HEP Theory

DOE/HEP PI Meeting 2018

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This talk will: (1) emphasize the HEP Theory program within the broader context of the overall HEP program; and (2) provide a planned-overview of the upcoming FY 2019 comparative review funding opportunity announcement. But please refer to the final announcement once issued and prior to any submission of an application.
The High Energy Physics Program Mission

... is to understand how the universe works at its most fundamental level:

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

The DOE Office of High Energy Physics fulfills its mission by:

- Building **projects** that enable discovery science
- Operating **facilities** that provide the capability for discoveries
- Supporting a **research** program that produces discovery science
Enabling the Next Discovery

- **Science drivers** identify the scientific motivation
- **Research Frontiers** are useful categorization of experimental techniques and serve as the basis of the budget process
- Research Frontiers are complementary
  - No one Frontier addresses all science drivers
  - Each Frontier provides a different approach to address science driver
  - Enables cross-checking scientific results

<table>
<thead>
<tr>
<th>Frontier</th>
<th>Energy Frontier</th>
<th>Intensity Frontier</th>
<th>Cosmic Frontier</th>
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<tbody>
<tr>
<td>Higgs Boson</td>
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<td>Neutrino Mass</td>
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<td>Dark Matter</td>
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<td>Cosmic Acceleration</td>
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<td>Explore the Unknown</td>
<td>☺</td>
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HEP underpins and advances the DOE missions and objectives through a balanced 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.
The U.S. Federal Budget Cycle I

- Typically, three budgets are being worked on at any given time
  - Executing current Fiscal Year (FY; October 1 – September 30)
  - OMB review and Congressional Appropriation for upcoming FY
  - Agency internal planning for the second FY from now

<table>
<thead>
<tr>
<th>FY 2018 Budget</th>
<th>FY 2019 Budget</th>
<th>FY 2020 Budget</th>
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<tbody>
<tr>
<td>Spend the Fiscal Year Budget</td>
<td>OMB Review</td>
<td>DOE Internal Planning with OMB and OSTP Guidance</td>
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<td>Congressional Budget and Appropriations</td>
<td>OMB Review</td>
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<td></td>
<td>Budget Release</td>
<td>Budget Release</td>
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<tr>
<td></td>
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- Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
- CY 2017 Calendar Year 2018 Calendar Year 2019 Calendar Year 2020

You are here

August 22, 2018

DOE/HEP PI Meeting - HEP Theory
The President submits a Budget Request (PBR)
Each house of Congress passes their vision of a draft budget (called a “mark”)

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

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”
FY 2019 President’s Budget Request

- 2019 President’s Budget Request for HEP is overlay of Administration, SC, P5 priorities
  - SC: interagency partnerships, national laboratories, accelerator R&D, QIS
  - P5: preserve vision, modify execution

- FY19 Budget Request reduces near-term science for P5-guided investments in mid- and long-term program
  - “Building for Discovery” by supporting highest priority P5 projects to enable future program
  - Research support advances P5 science drivers and world-leading, long-term R&D in Advanced Technology, Accelerator Stewardship, and Quantum Information Science
  - Operations support enables world-class research at HEP User Facilities

- The Administration and Congress support the overall P5 strategy
  - FY19 House Mark for HEP: $1,004,510,000 ; FY19 Senate Mark for HEP: $1,010,000,000

### HEP Funding Category ($ in K)

<table>
<thead>
<tr>
<th>Category</th>
<th>FY 2017 Actual</th>
<th>FY 2018 Enacted</th>
<th>FY 2019 Request</th>
<th>FY 2019 vs. FY 2018</th>
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<tbody>
<tr>
<td>Research</td>
<td>344,043</td>
<td>369,565</td>
<td>280,130</td>
<td>-89,435</td>
</tr>
<tr>
<td>Facilities/Operations</td>
<td>258,696</td>
<td>260,535</td>
<td>211,020</td>
<td>-49,515</td>
</tr>
<tr>
<td>Projects</td>
<td>222,261</td>
<td>277,900</td>
<td>278,850</td>
<td>+950</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>825,000</strong></td>
<td><strong>908,000</strong></td>
<td><strong>770,000</strong></td>
<td><strong>-138,000</strong></td>
</tr>
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</table>
FY 2019 Budget Request Highlights

- **Energy Frontier**: Actively engage in successful LHC program and HL-LHC upgrades
  - The **High-Luminosity Large Hadron Collider** (HL-LHC) ATLAS & CMS detector upgrades (new MIE starts) and the **HL-LHC Accelerator Upgrade Project** are together considered one of P5’s highest priority large projects
  - The U.S. will continue to play a **leadership role in LHC discoveries** by remaining actively engaged in analysis of world’s highest energy particle collider data

- **Intensity Frontier**: Support establishing U.S.-hosted world-leading neutrino program
  - **LBNF/DUNE** is P5’s highest priority U.S.-hosted large project, FY19 investments in far-site civil construction crucial to enable scheduled delivery of contributions from international partners
  - Support **Short-Baseline Neutrino** (SBN) program at Fermilab, **DUNE prototype R&D** efforts at CERN, and continued funding for **PIP-II** project to upgrade the Fermilab Accelerator Complex

- **Cosmic Frontier**: Advance our understanding of dark matter and dark energy
  - P5 recommended complementary suite of projects to search for **dark matter** candidates and study **dark energy**; request supports full planned profile for LZ, SuperCDMS-SNOLAB, DESI
Overall HEP Budget Trend

- P5 strategy continues to define investments in future of the field
- FY 2019 House/Senate Marks increase project funding above Request
  - Profiles for high-priority projects recommended by P5 continue to ramp up
  - Research funding could face pressure even if overall HEP budget rises

**HEP BUDGET ALLOCATION BY FISCAL YEAR ($ IN K)**

*All funding shown in “then-year” U.S. dollars*
2014 P5 was charged to consider three 10-year budget scenarios for HEP within the context of a 20-year vision for the global field

- Scenario A was the lowest constrained budget scenario
- Scenario B was a slightly higher constrained budget scenario
- Scenario C was “unconstrained,” but not considered unlimited

FY 2019 appropriations process is progressing

- Marks released; still awaiting final Congressional action for FY 2019
- Final language of appropriations bill/report impact how funding is directed
HEP Theory Research Program
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
University and Laboratory Research

University research is supported by a competitive, proposal-driven process:
- Grants issued after peer review of proposals submitted to Funding Opportunity Announcements (FOAs)

Program alignment is built into proposal review process:
- Relevance to HEP mission is explicit in review criteria
- HEP programmatic priorities inform the peer review process
- Program Managers consider reviewer feedback and program priority when determining awards

Laboratory research is mission-driven and funded through Field Work Proposals:
- HEP holds comparative reviews of the Laboratory research programs every 3-4 years.

Program guidance to the Laboratories is provided by HEP with input from a variety of sources including:
- The Laboratories themselves
  - Local strengths and resources
- Advisory committees
- Institutional reviews
University vs. Lab Funding

- **University PIs** are funded through grants ("financial assistance"). DOE-HEP can offer a grant or not, based on available budgets.
  - Selection is made through University Comparative Review. Grants typically have three-year cycles; review takes place upon renewal (once per three years).
  - The University program includes approximately 80 groups, 220 PIs, 100 postdocs, 120 graduate students.

- **Laboratories** are DOE facilities. They are managed/funded through contracts, and the laboratory management hire/fire research personnel, including theory personnel.
  - In general, the lab budget pays 100% of the salaries of lab personnel. DOE controls the top-level budget lines, but lab management determines its distribution within individual budget lines. Thus, DOE’s ability to sculpt/shape profiles of individual lab theory groups is more indirect.
  - Assessment is made through Laboratory Comparative Review. All assessments are made simultaneously in a single Comparative Review held every 3-4 years (2008, 2011, 2014, 2018).
  - Laboratory theory groups with HEP personnel: Argonne, Brookhaven, Fermilab, Lawrence Berkeley Lab, SLAC, Lawrence Livermore Lab, Los Alamos. Total: approximately 50 PI’s, 25 postdocs.

August 22, 2018 DOE/HEP PI Meeting - HEP Theory
Funding Allocation

Given an annual Theory budget, the Program Manager is responsible for recommending the relative allocations across the entire program.

Program Manager Decisions are not made in isolation:

- External reviewers are consulted for each proposal.
- Since FY12, members of a Comparative Review Panel also provide assessments and rankings.
- Program Managers also weigh programmatic needs and OHEP priorities.
- OHEP line of management subsequently must “concur” with all recommendations of Program Managers.

This procedure is not unique to DOE; NSF and many other grant-giving federal agencies follow these same procedures.
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.
Theoretical and Computational Physics

- **Theory Research**: higher priority to research that addresses the neutrino mass science driver
- **Computational HEP**: priority to advance computing research for HEP needs, and working with ASCR to optimize the high performance computing
- **Quantum Information Science**: focus on research techniques and algorithms, foundational concepts relating particle physics and QIS, quantum computing for HEP experiments and modeling, development and use of specialized quantum controls and precision sensors

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<thead>
<tr>
<th>Theoretical and Computational Physics ($ in K)</th>
<th>FY 2017 Actual</th>
<th>FY 2018 Enacted</th>
<th>FY 2019 Request</th>
<th>FY 19 vs. FY 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>55,713</td>
<td>75,303</td>
<td>71,280</td>
<td>-4,023</td>
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<tr>
<td>Theoretical Physics</td>
<td>44,848</td>
<td>43,000</td>
<td>32,753</td>
<td>-10,247</td>
</tr>
<tr>
<td>Computational HEP</td>
<td>7,924</td>
<td>8,500</td>
<td>7,435</td>
<td>-1,065</td>
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<tr>
<td>Quantum Information Science</td>
<td>-</td>
<td>18,000</td>
<td>27,500</td>
<td>+9,500</td>
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<tr>
<td>Projects</td>
<td>2,300</td>
<td>-</td>
<td>-</td>
<td>---</td>
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<tr>
<td>SBIR/STTR</td>
<td>2,238</td>
<td>2,853</td>
<td>2,700</td>
<td>-153</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>60,251</strong></td>
<td><strong>78,156</strong></td>
<td><strong>73,980</strong></td>
<td><strong>-4,176</strong></td>
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## Theory Funding through time

<table>
<thead>
<tr>
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<th>Universities</th>
<th>Labs</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>FY10</td>
<td>27.25M</td>
<td>25.83 M</td>
<td>53.09 M</td>
</tr>
<tr>
<td>FY11</td>
<td>27.42M (incl. 450K for EC)</td>
<td>25.63 M (incl. 1 ECA)</td>
<td>53.06 M</td>
</tr>
<tr>
<td>FY12</td>
<td>27.71 M (incl. 900K for EC)</td>
<td>24.72 M (incl. 1 ECA)</td>
<td>52.43 M (-1.2 %)</td>
</tr>
<tr>
<td>FY13</td>
<td>25.44 M (incl. 1.2M for EC)</td>
<td>25.75 M (incl. 2 ECA)</td>
<td>51.19 M (-2.4 %)</td>
</tr>
<tr>
<td>FY14</td>
<td>24.01 M (incl. 2.0M for EC)</td>
<td>24.62 M (incl. 2 ECA)</td>
<td>48.63 M (-5.0 %)</td>
</tr>
<tr>
<td>FY15</td>
<td>24.13 M (incl. 3.6M for EC)</td>
<td>25.19 M (incl. 2 ECA)</td>
<td>49.32 M (+1.4 %)</td>
</tr>
<tr>
<td>FY16</td>
<td>21.77 M (incl. 1.3M for EC)</td>
<td>24.92 M (incl. 2 ECA)</td>
<td>46.69 M (-5.3 %)</td>
</tr>
<tr>
<td>FY17</td>
<td>20.78 M (incl. 1.5M for EC)</td>
<td>24.07 M (incl. 2 ECA)</td>
<td>44.85 M (-3.9 %)</td>
</tr>
<tr>
<td>FY18</td>
<td>20.46 M (incl. 2.3M for EC)</td>
<td>22.75 M (incl. 1 ECA)</td>
<td>43.21 M (-3.7 %)</td>
</tr>
</tbody>
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Early Career Awards are helping to support the University Program. To date, 23 of 26 ECA in HEP Theory have gone to university PIs.
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.
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.
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</tr>
</thead>
<tbody>
<tr>
<td>Energy Frontier</td>
<td>72,268</td>
<td>79,530</td>
<td>56,119</td>
<td>-23,411</td>
</tr>
<tr>
<td>Intensity Frontier</td>
<td>56,317</td>
<td>60,700</td>
<td>41,246</td>
<td>-19,454</td>
</tr>
<tr>
<td>Cosmic Frontier</td>
<td>45,990</td>
<td>49,892</td>
<td>31,506</td>
<td>-18,386</td>
</tr>
<tr>
<td>Theory</td>
<td>44,848</td>
<td>43,000</td>
<td>32,753</td>
<td>-10,247</td>
</tr>
<tr>
<td>GARD</td>
<td>44,357</td>
<td>44,500</td>
<td>36,544</td>
<td>-7,956</td>
</tr>
<tr>
<td>Detector R&amp;D</td>
<td>16,177</td>
<td>17,000</td>
<td>13,690</td>
<td>-3,310</td>
</tr>
<tr>
<td>Accelerator Stewardship</td>
<td>8,270</td>
<td>9,000</td>
<td>8,032</td>
<td>-968</td>
</tr>
<tr>
<td>Construction (Line Item)</td>
<td>93,500</td>
<td>140,400</td>
<td>143,000</td>
<td>+2,600</td>
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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 2019 FOA will mark the 8th round in the process.
- Each HEP subprogram at the DOE national laboratories is also reviewed every 3-4 years.

Process was recommended by several DOE advisory committees, including the 2010, 2013, and 2016 HEP Committee of Visitors (COV):

- 2010 COV: "In several of the cases that the panel read, 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;

- and 2016 COV: Continue comparative reviews;
  - and continue communicating with PIs about program priorities at DOE PI-meetings held at a major conference/workshop.

**Goal:** improve overall quality and efficacy of the HEP research program by identifying the best proposals with highest scientific impact and potential.
FY19 HEP Comparative Review FOA & FAQ

- **DE-FOA-000xxxx** issued TBD
- Six HEP research subprograms
  - Energy, Intensity, and Cosmic Frontiers, HEP Theory, Accelerator Science and Tech. R&D, and Detector R&D
- Letter of Intent (strongly encouraged) due: **TBD**
- Final Proposal deadline: **TBD**

Please read the FOA carefully to comply with all requirements prior to submitting a proposal.

- In addition to the FOA, a FAQ is available and addresses topics on:
  - Registration and eligibility requirements
  - Proposal types and requirements;
  - Guidance for new faculty and those without current HEP 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

Both the FOA and FAQ are planned to be available at: [http://science.energy.gov/hep/funding-opportunities/](http://science.energy.gov/hep/funding-opportunities/)
Recent FOA Changes

- All *Research* proposals to DOE/SC must have a Data Management Plan (DMP)
  - Includes HEP comparative review and Early Career, but not conferences, workshops, operations, projects
  - Any research thrust in a proposal without a DMP will be **declined without review**

- All *Renewal* proposals must submit “proposal products” (publications, etc.) after the application is submitted
  - PIs will be notified by PAMS and have 5 days to respond
  - We **cannot review** incoming proposals until this step is completed
  - These will eventually be captured with your annual Progress Report, but must be entered by hand during the transition phase

- Recurring Submissions of Research Applications (**new in FY 2018**):
  - “A previously declined application may be resubmitted to this FOA, but **only after it has undergone substantial revision**. An application submitted to this FOA that has not clearly taken into account the major concerns from prior DOE reviews may be **declined without review and will not be considered for funding.**”

- All FOAs have different eligibility, technical requirements, page limits, etc.
  - *Read the instructions carefully!*
DOE HEP Research Priorities: Snapshot

- **Energy Frontier**
  - Analysis of LHC Run 2 data
  - Contribute to operational responsibilities and complete “Phase I” upgrades
  - Scientific support for HL-LHC program

- **Intensity Frontier**
  - Neutrino Program
    - Support ProtoDUNE, LBNF/DUNE, and PIP-II
    - Implement Fermilab Short-Baseline Neutrino Program and Intermediate Neutrino Program
    - NOvA, T2K/SK, Minerva, MicroBooNE data analysis
  - Muon Program: Complete Mu2e, take data with Muon g-2
  - Heavy Flavor Program: take and analyze data with Belle-II

- **Cosmic Frontier**
  - Dark Matter: Scientific support for G2 experiments (in fabrication)
  - Dark Energy: DES analysis; scientific support for LSST and DESI (in fabrication)
  - Continue science planning for CMB-S4

- **Accelerator R&D**
  - Focus on outcomes and capabilities that will dramatically improve cost effectiveness for mid-term and far-term accelerators
  - Hosting workshops to develop and implement R&D plan following P5 and GARD panels

- **Detector R&D**
  - Developing process to identify highest priority R&D activities for current phase of implementing P5
  - Long-term “high-risk” R&D with potential for wide applicability and/or high-impact
  - “Blue-Sky” scientific research on innovative technologies not already in contention for implementation in future DOE HEP projects

- **HEP Theory**
  - Phenomenological Studies and Data Interpretation
  - Precision Calculations and Quantum Corrections
  - Model Building: Unification and Describing New Phenomena
  - Quantum Field Theory, Quantum Gravity, Strings, and Mathematical Physics
Key Items to Keep in Mind

- Proposed research will review best if closely aligned with the DOE/HEP mission, its program, and the P5 strategy
  - Investigators in experimental HEP research frontiers (Energy, Intensity, Cosmic) will review best if they are closely integrated into HEP experiment collaborations and have key roles and responsibilities on those experiments
  - “Generic” research that is not to be carried out as part of a specific HEP experimental collaboration should be directed to the HEP Theory or Detector R&D programs, as appropriate.

- **Read the FOA carefully** and follow the requirements on content, length, etc.
  - Several requirements in the FOA are set from outside the DOE/HEP office, and there is little to no flexibility to modify.
    - Non-compliant proposals submitted to the FOA will not be reviewed.
  - In recent years, 10-15% of incoming proposals are declined without review. Requirements most often missed or overlooked include:
    - Data management plans, page limits, separate budget sheets (if needed) for each research subprogram or thrust, and inclusion of Personally Identifiable Information (PII)
Proposal Project Narrative

- 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 8½” x 11” paper with 1-inch margins (all sides). Font must not be smaller than 11 point.
  - Senior investigator ≡ active tenured or tenure-track faculty member at sponsoring institution
  - Non-tenure track faculty (e.g., research scientists) and staff with term appointments are not included in the 9-page limit per investigator unless they are the (lead) PI on the application
  - Faculty members at collaborating institutions listed on the proposal (if any) are not included

- Refer to Section IV of the planned FOA for useful information to prepare narratives
  - 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, ...
HEP Research Activities Supported

✓ **What DOE supports**

- Efforts that are in direct support of our programs
  - Support depends on merit review process, programmatic factors, and available funds
- Research efforts (mainly scientists) on R&D, experiment design, fabrication, data-taking, analysis-related activities
- Some engineering support may be provided in the Detector R&D subprogram
- Theory, simulations, phenomenology, computational studies

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

- **Research Scientists**
  - Support may be provided, but due to long-term expectations, need to consider case-by-case on merits: whether the roles and responsibilities are well-matched with individual capabilities and cannot be fulfilled by a term position
  - Efforts are related towards 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:
  - Engineering, major items of equipment, consumables for prototyping or production
  - Non-HEP related efforts (e.g. gravitational waves (LIGO), heavy-ion (RHIC/LHC), AMO Science)
Research Scientists (RS)

Panel will evaluate RS efforts where support is requested in a proposal

- Guidance to PIs given in Q&A of 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 respective frontier research areas
  - If RS conducting physics research-related activities, requests [scaled to % of time on such efforts] can be included
    - Any final support will be based on the merit review process

- Common [past] reviewer comments that result in unfavorable merit reviews:
  - “RS conducting scope of work typically commensurate at the postdoctoral-level…”
  - “RS involved in long-term ops/project activities with minimum physics research efforts…”
    - May review well in the operation/project program but not in a review of the experimental research program

- What are “physics research-related activities?”
  - Object reconstruction/algorithm development, performance studies, data taking and analysis, and mentorship of students & postdocs in these areas
  - Scientific activities in support of detector/hardware design and development

- From the research program, cases become an issue when operations/projects become the dominant activity in the long-term
  - A well-balanced portfolio that includes physics research-related activities is encouraged
  - Important to narrate complete plans in 2-page “appendix narrative” + provide 1-page bio
Crosscut, Multi-thrust, or Transitional Proposals

- Applications where a PI 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.
  - **Continue into the planned FY19 FOA:** in proposal’s Budget Justification material (Appendix 7), include level of effort table for any transition of effort during project period, as appropriate.

- As part of their overview of the subprogram and review process, DOE PMs will provide the panel with details regarding such research plans across multiple HEP thrusts.

- Reviewers with appropriate topical expertise in the research area(s) will assess the full scope, relevance, and impact of the proposed research in the merit review process — *e.g.*, merit review questions consider:
  - Are the plans for such cross-cutting efforts reasonably developed and balanced; will the proposed activities have impact?
  - 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?
Programmatic Considerations

- Generally very useful to have head-to-head reviews of PIs working in similar areas, particularly for large grants
  - Discussion of relative strengths and weaknesses of individual proposals and PIs

- Many factors weigh into final funding decisions
  - **Compelling research proposal** for next ~3-4 years
    - 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 HEP** programmatic priorities
  - **Balanced program** of R&D/design, support of construction or operations, data analysis
    - This may span multiple experiments over a 3 year proposal

- Supportive of excellent research, including excellent research from new PIs, even when times are tough!
  - Corollary: Some proposals from senior personnel will be ranked below average and may not be funded
Comparative Merit Review Criteria

Sub-questions to be provided in Section V of FOA

1. **Scientific and/or Technical Merit of the Proposed Research**
   e.g., What is the scientific scope and impact of the proposed effort? **How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?** What is the likelihood of achieving valuable results? How does the merit of the proposed research, both in terms of scientific and/or technical merit and originality, compare with other efforts within the same research area for a) applications submitted to this FOA and b) those in the overall HEP field? Is the Data Management Plan suitable for the proposed research and to what extent does it support the validation of research results? **Please comment individually on each senior investigator.**

2. ** Appropriateness of the Proposed Method or Approach**
   e.g., **How logical and feasible are the approaches? Does the proposed research employ innovative concepts or 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?

3. **Competency of Applicant’s Personnel and Adequacy of Available Resources**
   e.g., **How well qualified is each senior investigator and their team, and what is the likelihood of success in carrying out the proposed work?** Does the proposed work take advantage of unique facilities and capabilities? What is the past scientific performance of the team, including the dissemination of results? Are any proposed plans for recruiting any additional scientific and/or technical personnel including new senior staff, students and postdocs reasonable, justified, and appropriate? Are the environment and facilities adequate for performing the proposed effort, including any synergistic opportunities, institutional support, and/or infrastructure? Are the senior investigator(s) or any members of the research group that are being reviewed leaders within 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?

4. **Reasonableness and Appropriateness of the Proposed Budget**
   e.g., **Are the proposed budget and staffing levels adequate to carry out the proposed work?** If multiple research thrusts are proposed, is the balance of proposed efforts reasonable and well-matched to the proposed research goals? Are all travel, student costs, and other ancillary expenses adequately estimated and justified? **Is the budget reasonable, appropriate for the scope?**

5. **Relevance of the Proposed Research to the HEP Program Mission and Priorities**
   e.g., **How does the proposed research of each senior investigator 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 HEP’s overall priorities and strategic plan? For multi-thrust proposals, does the scope of the full proposed program provide synergy or additional benefits to the HEP mission beyond the individual thrusts? **How likely is the research to impact the direction of the overall HEP program?** For senior investigator(s) proposing to work and/or transition across multiple research thrusts during the project period, will their overall efforts add value in the broader context of HEP program goals?
Comparative Merit Review Criteria Use

For Reviewers/Panelists

- The merit review criteria and corresponding questions are given to all reviewers to input their reviews in DOE’s Portfolio Analysis and Management System (PAMS)
  - Serves as a guide for reviewers to address each review criteria for written reviews
- They are highlighted by DOE Program Managers at the beginning of panel deliberations
- These are presented and discussed by individual panelists for each proposal
- Other Program Policy Factors are also discussed with panelists.
  - 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 junior scientific personnel.

For Principal Investigators

- The merit review criteria and corresponding questions are given in Section V of the FOA
- Program Policy Factors are also given in Section V of the FOA
- Serves as an additional guide for PIs to address in their proposal’s project narratives
  - Do not just write an explicit paragraph answering each question-by-question, but instead, PIs should integrate and adapt these (as appropriate) when narrating the group’s activities and research plans
Focus of the SC Digital Data Management is the sharing and preservation of digital research data

- Data management involves all stages of the digital data life cycle including capture, analysis, sharing, and preservation
- See Dr. Laura Biven’s presentation on SC Digital Data Management, Sept. 2014 HEPAP meeting: [http://science.energy.gov/hep/hepap/meetings/201409/](http://science.energy.gov/hep/hepap/meetings/201409/)
- FOAs issued by HEP require Data Management Plan (DMP) compliance with the SC Statement
  - See Section IV, the subsection on Appendix 8 of the FOA, for requirements pertaining to DMPs that must be included in your application

Most experiments have developed DMPs for their collaborations

- When applying for financial assistance (universities) or submitting FWPs (labs), PIs can cite the DMPs for their experiments with the appropriate links
  - If DMP cited, PIs must briefly describe how proposed research relates to the experiment
- Theorists need DMPs: explain how theoretical/simulated data can be accessed/validated
- If there is 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 2019 Comparative Review FOA, requires addressing the DMP requirements for it to be reviewed, and hence, to be considered for funding.
Renewal Proposal Products

- ‘Renewal’ proposals plan to be accepted
  - Such proposals are appropriate where funds are requested for an award first awarded in 2012 or later with no change in
    - Recipient/applicant institution; research thrust(s) and research scope(s); and award’s lead-PI
  - See also, when available, FAQ Q&As for additional guidance

Renewal Proposal Products
- Since Feb 2015, PI must complete and submit ‘Renewal Proposal Products’ section in PAMS by entering each product created during the course of the previous project period
- Types of products include:
  - Publications (for collaborators on large experiments, list those where you were primary)
  - Intellectual property, technologies or techniques
  - Databases or software (made public)

Renewal Proposal Products are to be submitted after the application submission
- DOE will assign the renewal proposal to a Program Manager, resulting in an automated email from PAMS to the PI with instructions ← watch for this email in your inbox
- Navigate in PAMS to ‘Tasks’ and enter all products within 5-days after the proposal submission
- Application will not be considered complete and therefore cannot be reviewed until the product list has been submitted
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) Outstanding: Research that drives HEP theory (10-15%)
2) Excellent: Leading research within its field (20-30%)
3) Very Good: Solid research (20-30%)
4) 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 Statistics

<table>
<thead>
<tr>
<th>Proposals Reviewed</th>
<th>Proposals Funded</th>
<th>Proposals Declined</th>
<th>Junior PI Funded</th>
<th>Junior PI not funded</th>
<th>Previously not funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 (66 PI)</td>
<td>22</td>
<td>15</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>FY13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53 (146 PI)</td>
<td>35</td>
<td>18</td>
<td>13</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>FY14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 (89 PI)</td>
<td>16</td>
<td>17</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<td>FY15</td>
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<td>43 (87 PI)</td>
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<td>FY17</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>50 (133 PI)</td>
<td>38</td>
<td>12</td>
<td>13</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>FY18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 (79 PI)</td>
<td>26</td>
<td>7</td>
<td>17</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>
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.
  - Declined proposals may be poorly written or lack sufficient depth or innovation.
  - The topics proposed may not align 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.

- A declination is a serious warning to make sure:
  - that the next proposal is truly competitive:
  - that the research has the potential to provide breakthroughs
  - that the PI is active in the community, etc.
Guidance Checklist for FY19 Comp Rev

- 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 FY19 FOA.
- The list, on the opening pages of the FOA, is **not** intended to be complete; applicants should review the FOA in-detail and follow all instructions.

### FY 2018 Comparative Review FOA – GUIDELINE FOR APPLICATION REQUIREMENTS

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the proposed research scope aligned with programmatic priorities of DOE-HEP?</td>
<td>✔️</td>
</tr>
<tr>
<td>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.</td>
<td>✔️</td>
</tr>
<tr>
<td>A Data Management Plan is required for each research thrust (e.g., ATLAS, LSST, lattice gauge theory, etc.). It must appear in Appendix 8 of the application and comply with page-limit requirements specified in the FOA.</td>
<td>✔️</td>
</tr>
<tr>
<td>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.</td>
<td>✔️</td>
</tr>
<tr>
<td>DOE Cover Page: list each HEP research subprogram (e.g., Energy Frontier, HEP Theory) for which funding is requested. If there is more than one, be sure to attach the Cover Page Supplement.</td>
<td>✔️</td>
</tr>
<tr>
<td>Page limits for each section comply with the FOA requirements (as defined in Section IV of the FOA).</td>
<td>✔️</td>
</tr>
<tr>
<td>Biographical sketches carefully follow the FOA instructions and avoid PII.</td>
<td>✔️</td>
</tr>
<tr>
<td>Current and Pending Support information completed, including an abstract of the scope of work.</td>
<td>✔️</td>
</tr>
<tr>
<td>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.</td>
<td>✔️</td>
</tr>
<tr>
<td>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.</td>
<td>✔️</td>
</tr>
<tr>
<td>Post-submission of a ‘renewal’ application, timely submitted the Renewal Proposal Products (RPP) in PAMS.</td>
<td>✔️</td>
</tr>
</tbody>
</table>

August 22, 2018
Laboratory Comparative Review

- All Laboratory Research Groups have been undergoing Comparative Review since 2008.
- Lab Theory groups were reviewed in 2008, 2011, 2014 and 2018.
- Panels evaluate all laboratory theory groups at once and make recommendations on how to best allocate resources to labs, indicating areas of strength and weakness.
  - The High Energy Theory (HET) activity across the laboratories is generally an asset to the DOE-HEP mission and should be protected and developed as much as possible, within the current difficult budgetary constraints. Overall, the high energy physics theory groups at the labs are strong, and are playing a fruitful role both in their host laboratories, as well as for the national HEP program. There are specific places that require attention, but the net message of this review is one of a very positive evaluation. (Laboratory Groups Theory Review 2014 --- Final Report)
- The recommendations of the Lab Comparative Review Panel are forwarded to lab management for implementation, and the DOE-HEP budget line is adjusted accordingly.
- Laboratory groups have been affected by budget cuts in ways similar to University groups. At one lab: 30% reduction in Postdocs between FY12 and FY14; 9.5% reduction in permanent personnel; 20% reduction in student support.
Early Career Research Program
Preparing an Early Career Proposal I

- The Office of Science plans to issue a FY 2019 funding opportunity announcement for the next round of Early Career applicants
  - Stay tuned to [https://science.energy.gov/early-career/](https://science.energy.gov/early-career/) for further updates...

- In addition to the merit review criteria found in the FOA, the following guidance should be applied while preparing the proposal narrative:
  - What challenges/problems are you trying to solve? Communicate this!
  - Is someone else doing it already?
    - Alternatively, aren’t those research activities already being funded elsewhere?
    - If you carry-out these efforts, why are they unique and require ‘you’?
  - How does this research exploit/engage unique capabilities of your institution?
  - What resources are needed to complete the project?
  - Does your proposal outline a 5-year timeline, with key deliverables and personnel profiled during this project period?
  - If funded, what will be the outcome after 5-years?
  - Have you led the activities that you are proposing?
  - Why are you a future leader in HEP?
    - Identify your leadership activities in Collaboration, HEP, or broader scientific community
Preparing an Early Career Proposal II

- General observations of strong proposals
  - Provide **unique** capabilities and impact. What doesn’t get done, if 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)
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!
The HEP Theory Program has produced 26 awardees in the Office of Science Early Career Research Program.
Other Funding Opportunities

- **Workforce Development (WDTS) programs:** [https://science.energy.gov/wdts/](https://science.energy.gov/wdts/)
  - **Office of Science Graduate Student Research fellowships (SCSGR)**
    - Supports grad student research at a DOE lab, 3 to 12 months
    - Two calls per year, usually Feb/Aug.
    - Applications typically due May/Nov for following Fall or Summer start
  - **Science Undergraduate Laboratory Internships (SULI)**
    - Supports undergraduate research at a DOE lab, 10 to 16 weeks
    - Three calls per year, for following Spring/Summer/Fall terms
    - Now accepting applications for Spring 2018, due Oct 2
  - **Visiting Faculty Program**
    - Summer research support for faculty/students from historically underrepresented institutions
    - One call per year, usually in Oct. Applications due in Jan.

- **HEP/Office of Science programs:**
  - **Quantum Information Sciences** (See Lali Chatterjee’s talk)
  - **SC “Open Call”** [DE-FOA-0001820]
    - HEP uses this primarily for supplemental proposals, experimental operations support and conferences
Take Away Messages

- **HEP is maintaining the core of the DOE science mission**
  - We are delivering exciting discoveries, important scientific knowledge, and technological advances
  - We must stay focused and continue to deliver outcomes for the nation
  - Science results from the collaborations have impact in Washington, DC

- **HEP is executing the P5 plan and delivering science**
  - FY 2018 funding actions are moving forward
  - FY19 funding opportunities are anticipated to progress the same as FY18

- **FY 2019 Congressional Marks are ‘budget indicators’**
  - Fiscal budget is only known when Congress passes an appropriation and the President signs the bill
  - As P5-recommended projects ramp up, including those for the HL-LHC accelerator and detector upgrades and the U.S.-hosted international neutrino program, research funding may continue to face pressure
The P5 report identified five **intertwined science drivers**, compelling lines of inquiry that show great promise for discovery:

- Use the **Higgs boson** as a new tool for discovery
- Pursue the physics associated with **neutrino mass**
- Identify the new physics of **dark matter**
- Understand **cosmic acceleration**: dark energy and inflation
- Explore the **unknown**: new particles, interactions, and physical principles

*Since 2011, three of the five science drivers have been lines of inquiry recognized with Nobel Prizes*
Comparative Review Process
Why Perform Panel Reviews?

- The Intensity Frontier program comprises a number of highly complex experiments and projects and new opportunities arise and evolve for research and development
  - Discussion of proposals provides a richer context to the full Intensity Frontier HEP program compared to the 5-6 proposals each panelist reviews

- Reviewer numeric 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
  - Most panel members collaborate on many of the experimental efforts under review, and will be able to participate in the discussion
  - Note: Proposal assignments are anti-correlated with current research efforts