



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# High Energy Physics Program Status and Funding Opportunities

*June 2017*

**Glen Crawford**

**Research and Technology Division Director  
Office of High Energy Physics  
Office of Science, U.S. Department of Energy**

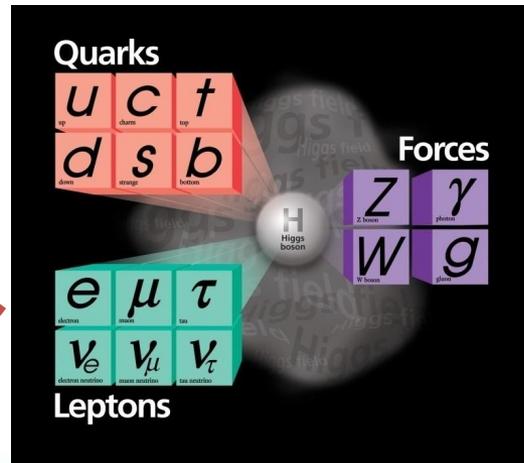
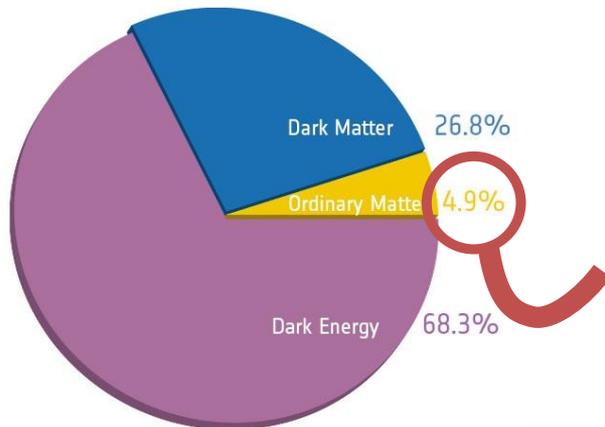
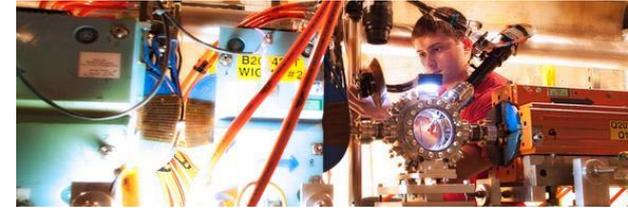
# The High Energy Physics Program Mission

...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 Office of High Energy Physics fulfills its mission by:

- Building **projects** that enable discovery science
- Operating **facilities** that provide the capability to perform discovery science
- Supporting a **research** program that produces discovery science



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# HEP FY 2018 President's Budget Request

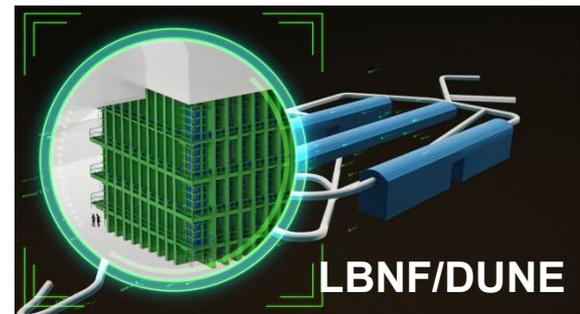
HEP Funding (\$ in thousands)	FY 2016 Enacted	FY 2017 Annualized CR	FY 2017 Enacted	FY 2018 Request	FY 2018 vs. FY 2016	FY 2018 vs. FY 2017 Enacted
Research	341,663	352,344	347,852	272,887	-68,776 -20%	-74,965 -21%
Facility/Operations	258,236	252,084	255,162	213,813	-44,423 -17%	-41,349 -16%
Projects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

- 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
  - More details of FY18 Request in Backup slides and PI Meeting talks
- The new administration supports the overall P5 strategy



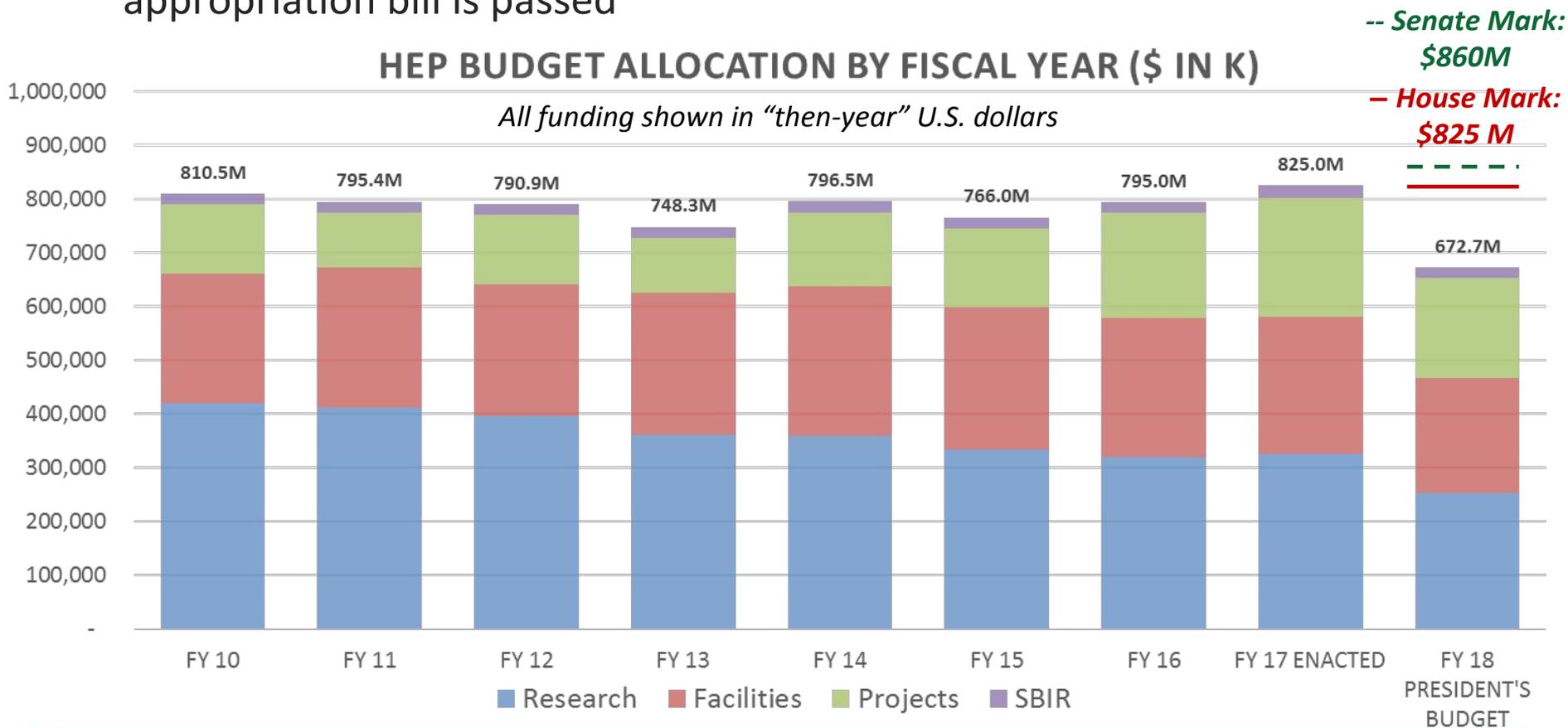
# HEP FY18 President's Budget Highlights

- **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 High-Luminosity Large Hadron Collider (HL-LHC) Accelerator Upgrade (new MIE start) and HL-LHC ATLAS & CMS detector upgrades
- **Intensity Frontier: Support establishing a U.S.-hosted, international 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



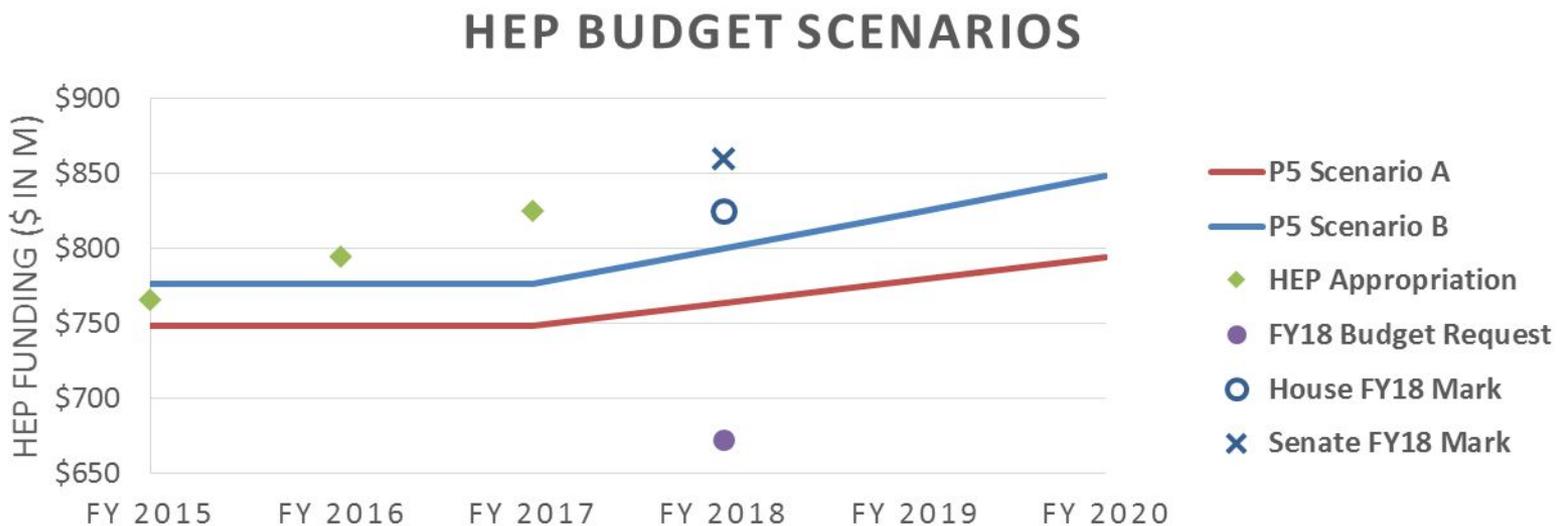
# Overall HEP Budget Trend

- P5 strategy continues to define investments in future of the field
- Current draft of House FY18 appropriations bill is flat with FY17
  - 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



# Quantum Information Science (QIS)

- **FY18 Request identified QIS as a new national and Office of Science priority**
- **HEP QIS emphasis (both near-term and long-term) is on:**
  - P5 science drivers – exploiting entanglement and QIS technology
  - New computational and foundational techniques via QIS
  - Advancing the national QIS enterprise
- **Approach: Interdisciplinary partnerships via connections with other SC programs and/or other federal agencies**
- **Areas of focus for HEP research via coordinated partnerships:**
  - Quantum Computing and Foundational QIS
    - Simulations, entanglement, algorithms, machine learning, data analysis on qubit systems
  - Quantum Sensor Technology
    - Sensors developed in alignment with qubit technology that expand the measurement ranges for experiments
  - Experiments Exploiting Quantum Entanglement
    - New windows on research utilizing QIS foundations, tools, and techniques
- **Reports available at:**
  - <http://science.energy.gov/hep/community-resources/reports/>
- **Program Manager: Lali Chatterjee <[Lali.Chatterjee@science.doe.gov](mailto:Lali.Chatterjee@science.doe.gov)>**



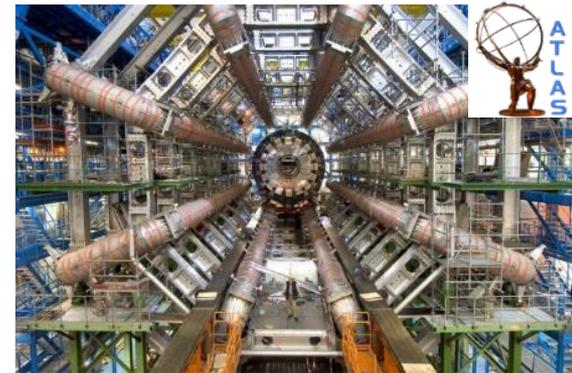


# HEP PROGRAM STATUS

# Energy Frontier Program

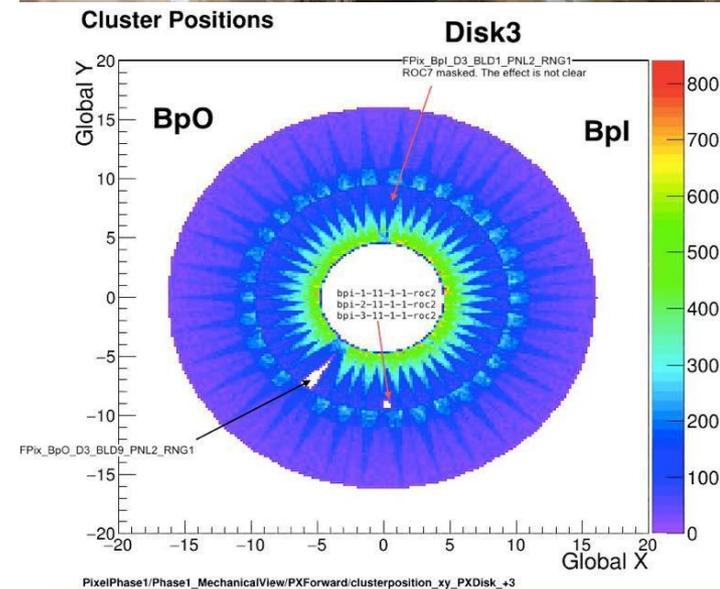
**The Large Hadron Collider (LHC) is currently the centerpiece of Energy Frontier research**

- Only means to produce and study the Higgs boson
- Searches for direct production of dark matter particles
- Explores for signs of new physics through direct production of new particles and precision measurements of known particles
- **P5 recognized that a compelling and comprehensive LHC program is a core part of U.S. particle physics**
  - DOE intends to support key leadership roles in the ATLAS and CMS experiments
- **ATLAS and CMS detector [Phase-I] upgrades for 2019-2020 progressing well**
  - Fully exploit opportunities at the LHC to make precision measurements and explore for new physics



# EF Highlight: Initial LHC Detector Upgrades

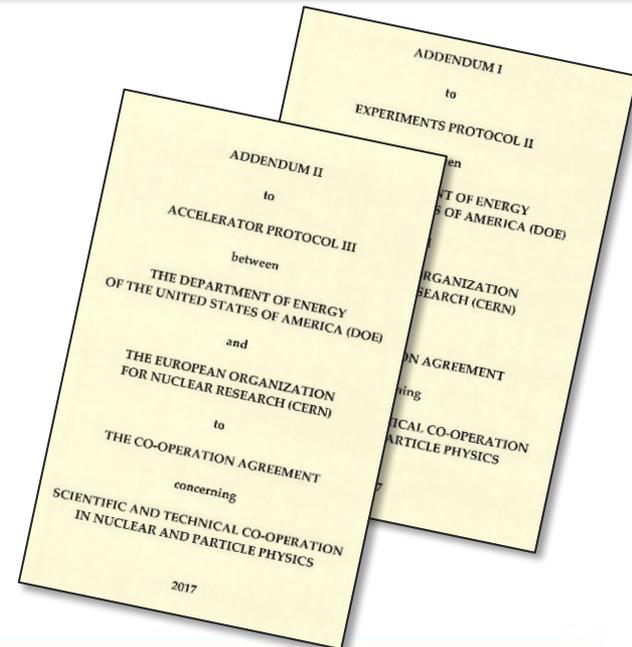
- **ATLAS “Phase 1” upgrade project installation and commissioning has begun**
  - Supported through the U.S.-ATLAS operations program
  - Will continue through 2019-2020 LHC shutdown as U.S.-built components are delivered
- **CMS “Phase 1” upgrade project on track for an early CD-4 in September**
  - Completed more than 90% of the project on budget and well ahead of schedule
  - The upgraded detector (pixel and trigger) is being used already in the current run
    - U.S.-built Forward Pixel (FPIX) trackers installed in March and now taking data



# Future of the Energy Frontier

## Future program building on historic bilateral U.S.-CERN Agreement and protocols, signed in 2015

- DOE-CERN addenda to the protocols for HL-LHC accelerator, experiments, and neutrinos signed May 2017
- Defines US contributions to HL-LHC program and CERN contributions to US neutrino program.
- Further future depends on accelerator R&D as well as physics landscape.
- **U.S. leadership in superconducting magnet technology, and with Nb<sub>3</sub>Sn 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



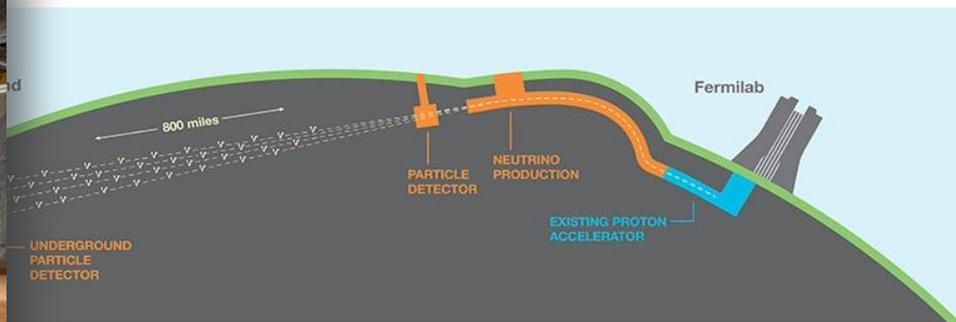
# Intensity Frontier Program

Intensity Frontier experiments address the P5 Science Drivers through intense beams and sensitive detectors

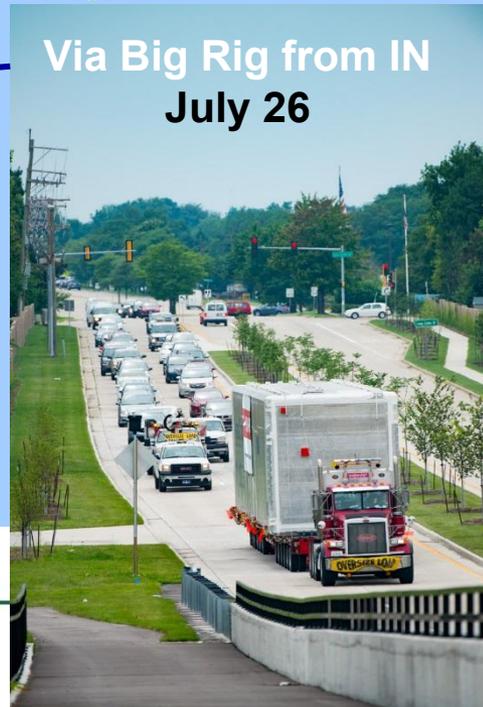
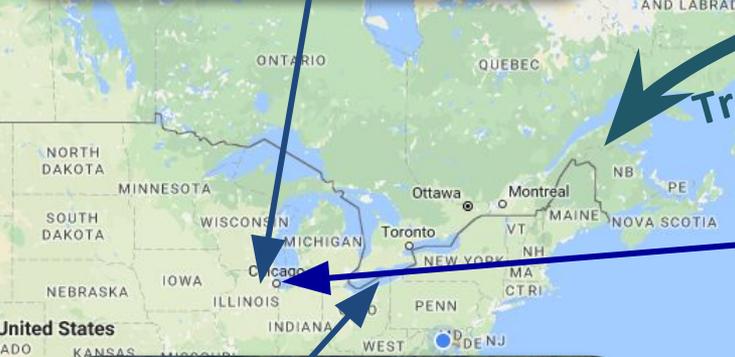
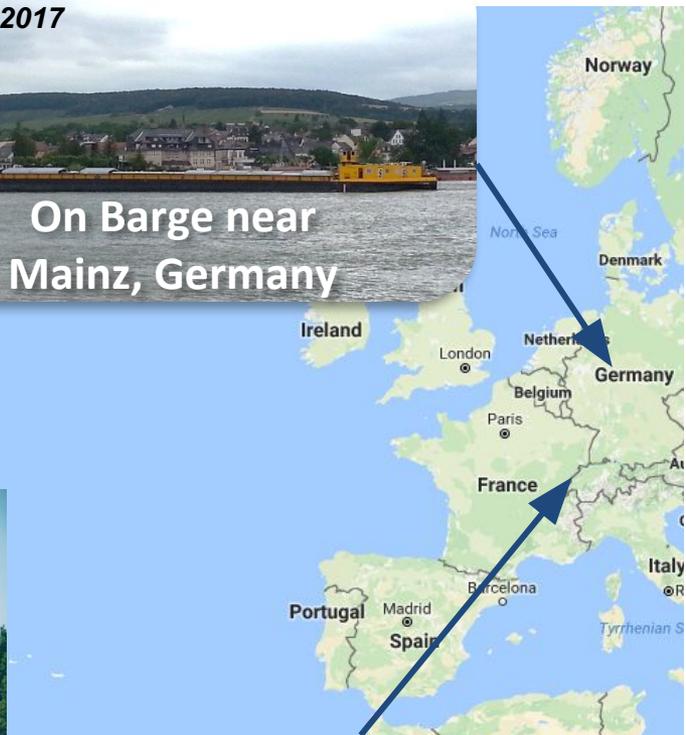
- Exploring the unknown through precision measurements of leptons and quarks
- Identify the new physics of dark matter with accelerator-based techniques
- Pursuing the physics associated with neutrino mass

P5 recommended *Long Baseline Neutrino Facility (LBNF)* as the centerpiece of a U.S.-hosted world-leading neutrino program

- DOE and Fermilab working closely with CERN and other global partners to establish a truly international “mega-science” facility with first physics in the mid-2020s
  - Currently, over 980 collaborators from 164 institutions in 31 countries
- The *Deep Underground Neutrino Experiment (DUNE)* will be a large (40 kiloton) liquid argon neutrino detector located nearly 1 mile underground at the Sanford Underground Research Facility
  - Groundbreaking for *LBNF/DUNE* far-site construction held on July 21, 2017



# IF Highlight: #IcarusTrip



# Cosmic Frontier Program

## Study dark energy through staged program of complementary surveys (in partnership with NSF Astronomy)

- Wide-area surveys map cosmic structure over vast volumes of space
- Focused surveys build deep, 3D maps of cosmic structure and growth

## Search for dark matter through direct detection experiments over a wide mass range (in partnership with NSF Physics)

- High- and low-mass ( $\sim 1$ -100 GeV) WIMP sensitivity
- Axion (ultralow mass) resonant cavity experiment

## Search for high energy particles, e.g. from dark matter annihilations in cores of galaxies (in partnership with NSF, NASA)

- Cosmic- and gamma-ray detectors on Earth and in space

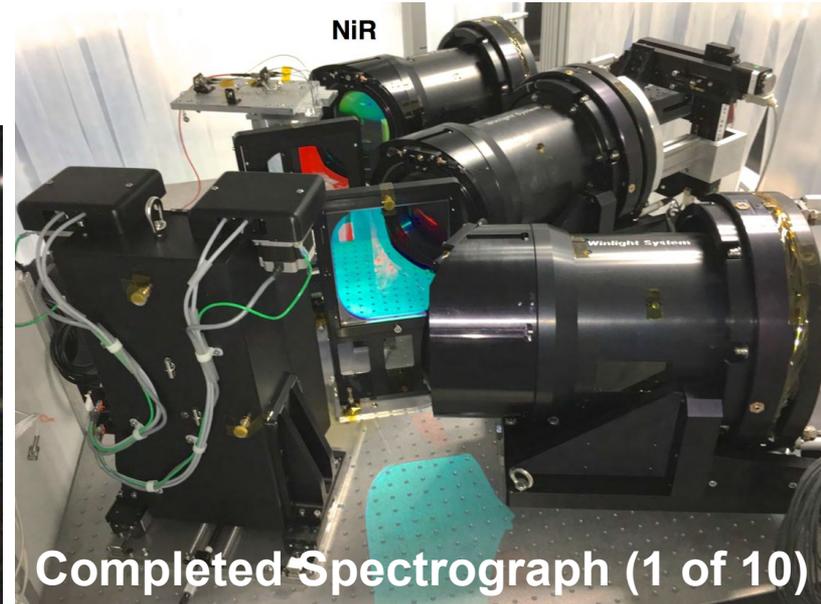
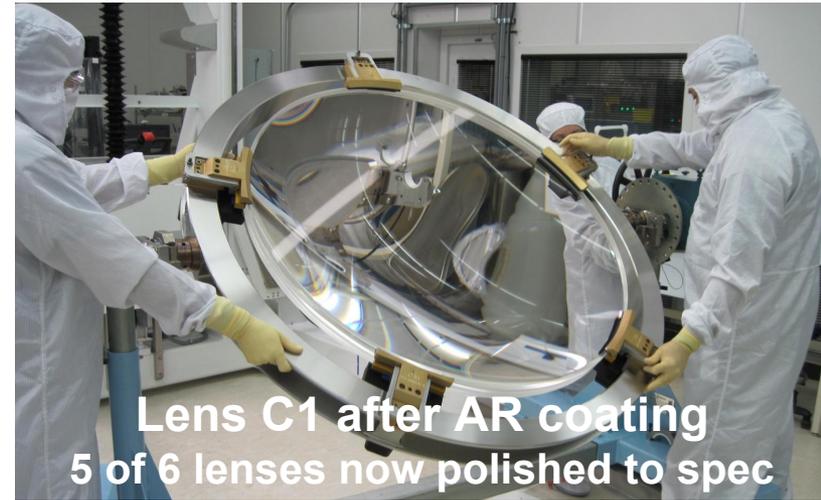
## Study cosmic acceleration (inflation) at energies near the Planck scale and neutrino properties through the cosmic microwave background (CMB) (in partnership with NSF)

- New generation South Pole experiment in operation
- Next generation array 10x more sensitive in planning



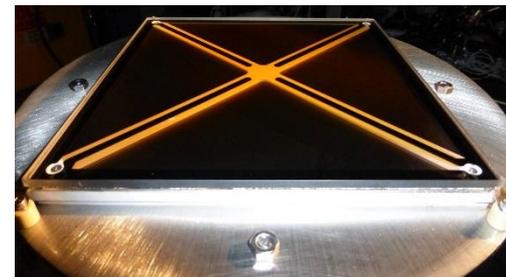
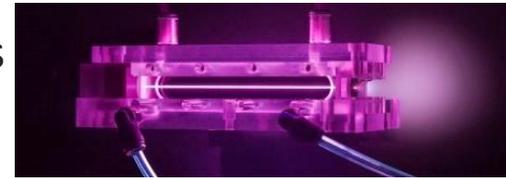
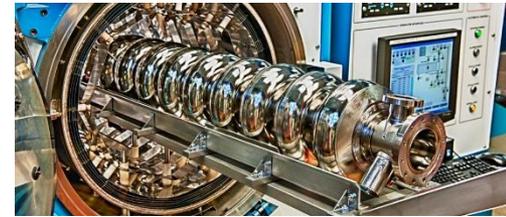
# CF Highlight: Dark Energy Spectroscopic Instrument

- **DESI is a Stage 4 Dark Energy spectroscopic experiment**
  - Will probe dark energy and gravity with Baryon Acoustic Oscillation (BAO) distance and Redshift Space Distortion (RSD) growth methods
  - Will map 3-D positions of 30 million galaxies



# Enabling Discovery through Advanced Technology R&D

- **Advanced Technology R&D supports and advances research at all three experimental Frontiers**
  - Fosters cutting-edge research in the physics of particle beams, accelerator R&D, and particle detection
- **Three broad categories:**
  - **Near- to mid-term directed R&D** for specific facilities or technologies in support of current DOE projects
  - **Mid-term, facility-inspired R&D** focused on specific concepts or technologies to demonstrate feasibility
  - **Long-term, proposal-driven research** on the fundamental science to enable breakthroughs in size, cost, beam intensity, beam energy, and control
- **Recent results:**
  - Low-Loss Superconducting Radio-Frequency (SRF) Cavities using new processes developed by Fermilab
  - Advances in laser-driven and beam-driven plasma wakefield accelerators
  - Record current in high-temperature superconductors
  - First commercial production of Large-Area Picosecond Photodetectors (LAPPDs)



# General Accelerator R&D Status

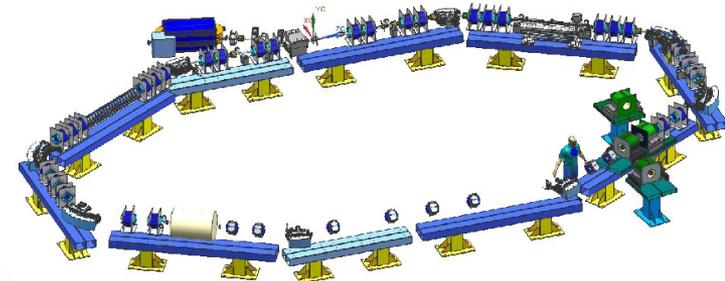
- Charting technical roadmaps for future accelerator R&D: community-based workshops defining R&D strategy
  - Advanced Accelerator Concepts [Done]
  - Superconducting Magnet and Materials [Done]
  - RF Acceleration Technology [workshop done, report in final editing stage]
  - Particle Sources and Targetry [preparatory workshop on targetry done, final workshop next FY]
  - Accelerator and Beam Physics [not started]



# General Accelerator R&D Highlight

## GARD accelerator facilities:

- BELLA @ LBNL focusing on:
  - 10 GeV beam from single module
  - High energy (5 GeV + 5 GeV) staging experiment
- FACET @SLAC
  - Analyze and publish FACET results
  - Develop expts, design study, simulation in preparation for FACET-II
- AWA @ANL
  - Dielectric two-beam & collinear accel
  - Beam manipulation expts
- FAST/IOTA @FNAL
  - Commissioning and completing electron and proton injectors, linac, IOTA ring, ...
  - $e^-$  expts in 2018,  $p^+$  expts in 2019 or 2020



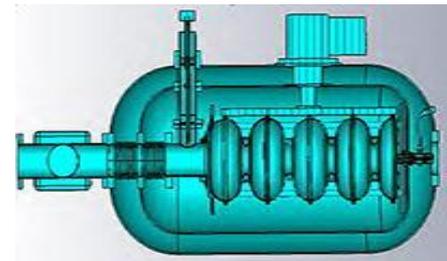
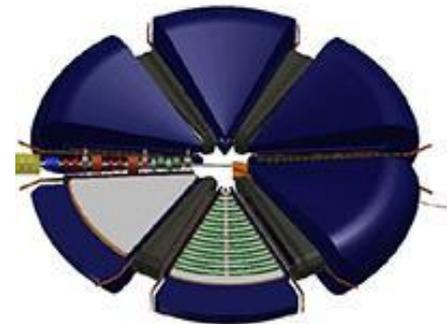
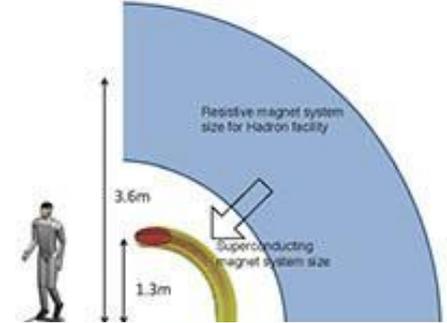
# The Accelerator Stewardship Program

Support fundamental accelerator science and technology development of relevance to many fields and to disseminate accelerator knowledge and training to the broad community of accelerator users and providers.

- Improve access to national laboratory accelerator facilities
- Develop innovative solutions to critical problems outside of the DOE Office of Science
- Broaden and strengthen the community
  - Bringing accelerator scientists, application scientists, and industrialists together to address high-impact challenges outside of “traditional” HEP

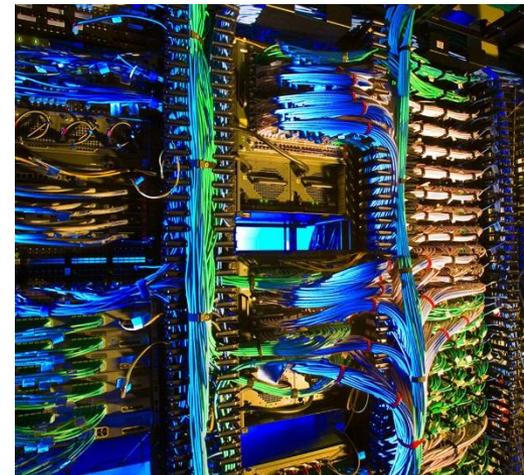
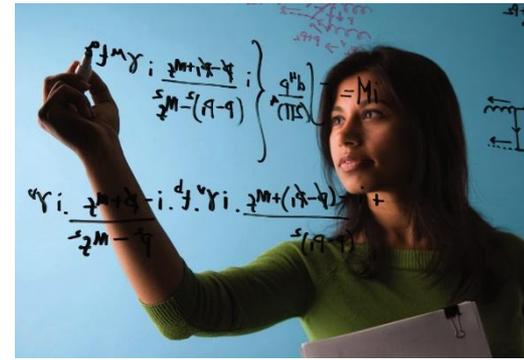
## Status & Outlook

- FY18 Request will support research activities at laboratories, universities, and in industry for technology R&D areas such as laser, ion-beam therapy, and accelerator technology
  - R&D on high power electron beam technologies for science and other applications will move from design studies to R&D
  - Test Facility Program will make SC accelerator infrastructure more readily available to non-DOE users
- FY17 Stewardship FOA is closed, proposals under review



# Theoretical and Computational Physics

- Provides the mathematical, phenomenological, and computational framework to understand and extend our knowledge of the dynamics of particles and forces, and the nature of space and time -- shaping and guiding the future of the field
  - **Theoretical research** essential for proper interpretation and understanding of the experimental research activities in other HEP subprograms
  - **Advanced computing** tools necessary for designing, operating, and interpreting experiments and scientific simulations that enable experimental discovery research
- **Implementing the P5 strategy requires advancing computing infrastructure to handle the exponentially increasing data and computing needs**
  - HEP aims to optimally leverage DOE resources in developing future computing solutions to meet our mission needs
  - Cross-cutting efforts aim to prepare for future of computing, especially Exascale facilities



# Theory and Computation: Status and Outlook

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- **SciDAC re-competed in FY 2017 in partnership with ASCR**
  - Partners researchers in science “domains” (like HEP) with computer scientists do make significant advances in software and algorithms
  - Selections to be announced soon
- **Increased funding in FY18 Request for Computational Physics will support new Quantum Information Science (QIS) and advanced computing initiatives**
  - QIS is Administration and SC priority which provided additional funds to HEP (\$15M) in late stages of FY18 budget development
  - HEP to work with ASCR and other SC offices to develop R&D plan that takes advantage of particular HEP capabilities (e.g., theory, SRF cavities, sensor development)

A photograph of several stacks of US pennies, arranged in a slightly descending staircase pattern from left to right. The coins are copper-colored and show some wear. The background is a plain, light-colored surface.

# HEP FUNDING OPPORTUNITIES

# Comparative Review and PI Meetings

- **FY 2017 Comparative Review completed. Had a similar number of proposals reviewed as FY 2016, but with larger research groups**
  - 136 proposals (FY 2017) vs. 134 proposals (FY 2016)
  - 386 senior investigators (FY 2017) vs. 309 senior investigators (FY 2016)
  - Overall proposal average success rate similar at 57%
  - FY 2017 New and Renewal awards are now being processed
- **FY 2018 Comparative Review FOA is out now (see details later)**

## DOE HEP PI Meetings progressing in parallel to DPF talks:

Session	Presenter	Date & Time	Location
HEP Civics	M. Cooke	Mon 7/31 @ 12:30	1 West
Intensity Frontier	M. Cooke	Tue 8/1 @ 12:30	1 West
Cosmic Frontier	E. Linder	Wed 8/2 @ 10:45	1 East
Energy Frontier	A. Patwa	Wed 8/2 @ 12:30	1 West
Detector R&D	H. Marsiske	Thurs 8/3 @ 10:45	1 East
Theory	W. Kilgore	Thurs 8/3 @ 12:30	1 West



# 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: Complete Belle-II and take data
- **Cosmic Frontier**
  - Dark Matter: Complete G1 analysis, construct G2 experiments, modest R&D
  - Dark Energy: Complete BOSS, DES analysis; construct LSST and DESI
  - Continue 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**
  - In process of seeking community input to identify highest priority R&D activities in wake of 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**
  - Maintain an overall “thriving” program as per P5



# U.S.-Japan FOA

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- **First DOE/HEP joint funding opportunity with Japan (MEXT/KEK)**
- **Evolves “traditional” (since 1979) US-Japan program**
  - Required collaborative proposals with coordinated US and Japanese scope on joint research/R&D efforts.
  - Parallel proposals, separately reviewed/funded by each side
  - Separate program for ILC cost reduction R&D per DOE/MEXT mgmt.
- **DOE call posted November 2016 via FOA and lab call**
  - Proposals were due Jan 2017, 41 applications received on U.S.-side
  - Mail/panel reviews in March
  - U.S./Japan sides exchanged info and met in early April to reconcile recommendations. Tentative selections endorsed by US-Japan Cooperation Committee in mid-April
    - U.S. priority on technology R&D
  - PIs have been notified, awards are being processed
- **Now discussing FY18 plans with Japanese colleagues**



# Other Funding Opportunities

- **HEP programs:**
  - DOE Traineeship in Accelerator Science and Engineering (new!)
    - Supports multiple graduate students in specific technology areas for up to 2 years
    - Application deadline just closed, proposals under review
- **Workforce Development (WDTS) programs:** <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.
- **Office of Science programs:**
  - Early Career Research : <https://science.energy.gov/early-career/>
  - SC “Open Call” DE-FOA-0001664 [HEP uses this primarily for supplemental proposals, experimental operations support and conferences]



# 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: 91.049

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: With the FY 2018 Research Opportunities in High Energy Physics (Comparative Review) Funding Opportunity Announcement (DE-FOA-0001781), and the questions and answers below are substantial terms and conditions specific to grant awards and the overall review process. Please refer to the "Keynote" 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.

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# 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
- **Eligible Applications (*new in FY 2018*):**
  - “All applications ... **requesting support for more than one person** must propose a Program Director/Principal Investigator who is currently in a **tenure-track appointment.**”
- **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!***



# Take Away Messages

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- **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 those discoveries**
  - Excellent progress across the program
    - A few recent project highlights in this talk, many new results here at DPF!
    - Many experiments in operation, or coming on-line soon
  - FY 2017 funding actions are moving forward
  - Anticipate FY 2018 Funding Opportunity process will be the same as FY 2017
    - Several DOE PMs are here at DPF; see PI meetings for more details
- **The FY 2018 Budget process is moving forward**
  - President's Budget Request and House and Senate Marks for HEP have some significant differences
  - Next steps are with Congress to finalize Appropriations bills
- **There is no shortage of things to do...**



# Let's Get to Work!





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# Energy Frontier: Status & Outlook FY18 Request

Project	TPC (\$M)	CD Status	CD Date
LHC ATLAS Detector Upgrade ("Phase I")	33	CD-3	November 12, 2014
LHC CMS Detector Upgrade ("Phase I")	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

- **LHC continues Run II operations at 13 TeV**
  - 2017 physics running began in May, scheduled to continue through December
- **ATLAS and CMS [Phase-I] detector upgrade projects receive final funding in FY17**
- **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**
- **FY18 Request supports 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
  - Project profiles adjusted in FY18 Request to reflect project maturity and schedule constraints



# Intensity Frontier: Status & Outlook FY18 Request

Project	TPC (\$M)	CD Status	CD Date
Long Baseline Neutrino Facility / Deep Underground Neutrino Experiment (LBNF/DUNE)	1,300 – 1,900	CD-3A	September 1, 2016
Proton Improvement Project (PIP-II)	465-650	CD-0	November 12, 2015
Muon g-2	46.4	CD-3	August 20, 2015
Muon-to-Electron Conversion Experiment (Mu2e)	273.7	CD-3	July 14, 2016

- **IF experiments will continue to advance and produce science results in FY18**
  - COHERENT, Daya Bay, MicroBooNE, MINERvA, Muon g-2, NOvA, Super-K, T2K : data taking and analysis
  - Belle II, Heavy Photon Search, ICARUS, KOTO, PROSPECT : installation and commissioning
- **Mu2e follows planned fabrication funding profile in FY18 Request**
- **FY18 Request slows LBNF/DUNE investment growth vs. CD-3A**
  - FY 2018 investments enable international contributions on schedule, but delays project completion
- **FY18 Request delays PIP-II vs. CD-1 schedule**
- **FY18 Request provides reduced funding for the Fermilab Accelerator Complex**
  - Impact on FY2018 run plan under discussion
- **House and Senate FY18 Marks address these issues.**



# Cosmic Frontier: Status & Outlook FY18 Request

Project	TPC (\$M)	CD Status	CD Date
LUX-ZEPLIN (LZ)	55.5	CD-3	February 9, 2017
Super Cryogenic Dark Matter Search - SNOLAB (SuperCDMS-SNOLAB)	16-21	CD-1	December 21, 2015
Dark Energy Spectroscopic Instrument (DESI)	56.3	CD-3	June 22, 2016
Large Synoptic Survey Telescope Camera (LSSTcam)	168	CD-3	August 27, 2015

- **CF experiments will continue to advance and produce science results in FY18:**
  - ADMX-G2, AMS-2, DES, eBOSS, FGST, HAWC, SPT-3G : data taking and analysis
- **FY18 Request prioritizes efforts on LSSTcam and LZ, slows DESI and SuperCDMS-SNOLAB**
  - **LSSTcam and LZ projects follow their planned fabrication funding profiles**
    - LSSTcam receives final funding in FY 2018; LZ in FY 2019
  - **DESI to be rebaselined**
    - Coordinating with NSF-AST to support continuity of Mayall Telescope operations plan
  - **SuperCDMS-SNOLAB will be delayed as project transitions to fabrication**
    - Will coordinate with NSF-PHY and SNOLab management
- **House and Senate FY18 Marks address these issues.**



# Advanced Tech. R&D: Status & Outlook FY18

## Request

Project	TPC (\$M)	CD Status	CD Date
Facility for Advanced Accelerator Experimental Tests II (FACET-II)	46-60	CD-1	December 21, 2015

- **FACET-II accelerator project will be delayed vs. CD-1 at the FY18 Budget Request**
  - Coordination with the BES LCLS-II project necessary to plan a new schedule for installation
- **FY18 Request Advanced Technology R&D Research priorities:**
  - **General Accelerator R&D:** Execute roadmaps developed with community, focus on AAC and SC magnets
  - **Directed Accelerator R&D:** LARP completes R&D for HL-LHC prototypes as funding transitions to HL-LHC projects. MAP receives final funding in FY17.
  - **Detector R&D:** Emphasis on long-term, high-risk, high potential impact efforts. Focus on advanced sensor development, possible synergy with QIS.

