fraction of reductions in "Core" Research**



HEP Theory Research Program

HEP Theory Portfolio

- Topics studied in theoretical high energy physics research include but are not limited to:
  - Phenomenological studies
  - Precision calculations
  - Development of new models
  - Progress in Quantum Field Theory
  - Development of analytical and numerical computational techniques
- The program is distributed across several research areas:
  - Standard Model Phenomenology
  - Beyond the Standard Model Phenomenology
  - Cosmology and Astroparticle Theory
  - Lattice Field Theory
  - Formal Theory and Mathematical Physics

Annual Budget Process

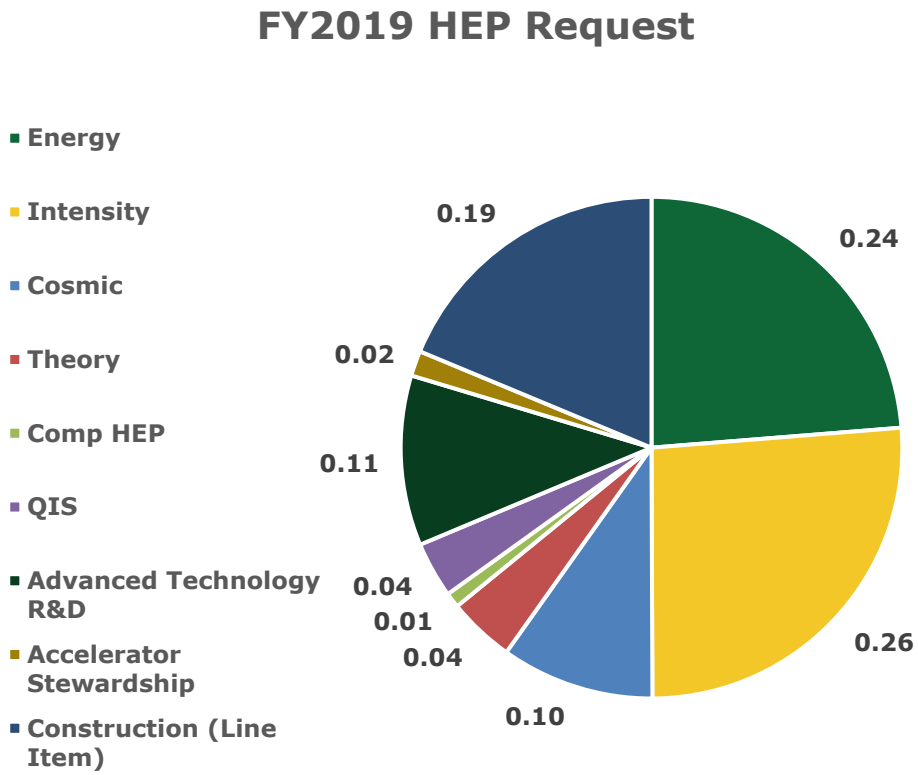
- The Program Manager receives an allocation from DOE-HEP leadership , i.e. the total budget for a given fiscal year.
  - First, the Program Manager fulfills commitments on continuing university grants (~33%)
  - Second, the Program Manager fulfills commitments to labs (~50%).
  - Remaining funds are available for new grants, renewals, supplements, conferences, summer schools, etc. etc. (~17%)
- The Comparative Review only determines how this remaining piece is divided. Commitments from previous years (for both universities and labs) can greatly affect the availability of funds. The Program Manager must balance the program across many years at once, even in the face of uncertain and, too often, declining budgets.

Theory Funding in HEP

The theory budget in DOE is a small fraction (about 4%) of a much larger budget which sustains the entire HEP infrastructure.

The total budget is determined by the entire Office of High Energy Physics, following a plan proposed and endorsed by the high energy physics community through the P5 panel.

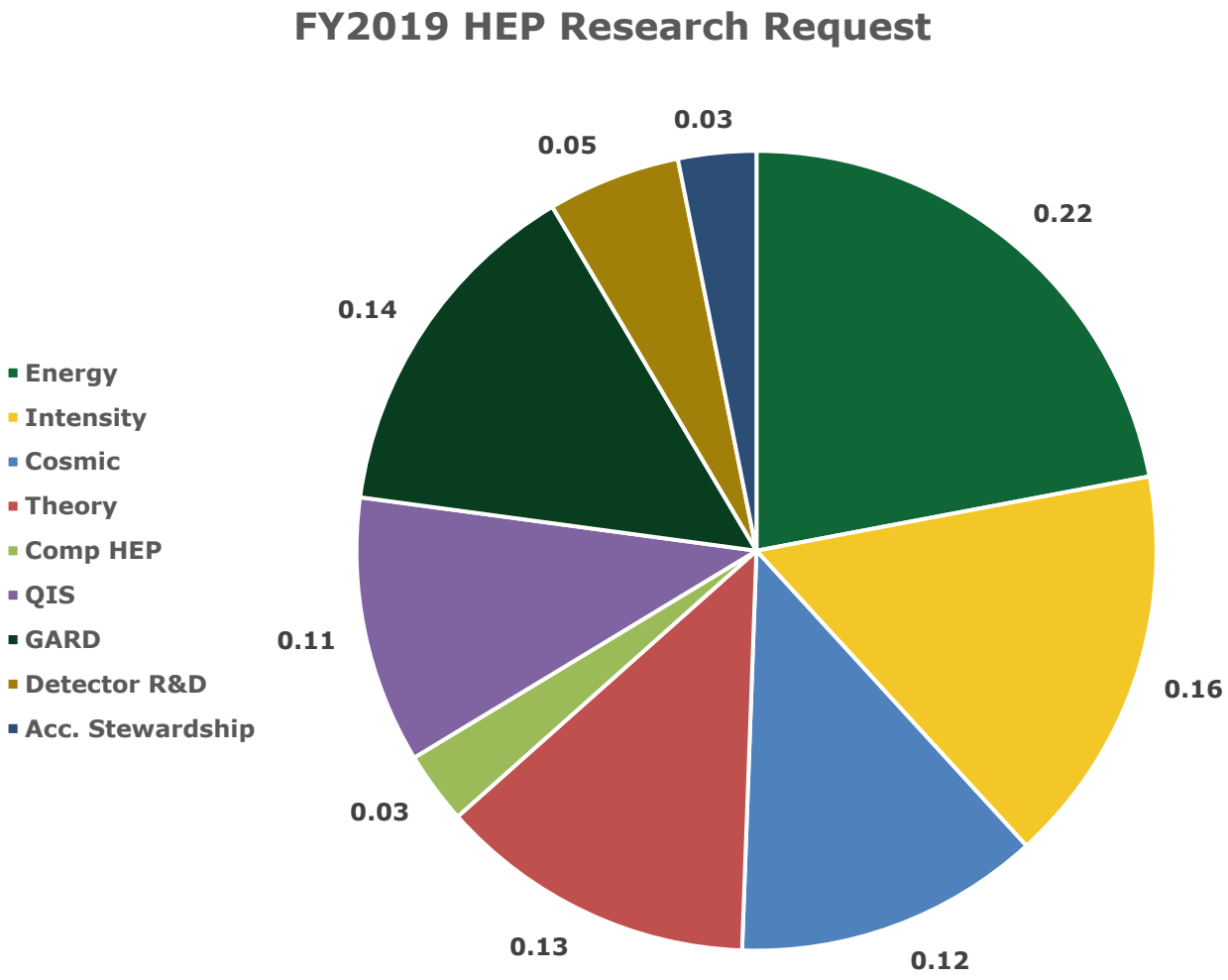
The primary driver of the overall HEP budget is the experimental program (R&D, Facilities, etc.)



A healthy, well-rounded theory program is essential to achieving maximum return from these investments

Theory in HEP Research Funding

The theory program only supports research. Since research funding makes up only ~40% of all HEP funding, theory is a small part of the whole but a substantial fraction of the research portfolio.



HEP Funding Opportunities

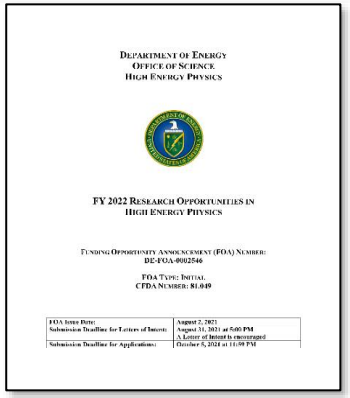
University Comparative Reviews

- **Since FY 2012, DOE/HEP uses a process of comparative grant reviews for university research grants – those scheduled for renewal and any new proposals**
  - **The FY 2023 Funding Opportunity Announcement (FOA) marks 12th round in the process**
  - **Each HEP subprogram at the DOE national laboratories is also reviewed every 3-5 years**
- **Process was recommended by several DOE advisory committees, including the 2010, 2013, 2016, and 2020 HEP Committee of Visitors (COV):**
  - 2010 COV: *"In several of the cases … proposal reviewers expressed negative views of the grant, but only outside of their formal responses. Coupled with the trend in the data towards very little changes in the funding levels over time, this suggests that 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 addressing these issues and keeping the program in peak form."*
    - use comparative review panels on a regular basis
  - 2013 COV: Continue comparative reviews. Augment with independent mail-in reviews
  - 2016 *and* 2020 COV: Continue comparative reviews
    - Continue communicating with PIs about program priorities at DOE-HEP PI meetings
    - Provide guidance to reviewers on, e.g., more uniform scoring, DE&I, …

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-000xxxx issued: TBA**
- **Six HEP research subprograms**
  - Energy, Intensity, and Cosmic Frontiers
  - HEP Theory, Accelerator Science and Technology R&D, and Detector R&D
- **Letter of Intent (strongly encouraged) due: TBA**
- **Final Proposal deadline:** TBA
- **Review process: October 2022 – February 2023**


DEPARTMENT OF ENERGY
OFFICE OF SCIENCE
HIGH ENERGY PHYSICS

FY 2022 RESEARCH OPPORTUNITIES IN HIGH ENERGY PHYSICS

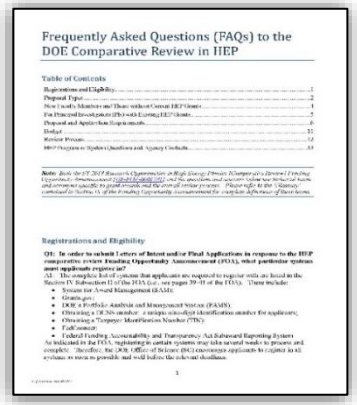
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER: DE-FOA-0002546

FOA TYPE: INITIAL
CFDA NUMBER: 81.049

FOA Issue Date:	August 2, 2021
Submission Deadline for Letters of Intent:	August 31, 2021 at 5:00 PM A Letter of Intent is encouraged
Submission Deadline for Applications:	October 5, 2021 at 11:59 PM

PIs and university SROs should read the FOA carefully to comply with all requirements prior to submitting a proposal.

- **In addition to the FOA, an FAQ is available and addresses topics:**
  - Registration and eligibility requirements
  - Proposal types and requirements;
  - Guidance for new faculty and those without current grants
  - Guidance for PIs with existing HEP grants
  - Budget information and guidance on scope of request(s)
  - Letter of Intent
  - Information on overall scientific merit review process
  - Contacts for program- or system-related questions


Frequently Asked Questions (FAQs) to the DOE Comparative Review in HEP

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Registrations and Eligibility

Both the FOA and FAQ are available at: ***https://science.osti.gov/grants/FOAs/Open***

Why Panel Reviews?

- The HEP Theory program spans a broad array of research topics
  - Discussion of proposals provides a richer context to the full HEP Theory program compared to the ~4 written reviews
- Reviewer numerical score calibration varies, and initial evaluations may be incomplete
  - We can provide a context for calibrating scores by discussing the highest- and lowest-ranked proposals determined by the initial evaluations
  - During and following panel discussions, panelists can revise and update their reviews, scores, and rankings based on additional factual information
- Discussion within a panel can help clarify the understanding of elements within a proposal, and thus sharpen the review narrative
- The objective of the panel discussion is to assess the priority of each PI's proposal.
  - Written review scores tend to be high because the overwhelming majority of the proposed research is at least "Good". With a finite budget, some good research will have to go unfunded so that the best research can be appropriately supported.

Programmatic Considerations

- **It is 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 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
- **We are supportive of excellent proposals, including proposals from *new* PIs, even when times are tough!**
- **Corollary: Some proposals, or parts of proposals, ranked below average may *not* be funded.**

What Makes a Proposal Strong?

- Strong proposals:
  - Are forward-looking.
    - Describe the work that will be done.
    - Recent results carry weight but …
    - Review panels tend to have a distinct 'what have you done for me lately?' attitude.
  - Have a clear program with definite objectives
  - Mix high-likelihood objectives with riskier goals.
  - Connect to the PI's established areas of expertise.

Comparative Review and Funding Allocations

- Grant sizes are determined by the rankings of the individual PIs' proposals. Historic funding levels are not considered.
  - Each PI's proposal is sorted into one of 5 tiers:
    1) Must Fund - Outstanding: Research that drives HEP theory (10-15%)
    2) Fund - Excellent: Leading research within its field (20-30%)
    3) Should Fund - Very Good: Solid research (20-30%)
    4) Fund if possible - Good: Good research but lower priority (~20%)
    5) Do Not Fund
- Proposals in higher tiers receive more funds than those in lower tiers
- For multi-PI grants, the total funding is (with minor corrections) the sum of the individual PI's funding.
  - Individual rankings/funding levels are available upon request.

Comparative Review Funding Levels

- PIs are funded according to the priority assessment which emerges from the review panel
- When funding permits, I have been using this funding model:
  - Tier 1: Summer Salary + Travel + Postdoc
  - Tier 2: Summer Salary + Travel + Student
  - Tier 3: Summer Salary + Travel (If Funds Available)
- Recent trends have challenged my funding models
  - Research funding remains highly constrained
    - Not really keeping up with inflation.
  - The number of proposals is growing
    - A steady supply of new junior faculty apply each year.
    - There is pressure to expand the scope of HEP theory with the startup of cosmic surveys.
  - HEP (and SC) prioritizes the support of students and postdocs
- I have been unable to support many Tier 3 PIs and have concluded that this model is unsustainable in the current environment.

Funding Models

- Weak funding (over-) stresses this funding model
- Preferred Funding Model:
  - ~~Tier 1: Summer Salary + Travel + Postdoc~~
  - ~~Tier 2: Summer Salary + Travel + Student~~
  - ~~Tier 3: Summer Salary + Travel (If Funds Available)~~
- Distressed Funding Model (with adjustments for local costs):
  - Tier 1: Postdoc + Student + Travel
  - Tier 2: Postdoc + Travel
  - Tier 3: Student + Travel (If Funds Available)
- I use the cost of supporting junior personnel to set the funding levels.
  - PIs can still take summer salary, with the same restrictions, but I want to make the trade-off between junior personnel and summer salary explicit.
- The objective is to maintain robust support for Tier 1 PIs while maintaining a broad program. This inevitably means reduced funding for Tiers 2,3.

On Not Being Funded

- Proposals ranked below a certain cutoff are not funded.
  - Typically, only the first three tiers have been funded.
  - Tier 4 proposals, while fundable, have lower priority.
- A declination is a comment on the proposal, not the PI.
  - In recent years, we have declined proposals from renowned PIs because reviewers and panelists felt that the research proposed was not a priority for HEP theory.
  - A history of low PI productivity is cause for assigning a proposal lower priority.
  - Proposals may not review well if they are poorly written or lack sufficient depth or innovation.
  - Proposals may not review well if they are not aligned with HEP priorities.
- Proposals that have been previously declined are given special scrutiny: What has changed? Why should this proposal be considered again? PIs are not judged by past declinations; proposals are.
- A declination is a serious warning to make sure:
  - That the next proposal is truly competitive:
    - That the objectives are clearly described and well-motivate;
    - That the research has the potential to provide breakthroughs;
    - That the PI is active in the community, etc.

Changes to the Comparative Review FOA in FY 2023

Newish for the FY 2023 FOA:

- Changes to the formats of Biographical sketches and reports of Current and Pending Support.
  - Both are available through SciENcv (preferred) or from NSF as fill-in pdfs.
- Changes to the way Collaborators and others who should not be used as reviewers are reported.
  - A Template (Excel Spreadsheet) is available from Office of Science web-site
- New Appendix concerning the Recruitment and Retention of Students and Early-Stage Investigators.
- Changes to the Merit Criteria, including a new Merit Criterion regarding Recruitment and Mentoring Plans for junior personnel.
- New instructions on the Project Narrative.
  - No change in page limits, but clarifications about topics to be included
- Alternative ways to submit sub-program budgets for multi-task proposals.

New since FY 2022 FOAs: Changes to the Biosketch

- The Office of Science (SC) requires the NSF format in the Science Experts Network Curriculum Vita (SciENcv) system (or a fillable PDF available from NSF).
  - The NSF format is not fully compatible with the information required by the FOA. Pages containing non-compatible information can be printed on a separate sheet and appended to the required format without incurring page limit violations.
  - The "Collaborator list" is no longer part of the biosketch.
  - I recommend using SciENcv over the fillable PDF:
    - Software incompatibilities have occurred when merging fillable PDFs with other proposal documents.
    - It is anticipated that the Office of Science will participate in a multi-agency effort to develop a common SciENcv Biosketch format for future FOAs and you will already be in the system.
  - Refer to the FOA for full details.

New since FY 2022 FOAs: Reporting Current & Pending Support

- The Office of Science (SC) requires the NSF format in the Science Experts Network Curriculum Vita (SciENcv) system (or a fillable PDF available from NSF).
  - The NSF format is not fully compatible with the information required by the FOA. Pages containing non-compatible information can be appended to the required format without incurring page limit violations.
  - I recommend using SciENcv over the fillable PDF:
    - Software incompatibilities have occurred when merging fillable PDFs with other proposal documents.
    - It is anticipated that the Office of Science will create its own SciENcv Current & Pending Support format for future FOAs and you will already be in the system.
    - The fillable PDF has many pages allowing a large number of entries. If used, please delete unused pages. There is no benefit to making Program Managers and Reviewers scroll through dozen of empty pages looking for content.
  - All foreign government-sponsored talent recruitment programs must be identified in current and pending support. Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided on request to either the applicant institution or DOE.
  - Refer to the FOA for full details.

New since FY 2022 FOAs: Collaboration List

- The list of Collaborators and other Individuals Who Should Not Serve as Reviewers is no longer part of the Biographical sketch. It should be attached to:
  - Letters of Intent (LOI) and/or Pre-Proposals and
    - Having this in the LOI helps HEP Program Managers to use the information in reviewer selection and assignment.
  - Submitted with the proposal, separate from Biosketches, Appendices, etc., as described in the FOA
    - Including the list in the LOI/Pre-proposal does NOT excuse you from attaching it to the proposal
- The list should include:
  - Graduate and Postdoctoral Advisors and Advisees.
  - Specify the Association. The Graduate student Adivsor/Advisee relationship is a lifetime COI; the Postdoctoral Advisor/Advisee relationship is not.
  - Collaborator and Co-editors on research publication within 48 months of proposal submission.
    - Members of large collaborations (10+) **should not** list every co-author; only list those with whom the applicant collaborated.
  - For each person named, provide first name, last name, ORCiD (if known), institutional affiliation, reason for being listed, year of most recent collaboration, etc.
  - An Excel template is available for download from SC.
- Refer to the FOA for full details

New since FY 2021 FOAs: Appendix on Recruitment and Retention

Recruitment and Retention of Students and Early-Stage Investigators

- For your institution and research group:
  - Describe plans for recruiting and retaining graduate students and early-stage investigators (untenured faculty, postdoctoral researchers, and others);
  - Explain how such personnel will be trained and mentored in the conducting proposed activities;
  - Provide a plan to help foster a diverse, equitable and inclusive research environment;
  - Describe anticipated progression of such personnel toward degrees or in their careers;
  - Describe how you assess the success of your research group in training and mentoring early-stage personnel;
  - You may include a list of past students and other former early-stage personnel along with their current (or last known) position(s) as a reference

Comparative Review Merit Criteria (FY 2022)

MERIT REVIEW CRITERIA	REVIEW CRITERIA SUB-QUESTIONS FOR MERIT REVIEWER'S EVALUATIONS
SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROJECT	• 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 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	• 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?
COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES	• 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 the plans for such cross-cutting efforts reasonably developed and will the proposed activities have impact?
REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET	• Are the proposed budget and staffing levels adequate to carry out the proposed research? • If multiple research thrusts are proposed, is the balance of proposed efforts reasonable and well-matched to the proposed research goals? • Is the budget reasonable and appropriate for the scope?
ALIGNMENT OF THE PROPOSED RESEARCH TO THE PRIORITIES ESTABLISHED IN THE 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? • Is the proposed research consistent with the priorities and strategic plan described in the P5 report? • For multi-thrust proposals, does the scope of the full proposed program provide synergy or additional public benefits within HEP's Congressionally-authorized mission-space beyond the individual thrusts? • How likely is the research to impact the direction of the overall HEP program? • For applications proposing work and/or a transition across multiple research thrusts, will the overall efforts add value in the broader context of the program goals described in the P5 strategic plan?
QUALITY AND EFFICACY OF RECRUITMENT AND MENTORING PLAN	• 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?

New since the FY 2022 FOA: New Merit Criterion

- A new merit criterion has been added for proposal evaluation:

Quality and Efficacy of Recruitment and Mentoring Plan

  - What is the past performance of the investigator(s) for mentoring and advancing career opportunities of students and other early-stage personnel in their 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 any 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?

Proposal Project Narrative

- **The Project Narrative comprises the *research plan* for the project**
  - Should contain enough background material in the introduction to demonstrate sufficient knowledge of the research
  - Devote main portion to a description and justification of the proposed project, include details of the methods to be used and any relevant results
  - Indicate which project 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 when printed on standard 8 ½" x 11" paper with 1-inch margins (top, bottom, left, and right). Font must not be smaller than 11 point.**
  - Senior investigator means active tenured or tenure-track faculty member at the 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 senior 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 planned FOA**
  - Includes useful information to help PIs in preparing better narratives — for e.g.:
    - What to address for the Background/Introduction
    - Multiple Investigators and/or Multiple Research Subprograms or Thrusts
    - Common narrative with overview of each group's activities in different research areas
      - Discussion of any synergies and connections between areas
    - Proposed Project Objectives, Research Methods, Resources
    - Timetable and Level of Effort of different activities, …

New since the FY 2022 FOA: Instructions for Project Narrative

- We have added suggestions for the Project Narrative to provide reviewers with clearer picture of the research activities:
  - Progress Report (for Renewal Applications): The narrative should include a section describing:
    - Work accomplished during the current (pre-renewal) project period and the connection to the work being proposed
    - Identify graduate students and postdocs supported and whether they would continue to be supported in the next project period.
    - Estimate unspent funds that will remain at the end of the current project period.
  - For research being proposed: provide a brief review of background material: literature review, prior research by PI, …
  - The bulk of the narrative should consist of a description and justification of the proposed project including details of the methods to be used.
  - Include a timeline for major activities.
  - For collaborative projects, provide a clear delineation of responsibilities.
  - Research using AI or ML:
    - Describe any efforts in AI/ML and their importance to completing the proposed research.
    - Describe the methods to be used and expected impact on scientific results.
    - Identify personnel (including postdocs and students) who would be involved and level of effort.
- Refer to the FOA for full details

Artificial Intelligence / Machine Learning

- **AI/ML continues to be a priority for the Administration and for the U.S. Congress.**
  - Appropriations since FY 2020 have provided dedicated funds in DOE/HEP Research Program to advance AI/ML initiatives.
- **The development and implementation of machine or deep learning tools, techniques, and algorithms are rapidly becoming part of many experimental analyses and some theoretical work.**
- **There are typically two categories of AI/ML-based proposal narratives:**
  1. **Developer:** PIs and their research teams are explicitly leading efforts to develop ML-based tools and algorithms for the collaboration to enhance sensitivity in physics studies.
  2. **End-user:** PIs and their research teams are implementing ML-based algorithms , developed by others, in an analysis.
  - "Developers" usually draw better reviews in research proposals than "end-users".
- **The FY 2023 FOA is expected to encourage investigators to identify their research group's AI/ML efforts in the proposal narrative as they would for other key areas of expertise.**
  - If applications or development of AI/ML techniques are a part of your research effort, call attention to them so that it can be properly reviewed. Consider adding a dedicated section to your narrative to describe the research group's efforts in AI/ML and their importance to completing the proposed research, explaining the associated AI/ML methods used and their impact to advance the group's scientific results; highlight particular results which are expected to be significantly improved or enabled by the use of AI/ML methods. Identify the personnel and effort level (e.g., students, postdoctoral researchers, etc.) carrying out AI/ML activities in the proposed research plan. Additional supporting information (if needed) may be included in Appendix 8.

Quantum Information Science

- **Quantum Information Science continues to be a priority for the Administration and for the U.S. Congress.**
- **QIS has become a standard research tool for parts of the HEP theory program. Until recently, QIS funding was kept apart from core research funding. Recently, HEP management has approved the use of QIS funds to support core research where appropriate.**
- **Although not stated in the FOA, I advise that you treat QIS components of your research as the FOA may recommend for AI/ML:**
  - If applications or development of QIS techniques are a part of your research effort, call attention to them so that it can be properly reviewed. Consider adding a dedicated section to your narrative to describe the research group's efforts in QIS and their importance to completing the proposed research, explaining the associated QIS methods used and their impact to advance the group's scientific results; highlight particular results which are expected to be significantly improved or enabled by the use of QIS methods. Identify the personnel and effort level (e.g., students, postdoctoral researchers, etc.) carrying out QIS activities in the proposed research plan. Additional supporting information (if needed) may be included in Appendix 8.
  - I am more interested in supporting the use of QIS to enhance HEP Theory than in developing QIS but I recognize that such efforts may be part of a well-balanced effort (if **not** already supported by a QuantISED award).

Proposal Budgets and Budget Justifications

- Applicants are encouraged to work with their SRO/SPO to develop their budgets and budget justifications with the same care that is devoted to the project narrative.
  - Reviewers and panelists often express frustration and/or confusion about budget details leading to lengthy panel discussions about what is being requested.
  - Points for consideration:
    - 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!
    - Reviewers will notice and call out:
      - Excessive or inappropriate requests
      - Arithmetic errors
      - Poorly justified expenses
      - Discrepancies between the project narrative and budgeted expenses
  - Worst case: Reviewers will start guessing if items are not adequately explained.

New to the FY 2022 FOA: Changes to Additional Budget Requirements

- If support is requested from two or more HEP research subprograms, you must provide separate budgets and budget justifications for each research subprogram for each.
  - This requirement does not apply to applications that request support from only a single research thrust, e.g., Accelerator Science and Technology R&D, Theory, CMS, ATLAS, LSST, DESI, DUNE, etc.
- There are two options for submitting the additional budget information:
  - (Old) Attach budget forms in the style of SF-424 (R&R) budget pages as well as justifications in Appendix 7.
  - (New) Use the SF-424 (R&R) Subaward Budget forms available in grants.gov to submit budgets for each subprogram or separate research task. You can attach the separate justifications to the subaward budgets.
- If any investigator requests support from two or more HEP research subprograms and/or thrusts (including two or more thrusts in the same research subprogram), you must provide information on the distribution of full-time effort (FTE) for them in a table.
- Refer to the FOA for full details.

Not-so-New Updates in the FOA

- **All Research proposals submitted to DOE Office of Science 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 "Renewal Proposal Products" (publications, etc.) *after* the application is submitted**
  - PIs are notified by PAMS and have 5-7 days to respond .
  - We cannot send renewal proposals out for review until this step is completed.
  - Prior-year 'products' are captured with your annual Progress Report but during the review process, applicants are able to update past entries and add current-year products to be considered in the merit review process.
- **Recurring submissions of Research applications (initiated in FY 2018)**
  - **"Previously declined applications that have not been substantially revised in light of merit reviewer comments may be declined without additional merit review and will not be considered for funding."**
- **All FOAs have different eligibility, technical requirement, page limits, etc.**
  - **Prior to any submission, read the FOA carefully!**

Data Management Plan

- **Data management involves all stages of the digital data life cycle: capture, analysis, sharing, and preservation. The SC Digital Data Management Statement focuses on sharing and preserving digital research data.**
  - See Dr. Laura Biven's presentation on SC Digital Data Management, Sept. 2014 HEPAP meeting: *https://science.osti.gov/hep/hepap/Meetings/201409*.
  - FOAs issued after October 1, 2014 require a DMP and compliance with the SC Statement.
    - SC statement on DMP available at: *https://science.osti.gov/Funding-Opportunities/Digital-Data-Management*.
    - DMPs are included as an appendix of the proposal.
    - See also Section IV of the comparative review FOA, the subsection for Appendix on 'Data Management Plan', for requirements pertaining to DMPs that must be included in an application .
- **Most International collaborations have developed DMPs for their collaborations**
  - Those seeking financial assistance grants [universities] or submitting FWPs [labs] for 'research' support can cite the DMPs for the respective experiment with the appropriate links.
    - If an experiment's DMP is cited, the PIs must briefly describe how proposed research relates to that experiment.
  - Theorists need DMPs: explain how theoretical/simulated data can be accessed/validated.
  - If there are no data of any sort generated by the proposed research, the DMP must state this. A DMP that is blank or states "not applicable" is not acceptable.

Each research thrust in a proposal requesting DOE research support, including the FY 2023 Comparative Review FOA, must address the DMP requirements to be reviewed and considered for funding

Guidance Checklist for FY 2023 Comparative Review

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

HEP Comparative Review FOA – GUIDELINE FOR APPLICATION REQUIREMENTS	COMPLETED
Is the proposed research scope aligned with programmatic priorities of DOE/HEP?	☑
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.	☑
Is Appendix for a Data Management Plan submitted? Comply with page-limit requirements specified in the FOA?	☑
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.	☑
DOE Cover Page: list each HEP research subprogram (e.g., Energy Frontier, HEP Theory, etc.) for which funding is requested. If support is requested from more than one subprogram, be sure to attach the Cover Page Supplement, as specified in the FOA.	☑
Page Limits: Complied with all page limits as defined in Section IV of the FOA?	☑
Biographical sketches carefully follow the FOA instructions, including page limits, and avoid PII.	☑
Current and Pending Support information completed, including period and an abstract of the scope of work.	☑
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.	☑
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.	☑
Include Appendix 6 narrative addressing recruitment and retention of students and early-stage investigators	☑
Post-submission of a 'renewal' application, timely submitted the Renewal Proposal Products (RPP) in PAMS.	☑

Early Career Research Program

Preparing an Early Career Proposal

- See slides from my talk from Tuesday, July 19
- General observations of strong proposals:
  - Provide **unique** capabilities and impact. What doesn't get done, if this proposal is not funded?
    - Proposal should address "why is it critical that **I** carry-out this research?"
    - How does your work **impact** efforts within the collaboration or international community?
    - Include figures/plots that address your study; show any simulation results, efficiency studies, or quantitative projections **you have completed** on your research activity
    - Identify, where appropriate, **innovative approaches** to analysis method
- Prior to submission, applicants may want to seek guidance from appropriate senior faculty and/or staff while preparing proposals (including the narrative and budget material)

Competitive Early Career Proposals

- The Early Career program for HEP theory is extremely competitive
- Successful proposals must be outstanding:
  - Clear and well-written
  - Timely, Exciting, and Innovative
  - The PI must clearly "own" the proposed research.
- There should be a clear 5-year plan:
  - If the topic is important enough to merit an Early Career Award, there should be five years worth of work and you should have a clear plan about how you will execute it
- All of that may not be enough!

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