U.S. DEPARTMENT OF ENERGY | Office of Science

# Energy Frontier Program and Program Review FOAs

**2017 Meeting of the APS Division of Particles and Fields**
**DOE-PI Meeting Session • Fermilab**
**July 31 — August 4, 2017**

**Abid Patwa**
**Office of High Energy Physics**
**Office of Science, U.S. Department of Energy**

# Outline

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

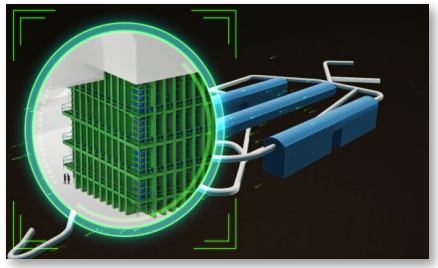
**This talk will emphasize the Energy Frontier program — which includes the science programs at the LHC and future particle colliders — within the broader context of the overall HEP program**

# 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 (SBN and LBNF/DUNE)**

- **DOE execution of the P5 strategy requires navigating many factors, including:**
  - **Balancing full scope of the HEP program**
    - **projects, operations, research**
  - **U.S. budget formulation and execution**
  - **Coordination among U.S. and international partners**



# The U.S. Federal Budget Cycle (1)

- The President submits a budget request (PBR)
- Each house of Congress passes their vision of a draft budget (called a "mark")

For FY 2018, we are here

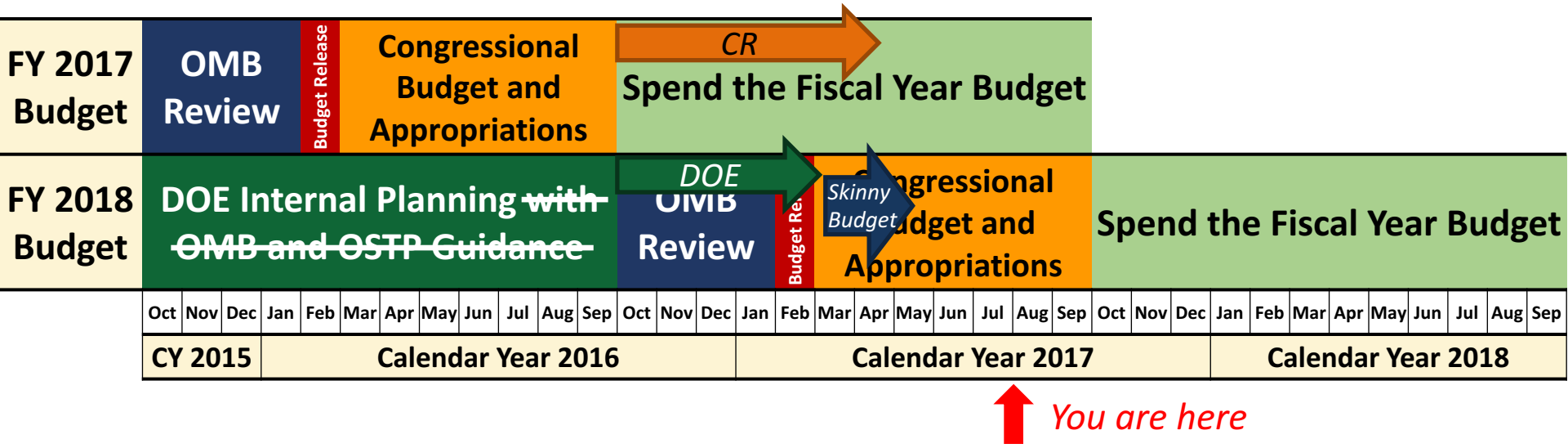
- Both houses agree on a single bill (through "reconciliation")
  - No amendments are allowed beyond this point, to ensure the process converges
- Congress passes this legislation
- The President signs it and it becomes law

*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 passes a "continuing resolution"

# The U.S. Federal Budget Cycle (2)

- **Formulation: Executive branch prepares the President's Budget Request**
  - White House Office of Management and Budget (OMB) controls process, gives guidance
- **Congressional: Enacts laws that control spending and receipts**
  - Congress considers the Budget Request, enacts laws that control spending and receipts
- **Execution: Executive branch agencies carry out program**
  - OMB apportions funds to Executive Branch agencies, which obligate and disperse funding
- **This year's cycle is not "typical"**
  - Congress used Continuing Resolutions (CRs) until passing an appropriation on May 5, 2017
  - White House released the "skinny budget" on March 13, guiding the budget formulation
  - FY 2018 President's Budget Request released on May 23, Congressional Marks in June/July



# FY 2017 Appropriation

**HEP received $825M in the FY 2017 Congressional Appropriation, about $7M above the FY 2017 President's Budget Request**

- **Congressional direction increased funding for projects**
  - Congress provided LBNF/DUNE with an increase of $4.9M over the request
  - Congress directed HEP to spend $12.5M for LZ, increase of $2M over the request
  - Congress directed HEP to spend $12M for TEC for DESI, $3M over the request
- **HEP Research Program funding was reduced as a result of Project funding increasing more than the HEP top line increase**

DEPARTMENT OF ENERGY
(Amounts in thousands)

| | FY 2016 Enacted | FY 2017 Request | Final Bill |
|---|---|---|---|
| High energy physics: | | | |
| Research | 728,900 | 729,476 | 731,500 |
| Construction: | | | |
| 11-SC-40 Long baseline neutrino facility / deep underground neutrino experiment, FNAL | 26,000 | 45,021 | 50,000 |
| 11-SC-41 Muon to electron conversion experiment, FNAL | 40,100 | 43,500 | 43,500 |
| Subtotal, Construction | 66,100 | 88,521 | 93,500 |
| Subtotal, High energy physics | 795,000 | 817,997 | 825,000 |

# HEP FY 2018 President's Budget Request

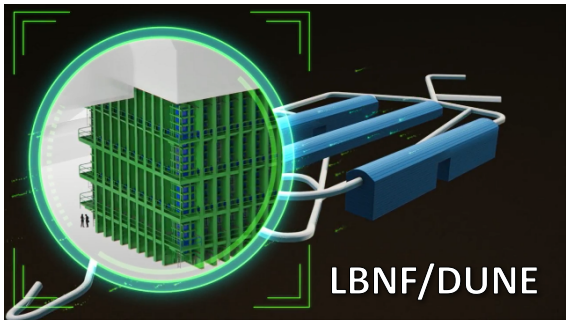
| HEP Funding ($ in thousands) | FY 2016 Enacted | FY 2017 Annualized CR | FY 2017 Enacted | FY 2018 Request | FY 2018 *vs.* FY 2016 | | FY 2018 *vs.* FY 2017 Enacted | |
|---|---|---|---|---|---|---|---|---|
| Research | 341,663 | 352,344 | 347,852 | 272,887 | -68,776 | -20% | -74,965 | -21% |
| Facility/Operations | 258,236 | 252,084 | 255,162 | 213,813 | -44,423 | -17% | -41,349 | -16% |
| Projects & Constr. | 195,101 | 189,061 | 221,986 | 186,000 | -9,101 | -4% | -35,986 | -16% |
| **Total** | **795,000** | **793,489** | **825,000** | **672,700** | **-122,300** | **-15%** | **-152,300** | **-18%** |

- **The 2018 President's Budget Request for HEP is an overlay of Administration, DOE Office of Science, and P5 priorities**
- **FY18 Budget Request reduces near-term science for P5-guided investments in mid- and long-term program**
  - **All projects continue, some with delays**
  - **Research maintained at 40% of the program budget, but Request will reduce activities at the National Labs and Universities, with higher priority given to:**
    - **Laboratory research programs that are critical to executing the P5 recommendations**
    - **R&D that requires long-term investments (*i.e.*, "seeding the future") including Accelerator Stewardship, Detector R&D, and Quantum Information Science (QIS)**
  - **Operations support for ongoing experiments reduced to make this possible**
- **Both the Administration and Congress support the overall P5 strategy**

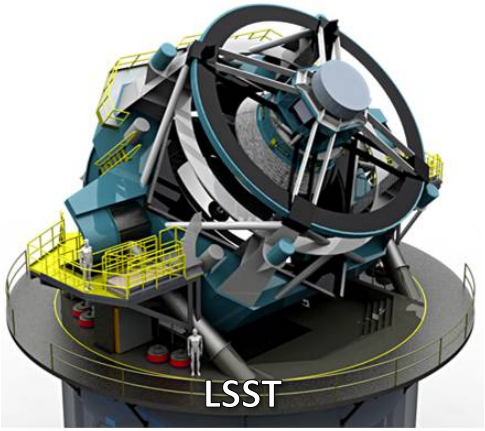
# HEP FY 2018 President's Budget Highlights

- **Energy Frontier: Actively engage in successful LHC program and High-Luminosity LHC (HL-LHC) upgrades**
  - **P5's highest priority near-term large projects are the HL-LHC accelerator upgrade (new MIE start) and the HL-LHC ATLAS & CMS detector upgrades**

- **Intensity Frontier: Support establishing a U.S.-hosted world-leading neutrino program**
  - **LBNF/DUNE is the highest P5 priority in its time frame and FY 2018 investments in initial far-site construction are crucial to enable scheduled delivery of contributions from international partners**

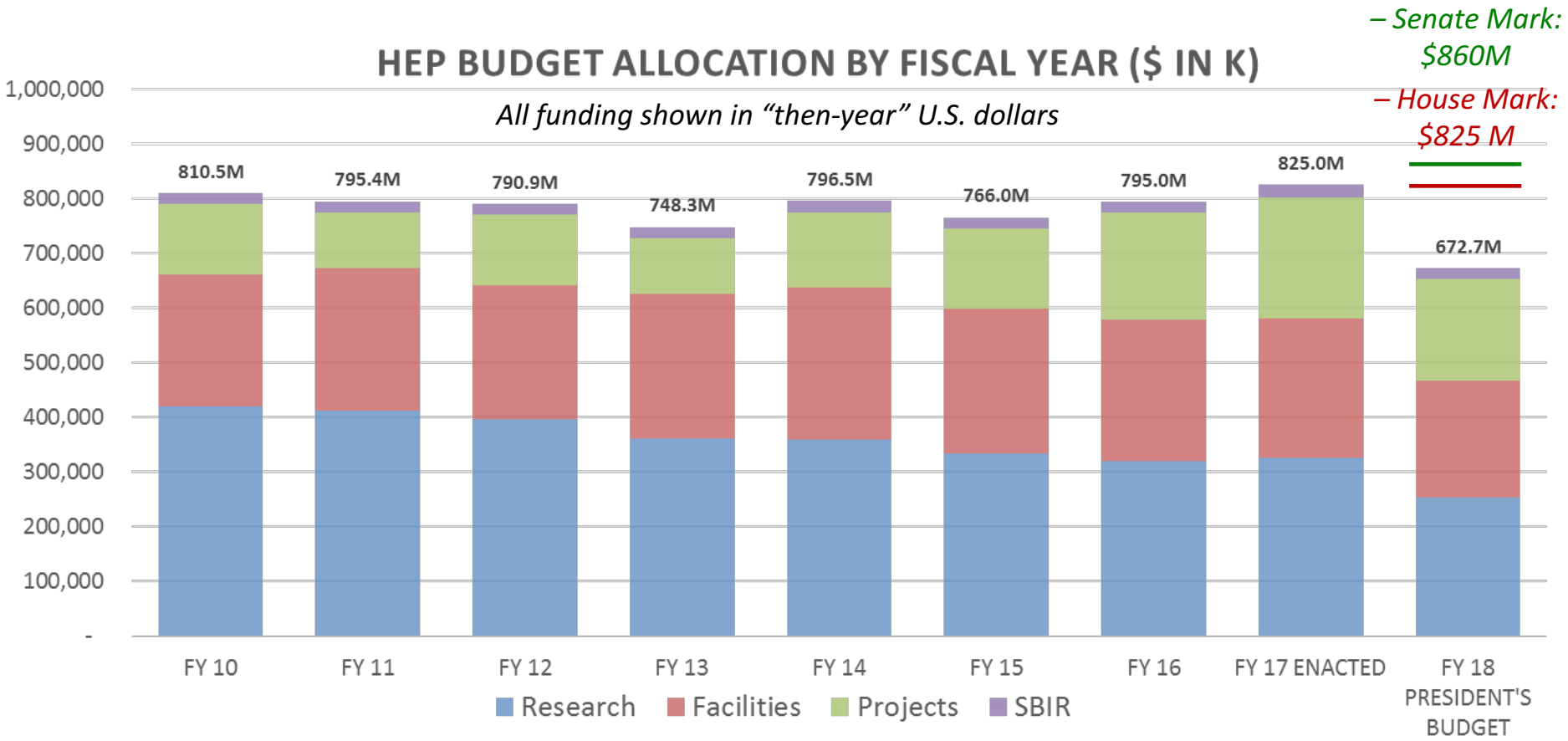



- **Cosmic Frontier: Advance understanding of dark matter and dark energy**
  - **P5 recommended a complementary suite of projects to study dark matter and dark energy and to support CMB experiments as part of core program**



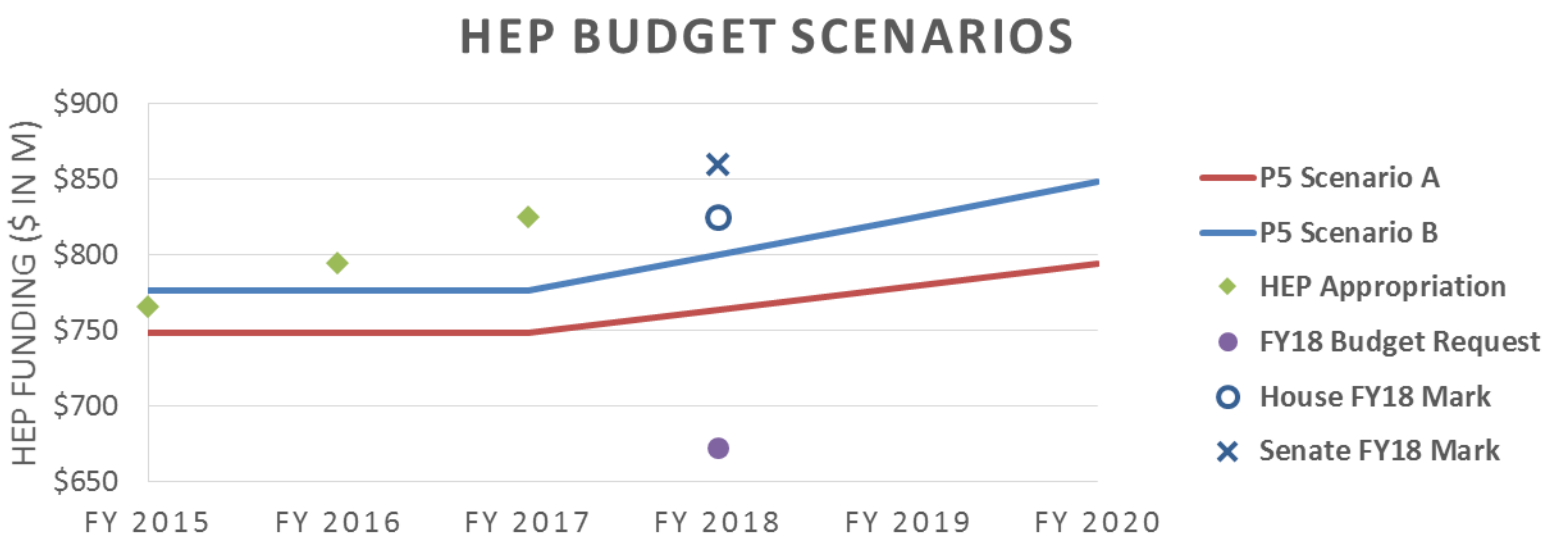
# Overall HEP Budget Trend

- P5 strategy continues to define investments in future of the field
- Current draft of House FY 2018 appropriations bill is flat/Senate slightly up
- Congressional marks are a budget indicator, but funding level not set until appropriation bill is passed



# HEP Budget *vs.* P5 Funding Scenarios

- **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 2018 appropriations process is progressing**
  - President's Budget Request released May 23; House/Senate Marks in June/July
  - Congressional Appropriations Committees are drafting legislation
  - Final language of appropriations bill (and report) impact how funding is directed



# ENERGY FRONTIER

*Credit: DC Comics' Justice League – Power Rangers Issues #3 and #4, May 2017 and June 2017*

# DOE/HEP Energy Frontier

| Experiment | Location | Center-of-Mass Energy; Status | Description of Science | # Institutions; # Countries | # U.S. Institutions | #U.S. Coll. |
|---|---|---|---|---|---|---|
| ATLAS (A Toroidal LHC ApparatuS) | CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Meyrin, Switzerland] | 7-8 TeV; 13-14 TeV<br>Run 1 ended: Dec. 2012<br>Run 2 started: May 2015 | Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics | 182 Institutions; 38 Countries | 41 Univ., 4 National Labs | 620 |
| CMS (Compact Muon Solenoid) | CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Cessy, France] | 7-8 TeV; 13-14 TeV<br>Run 1 ended: Dec. 2012<br>Run 2 started: May 2015 | Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics | 210 Institutions; 45 Countries | 48 Univ., 1 National Lab [+1 National Lab as sub-institute] | 650 |

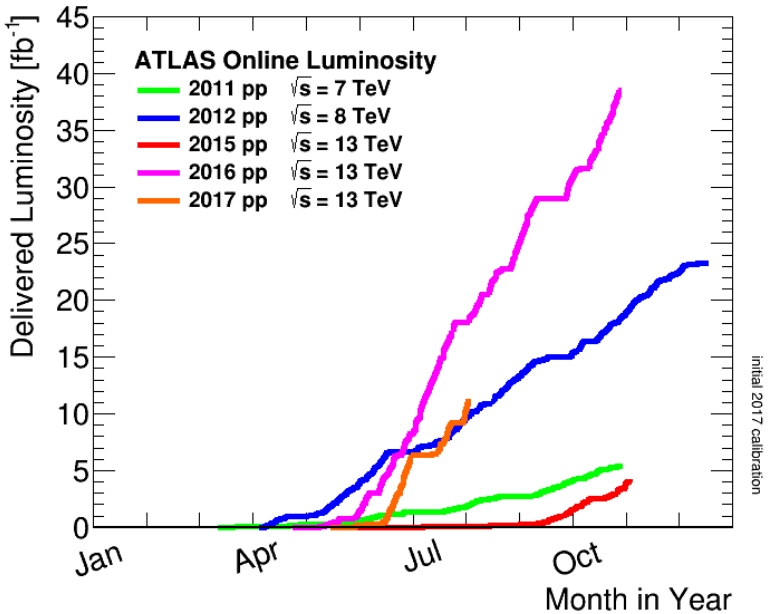
*LHC data provided by U.S. LHC collaborations, as of April 2017.*

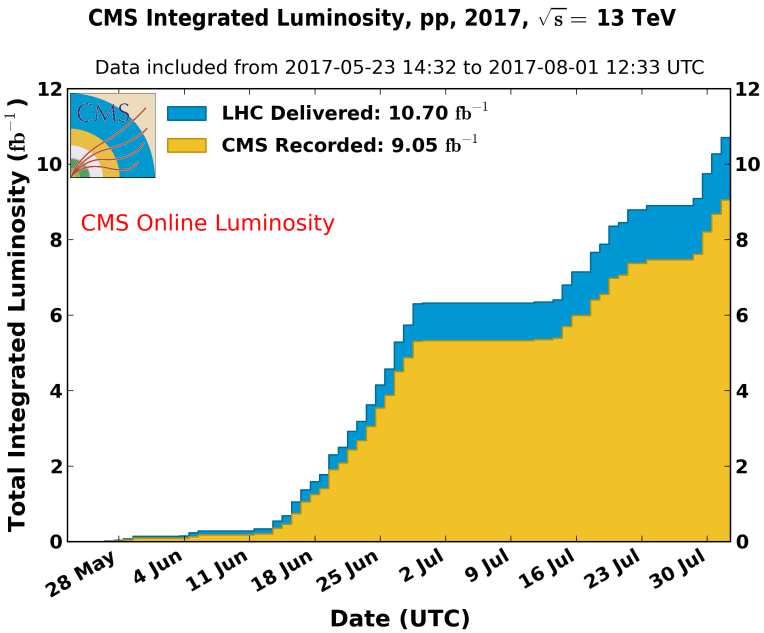
- One main scientific thrust – LHC at CERN (*pp* collider): ATLAS and CMS Collaborations
- Modest support for studies on future collider initiatives:
  - mainly ~3-4 FTEs on ILC *or* FCC/CERN physics studies and detector R&D

- U.S. is the single largest collaborating nation in both the ATLAS and CMS experiments at LHC
  - U.S.-ATLAS: ~22% of the international ATLAS Collaboration
    - ~190 U.S. graduate students
  - U.S.-CMS: ~27% of the international CMS Collaboration
    - ~210 U.S. graduate students

# LHC Continues Excellent Performance!

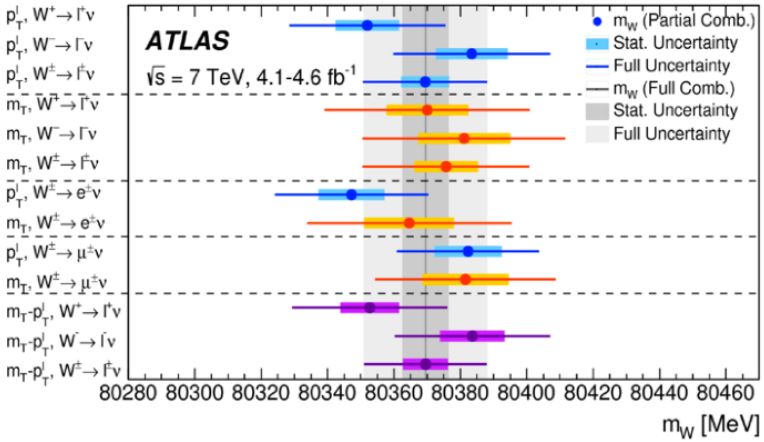
- After Extended Year-end-Technical Stop, Run 2 resumed at full throttle earlier this year!
- LHC continues to set new performance records in 2017:
  - Unprecedented peak instantaneous luminosity of ~1.68 x $10^{34}$ $cm^{-1}s^{-1}$ exceeds design luminosity by ~70%!
  - Number of proton bunches circulating
- Currently ~10.7 $fb^{-1}$ of data delivered in 2017 (goal of 45 $fb^{-1}$ by the end of 2017)
- Congratulations to the CERN accelerator team for the hard work in operating the LHC, and to the experiments for the high performance efficiency in acquiring data!



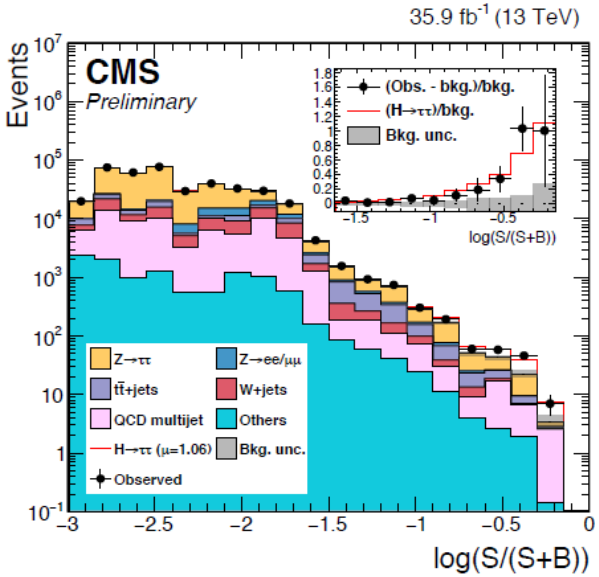



# Highlights from the LHC

- **Over 660 LHC Run 1+2 papers submitted by each of the CMS and ATLAS Collaborations**
  - **Excellent showing at the summer conferences**
- **Recent highlights include:**
  - **ATLAS measurement of the *W* boson mass to 19 MeV precision**
  - **CMS result for $H \rightarrow \tau\tau$: observed (expected) significance of 4.9σ (4.7σ) for $m_H$ = 125 GeV**
- **DOE looks forward to more exciting results during Run 2**
  - **And looks forward to the 25th Anniversary Celebration of LHC'92 scheduled at CERN in December 2017**
    - **Milestone of the March 1992 Evian Meeting launching the LHC experiments**




$m_W$ = 80.370 ± 0.007 (stat.) ± 0.011 (exp.syst.) ± 0.014 (mod.syst.) GeV
= 80.370 ± 0.019 GeV

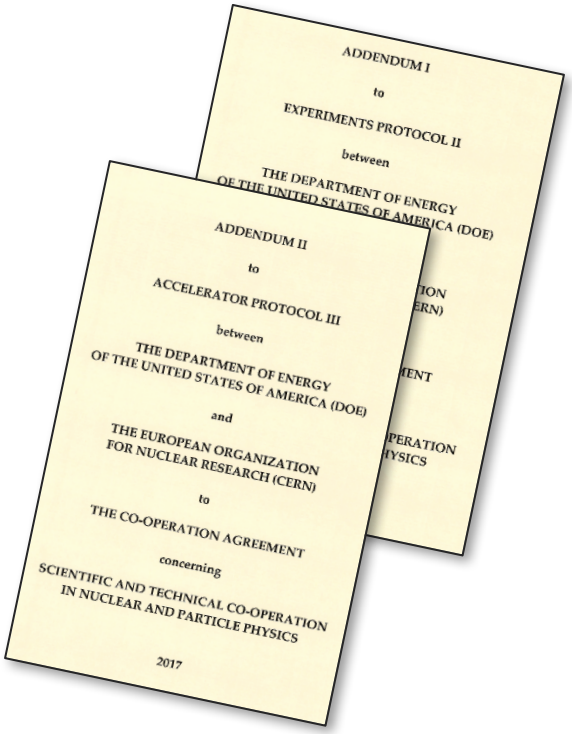


# U.S. Contributions to the LHC

**Energy Frontier program continues to build on the bilateral U.S.-CERN Agreement and Protocols, signed in 2015**

- **The unique scientific capabilities of the LHC promise compelling science for decades to come**
- **DOE-CERN addenda to the protocols for HL-LHC accelerator, experiments; and neutrinos signed May 2017**

- **P5 report identified High-Luminosity LHC (HL-LHC) upgrades as highest priority near-term large project**
  - HL-LHC extends discovery potential by increasing LHC collision rate, enabling detectors to collecting a factor of ten more data over another decade
- **U.S. leadership in superconducting magnet technology, and with $Nb_3Sn$ in particular, is essential to the success of the HL-LHC project**
  - HL-LHC Accelerator Upgrade Project uses this expertise to serve HEP community needs
- **U.S. laboratories and institutions will develop and build major subsystems for the HL-LHC ATLAS and CMS detector upgrades**
  - Detector expertise and support provides foundation for continued U.S. leadership in HL-LHC scientific research program


ADDENDUM I
to
EXPERIMENTS PROTOCOL II
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)

ADDENDUM II
to
ACCELERATOR PROTOCOL III
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)
and
THE EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH (CERN)
to
THE CO-OPERATION AGREEMENT
concerning
SCIENTIFIC AND TECHNICAL CO-OPERATION
IN NUCLEAR AND PARTICLE PHYSICS
2017

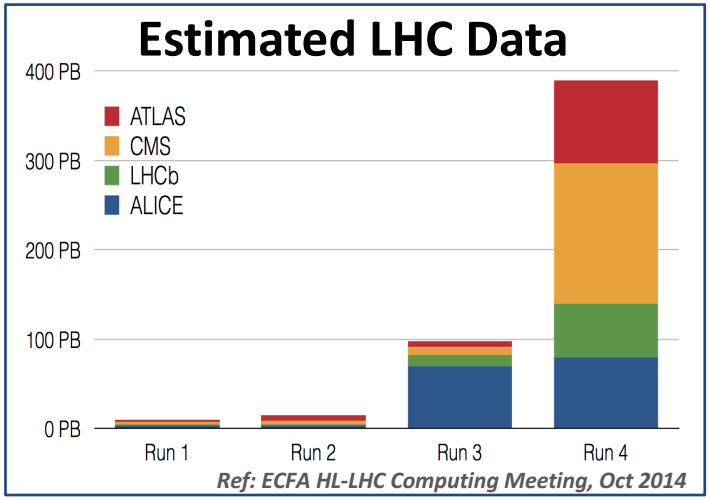
# Energy Frontier: Status & Outlook

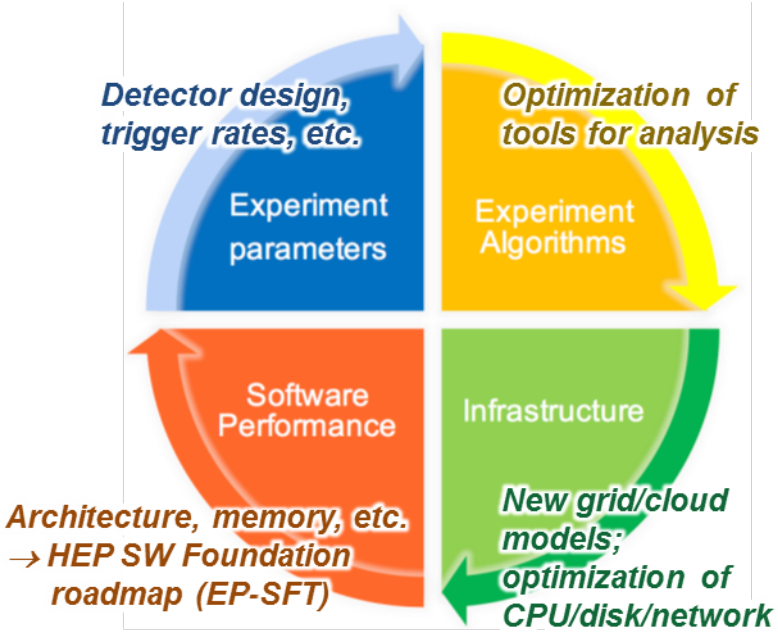
| Project | TPC ($M) | CD Status | CD Date |
|---|---|---|---|
| LHC ATLAS Detector Upgrade [“Phase-1”] | 33 | CD-3 | November 12, 2014 |
| LHC CMS Detector Upgrade [“Phase-1”] | 33 | CD-3 | November 12, 2014 |
| High-Luminosity LHC (HL-LHC) Accelerator Upgrade | 180-250 | CD-0 | April 13, 2016 |
| High-Luminosity LHC (HL-LHC) ATLAS Detector Upgrade | 125-155 | CD-0 | April 13, 2016 |
| High-Luminosity LHC (HL-LHC) CMS Detector Upgrade | 125-155 | CD-0 | April 13, 2016 |

- The U.S. will continue to play a leadership role in LHC discoveries by remaining actively engaged in analysis of LHC collider data at 13-14 TeV
- ATLAS and CMS [Phase-I] detector upgrade projects receive final funding in FY17
  - [early] CD-4a planned in September 2017 for portion of CMS upgrade
- With the approval of CD-0 for the HL-LHC Accelerator Upgrade Project and HL-LHC ATLAS and CMS Detector Upgrades, project funding starts in FY17
- HL-LHC Accelerator Upgrade Project (MIE start) and design and R&D efforts for HL-LHC ATLAS and CMS detector upgrades:
  - HL-LHC Accelerator Upgrade Project CD-1 review scheduled in August 2017
  - HL-LHC ATLAS and CMS Upgrade Projects CD-1 reviews planned for March 2018

# Computing in the HL-LHC Era

- **Simple extrapolation takes us to an unsustainable place**
  - Costs in excess of the entire DOE-HEP budget
- **Our goal is to match demonstrable experiment need with a realistic funding profile – we want the science to succeed**
  - How do the software and computing models evolve?
    - Much was developed beginning 15 years ago
    - They need to function 15 years from now
  - To what extent can we leverage DOE-ASCR capabilities?
  - What is the optimum balance between CPU/disk/networking?
- **What is the optimum balance between people and hardware?**
  - How do we fund people today so we don't need hardware tomorrow?
  - Goal: assess computing needs early enough to help inform experiments and funding agencies for successful LHC operations during HL-LHC era



# HEP FUNDING OPPORTUNITY ANNOUNCEMENT (FOA): COMPARATIVE REVIEWS

# University HEP 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**
  - **FY 2018 FOA marks the 7th 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**

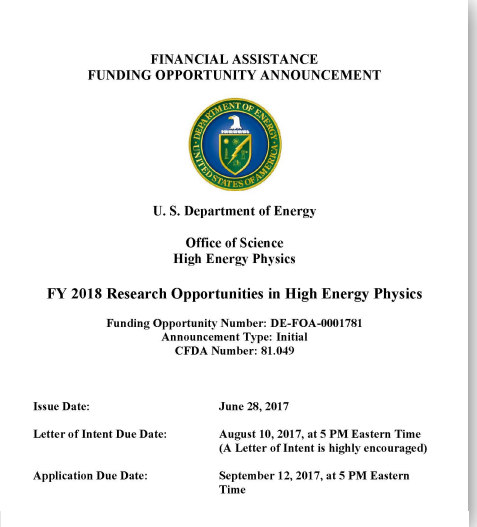
**Goal: improve overall quality and efficacy of the HEP research program by identifying the best proposals with highest scientific impact and potential**

# FY18 HEP Comparative Review FOA and FAQ

- **DE-FOA-0001781 issued June 28, 2017**
- **Six HEP research subprograms**
  - Energy, Intensity, and Cosmic Frontiers
  - HEP Theory
  - Accelerator Science and Technology R&D
  - Detector R&D
- **Letter of Intent due August 10, 2017 by 5 PM Eastern Time**
  - *Strongly encouraged*
- **Final Proposal deadline September 12, 2017 by 5 PM Eastern Time**

- **In addition to the FOA, a FAQ is available and addresses topics on:**
  - Registration and eligibility requirements
  - Proposal types and proposal 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 available at:**
***http://science.energy.gov/hep/funding-opportunities/***



FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

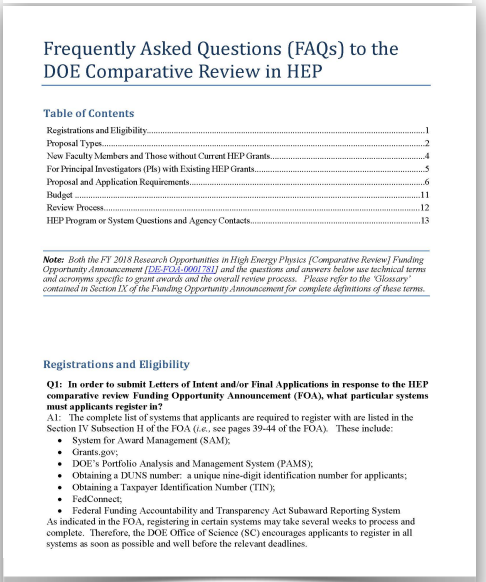
U. S. Department of Energy

Office of Science
High Energy Physics

FY 2018 Research Opportunities in High Energy Physics

Funding Opportunity Number: DE-FOA-0001781
Announcement Type: Initial
CFDA Number: 81.049

| | |
|---|---|
| Issue Date: | June 28, 2017 |
| Letter of Intent Due Date: | August 10, 2017, at 5 PM Eastern Time (A Letter of Intent is highly encouraged) |
| Application Due Date: | September 12, 2017, at 5 PM Eastern Time |



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

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**Note:** *Both the FY 2018 Research Opportunities in High Energy Physics [Comparative Review] Funding Opportunity Announcement [DE-FOA-0001781] and the questions and answers below use technical terms and acronyms specific to grant awards and the overall review process. Please refer to the 'Glossary' contained in Section IX of the Funding Opportunity Announcement for complete definitions of these terms.*

Registrations and Eligibility

**Q1: In order to submit Letters of Intent and/or Final Applications in response to the HEP comparative review Funding Opportunity Announcement (FOA), what particular systems must applicants register in?**

A1: The complete list of systems that applicants are required to register with are listed in the Section IV Subsection H of the FOA (*i.e.*, see pages 39-44 of the FOA). These include:

- System for Award Management (SAM);
- Grants.gov;
- DOE's Portfolio Analysis and Management System (PAMS);
- Obtaining a DUNS number: a unique nine-digit identification number for applicants;
- Obtaining a Taxpayer Identification Number (TIN);
- FedConnect;
- Federal Funding Accountability and Transparency Act Subaward Reporting System

As indicated in the FOA, registering in certain systems may take several weeks to process and complete. Therefore, the DOE Office of Science (SC) encourages applicants to register in all systems as soon as possible and well before the relevant deadlines.

# 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**

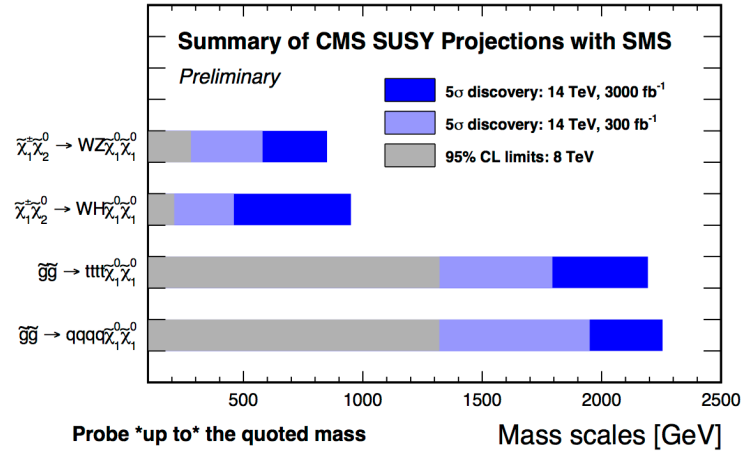
- **Investigators in experimental HEP research frontiers (Energy, Intensity, Cosmic) will review best if they are closely integrated into HEP experiment collaborations and have key roles and responsibilities on those experiments**

- **"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 that are 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)**

# Energy Frontier Merit Reviews: LHC

- **Energy Frontier Research supports science analysis efforts on ATLAS and CMS:**
  - Physics analyses
  - Activities that support analyses (*e.g.*, reconstruction, object-ID, triggers, …)
  - Within these topical areas, reviews evaluate:
    - Scientific output, impact and accomplishments by each PI and overall group
    - Group's research plans and timeline for deliverables during the Run 2 program




- **… and in next ~8-10 years with the planned LHC upgrades**
  - Upgrade activities will mix with physics research-related efforts
    - PIs are encouraged to provide a ***balanced*** proposal illustrating that the group conducts activities across: research + operations + upgrade
    - HL-LHC plans should be ***aligned*** with respect to the U.S.-CMS or U.S.-ATLAS projects

- **Other general observations**
  - In addition to activities at CERN, encourage the university community to exploit and interact with CMS LHC Physics Center (LPC) or the ATLAS Centers (ATCs)

# 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 (top, bottom, left, and right). Font must not be smaller than 11 point.**
  - **Senior investigator ≡ 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**

- **Encouraged to refer to Section IV of the 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, …**

# 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 — *for e.g.:*
    - gravity waves (LIGO), heavy-ion (RHIC *or* at LHC), AMO Science

# Research Scientists (RS)

- Panel will evaluate RS efforts where support is requested in a comparative review 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 operation/project activities with minimum physics research efforts…'
    - such efforts may review well in a DOE review of the operation/project program but not as well in a review of the experimental research program
- What is "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 '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 sketch

# Cross-cut, Multi-thrust, or Transitional Proposals

- **Applications where a PI is proposing to conduct research across multiple HEP research subprograms during the project period will be considered**

- **PIs are encouraged to submit only one application, describing:**
  - **Overall research activity, including fractional time planned in each subprogram**
  - **Continuing into the FY18 FOA: in proposal's Budget Justification material (Appendix 7), include level of effort table for any transitions 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
    - ☑ 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

- Supportive of excellent people, including excellent *new* people, even when times are tough!
- Corollary: Some proposals or senior personnel ranked below average will *not* be funded.

# Comparative Merit Review Criteria

*[Sub-questions are provided in Section V of FOA and to merit reviewers/panel to evaluate proposal and PI(s)]*

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.,* Does the proposed research employ innovative concepts or methods? How logical and feasible are the approaches? 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 Research Team 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 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 (cont.)

## 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
- Are highlighted by DOE Program Managers at the beginning of panel deliberations
- Are presented and discussed by individual panelists for each proposal
- Other Program Policy Factors, such as program alignment with respect to the P5 strategic plan, are also discussed with panelists

## 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

# Office of Science (SC): Data Management Plan (DMP)

- **Data management involves all stages of the digital data life cycle including capture, analysis, sharing, and preservation. The focus of the SC Digital Data Management is the sharing and preservation of digital research data**
  - **See Dr. Laura Biven's presentation on SC Digital Data Management, Sept. 2014 HEPAP meeting: *http://science.energy.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: *http://science.energy.gov/funding-opportunities/digital-data-management/***
    - **See Section IV, the subsection on Appendix 8 of the FOA, for requirements pertaining to DMPs that must be included in your application**

- **CMS and ATLAS have developed DMPs for their collaborations**
  - **When applying for financial assistance grants [universities] or submitting FWPs [labs] for research, proposals can cite the DMPs for their experiments with the appropriate links:**
    - **CMS Data Policy Document: CMS Document 6032-v1 (2012)**
      - ***https://cms-docdb.cern.ch/cgi-bin/PublicDocDB/ShowDocument?docid=6032***
    - **ATLAS Data Access Policy Document: ATLAS-CB-PUB-2015-001 (2015)**
      - ***https://cds.cern.ch/record/2002139?ln=en***

**Each research thrust in a proposal requesting DOE research support, including the FY 2018 Comparative Review FOA, will require addressing the DMP requirements for it to be reviewed, and hence, to be considered for funding**

# Renewal Proposal Products

- ‘Renewal’ proposals are 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 FAQ Q&As #9 and #17-19 for additional guidance
- Renewal Proposal Products [see Section II.G of the FY18 comp rev FOA]
  - 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
    - Details with step-by-step instructions available in PAMS User Guide, Section 9.2: *https://pamspublic.science.energy.gov/WebPAMSEPSExternal/CustomInterface/Common/ExternalUserGuide.pdf*
  - Types of products include:
    - Publications (note: 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 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 ← be on the look-out 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

# Guidance Checklist for FY18 Comp Rev

- Non-compliant applications will not be reviewed, and therefore, will not be considered for funding. As a convenience and courtesy, DOE/HEP has provided a checklist in the FY18 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 | 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. | ☑ |
| 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. | ☑ |
| 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) for which funding is requested. If there is more than one, be sure to attach the Cover Page Supplement. | ☑ |
| Page limits for each section comply with the FOA requirements (as defined in Section IV of the FOA). | ☑ |
| Biographical sketches carefully follow the FOA instructions and avoid PII. | ☑ |
| Current and Pending Support information completed, including 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. | ☑ |
| Post-submission of the application, timely submitted the Renewal Proposal Products (RPP) in PAMS. | ☑ |

# HEP Proposal Review and Award Process

**Pre-Review**

- August: Letter of Intent (LOI) received from PI. Program and review planning at DOE/HEP.
- September: Proposal received. FOA compliance checks at DOE: PI qualifications, scope, page limits, budget pages, DMP, etc.

**Merit Review**

- Sept-October: Proposals assigned to *at least* three merit reviewers via DOE's Portfolio Analysis and Management System (PAMS);
- October-November: Reviewers' input their written evaluations in PAMS.
- November: Panel deliberations of proposals and senior investigators. Add any additional reviews and make comparative reviews & evaluations.

**Post-Review and Award**

- December: Assessment of each proposal and each PI by DOE/HEP using merit review, grant monitor input, programmatic priorities, budget constraints.
- Early-to-mid January: Prioritized budget guidance sent to PIs and requests for revised budgets and budget justifications using proper DOE forms.
- During the Spring: Route proposal's procurement packages through DOE/SC and DOE Chicago Operations Office for approval. Awards processed by the DOE Chicago Operations Office.

# EARLY CAREER RESEARCH PROGRAM

# How to Prepare for an Early Career Proposal

**Address the following questions:**

- **What challenges/problems are you trying to solve? Communicate this in the proposal.**
- **Is someone else doing it already?**
  - **Alternatively, aren't those research activities already being funded elsewhere?**
  - **If you carry-out these efforts, why are they unique and require 'you'?**
- **How does this research exploit/engage the 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?**

**General observations for proposals submitted for research at the LHC (ATLAS, CMS)**

- **Provide *unique* capabilities. What does not get done?**
  - **During preparation, PIs should address "why is it critical that I carry-out this research?"**
  - **How does your work impact the efforts within the international collaboration?**
- **A *balanced* program: strong physics effort + a hardware project attached to an experiment, where PI takes a lead**
- **For searches, discuss the *discovery reach* and do not just state: "in the absence of a signal, a 95% C.L. limit will be set."**

**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)**

- **Applicants are also encouraged to draw guidance from any members within the collaboration**

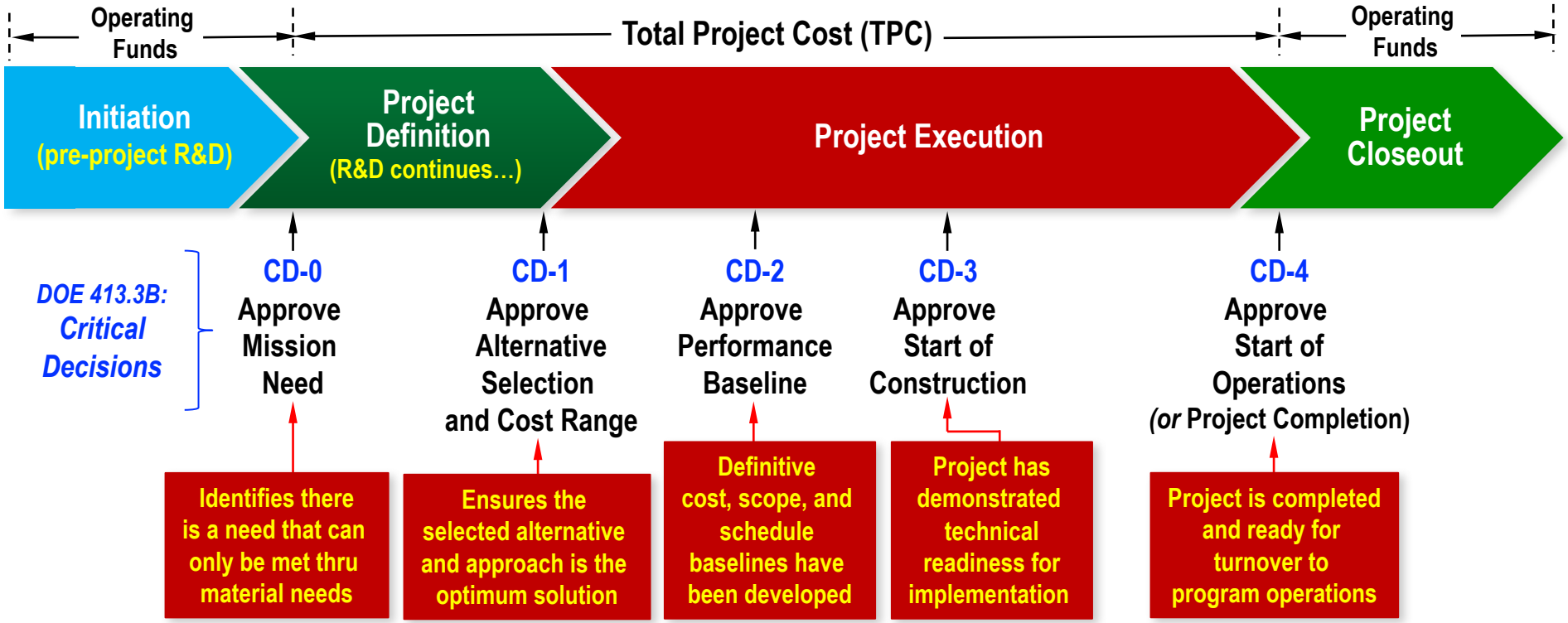
# Take Away Messages

- **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 these outcomes for the nation
- **HEP is executing the P5 plan and delivering science**
  - Only a few highlights in this talk, many new results this week at DPF!
  - FY 2017 funding actions are moving forward
  - FY 2018 funding opportunities will progress the same as FY 2017
- **The FY 2018 budget process is moving forward**
  - President's Budget Request was released
  - House and Senate are drafting legislation that include some significant differences
  - Next steps are with Congress to finalize appropriations bills

U.S. DEPARTMENT OF ENERGY | Office of Science

# DOE Project Management

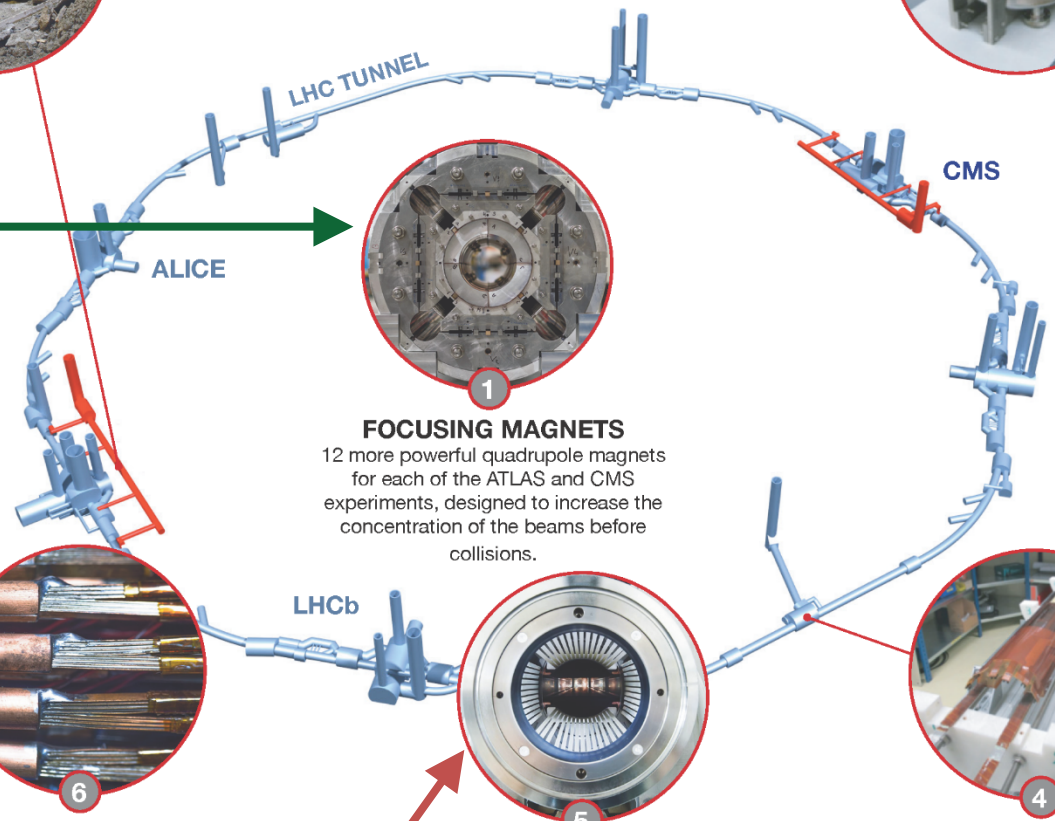
- Construction projects and fabrication of large pieces of experimental equipment costing over $5M are managed through a series of "Critical Decision" milestones
- The CD process ensures successful project execution and scientific return on agency investments, but funding must still be appropriated
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



# HL-LHC Accelerator Upgrades:
# Enabling U.S. Science Participation

**CIVIL ENGINEERING**
2 new 300-metre service tunnels and 2 shafts near to ATLAS and CMS.

**"CRAB" CAVITIES**
16 superconducting "crab" cavities for each of the ATLAS and CMS experiments to tilt the beams before collisions.



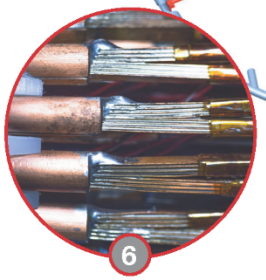



**FOCUSING MAGNETS**
12 more powerful quadrupole magnets for each of the ATLAS and CMS experiments, designed to increase the concentration of the beams before collisions.

**DOE contribution:**
**10 Cold Mass Assemblies**
- **4 each for ATLAS/CMS IRs**
- **2 spares**

**DOE contribution:**
**20 Crab Cavities**
- **16 + 4 spares**

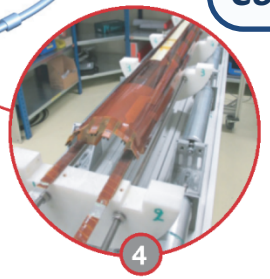
***OR:***
***10 Crab cavities & Hollow e-Lens Components***



**SUPERCONDUCTING LINKS**
Electrical transmission lines based on a high-temperature superconductor to carry current to the magnets from the new service tunnels near ATLAS and CMS.



**COLLIMATORS**
15 to 20 new collimators and 60 replacement collimators to reinforce machine protection.



**BENDING MAGNETS**
4 pairs of shorter and more powerful dipole bending magnets to free up space for the new collimators.

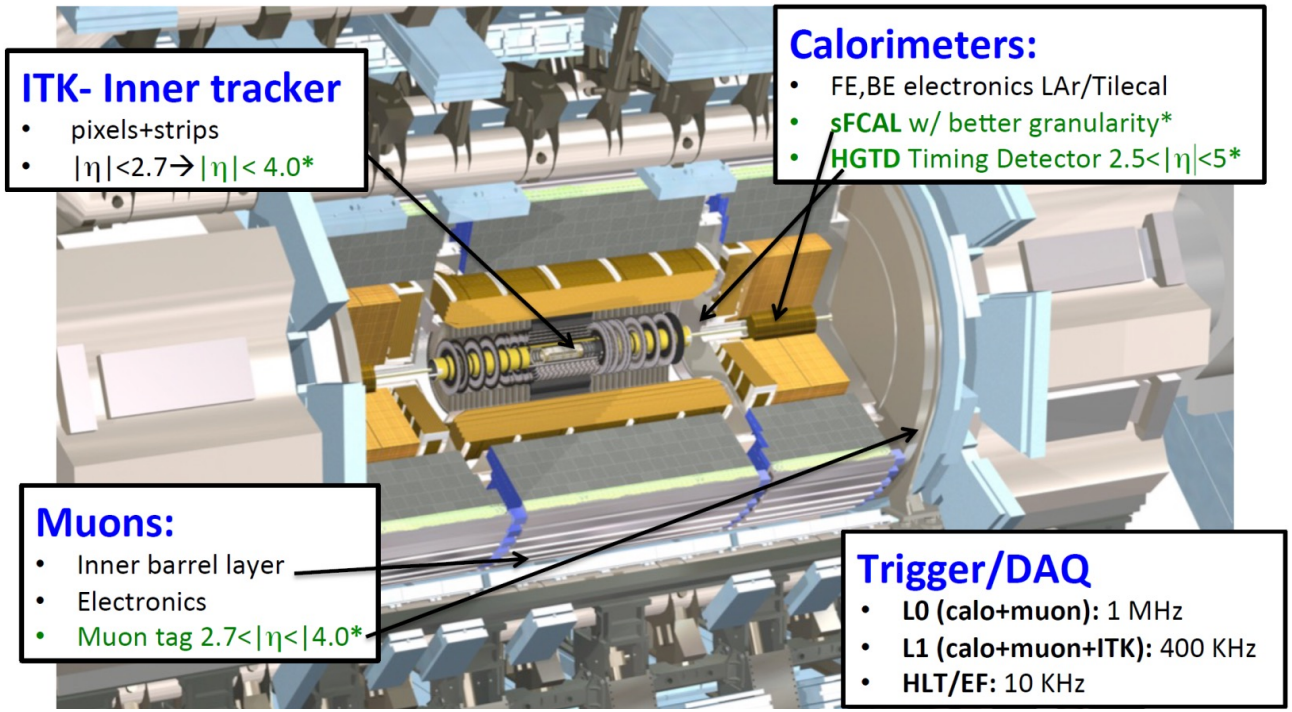
**DOE contribution:**
***Hollow e-Lens Components (under discussion)***

# ATLAS HL-LHC Upgrade

- **U.S. ATLAS has defined the scope of its potential contributions to the HL-LHC upgrades**
  - Driven by future science discovery potential while leveraging the interests and experience of U.S. groups
  - Active coordination with international ATLAS — at all levels

- **DOE Scope:**
  - Barrel ITK (pixel & strip detector)
  - DAQ hardware (data flow elements)
  - LAr front end analog chip development

- **NSF Scope:**
  - Trigger and readout electronics for LAr, Tile, Muons




** Large eta scenarios, as described in the 2015 scoping document for the reference 275 MCHF CORE cost scenario*

# CMS HL-LHC Upgrade

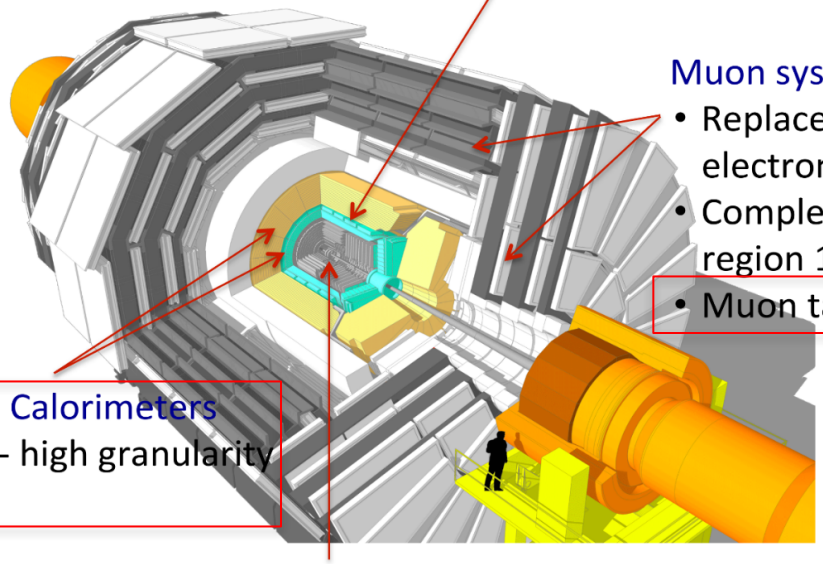
- **U.S. HL-LHC CMS upgrade scope driven by future science opportunities, expertise by U.S. scientists, and coordination with international CMS**

DOE
NSF

Trigger/HLT/DAQ
- Track information at L1-Trigger
- L1-Trigger: 12.5 μs latency - output 750 kHz
- HLT output ≈7.5 kHz

Barrel EM calorimeter
- Replace FE/BE electronics
- Lower operating temperature (8◦)

NSF



Muon systems
- Replace DT & CSC FE/BE electronics
- Complete RPC coverage in region 1.5 < η < 2.4
- Muon tagging 2.4 < η < 3

NSF
DOE

DOE

*Replace Endcap Calorimeters
- Rad. tolerant - high granularity
- 3D capability

Replace Tracker *
- Rad. tolerant - high granularity - significantly less material
- 40 MHz selective readout (Pt≥2 GeV) in Outer Tracker for L1-Trigger
- Extend coverage to η = **3.8**

DOE
NSF



= Significant U.S. contributions

# U.S.-CERN International Agreements, Protocols

CO-OPERATION AGREEMENT
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA
and
THE NATIONAL SCIENCE FOUNDATION
OF THE UNITED STATES OF AMERICA
and
THE EUROPEAN ORGANIZATION FOR
NUCLEAR RESEARCH
concerning
Scientific and Technical Co-operation in Nuclear and
Particle Physics
2015

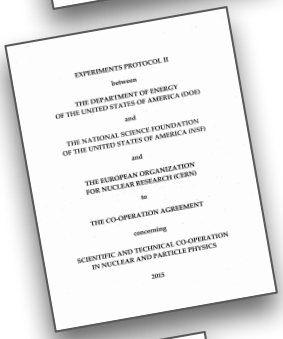
### *International Co-Operation Agreement between the U.S. and CERN concerning Scientific and Technical Co-Operation in Nuclear and Particle Physics*

Parties: United States (DOE and NSF), European Organization for Nuclear Research (CERN)
Signed at Washington, D.C. May 7, 2015; Entered into force May 7, 2015. With Annex.
**Document:** *http://www.state.gov/documents/organization/244968.pdf*

ACCELERATOR PROTOCOL III
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)
and
THE EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH (CERN)
to
THE CO-OPERATION AGREEMENT
concerning
SCIENTIFIC AND TECHNICAL CO-OPERATION
IN NUCLEAR AND PARTICLE PHYSICS
2015

### *Accelerator Protocol III between the U.S. and CERN to the Agreement of May 7, 2015 on Scientific and Technical Cooperation*

Parties: United States (DOE), European Organization for Nuclear Research (CERN)
Signed at Geneva, Switzerland December 18, 2015; Entered into force December 18, 2015. With Addendum on FCC.
**Document**: *https://www.state.gov/documents/organization/253295.pdf*


EXPERIMENTS PROTOCOL II
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)
and
THE NATIONAL SCIENCE FOUNDATION
OF THE UNITED STATES OF AMERICA (NSF)
and
THE EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH (CERN)
to
THE CO-OPERATION AGREEMENT
concerning
SCIENTIFIC AND TECHNICAL CO-OPERATION
IN NUCLEAR AND PARTICLE PHYSICS
2015

### *Experiments Protocol II between the U.S. and CERN to the Agreement of May 7, 2015 on Scientific and Technical Cooperation*

Parties: United States (DOE and NSF), European Organization for Nuclear Research (CERN)
Signed at Geneva, Switzerland December 18, 2015; Entered into force December 18, 2015.
**Document:** *https://www.state.gov/documents/organization/253294.pdf*

NEUTRINO PROTOCOL I
between
THE DEPARTMENT OF ENERGY
OF THE UNITED STATES OF AMERICA (DOE)
and
THE EUROPEAN ORGANIZATION
FOR NUCLEAR RESEARCH (CERN)
to
THE CO-OPERATION AGREEMENT
concerning
SCIENTIFIC AND TECHNICAL CO-OPERATION
IN NUCLEAR AND PARTICLE PHYSICS
2015

### *Neutrino Protocol I between the U.S. and CERN to the Agreement of May 7, 2015 on Scientific and Technical Cooperation*

Parties: United States (DOE), European Organization for Nuclear Research (CERN)
Signed at Geneva, Switzerland December 18, 2015; Entered into force December 18, 2015.
**Document:** *https://www.state.gov/documents/organization/253290.pdf*