U.S. DEPARTMENT OF ENERGY | Office of Science

Intensity Frontier

38th International Conference on High Energy Physics
DOE-PI Meeting Session • Sheraton Grand Chicago
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Alan L. Stone
Office of High Energy Physics
Office of Science, U.S. Department of Energy

Outline

- HEP Overview
- Budget
- LBNF/DUNE
- Intensity Frontier Overview
- Comparative Review
- Early Career
- Workforce Development
- Last Word
- Q&A

The High Energy Physics Program Mission

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

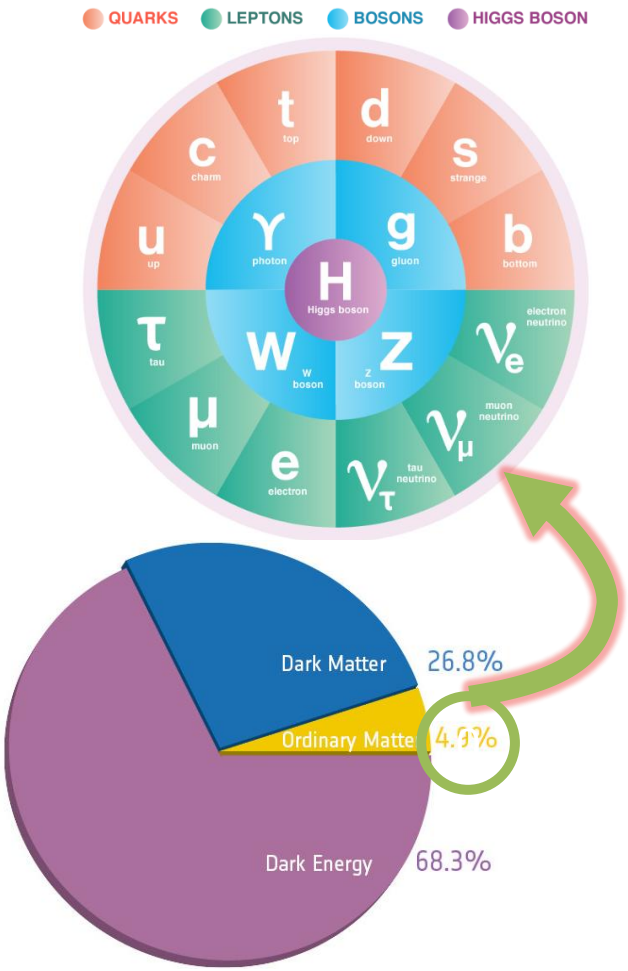
- **Discover** the most elementary constituents of **matter and energy**
- **Probe** the **interactions** between them
- **Explore** the basic nature of **space and time**

Office of High Energy Physics (HEP) fulfills its mission by:

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

Our program is formally advised by:

- High Energy Physics Advisory Panel (HEPAP)
  - Jointly chartered by DOE and NSF to advise both agencies
- Astronomy and Astrophysics Advisory Committee (AAAC)
  - Advises DOE, NASA, and NSF on selected issues in astronomy & astrophysics of mutual interest and concern
- National Academy of Sciences (NAS)
  - Established by Congress in 1863 to advise the government and any department thereof on the arts and sciences



The Next Big Discovery in Particle Physics

The DOE HEP mission is to understand how the universe works at its most fundamental level:

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

Science priorities guided by the five intertwined science drivers presented by P5:

- Use the **Higgs boson** as a new tool for discovery *2013
- Pursue the physics associated with **neutrino mass** *2015
- Identify the new physics of **dark matter**
- Understand **cosmic acceleration**: dark energy and inflation *2011
- **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*

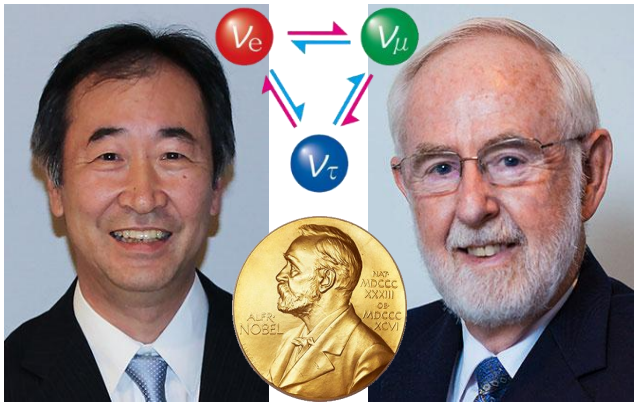
Enabling Discovery at the Intensity Frontier

- **Intensity Frontier researchers use intense particle beams and highly sensitive detectors to make precise measurements and search for new physics**
  - **Precise measurements of particle properties and studies of the rarest particle interactions predicted by the Standard Model could uncover new physics**
  - **Measuring the mass and other properties of neutrinos may have profound consequences for understanding the evolution and fate of the universe**
- **The Intensity Frontier pursues these science drivers:**
  - **Pursue the physics associated with neutrino mass**
  - **Identify the new physics of dark matter**
  - **Explore the unknown: new particles, interactions, and physical principles**

Neutrino Mass | Dark matter | Explore the Unknown

Neutrino Physics

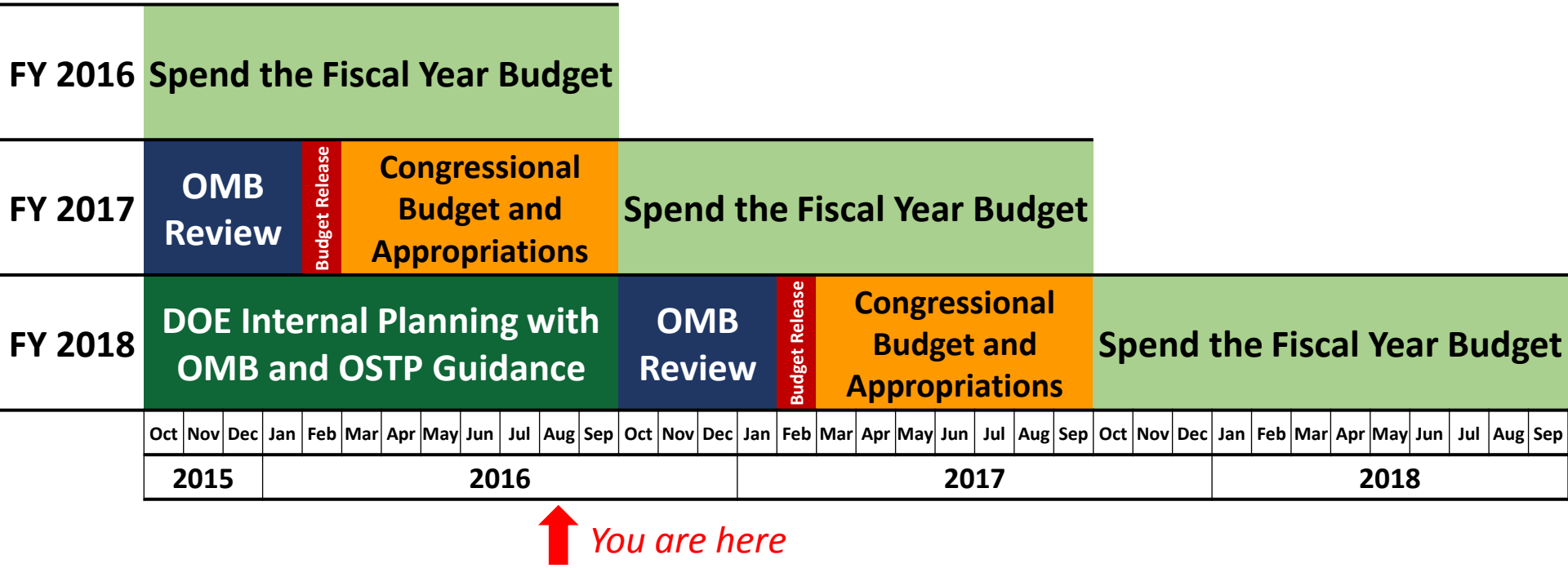
- The Nobel Prize in Physics for 2015 was awarded to T. Kajita and A.B. McDonald for the discovery of neutrino oscillations, which shows that neutrinos have mass
- The 2016 Breakthrough Prize in Fundamental Physics was awarded to five experiments investigating neutrino oscillations
- Understanding neutrino masses and interactions may lead to answers to big questions:
  - Are there more than three types of neutrinos? (Short-baseline)
  - What is the mass ordering of neutrinos? (Long-baseline)
  - Do neutrinos and antineutrinos oscillate differently? (Long-baseline)
  - Are neutrinos their own antiparticle? (0νββ; DOE NP)
- P5 recommended that the U.S. host a coherent short- and long-baseline neutrino program




BUDGET
OF THE U.S. GOVERNMENT
FISCAL YEAR 2017
OFFICE OF MANAGEMENT AND BUDGET

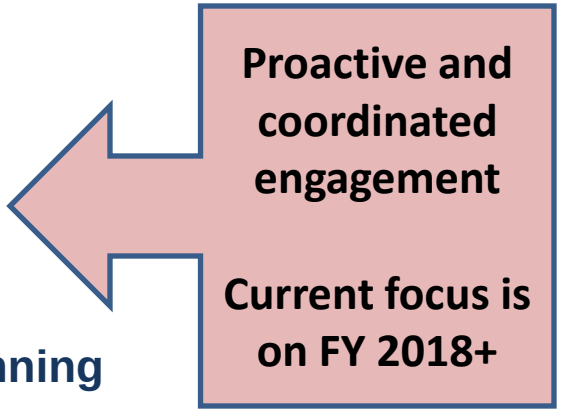
The U.S. Federal Budget Cycle

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



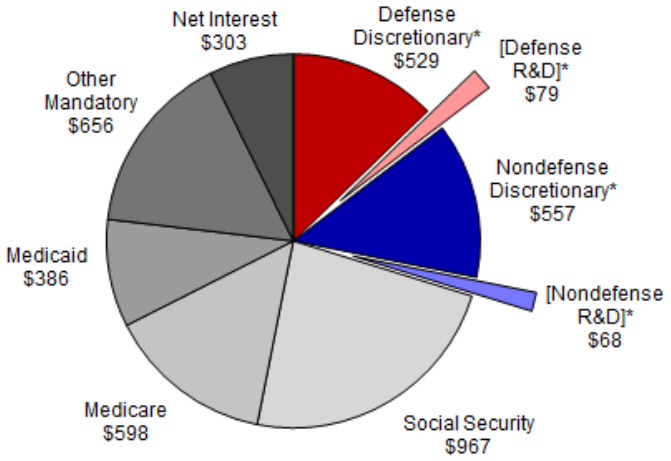
U.S. Budget and Appropriations Process

- **Many factors are involved in generating the President's Budget Request (PBR)**
  - **Bottom-up factors include:**
    - **Community-driven strategic plans (P5)**
    - **Advisory Panel input**
    - **Review committee & workshop reports**
    - **Project performance**
    - **Agency management and OHEP program planning**
  - **Top-down factors include:**
    - **White House priorities and directives**
- **President suggests, but Congress "holds the purse"**
  - **Congressional budget process is itself complex**
    - ***12* spending bills must pass House and Senate, then be signed by President**
  - **Agencies usually invited to brief Congress on their budget request**
    - **Congress must individually approve each DOE construction project >$10M**
    - **Respond to requests regarding impact of alternative funding decisions**



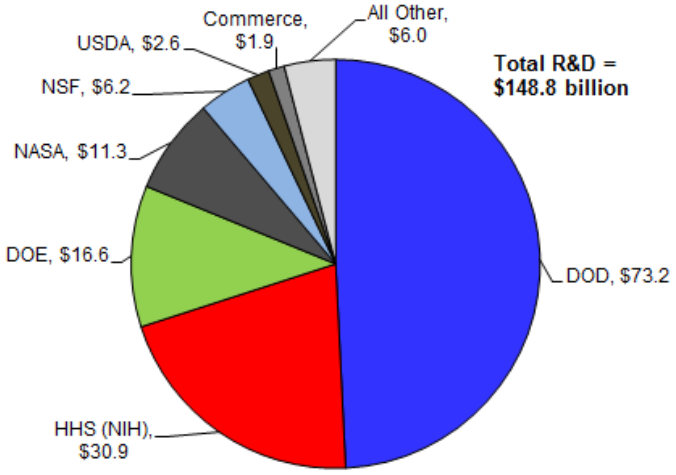
FY 2017 President's Request - R&D Programs

Figure 2: Composition of the Proposed FY 2017 Budget
Total Outlays = $4.1 trillion
outlays in billions of dollars



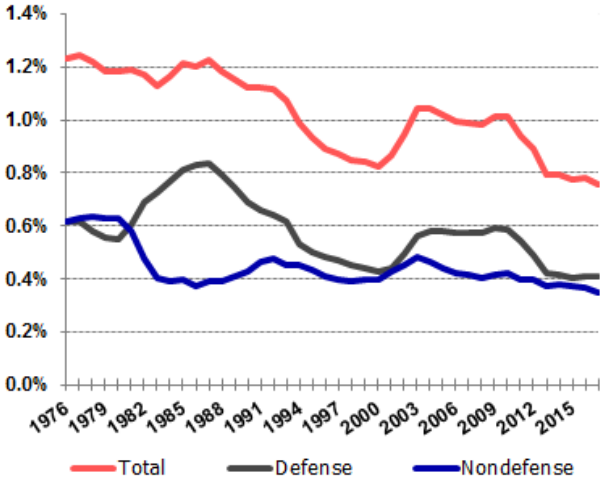
*Approximately $4 billion for R&D is financed through mandatory spending. Figures are estimates.
Source: *Budget of the United States Government FY 2017.* © 2016 AAAS

Figure 3: Base Budget R&D by Agency, FY 2017
budget authority in billions of dollars



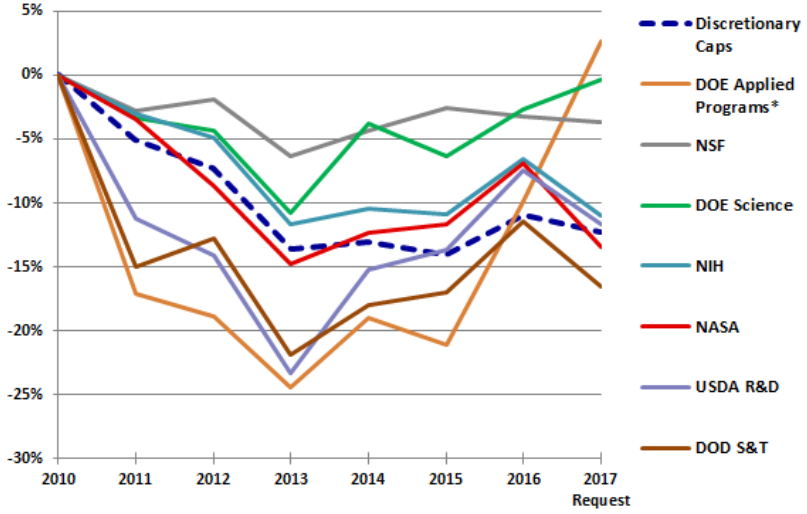
Source: OMB R&D data, agency budget justifications, and other agency documents and data.
R&D includes conduct of R&D and R&D facilities. © 2016 AAAS

Figure 7: Federal R&D as a percent of GDP
base budget only in FY 2017



Source: AAAS analyses of historical budget and agency data and the FY 2017 request. GDP figures from OMB. R&D includes conduct and facilities. ® AAAS

Figure 8: Federal Spending Since FY 2010
Percent change from FY10 levels, constant dollars



*Includes EERE, OE, Fossil, Nuclear; excludes ARPA-E (regular appropriations began in FY 2011).
Based on AAAS analyses of historical OMB , agency, and appropriations data and the President's FY 2017 request. ® 2016 AAAS

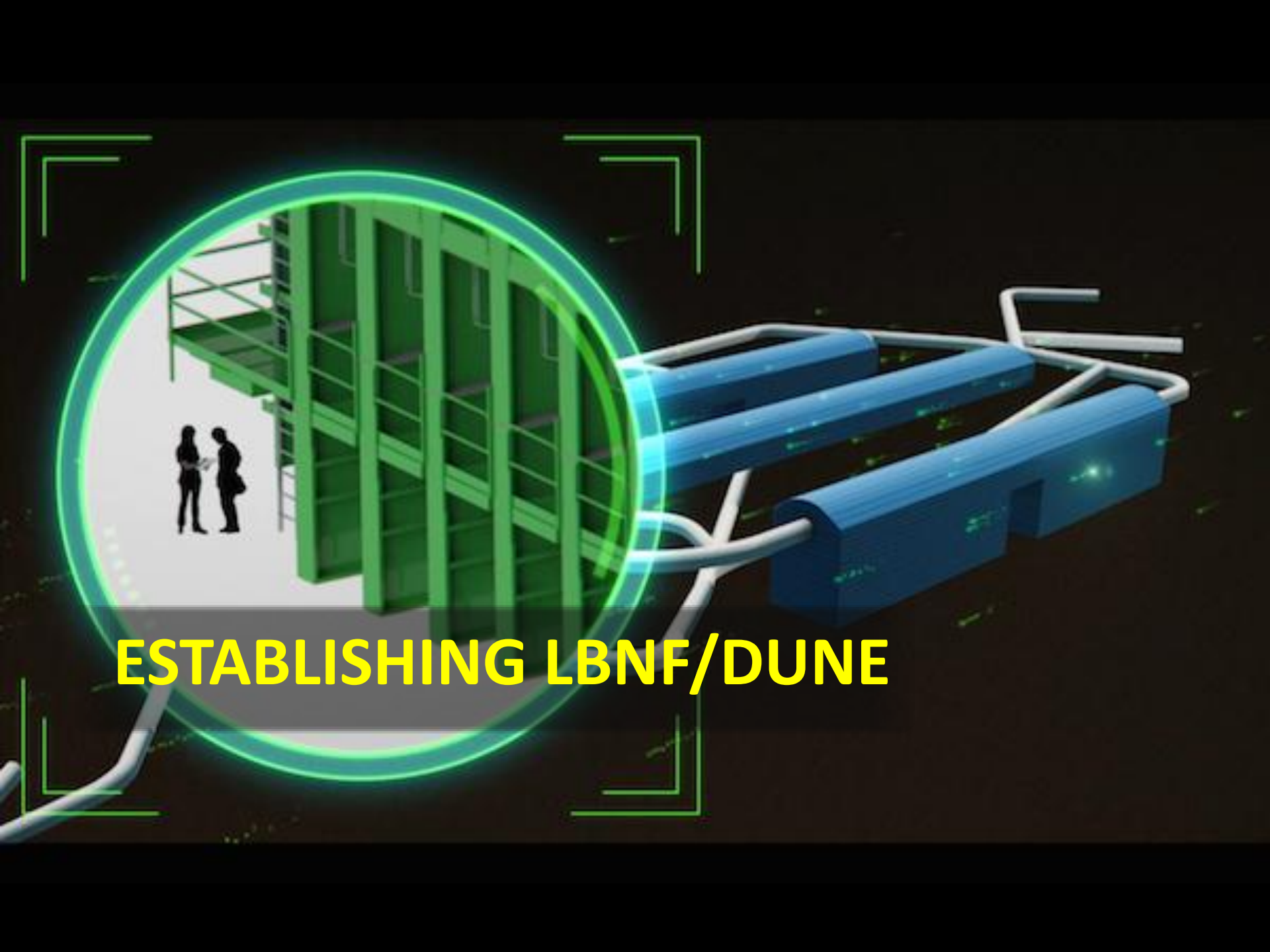
FY 2017 HEP Budget Strategy

- **The FY 2017 HEP budget request reflects the way that implementing the P5 strategy has evolved as the U.S. and international community has adopted and responded to it**
  - **LHC (including upgrades) is still the highest near-term HEP priority**
  - **LBNF/DUNE has been reconfigured and is gaining international support much more rapidly than anticipated in the P5 strategy**
  - **U.S. Administration and Congress strongly support establishing LBNF/DUNE as the first U.S.-hosted international science facility**

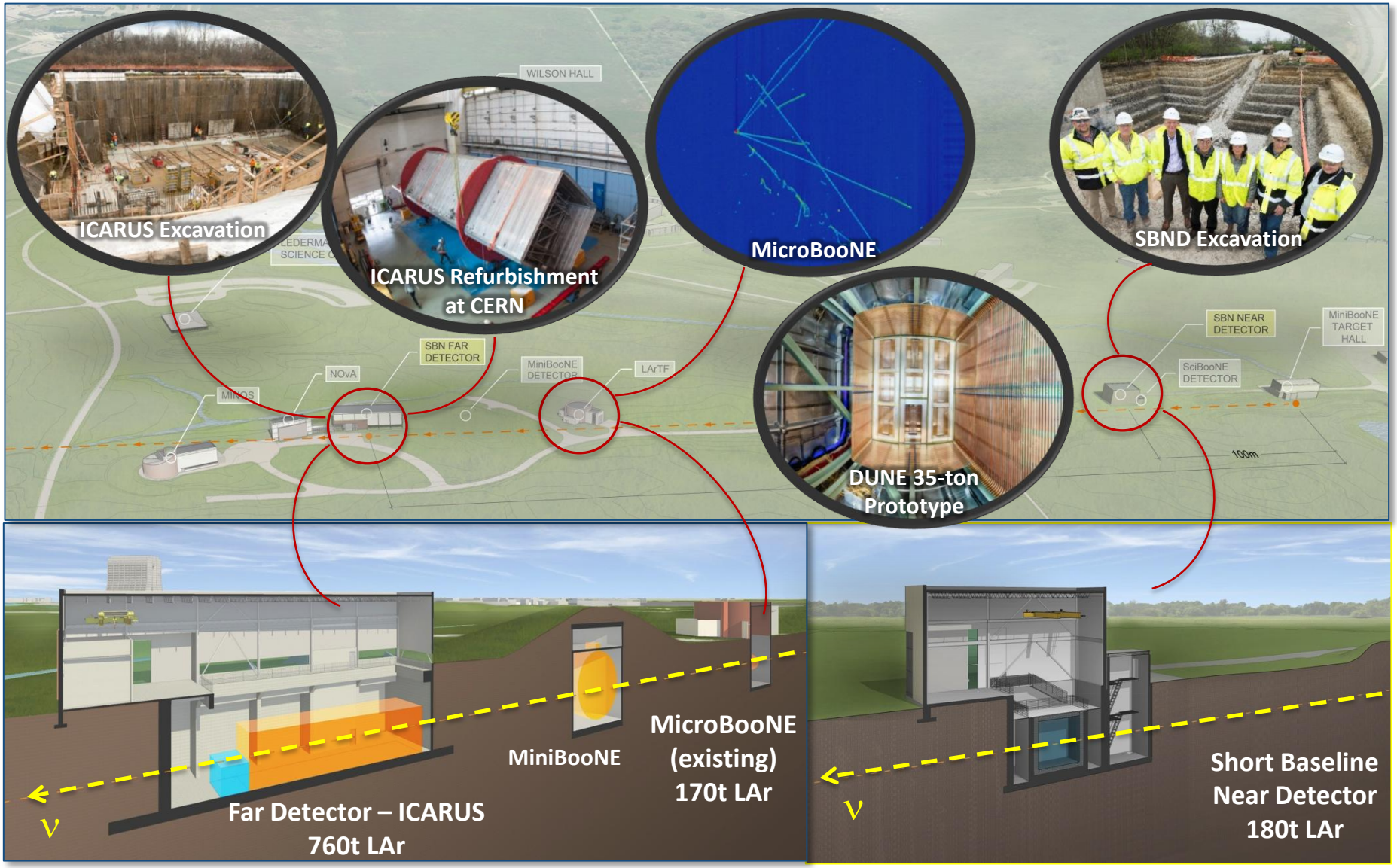
- **This presents an opportunity to advance the P5 strategy on a shorter time scale through additional funding: "Scenario B+"**
  - **HL-LHC accelerator and detector upgrades per CERN schedule**
  - **Support all other projects in P5's Scenario B**
  - **Maintain balance between Research, Operations, and Projects**
  - **Additional funding *beyond* the above priorities would support accelerating the implementation of LBNF/DUNE**

HEP FY 2017 Budget: Research Thrusts

- **Energy Frontier: Continue to support leadership roles in highly successful LHC program**
  - Initial (Phase-1) LHC detector upgrade project funding completes in FY17
  - Develop TDRs for High Luminosity (HL)-LHC experiments; CD-0 April 2016
  - Continue R&D/prototyping towards HL-LHC accelerator; CD-0 April 2016
  - The U.S. will continue to play a leadership role in LHC discoveries by remaining actively engaged in LHC operations and data analysis
- **Intensity Frontier: Solidify international partnerships for U.S.-hosted LBNF/DUNE**
  - Rapid progress on LBNF/DUNE has attracted attention from interested international partners and FY17 investments in site preparation and cavern excavation aim to solidify international partnerships
  - Fermilab will continue improvements to accelerator complex while serving high-intensity beams to short-and long-baseline neutrino experiments and muon experiments, enabling full utilization of the FNAL facilities
- **Cosmic Frontier: Advance leadership efforts in the dark matter and dark energy programs**
  - Fabrication funding ramp-up in FY17 supports key P5 recommended Cosmic Frontier projects: LSSTcam, DESI, SuperCDMS-SNOLab, LZ
- **Theoretical Physics: Support a vibrant program that plays essential roles in all areas**
  - Interpreting results from current experiments, motivating future experiments, and pursuing the deepest questions about the foundations of particle physics

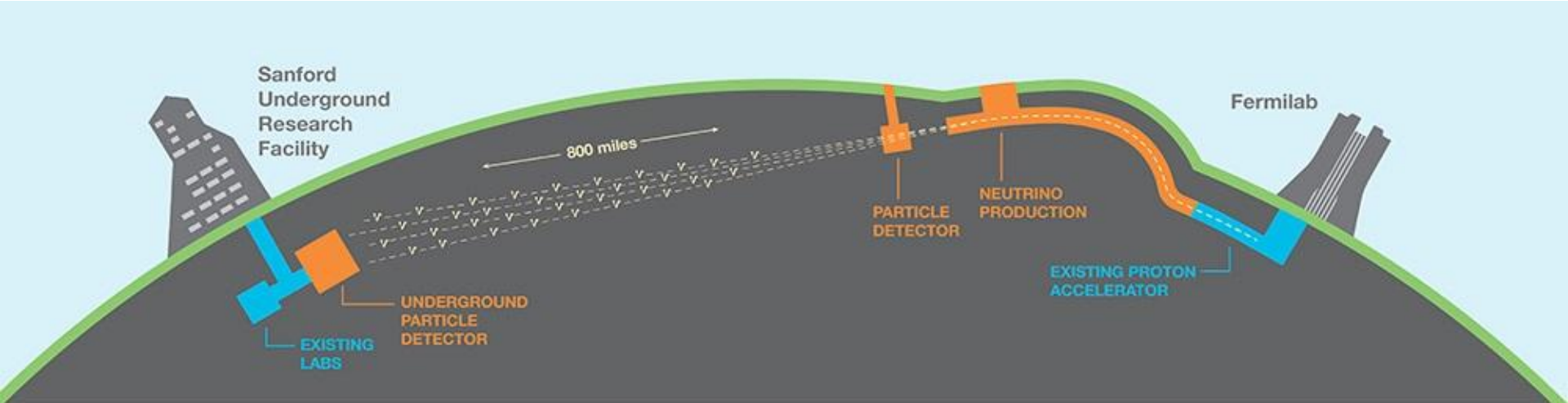

ESTABLISHING LBNF/DUNE

FNAL Short-Baseline Neutrino Program



Long-Baseline Neutrino Facility (LBNF)

- **P5 recommended LBNF as centerpiece of a U.S.-hosted world-leading neutrino program, recognizing it as the highest-priority large project in its timeframe**
- **The world's most intense neutrino beam will be produced at Fermilab and directed 800 miles through the earth to Lead, South Dakota**
  - **Fermilab leading this effort with close collaboration and support from CERN and other international partners**
- **A very large (40 kiloton) liquid argon neutrino detector will be placed in the Homestake Mine in Lead, SD**
  - **An international collaboration has been established for the Deep Underground Neutrino Experiment (DUNE)**
    - **Collaboration currently includes 889 members from 154 institutions in 28 countries**
  - **U.S. will contribute to the detector as part of the LBNF/DUNE project**



LBNF/DUNE Progress

- **P5 regards LBNF/DUNE as the highest priority large project in its time frame**
- **Progress has been extremely rapid since the P5 report was released:**
  - ✓ Framework for internationalization of LBNF/DUNE established
  - ✓ DUNE Spokespersons and Technical & Resources Coordinators appointed
  - ✓ DUNE Executive Committee in-place
  - ✓ DUNE Institutional Board Chair elected
  - ✓ Experiment-Facility Interface Group (EFIG) established
  - ✓ U.S.-CERN bilateral International Cooperation Agreement signed
  - ✓ Fermilab Deputy Director for LBNF appointed
  - ✓ CD-1 Refresh Review held
  - ✓ CD-1 Refresh DOE-agency Approval
  - ✓ Approval of Protocols to the U.S.-CERN International Cooperation Agreement
  - ✓ CD-3A (Early Far-Site Construction) Review held
  - ✓ Supported in FY 2017 U.S. President's Budget Request & U.S. Congressional Budget Marks
- **Next steps:**
  - ❑ CD-3A DOE-agency Approval
  - ❑ Solidify international partnerships via investments in site preparation & cavern excavation
  - ❑ CD-2 [baseline] Review & DOE-agency Approval
  - ❑ Establish Common Projects and Common Funds for international DUNE
  - ❑ Develop operations program structure for DUNE operations

ProtoDUNE

- **ProtoDUNE facility at CERN will include 2 test beams, 2 cryostats**
  - **CERN invested ~6 MCHF into each prototype**
  - **Construction of detector hall well underway**
  - **ProtoDUNE is an integral component of the international neutrino program**


Detector hall construction

- **US Point of Contact (POC) for the ProtoDUNE-Single Phase (SP) project is Eric James who is the DUNE US Project Director.**
  - **For ProtoDUNE-SP operations at CERN, the US POC is Flavio Cavanna who is a co-coordinator of DUNE ProtoDUNE-SP detector organization.**
- **The POC for ProtoDUNE operations funds will be the DUNE Technical Coordinator (Eric James).**
  - **The POC will allocate the funds working in consultation with the DUNE Resource Coordinator (Chang-Kee Jung) and the Fermilab Neutrino Division Financial manager (Molly Anderson)**
- **PIs should work with the ProtoDUNE management to coordinate their roles, responsibilities and deliverables and to make requests for operations support**

Messages for U.S. Neutrino Community

- As part of the P5 global vision, DOE is working to establish a U.S.-hosted world-leading neutrino physics program with LBNF as its centerpiece
  - This major U.S. initiative in the global program must succeed to balance U.S. participation in science facilities hosted elsewhere, including the LHC
  - Given the compelling scientific discovery potential of LBNF/DUNE, Fermilab is working closely with its global partners to establish a truly international "mega-science" facility with first physics in mid-2020s
  - International partners are beginning to come aboard with contributions; more are expected…
    - CERN will be a major partner through the agreements signed last year
- "Scenario B+" strategy aims to accelerate LBNF/DUNE using additional funding while maintaining program balance and supporting priorities of Scenario B
  - CD-3A investments in early far-site construction necessary to enable interested international partners to make "in-kind" contributions on schedule
- Completion of ProtoDUNE is an important R&D step towards timely realization of LBNF/DUNE

HEP INTENSITY FRONTIER OVERVIEW

Major Recommendations of 2014 Advisory Panel (P5)

Pursuing the physics associated with neutrino mass

- Mass hierarchy & ν properties studied at Fermilab, Japan, China
  - Physics data taking with MicroBooNE, MINERvA, NOvA, Super-K, T2K, EXO-200
  - MINOS+ completed operations in June 2016. Daya Bay ends FY17.
- Sterile neutrino search, neutrino CP violation and technology development program continues to evolve:
  - Fermilab Short-Baseline Neutrino (SBN) program will complement MicroBooNE with ICARUS arrival in 2017, SBND installation in 2018
  - ProtoDUNE-SP at CERN in 2017-2018
  - DUNE CD-2 baseline review in 2020; R&D and science planning for Near and Far Detector

Identify the physics of dark matter

- APEX and HPS performing particle beam based searches for DM at Jlab
- Dark Sectors Workshop at SLAC (April 2016) – Provide input for future initiatives

Exploring the unknown through precision measurements

- Development of muon-beam based program at Fermilab continues:
  - Muon g-2: Reached CD-2/3 on Aug 20, 2015. Magnet operating.
  - Mu2e: Reached CD-2/3 on March 4, 2015
- Collaborating with Japan on K meson, c/b quark, and τ lepton precision studies:
  - Belle II: Obtained CD4. Last iTop installed. SuperKEKB e+e- turned on Feb 2016. First physics 2018.
  - K0TO (J-PARC) physics data taking began in 2015

Research and Development directed toward specific future Intensity Frontier experiments or needs

- Perform simulations and physics studies in support of the conceptual and preliminary design of a future experiment or project
- Develop and demonstrate the technical feasibility of novel detectors or systems
- Design, construct, commission, and operate a prototype experiment

HEP Intensity Frontier Science

As of Aug 2015

Experiment	Location	Status	Science Driver(s)	#US Inst.	#US Coll.
APEX	Jefferson Lab, Newport News, VA, USA	First data 2018	Search for massive vector gauge bosons which may be evidence of dark matter or explain g-2 anomaly	22 Univ, 2 Lab	62
Belle II	KEK, Tsukuba, Japan	First data 2018	Physics of the bottom and charm quarks and the tau lepton; CP asymmetries; new states of matter	13 Univ, 1 Lab	74
Daya Bay	Dapeng Penisula, China	Run thru 2017	Measure $\sin^2 2\theta_{13}$ within 3%; precise measurement of atmospheric mass splitting	14 Univ, 2 Lab	65
EXO-200	Waste Isolation Pilot Plant, Eddy County, NM, USA	Run thru 2018	Search for neutrinoless double beta decay.	13 Univ, 1 Lab	56
Heavy Photon Search	Jefferson Lab, Newport News, VA, USA	Physics run 2015-	Search for massive vector gauge bosons which may be evidence of dark matter or explain g-2 anomaly	6 Univ, 3 Lab	44
ICARUS	Fermilab, Batavia, IL, USA	First data 2018	Search for sterile neutrinos in LArTPC	2 Univ, 4 Lab	15
K0TO	J-PARC, Tokai , Japan	Physics run 2015-	Discover and measure $K_L \rightarrow \pi^0 \nu\nu$ to search for CP violation	3 Univ	9
LArIAT	Fermilab, Batavia, IL, USA	Physics run 2015-	Characterize LArTPC performance with a test beam in the range of energies relevant to short- and long-baseline neutrino physics at Fermilab.	13 Univ, 2 Lab, 1 SBIR	58
LBNF DUNE	Fermilab, Batavia, IL & Homestake Mine, SD, USA	CD1r Nov 2015	Discover and characterize CP violation in the neutrino sector; comprehensive program to measure neutrino oscillations, proton decay and supernova neutrinos	57 Univ, 7Lab	480
MicroBooNE	Fermilab, Batavia, IL, USA	Running	Address MiniBooNE low energy excess; measure neutrino cross sections in LArTPC	16 Univ, 5 Lab	101
MINERvA	Fermilab, Batavia, IL, USA	Running	Precise measurements of neutrino-nuclear effects and cross sections at 2-20 GeV	11 Univ, 1 Lab	50
MINOS+	Fermilab, Batavia, IL & Soudan Mine, MN, USA	Completed. Data Analysis phase	Search for sterile neutrinos, non-standard interactions and exotic phenomena	14 Univ, 3 Lab	53
Mu2e	Fermilab, Batavia, IL, USA	First data 2021	Charged lepton flavor violation search for $\mu N \rightarrow eN$	20 Univ, 4 Lab, 1 SBIR	149
Muon g-2	Fermilab, Batavia, IL, USA	First data 2017	Definitively measure muon anomalous magnetic moment	15 Univ, 3 Lab, 1 SBIR	98
US-NA61	CERN, Geneva, Switzerland	Target runs 2015-18	Measure hadron production cross sections crucial for neutrino beam flux estimations needed for Fermilab neutrino experiments	4 Univ, 2 Lab	16
NOvA	Fermilab, Batavia, IL & Ash River, MN, USA	Running	Measure ν_μ-ν_e and ν_μ-ν_μ oscillations; resolve the neutrino mass hierarchy; first information about value of δ_{cp} (with T2K)	20 Univ, 2 Lab	146
SBND	Fermilab, Batavia, IL, USA	First data 2018	Precision neutrino-LAr interaction measurements	8 Univ, 5 Lab	58
Super-K	Mozumi Mine, Gifu, Japan	Running	Long-baseline neutrino oscillation with T2K, nucleon decay, supernova neutrinos, atmospheric neutrinos	7 Univ	32
T2K	J-PARC, Tokai & Mozumi Mine, Gifu, Japan	Running	Measure ν_μ-ν_e and ν_μ-ν_μ oscillations; resolve the neutrino mass hierarchy; first information about value of δ_{cp} (with NOvA)	11 Univ	73

HEP Intensity Frontier R&D Program

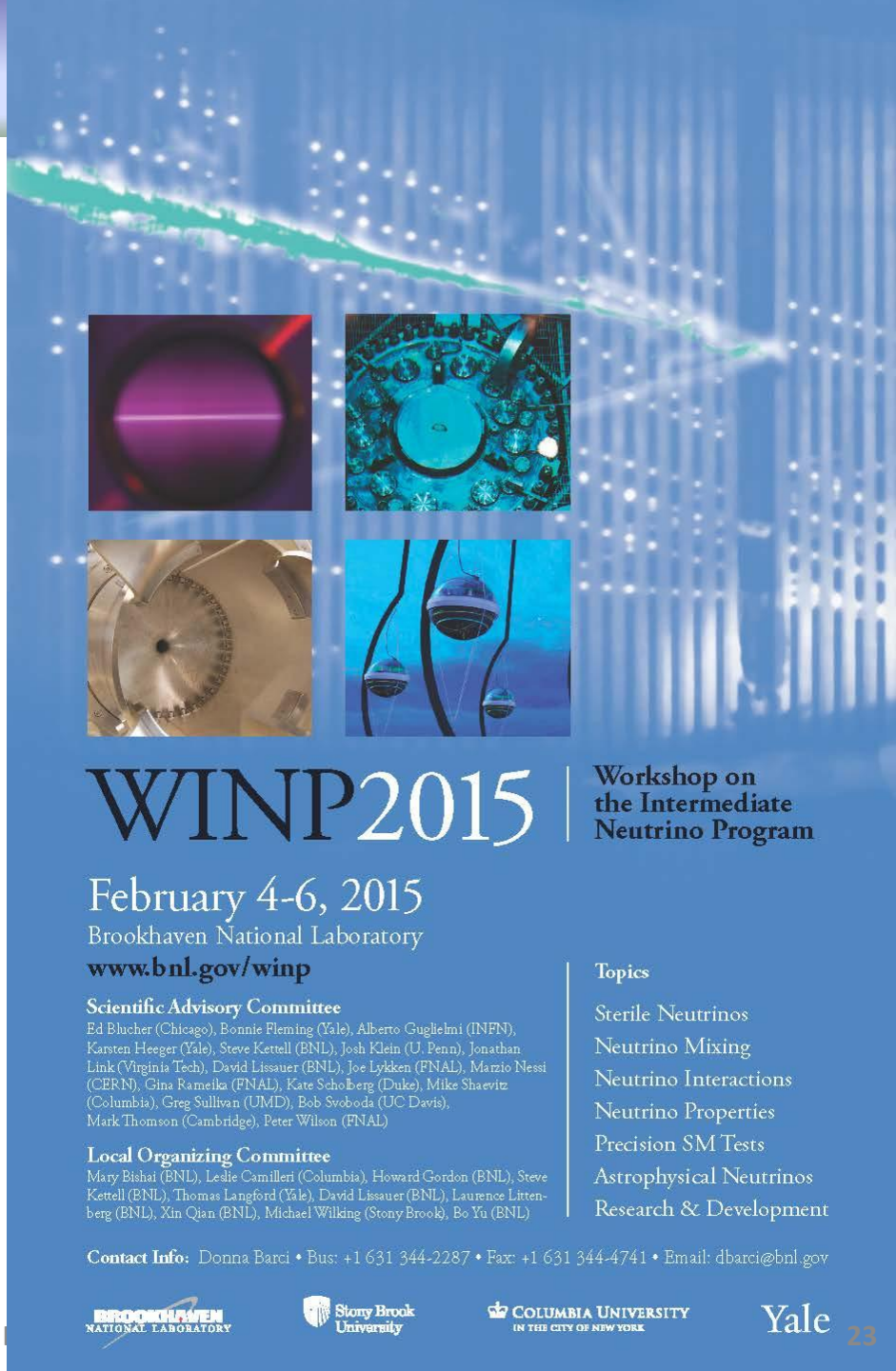
As of Aug 2015

Experiment	Location	Status	Research & Development Program	#US Inst.	#US Coll.
ANNIE	Fermilab, Batavia, IL, USA	Stage 1 from FNAL PAC.	Study neutrino-nucleus interactions in a Water Cherenkov detector using new photodetector technology	6 Univ, 2 Lab	12
CAPTAIN	Los Alamos, NM, USA	ECA and R&D; Neutron run 2016.	Cryogenic apparatus for precision tests of argon interactions with neutrinos	13 Univ, 5 Lab	66
CAPTAIN MINERvA	Fermilab, Batavia, IL, USA	Stage 1 from FNAL PAC.	Study neutrino-argon interactions in the medium-energy NuMI beam	25 Univ, 5 Lab	110
COHERENT	Spallation Neutron Source, ORNL, Oak Ridge, TN, USA	ECA and R&D thru 2017. CENNS physics data 2018.	Detect coherent elastic neutrino-nucleus scattering	10 Univ, 5 Lab	48
DarkLight	Jefferson Lab, Newport News, VA, USA	R&D. Initial data run 2016.	Search for massive vector gauge boson A' which may explain g-2 anomaly	5 Univ, 1 Lab	40
nEXO	SLAC, LLNL, Stanford, and other institutions	R&D. HEP support ends in 2016.	High voltage stability in LXe detectors; cryogenic electronics for low background detectors	12 Univ, 4 Lab	75
NNbar	European Spallation Source, Lund, Sweden	R&D.	Search for Baryon number violation with $\Delta B=2$	8 Univ, 2 Lab	18
PROSPECT	High Flux Isotope Reactor, ORNL, Oak Ridge, TN, USA	R&D; First data 2017.	Search for sterile electron antineutrino oscillation at very short baseline	9 Univ, 4 Lab, NIST	63
SOX (CeANG)	Borexino, Laboratori Nazionali del Gran Sasso , L'Aquila, Italy	ECA and R&D thru 2016. First data 2017.	Employs anti-v generator 144Ce-144Pr to search for short baseline oscillation as evidence for sterile neutrinos	6 Univ	14

- **After P5, the R&D program needed to focus & converge. Recommendation 15:**
  - **Select and perform in the short term a set of small-scale short baseline experiments that can conclusively address experimental hints of physics beyond the three-neutrino paradigm. Some of these experiments should use liquid argon to advance the technology and build the international community for LBNF at Fermilab.**
- **Some efforts are funded through the Early Career Research Program**

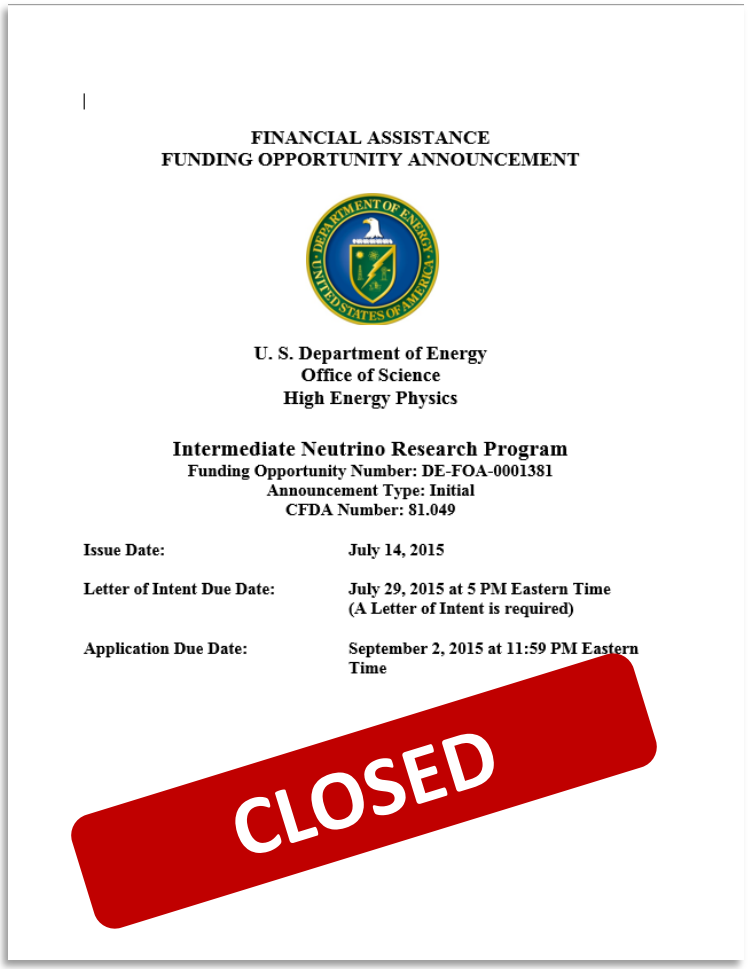
Intermediate Neutrino Program

- **Workshop on the Intermediate Neutrino Program was hosted at BNL in February 2015**
- **There were many possible short-baseline neutrino experiments using other facilities, with and without accelerator beams**
  - **Many R&D efforts underway at various stages of maturity**
- **DOE was interested in understanding these various options and plans in more detail**
  - **This workshop provided important community input, necessary for formulating and executing a successful program based on the P5 strategy**
- **Many of the scientific opportunities in neutrino physics were described in the report from the Workshop: http://arxiv.org/abs/1503.06637**



Intermediate Neutrino Research Program

- Funding Opportunity Announcement (FOA), "Intermediate Neutrino Research Program" [DE-FOA-0001381, LAB 15-1381], was issued July 14, 2015
- Required LOI due date was July 29, 2015
- 21 LOIs were received, and 14 were encouraged
  - 2 LOIs were submitted to the incorrect FOA
  - 5 LOIs were requesting for support of experimental R&D on a project in final design or fabrication phase
- 12 proposals requesting support totaling $26.151M were received by the September 2, 2015 deadline
  - After pre-screening all incoming proposals for responsiveness and compliance to the solicitation, one proposal was declined without review
- 11 proposals were externally reviewed. In addition, a panel of experts met in DOE Germantown on December 7-8, 2015 to compare and rank the proposed experiments on whether they were scientifically compelling, competitive within the world program, modest in cost and time-scale, and technically ready. Priority was given to those efforts that can provide publishable results within a five-year time frame
- Each proposal was reviewed by at least four experts
  - 11 of the 25 reviewers comprised the panel of experts
  - Overall, 72 evaluations were completed with an average of 6.45/proposal



FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy
Office of Science
High Energy Physics

Intermediate Neutrino Research Program
Funding Opportunity Number: DE-FOA-0001381
Announcement Type: Initial
CFDA Number: 81.049

Issue Date:	July 14, 2015
Letter of Intent Due Date:	July 29, 2015 at 5 PM Eastern Time (A Letter of Intent is required)
Application Due Date:	September 2, 2015 at 11:59 PM Eastern Time

CLOSED

Intermediate Neutrino Decisions

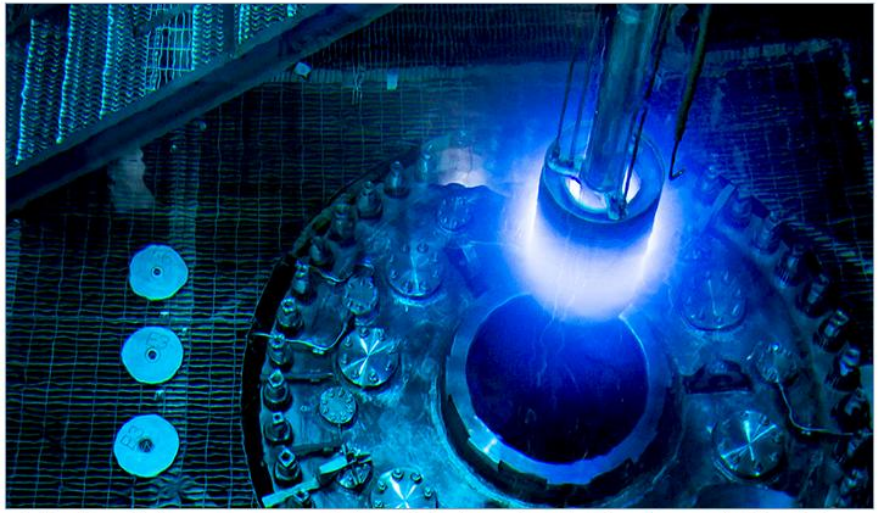
YaleNews

For the Media | Yale Portal

ARTS & HUMANITIES BUSINESS, LAW, SOCIETY CAMPUS & COMMUNITY SCIENCE & HEAL

PROSPECT experiment will search for sterile neutrinos, thanks to $3M DOE grant

By Jim Shelton May 31, 2016



Refueling of the High Flux Isotope Reactor at Oak Ridge National Laboratory (ORNL). Antineutrinos are emitted from the decays of the fission products. (Image by Genevieve Martin/ORNL)

Buoyed by a $3 million federal grant, a Yale University-led experiment will explore key questions about the elusive particles called neutrinos — and potentially improve the way we monitor and safeguard nuclear reactors in the process.

The U.S. Department of Energy grant from the Office of High Energy Physics will be used to build a first-of-its-kind, short-distance detection device for the Precision Oscillation and Spectrum Experiment (PROSPECT), a project involving 68 scientists and engineers from 10 universities and four national laboratories.

The detection instrument will be constructed at Yale's newly renovated Wright Laboratory and later be deployed at the High Flux Isotope Reactor at Oak Ridge National Laboratory, in Tennessee. The PROSPECT experiment has been in development for more than three years.

ANNIE finds a home at Fermilab

150k

April 20, 2016 | Rashmi Shivni

Carrie McGivern prepares photomultiplier tubes during the ANNIE detector assembly. Photo: Reidar Hahn

If you've passed by the old SciBooNE hall at Fermilab in the last couple of months, you might have heard a bit of commotion. A little experiment with big ambitions just finished moving in this week after a year's worth of planning and research. The Accelerator Neutrino-Neutron Interaction Experiment, called ANNIE, recently settled down and began taking phase one data on April 15.

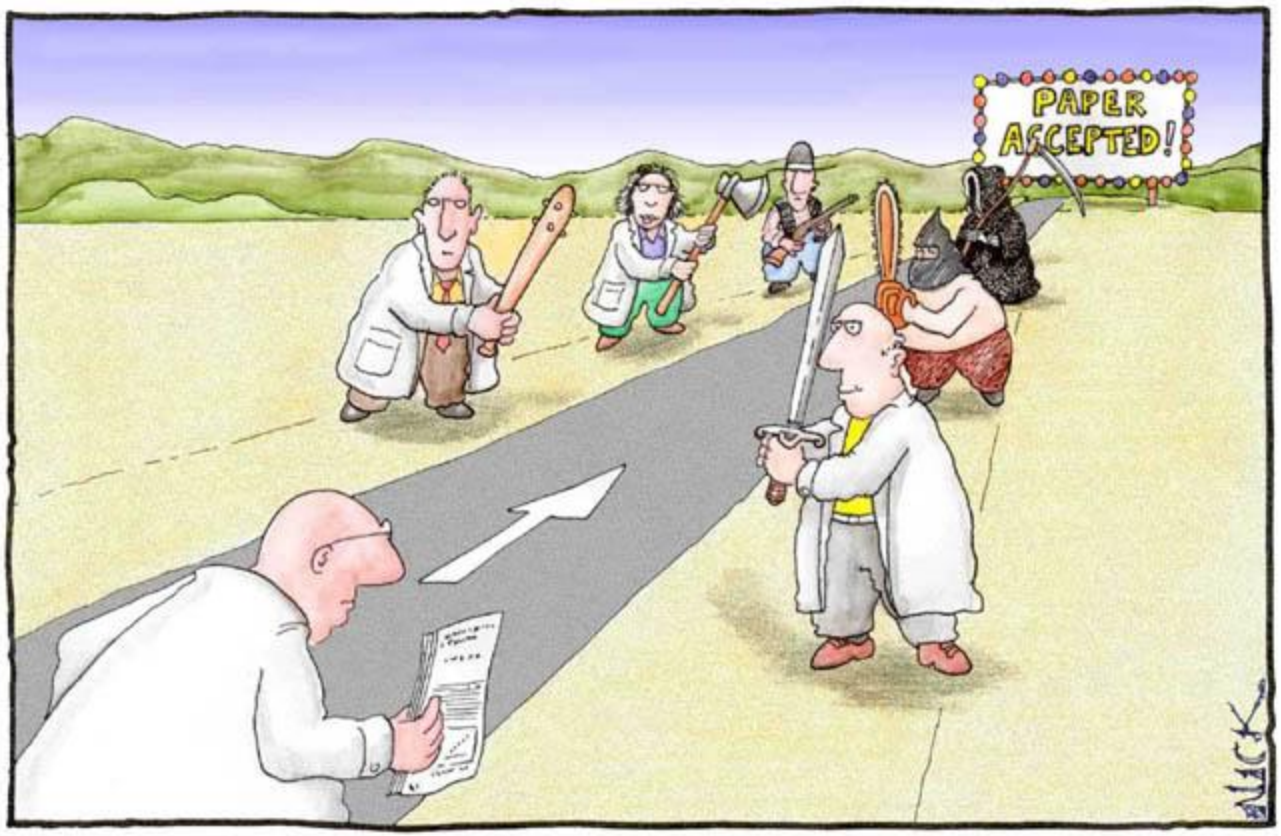
"We want to better understand the nature of neutrino interactions by looking at their effects on an atom's nucleus," said Matthew Wetstein, a co-spokesperson for the ANNIE project and a Fermilab visiting scientist from Iowa State University. ANNIE will be the first realization of a new kind of detector in a large neutrino experiment. The technology will help look for particle interactions that are hard to distinguish in other detectors, he said.

The ANNIE team aims to study phenomena and techniques relevant to neutrino energy and proton decay measurements through the use of a water Cherenkov detector loaded with a chemical element called gadolinium and surrounded by never before used photosensors called large-area picosecond photodetectors (LAPPDs).

Light travels slower in a medium such as glass, water or other transparent materials than in air or in a vacuum. Sometimes, light travels slow enough in these materials that particles can overtake it. That's why Cherenkov detectors are common in neutrino experiments. When neutrinos hit atoms in such media, the resulting free-flying electrically charged particles emit their own light, known as Cherenkov radiation, and these detectors record this light, allowing scientists to identify the type of particle and calculate its energy. In ANNIE's case, neutrinos streaming down the Fermilab Booster Neutrino Beam will strike water molecules in the detector and knock off neutrons. Neutrons are electrically neutral and do not emit Cherenkov radiation, so they need to be detected some other way. After the initial neutrino-nucleus collisions, the gadolinium salts in the water effectively capture the neutrons and subsequently emit photons, which can be detected by photosensors.

"Neutrons have always been a challenging particle to detect," Wetstein said. "We hope ANNIE can determine how many neutrons are produced when neutrinos interact."

- **With this decision the HEP neutrino portfolio is complete for the near future.**
- **The suite of HEP ongoing experiments and future projects provide a rich basis for precision physics, scientific discovery and technology development.**

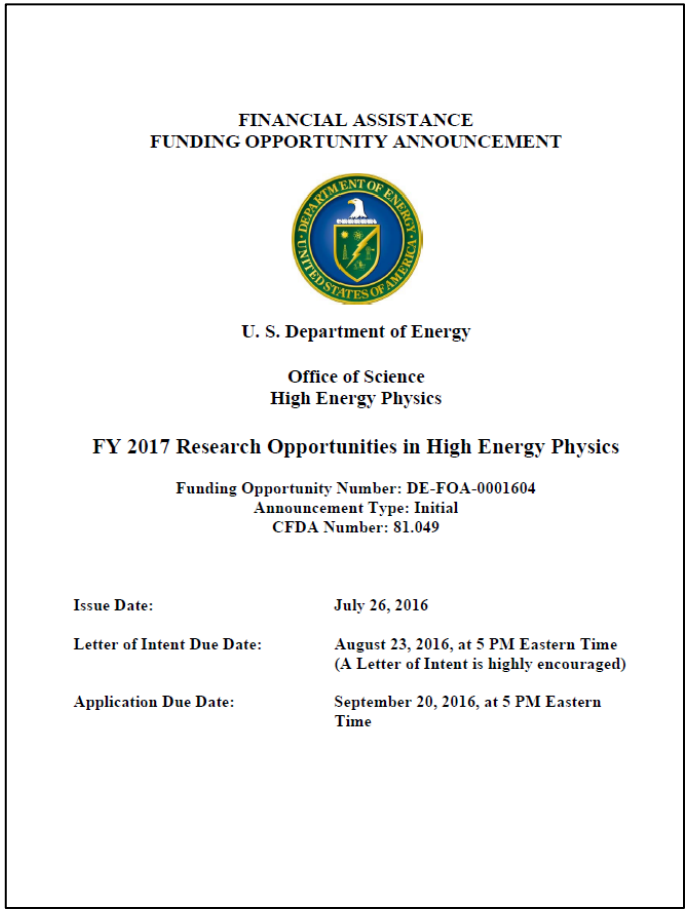


Most scientists regarded the new streamlined peer-review process as 'quite an improvement.'

FY2017 HEP COMPARATIVE REVIEW PROCESS

FY17 HEP Comparative Review FOA

- DE-FOA-0001604 issued Jul 26, 2016
- Six HEP research subprograms
  - Energy, Intensity, and Cosmic Frontiers
  - HEP Theory
  - Accelerator Science and Technology R&D
  - Detector R&D
- Letter of Intent: Aug 23, 2016 by 5 PM ET
  - Strongly encouraged
- Proposal deadline Sep 20, 2016 by 5 PM ET
- In addition to information provided in 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
  - Letter of Intent
  - Budget information and guidance on scope of request(s)
  - Information on overall scientific merit review process



FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy

Office of Science
High Energy Physics

FY 2017 Research Opportunities in High Energy Physics

Funding Opportunity Number: DE-FOA-0001604
Announcement Type: Initial
CFDA Number: 81.049

Issue Date:	July 26, 2016
Letter of Intent Due Date:	August 23, 2016, at 5 PM Eastern Time (A Letter of Intent is highly encouraged)
Application Due Date:	September 20, 2016, at 5 PM Eastern Time

Both the FOA and FAQ available at:
http://science.energy.gov/hep/funding-opportunities/

Key Items to Keep in Mind

- **Proposed research will review best if closely aligned with the DOE/HEP mission, its program, and the Particle Physics Project Prioritization Panel (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 w/o review. Requirements that are most often missed or overlooked include: data management plans, page limits, separate budget sheets for each frontier (if needed), and inclusion of Personally Identifiable Information (PII)**

HEP Research Activities Supported

- **What DOE supports**
  - Research efforts (mainly scientists) on R&D, experiment design, fabrication, installation, physics commissioning, data-taking, analysis-related activities
  - Theory, simulations, phenomenology, computational studies
  - Some engineering support may be provided for R&D and pre-project
    - Support depends on merit review process and programmatic factors
- **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 summer salary
  - The Principal Investigator's research effort commitment is an integral part of the award. This should be indicated in the approved budget pages, which becomes a part of the legal agreement between DOE and the awardee.
  - Similarly, we need to ensure that sufficient effort (whether from the PI or other individuals) is being provided to make the research feasible. This is a standard part of our oversight obligation.
- **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 experimental operations and/or project-related (CD0+) activities:
    - Engineering, major items of equipment, consumables for prototyping or production
  - Non-HEP related efforts
    - Gravity waves (LIGO), Heavy Ion (RHIC or LHC), Polar Science, AMO Science, Astronomy
    - As of FY 2017, neutrinoless double beta decay is under the DOE Office of Nuclear Physics

Cross-cut 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
  - New in FY17 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 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 in the context of HEP program goals and mission?
  - Is there a clear plan to ramp down effort in one area in order to pick up new research scope in another area?

Guidance Checklist for FY17 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 FY17 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 2017 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 and every research thrust (*e.g.,* ATLAS, LSST, lattice gauge theory, etc.), and must appear in Appendix 8 of the application.	☑
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.	☑

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 innovation of proposed effort? What is the likelihood of achieving valuable results? How might the results of the proposed research impact the direction, progress, and thinking in relevant scientific fields of research? How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality? What is the merit of the proposed research, compared to 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 is the research approach of each senior investigator? 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 Research Team and Adequacy of Available Resources**
   e.g., What is the past performance of each senior investigator? How well qualified is each senior investigator and their team, and what is the likelihood of success in carrying out the proposed research? Are the research environment and facilities adequate for performing the research? Are PIs or any members of the group leaders on proposed effort(s) and/or potential future leaders in the field? Does the proposed work take advantage of unique facilities and capabilities? Are any proposed plans for recruiting any additional scientific and/or technical personnel including new senior staff, students and postdocs reasonable, justified, and appropriate? For PIs proposing 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 (scope)? Are all travel, student costs, and other ancillary expenses adequately estimated and justified? Is the budget reasonable, appropriate for the scope?

5) **Relevance to the mission of the DOE Office of High Energy Physics (HEP) program**
   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 it consistent with HEP's overall priorities and strategic plan? For PIs 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? How likely is the research to impact the mission or direction of the overall HEP program?

Comparative Merit Review Criteria (cont.)

For Reviewers/Panelists

- The merit review criteria items 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 PMs at the beginning of panel deliberations
- Are presented and discussed by individual panelists for each proposal

For Principal Investigators

- The merit review criteria items and corresponding questions are 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

Subprogram Review Panels

- The Comparative Review process is very competitive and hard choices have to be made based on the reviews, as well as to fit into our limited funding availability
  - The process implies that certain proposals and PIs will be ranked at the top, middle, and bottom
- It is understood that the vast majority of people applying are working hard and their efforts are in support of the HEP program. Due to the rankings & comments by the reviewers and our constrained budgets, some people whose research activities and level of effort who are ranked lower in terms of priority and impact relative to others in the field will not be funded on the grant
  - This does not necessarily mean the person cannot continue working on the experiments; they are not being funded by the grant to do it. It could be that the person has a critical role in the program, but this did not come out in the proposal or review process.
  - This is why it is imperative to respond to the FOA solicitation and detail each person's efforts
- Members of subprogram review panels see all of the proposals and each member provides input and ranks proposals relative to the others. When a panel member is faced with comparing efforts, impacts and limited budgets, rather than rank the whole proposal low, he/she may provide guidance regarding details of the proposals
  - e.g., Current group size is okay, and therefore, do not add additional postdoc on this effort

Panel Review

- **All of the proposals have been evaluated. Why convene a panel?**
- **In following the 2014 P5 roadmaps, DOE HEP has developed an Intensity Frontier program that comprises a number of highly complex experiments and projects. In addition, 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 calibration often varies by a full point (out of six)**
  - **On a scale of 1=Poor and 6=Outstanding, some panelists are very generous in handing out 6's, while others may give nothing higher than a 5.**
  - **Panelists will have different reviews, scores or rankings. However, we can provide a "standard candle" by discussing the top- and lowest-ranked proposals determined by the initial evaluations.**
- **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**
- **Initial evaluations are very good but incomplete**
  - **During and following the panel discussion(s), panelists can revise and update the reviews, scores and rankings.**
  - **In addition, include a brief summary of the panel discussion.**
    - **Keep it simple. Emphasize key highlights and issues.**

What Are The Panel Summaries?

- The individual evaluations from each reviewer can vary in context, detail and depth of analysis. In addition, there may be some reviewers who do not participate in the panel.
- In the event of an unfavorable outcome, the PI(s) will take the individual pieces of information and try to determine how to proceed.
  - It is very common for a proponent to tease out every drop of praise and ignore any criticism, in an attempt to appeal the decision.
- A lesson learned from the first round of comparative review was to digest the highlights from panel discussion and include this summary with the individual evaluations.
  - The panel summaries give the PIs a window into what was discussed about their proposed research. Strengths, weaknesses, budget, etc. How did their group compare to similar efforts?
- More on the panel summaries
  - Less is more. What are the key factors to influence funding decisions and the level of funding?
  - Secondary reviewer should take notes while primary gives presentation. Work together to prepare summary. Tertiaries are welcome to assist.

What Are The Top 5 Lists?

- Each panelist is asked to provide an individual list of no more than five senior investigators, in rank order, which they view as the most deserving of funding.
  - Include a few sentences commenting for each senior investigator on your list as to why you chose this ranking.
  - You can select among any of the PIs under review.
- Provides one more additional piece of information to help HEP when making final funding decisions.
  - In FY12, 21 (out of 35) PIs appeared on at least one Top 5 list (60%)
  - In FY13, 27 (out of 54) PIs appeared on at least one Top 6 list (50%)
  - In FY14, 23 (out of 57) PIs appeared on at least one Top 5 list (40%)
  - In FY15, 26 (out of 59) PIs appeared on at least one Top 5 list (44%)
  - In FY16, 17 (out of 42) PIs appeared on at least one Top 5 list (40%)
- Opportunity to increase someone's visibility within a larger group, effort or project.
  - Or lift someone up out of the mediocrity of a poorly written proposal.
- These lists are internal to HEP and do not get shared with other panelists or the senior investigators.

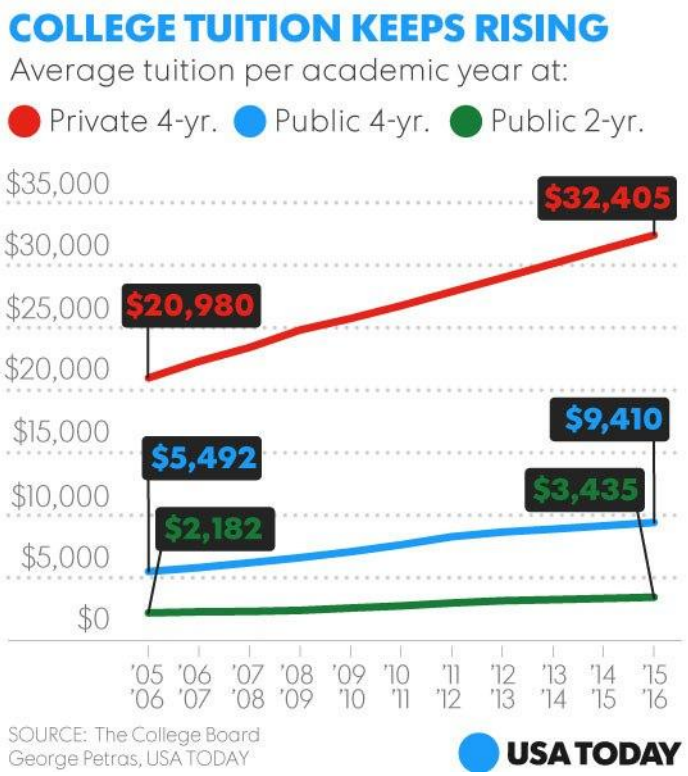
Programmatic Considerations

- Generally very useful to have head-to-head reviews of PIs working in similar areas, particularly for large grants
- Lots of discussion of relative strengths and weaknesses of individual proposals and PIs
- Many factors weigh into final funding decisions
  - Compelling research proposal for next ~3 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.

Particular Considerations for DUNE

- **Factors weighing into final funding decisions**
  - **Compelling research proposal for next ~3 years**
    - ✓ **Demonstrable impact on DUNE R&D/fabrication plan or performance**
    - ✓ **Supports current timeline for DOE CD's or other milestones**
    - X **Outside of DUNE plan, not timely, or no clear leadership role**
    - X **Project activities**
  - **Significant recent contributions in last 3-4 years**
    - **Should be able to show science impact/leadership in neutrino physics and/or detector development**
  - **Alignment with programmatic priorities**
    - ✓ **Highest priority mid-term HEP project**
  - **Balanced program of R&D/design, support of construction or operations (ProtoDUNE), data analysis**
    - **DUNE research program will be focused on first item in next ~3-4 years**
    - **PIs should look to other experiments for additional operations or analysis elements during this period**

Cost Drivers



- **University tuition rates have significantly driven up full-time GS costs in the past decade**
- **Fewer HEP research dollars in order to implement P5**
- **Cost of doing business (university to university) can vary significantly.**
  - **Indirect rates (24% to 66.5%).**
  - **Fringe rates from 0% to more than 40%**
- **Travel is a necessary expense for design, execution and delivery of science**
  - **Tradeoffs between adequate travel budgets and workforce**

Experience Affects Postdoctoral Research Associate Salaries

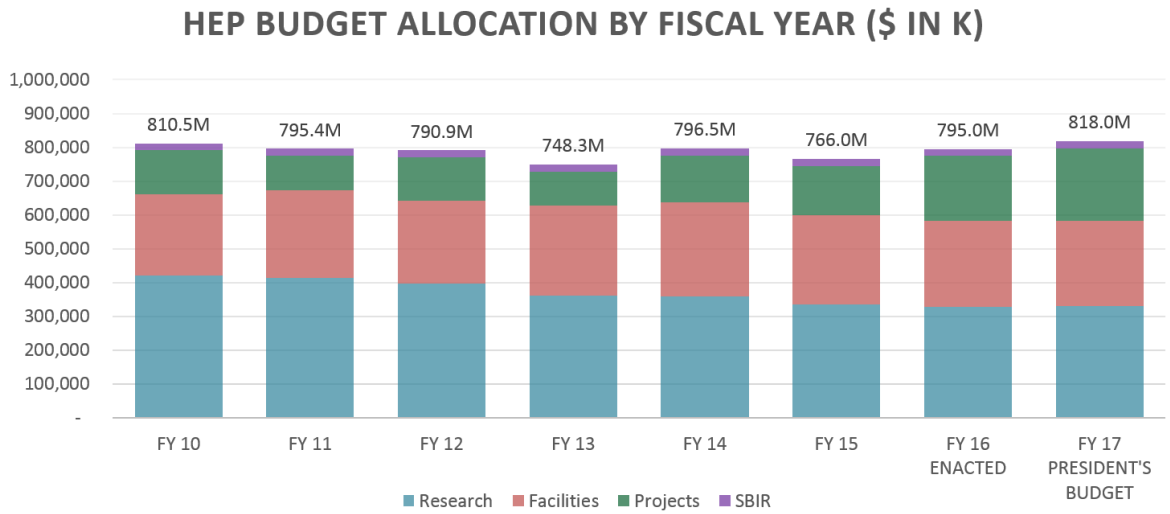
Late-Career	▲37%
Experienced	▲7%
Mid-Career	▲5%
National Average	**$44,000**
Entry-Level	▼1%

payscale.com

Skills That Affect Postdoctoral Research Associate Salaries

Physics	▲18%
Statistical Analysis	▲10%
Matlab	▲4%
Bioinformatics	▲2%
Data Analysis	▲1%
Material Science	▲1%
Biophysics	▲1%
Research Analysis	0%
National Average	**$44,000**

10-20% higher at Office of Science Laboratories.



HEP Proposal Review and Award Process

Pre-review

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

Panel Review

- **Sept-October**: Proposals assigned to *at least* three merit reviewers* via DOE's Portfolio Analysis and Management System (PAMS);
- **October-November**: Reviewers' input written evaluations in PAMS.
- **November**: Panel discussion of all proposals and all senior personnel. Add 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.
- **End-January - March**: Route proposal's procurement packages through DOE/SC and DOE Chicago Operations Office for approval.
- **March-April**: Awards to university from DOE Chicago Operations Office.

*Usually assign 4 or 5 reviewers to each proposal.

FY12-16 IF Comp Review Summary

	Intensity Frontier					
	Proposals Received (Funded)	Senior Investigators (Funded)	Junior PIs (Funded)	Funding Request (Provided) [$k]	Ratio of Request to Funding	Avg PI New/Renewal Support [$k]
FY16	27 (15)	52 (27)	7 (3)	8,500 (5,500)	1.54	204
FY15	30 (19)	59 (40)	8 (6)	12,250 (7,760)	1.58	194
FY14	26 (17)	57 (41)	14 (11)	10,800 (6,790)	1.59	167
FY13	33 (24)	56 (43)	9 (7)	12,650 (7,730)	1.63	180
FY12	19 (15)	36 (24)	6 (4)	7,720 (4,710)	1.64	196

- IF Research program supports ~60 University grants and ~100 University senior investigators
- 15-20 PIs submit proposals each year to continue ongoing research, e.g. renewals
  - 30-40 senior investigators are PIs/co-PIs on these renewal proposals
- 5-10 'new' proposals each year compete for resources
  - Some fraction are re-submissions
- 10-20 senior investigators, including new assistant professors, request research support on new Intensity Frontier scope

Note: 4 proposals/10 PIs declined w/o review in FY16. See Slides 28 & 31.

Full Funding of Multi-Year Grants
(Intensity Frontier)

Year	# Proposals Reviewed	# Proposals Funded	# Multi-Year Grant Awards Fully Forward Funded (Period > 1 year)	$k TOTAL: (1st year of project period)	$k TOTAL: (over *entire* multi-year project period for Fully Forward Funded grants)
FY16	23	15	3	365	940
FY15	30	19	0	0	0
FY14	26	17	4	470	1,217

- On January 17, 2014, the President signed the 2014 Consolidated Appropriations Act (CAA): Section 310(D) requires full funding of multi-year grants and/or cooperative agreements received from academic institutions with total cost less than $1M.
  - "Full funding" implies funds for the entire award for the proposal's project period is obligated at the time the award is made, instead of funding year-by-year.
- Logistics on full funding:
  - Process applies to new, renewal, or supplemental grant awards that are made after the merit review process.
  - No other exemptions from this provision apply other than grants and cooperative agreements are of total cost less than $1M – integrated over the project period approved for the proposal
- During the submission of a proposal along with conducting its merit review and making decisions on the award:
  - There will be no change to how an applicant applies for a grant or cooperative agreement.
  - There will be no change to the merit review process.
  - There will be no change to DOE Program Managers requesting revised budgets from PIs.
- DOE Program Managers (PM) will continue to have oversight of the research program by requiring PIs to submit an annual research performance progress report that must be approved by the PM prior to any funds being accessed by the PI the following year.
- SC program offices, including HEP, will aim to carry out the transition in a way that minimizes impacts on the scientific community and the mission needs served by the office.

University Intensity Frontier Demographics

Fiscal Year	Total PIs	East	Midwest	South	West	M	F	Jr	RS
FY10	115	27	30	33	25	105	10	5	20
FY11	113	26	29	31	27	103	10	6	21
FY12	104	26	22	30	26	93	11	9	21
FY13	99	27	22	26	24	88	11	11	20
FY14	105	28	26	31	20	92	13	16	18
FY15	104	30	26	30	18	92	12	16	13
FY16	105	29	28	29	19	91	14	18	9

Research Scientists

- 3 retired (Jan 2012; Aug 2014; Mar 2015)
- Most have found new employment: Asst. Prof SDSMT; PNNL Comp. Scientist; Data Scientist at Quantum Retail Technology; Lab Instructor Univ. of Pittsburgh; Senior Scientist at Carleton University; Asst. Prof. Missouri State

Tracking nearly 300 Intensity Frontier DOE-supported post-doc positions (lab and univ.)

- From FY10-15, about 100 have moved beyond a post-doc position (or left the field)
  - 30% have found University faculty positions in the US and abroad
  - 30% have found employment in the private sector (data scientist most common)
  - 15% have permanent DOE laboratory staff positions
  - 10% are teachers, medical physicists, govt. employees or stay-at-home parents
  - 10% have unsecure positions: Research Scientist, Adjunct Professor, Fellow

HEP Reviewer Selection and Panels

	Proposals	Panel	External	M	F	Intensity	Energy	Cosmic	Theory	Other	Univ	Lab
FY12	18	16		15	1	13	3	2		3	14	2
FY13	31	18		17	1	18		1		4	13	5
FY14	26	16	1	13	4	13	3	1	2	1	12	5
FY15	30	16	4	14	6	15	4	1	2	1	15	5
FY16	23	16	4	16	4	17	2	2	2	3	15	5

- **To date, 74 people have participated as a reviewer in the Intensity Frontier Comparative Review process**
  - **Excluding the 1st year, about 25% of the reviewers each year were on a previous panel**
  - **Many reviewers cut across more than one frontier and/or related fields, e.g. Nuclear Physics**
- **Panelists and external reviewers are experts representing the HEP community, primarily from the DOE national laboratories and U.S. Universities**
- **A major factor in a funding decision is the reviewers' evaluations**
- **High quality reviewers are essential for successful science. We seek people who are informed, engaged, and conscientious; and who are willing to give their honest opinion. We avoid people who mainly want to tweak HEP policy.**
- **Our panelists almost universally take their jobs very seriously and contribute enormously to the field.**

Implicit Bias in Scientific Peer Review

- **How does implicit bias influence evaluations?**

- **A few key characteristics of implicit biases**
  - Implicit biases are pervasive and robust. **Everyone possesses them**
  - Implicit and explicit biases are generally regarded as related but **distinct mental constructs**
  - The implicit associations we hold arise **outside of conscious awareness**
  - We generally tend to hold implicit biases that **favor our own ingroup**
  - The implicit associations that we have formed **can be gradually unlearned** and replaced with new mental associations

  http://kirwaninstitute.osu.edu/wp-content/uploads/2014/03/2014-implicit-bias.pdf

- **In a perfect world, peer review would require scientific research to pass a uniformly high bar based solely on its merit**
  - Physicists, like all people, will find it difficult to set aside all of their biases
  - Single-blind peer review allows conscious and unconscious biases regarding the author's professional reputation, age, gender, race, or institutional affiliation to influence reviews
  - In theory, concealing the identity of the PI(s) would remove these biases
  - However, the high degree of specialization in particle physics makes the preservation of anonymity very challenging

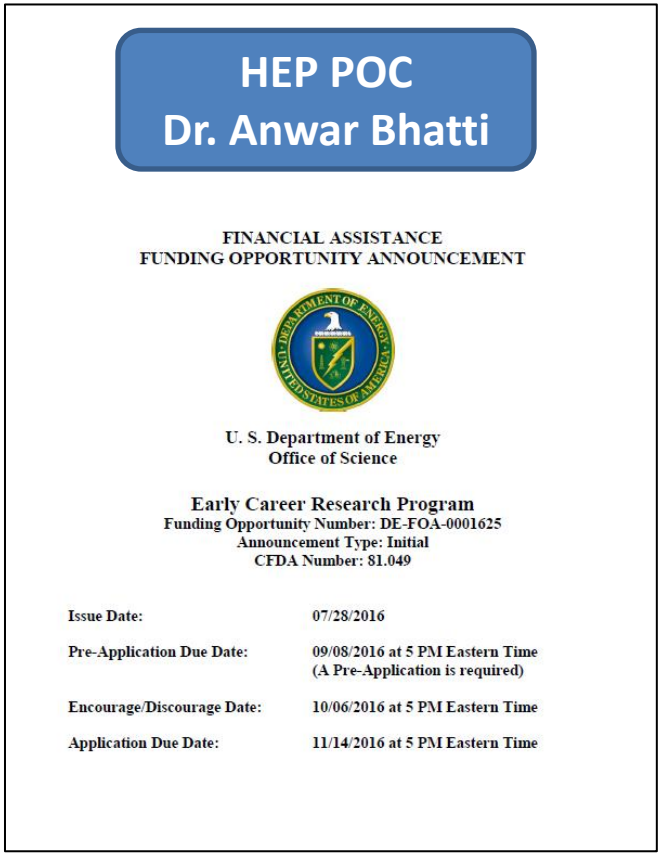
- **Test for implicit bias**
  - https://implicit.harvard.edu/implicit/selectatest.html

EARLY CAREER RESEARCH PROGRAM

FY 2017 Early Career FOA

- DE-FOA-0001625 and LAB 16-1625 issued Jul 28, 2016
- Six HEP research subprograms
  - Energy, Intensity, and Cosmic Frontiers
  - HEP Theory
  - Accelerator Science and Technology R&D
  - Detector R&D
- Pre-applications: Sep 8, 2016 by 5 PM ET
  - A Pre-Application is Required
- Encourage/Discourage: Oct 6, 2016 by 5 PM ET
- Proposal deadline Nov 14, 2016 by 5 PM ET
- Must have received Ph.D. no earlier than 2006
- All due times are 5 PM Eastern Time to take advantage of the PAMS help desk hours.
- DOE HEP will be increasing the investments in the Early Career Research Program by ~50% starting with FY 2017

HEP POC
Dr. Anwar Bhatti



FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy
Office of Science

Early Career Research Program
Funding Opportunity Number: DE-FOA-0001625
Announcement Type: Initial
CFDA Number: 81.049

Issue Date:	07/28/2016
Pre-Application Due Date:	09/08/2016 at 5 PM Eastern Time (A Pre-Application is required)
Encourage/Discourage Date:	10/06/2016 at 5 PM Eastern Time
Application Due Date:	11/14/2016 at 5 PM Eastern Time

- Presidential Early Career Awards for Scientists and Engineers (PECASE)
  - PECASE-eligible candidates are selected from the pool of Early Career awardees

http://science.energy.gov/about/honors-and-awards/pecase/

Both the FOA and FAQ available at:
http://science.energy.gov/early-career/

HEP Early Career Selection Process

- **Two-stage merit review process**
  - Stage 1: Three to six specialized external reviews collected for all candidates, followed by down-select of top proposals in each research subprogram based on external evaluations and programmatic priorities
    - Advanced Accelerator R&D, Cosmic Frontier, Detector R&D, Energy Frontier, Intensity Frontier, Theoretical and Computational HEP.
  - Stage 2: Panel review of top proposals selected based on external reviews, with a single panel evaluating all proposals together.
    - Panel members provide DOE HEP with their top rank-ordered proposals across all research subprograms.

- **"Super Panel" approach**
  - Lab and university proposals are reviewed together.
  - Theory, accelerator, detector R&D and three experimental subprograms all reviewed together. Panel members with broad view of HEP program are selected and instructed to take a "big picture" view to identify the proposals/PIs which/who are most likely to impact HEP.

HEP Early Career Proposal Framework

Starting Point

- A faculty position does not guarantee anyone a DOE grant
- A laboratory position does not guarantee anyone new resources
- All proposals are subject to peer-review
- All proposals for DOE HEP support must be written in the context of the DOE mission
- All proposals to DOE HEP need to connect to at least one of the P5 science drivers on the previous slide
- Review process is comparative and competitive
- A grant is financial assistance funded by taxpayer dollars
- A contract is the purchase of a product or service for federal use

Big Questions

1. What are the challenges you are addressing and the problems you are trying to solve?
2. Is someone else already doing it? Alternatively isn't that already being funded?
3. How does this research exploit/engage the unique capabilities of your institution?
4. What resources are needed to complete this project?
5. Does your proposal outline a 5-year timeline, with key deliverables and personnel profiled during this project period?
6. Have you led the activities that you are proposing? Why are you a future leader in high energy physics?

Proposals: What To Do

Do Follow Instructions

- Read the FOA thoroughly, as well as any supporting materials, e.g. FAQ
- SC rules & procedures and HEP program requirements are regularly updated

Do seek out advice and support from trusted colleagues and mentors

- Your institution has invested a lot of time and money hiring you. They want you to succeed. Let them help you.
- Request a review of the proposal

Do learn the rules, regulations, and costs of your institution

- Funds are awarded to the institution
- Establish a relationship with your budget office or sponsored research office

Do follow through on reviewer feedback

- Give weight to the critical reviews

Do follow proper English grammar and composition

- Careless editing will annoy or confuse reviewers
- Hire someone to proof-read your proposal

Do ask for what you reasonably need

- Standard research requests
  - Salary and travel
  - Other Personnel including post-docs, Eng., students
  - Equipment, M&S, etc.
- Realistic funding expectations
  - Early Career >$150k Univ & >$500k Lab
  - 50% FTE to proposal
  - Stagger personnel

Proposals: What Not To Do

Do Not submit a proposal late

- Applications received after the deadline will not be reviewed or considered for award
- There are no acceptable justifications. There are no appeals.

Do Not brag or exaggerate

- Be professional and objective
- Fully list your accomplishments in the bio
- Accurately and reasonably describe research plan

Do Not preach to the choir

- The narrative should be accessible to a review panel with a wide range of expertise
- Avoid jargon when possible
- Describe in clear and concise language. Tell a story.

Do Not submit a sloppy budget

- The budget sheets and justification should be prepared with the same care as the narrative
- Reviewers will call out any:
  - Excessive or inappropriate requests
  - Arithmetic errors

Do Not be discouraged

- Competition is strong.
- Some very good proposals are declined due to limited resources.

Early Career Merit Review

- **1. Scientific and/or Technical Merit of the Project**
- **What is the scientific innovation of proposed research? How does the proposed research compare with other research in its field, both in terms of scientific and/or technical merit and originality? How might the results of the proposed research impact the direction, progress, and thinking in relevant scientific fields of research? What is the likelihood of achieving influential results? Is the Data Management Plan suitable for the proposed research and to what extent does it support the validation of research results?**

- **2. Appropriateness of the Proposed Method or Approach**
- **Does the proposed research employ innovative concepts or methods? How logical and feasible are the research 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 Applicant's Personnel and Adequacy of Proposed Resources**
- **Does the proposed work take advantage of unique facilities and capabilities? What are the past performance and potential of the Principal Investigator (PI)? How well qualified is the research team to carry out the proposed research? Are the research environment and facilities adequate for performing the research?**

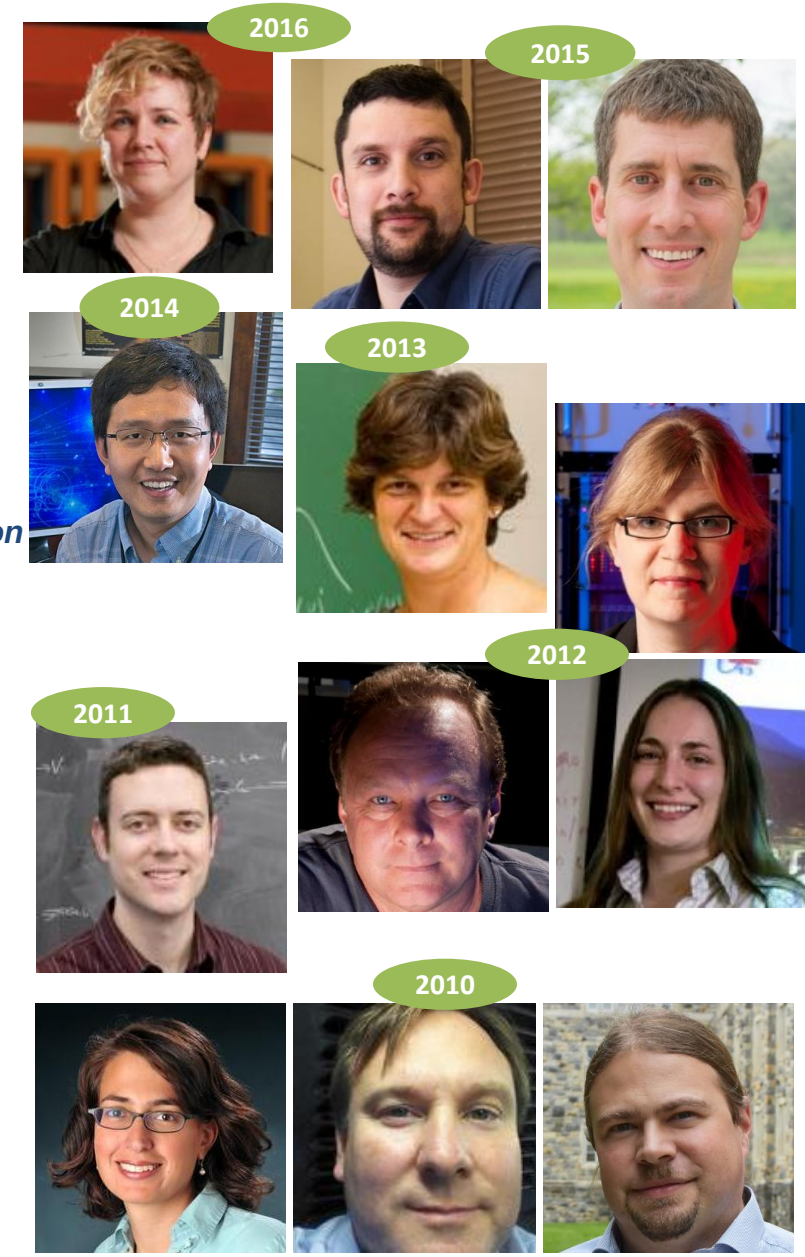
- **4. Reasonableness and Appropriateness of the Proposed Budget**
- **Are the proposed budget and staffing levels adequate to carry out the proposed research? Is the budget reasonable and appropriate for the scope?**

- **5. Relevance to the Mission of the Specific Program (e.g., ASCR, BER, BES, FES, HEP, or NP) to which the Application is Submitted**
- **How does the proposed research contribute to the mission of the program in which the application is being evaluated?**

- **6. Potential for Leadership within the Scientific Community**
- **Scientific leadership can be defined very broadly and can include direct research contributions. How has the PI demonstrated the potential for scientific leadership and creative vision? How has the PI been recognized as a leader?**

Intensity Frontier Early Career Awards

- 2016: Jennifer Raaf (Fermilab) *"Coming in from the Cold: A High-Pressure Gaseous Argon Time Projection Chamber as an Option for the DUNE Near Detector"*
- 2015: Phillip Barbeau (Duke University) "*Coherent Neutrino-Nucleus Scattering: A Tool to Search for New Physics*"
- 2015: Peter Winter (ANL) "*Muon g-2: Precision Determination of the Magnetic Field and Enhanced Trolley Features*"
- 2014: Xin Qian (BNL) "*Detector Development towards Precision Measurements of Neutrino Mixing*"
- 2013: Jelena Maricic (University of Hawaii) "*Resolving Reactor Antineutrino Anomaly with Strong Antineutrino Source*"
- 2012: Geralyn (Sam) Zeller (Fermilab) "*Understanding Liquid Argon Neutrino Detectors: Moving from Art to Science*"
- 2012: Brendan Casey (Fermilab) *"Early Career: Tracking for the New Muon g-2 Experiment"*
- *2012: Lisa Whitehead (University of Houston) "Precision Measurement of Electron Antineutrino Disappearance in the Daya Bay Experiment"*
- 2011: Ryan Patterson (California Institute of Technology) "*Developing novel techniques for readout, calibration and event selection in the NOvA long-baseline neutrino experiment*"
- 2010: Alysia Marino (University of Colorado) "*Probing Neutrino Properties with Long-Baseline Neutrino Beams*"
- 2010: Christopher Mauger (LANL) "*Design of the near detectors and optimization of water and ice targets for fine-grained tracking detectors for the Fermilab Long-Baseline Neutrino Experiment*"
- 2010: Patrick Huber (Virginia Polytechnic Institute & State University) *"Neutrinos in the Universe"*



HEP Early Career FY10-16 Proposals

L = National Laboratory Proposal
U = University Proposal

Subprogram Proposals	FY10 (L/U)	FY11 (L/U)	FY12 (L/U)	FY13 (L/U)	FY14 (L/U)	FY15 (L/U)	FY16 (L/U)	Total (L/U)
Energy	47 (7/40)	32 (5/27)	18 (2/16)	15 (4/11)	14 (4/10)	10 (3/7)	18 (4/14)	154 (29/125)
Intensity	16 (6/10)	21 (10/11)	17 (9/8)	7 (4/3)	14 (9/5)	15 (8/7)	19 (7/12)	109 (53/56)
Cosmic	20 (8/12)	12 (5/7)	17 (5/12)	22 (9/13)	13 (7/6)	14 (6/8)	14 (6/8)	112 (46/66)
HEP Theory	49 (6/43)	45 (7/38)	23 (5/18)	20 (3/17)	23 (3/20)	25 (3/22)	21 (1/20)	206 (28/178)
Accelerator	19 (18/1)	18 (16/2)	10 (9/1)	8 (6/2)	11 (11/0)	7 (6/1)	10 (9/1)	83 (75/8)
Detector	3 (2/1)	0 (0/0)	4 (4/0)	6 (3/3)	2 (2/0)	2 (1/1)	2 (0/2)	19 (12/7)
Total Proposals	154 (47/107)	128 (43/85)	89 (34/55)	78 (29/49)	77 (36/41)	73 (27/46)	84 (27/57)	683 (243/440)

HEP Early Career FY10-16 Awards (I)

L = National Laboratory Proposal
U = University Proposal

Subprogram Awards	FY10 (L/U)	FY11 (L/U)	FY12 (L/U)	FY13 (L/U)	FY14 (L/U)	FY15 (L/U)	FY16 (L/U)	Total (L/U)
Energy	3 (1/2)	3 (1/2)	1 (0/1)	2 (0/2)	2 (1/1)	0 (0/0)	2 (0/2)	13 (3/10)
Intensity	2 (1/1)	1 (0/1)	3 (2/1)	1 (0/1*)	1 (1/0)	2 (1/1)	1 (1/0)	11 (6/5)
Cosmic	2 (0/2)	3 (2/1)	3 (1/2)	2 (1/1)	1 (0/1)	0 (0/0)	1 (0/1)	12 (4/8)
HEP Theory	6 (1/5)	4 (0/4*)	3 (0/3)	3 (1/2)	1 (0/1)	3 (0/3)	1 (1/0)	21 (3/18)
Accelerator	1 (1/0)	2 (2/0)	2 (1/1)	1 (0/1)	1 (1/0)	0 (0/0)	2 (2/0)	9 (7/2)
HEP Awards	14 (4/10)	13 (5/8)	12 (4/8)	9 (2/7)	6 (3/3)	5 (1/4)	7 (4/3)	66 (23/43)
Proposals	154 (47/107)	128 (43/85)	89 (34/55)	78 (29/49)	77 (36/41)	73 (27/46)	84 (27/47)	683 (243/440)

* Two awards funded by DOE Office of Basic Energy Sciences (BES) as an EPSCoR [Experimental Program to Stimulate Competitive Research] award with grant monitored by DOE Office of High Energy Physics (HEP).

HEP Early Career FY10-16 Awards (II)

M= Male
F= Female

Subprogram Awards	FY10 (M/F)	FY11 (M/F)	FY12 (M/F)	FY13 (M/F)	FY14 (M/F)	FY15 (M/F)	FY16 (M/F)	Total (M/F)
Energy	3 (2/1)	3 (2/1)	1 (1/0)	2 (1/1)	2 (1/1)	0 (0/0)	2 (2/0)	13 (9/4)
Intensity	2 (1/1)	1 (1/0)	3 (1/2)	1 (0/1*)	1 (1/0)	2 (2/0)	1 (0/1)	11 (6/5)
Cosmic	2 (2/0)	3 (3/0)	3 (2/1)	2 (2/0)	1 (1/0)	0 (0/0)	1 (1/0)	12 (11/1)
HEP Theory	6 (6/0)	4 (3/1*)	3 (3/0)	3 (3/0)	1 (1/0)	3 (2/1)	1 (1/0)	21 (19/2)
Accelerator	1 (0/1)	2 (2/0)	2 (2/0)	1 (1/0)	1 (0/1)	0 (0/0)	2 (2/0)	9 (7/2)
HEP Awards	14 (11/3)	13 (11/2)	12 (9/3)	9 (7/2)	6 (4/2)	5 (4/1)	7 (6/1)	66 (52/14)
Proposals	154 (131/23)	128 (110/18)	89 (75/14)	78 (64/14)	77 (62/15)	73 (57/16)	84 (65/19)	683 (564/119)

* Two awards funded by DOE Office of Basic Energy Sciences (BES) as an EPSCoR [Experimental Program to Stimulate Competitive Research] award with grant monitored by DOE Office of High Energy Physics (HEP).

Engagement and Leadership

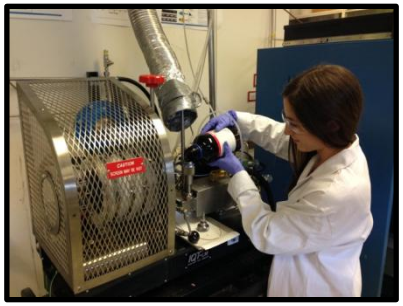
- Review criteria for HEP Comparative Review and Early Career includes **"leader within the proposed effort and/or potential future leader in the field"**
  - Important to seek out and/or volunteer for roles and responsibilities which increase visibility and provide career advancement opportunities
  - Editorial Boards, Sub-detector systems, Physics Working Groups, Run Coordinator, etc.
  - Service work for community is also valued, e.g. co-chairing a conference committee or serving on an NSF review panel
- When asked to review, co-chair, attend, speak, etc. try NOT to say no!
  - You need the experience
  - Ask for feedback (if possible)
  - Respond promptly to all communication
- Timescales for HEP projects from conception to first data will only get longer in the continued pursuit of discovery science due to cost, size and complexity
- HEP academic research track (Univ. or Lab) would benefit from developing a short-, mid- and long-term research plan
  - Balance research between ongoing experiment, upgrades and R&D with future experiment
- Starting Assistant Prof. at University or Associate Scientist at a National Laboratory will most likely continue research from most recent post-doc position
  - Will you be working on that same experiment in 5 years? How about 10 years? In 20 years?!
  - Optimize your start-up or LDRD funds by expanding your research portfolio

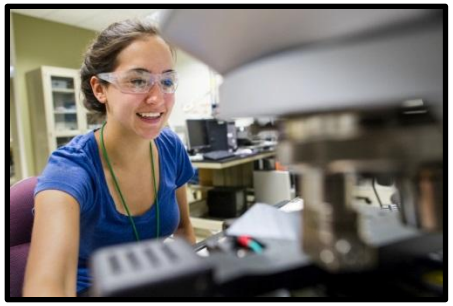
WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS

Workforce Development for Teachers and Scientists at a Glance
Ensuring a pipeline of STEM workers to support the DOE mission

- **At DOE labs and facilities, WDTS supports >1,000 students and faculty annually:**
  - **100 graduate students engaged in Ph.D. thesis research for 3-12 months at a DOE laboratory (SCSGR)**
  - **100 Community College Interns (CCI)**
  - **800 Science Undergraduate Laboratory Interns (SULI) placed at one of 17 DOE labs or facilities**
  - **60 faculty and 25 students in the Visiting Faculty Program (VFP)**
- **Support for the National Science Bowl®**
  - **The Department of Energy (DOE) created the National Science Bowl® in 1991 to encourage students to excel in mathematics and science and to pursue careers in these fields. More than 250,000 students have participated in the National Science Bowl® throughout its 25-year history**
  - **The National Science Bowl® regional winning teams receive expenses-paid trips to Washington D.C. to compete at the National Finals in late April. SC manages the National Science Bowl®, provides central management of 116 regional events, and sponsors the NSB Finals competition**
- **Support for 6 Albert Einstein Distinguished Educator Fellows**
- **Support for on-line business systems modernization**
  - **This activity modernizes on-line systems used to manage applications and review, data collection, and evaluation for all WDTS programs.**
- **Support for program evaluation and assessment**
  - **This activity assess whether programs meet established goals using collection and analysis of data and other materials, such as pre- and post-participation questionnaires, participant deliverables, notable outcomes, and longitudinal participant tracking.**

http://www.science.energy.gov/wdts





DOE Office of Science Graduate Student Research (SCGSR) Program

The SCGSR Program provides supplemental awards to outstanding graduate students to spend 3 to 12 months conducting part of their doctoral thesis/dissertation research at a DOE national laboratory in collaboration with a DOE laboratory scientist.

- Graduate students must apply online through the online application system.
- The application requires a research proposal and letters of support from both the graduate student's thesis advisor and the collaborating DOE laboratory scientist.
- Student's research and proposed SCGSR project must be aligned with one of the identified SCGSR priority research areas defined by the SC Program Offices and specified in the solicitation.
- Applications proposing to use an SC user facility must apply for user facility time separately.

Award Benefits:

- **A monthly stipend of up to $3,000/month for general living expenses**
- **Reimbursement of inbound/outbound traveling expenses to/from the DOE laboratory of up to $2,000.**

(Award payments are provided directly to the student.)

Eligibility:

- **U.S. Citizen or Permanent Resident**
- **Qualified graduate program & Ph.D. Candidacy**
- **Graduate research aligned with an SCGSR priority research area**
- **Establishment of a collaborating DOE laboratory scientist at the time of application**

2016 Solicitation 2 – Applications Due: November 21, 2016 5:00PM ET

Full details, requirements, FAQs, and link to application at: http://science.energy.gov/wdts/scgsr/

Program Contact : sc.scgsr@science.doe.gov

SCGSR Program 2016 Solicitation 2 – Priority Research Areas

Advanced Scientific Computing Research (ASCR)

(a) Applied Mathematics
(b) Computer Science
(c) Next Generation Networking for Science
(d) Research and Evaluation Prototypes

Basic Energy Sciences (BES)

(a) Accelerator and Detector R&D
(b) Heavy Element Radiochemistry
(c) Neutron Scattering Research and Instrumentation
(d) Predictive Materials Science and Chemistry
(e) Fundamental Electrochemistry related to Energy Transduction, Storage, and Corrosion
(f) Crystal Growth
(g) Ultrafast Materials and Chemical Sciences
(h) Electron and Scanning Probe Microscopy Research and Instrumentation
(i) Basic Geosciences
(j) Gas Phase Chemical Physics

Biological and Environmental Research (BER)

(a) Computational Biology and Bioinformatics
(b) Biological Imaging - Mesoscale to Molecules
(c) Plant Science for Sustainable Bioenergy
(d) Environmental System Science

Biological and Environmental Research (BER) – cont'd

(e) Atmospheric Systems Research
(f) Earth System Modeling
(g) Regional and Global Climate Modeling

Fusion Energy Sciences (FES)

(a) Burning Plasma Science & Enabling Technologies
(b) Discovery Plasma Science

High Energy Physics (HEP)

(a) Theoretical and Computational Research in High Energy Physics
(b) Advanced Technology Research and Development in High Energy Physics
(c) Experimental Research in High Energy Physics

Nuclear Physics (NP)

(a) Medium Energy Nuclear Physics
(b) Heavy Ion Nuclear Physics
(c) Low Energy Nuclear Physics
(d) Nuclear Theory
(e) Nuclear Data and Nuclear Theory Computing
(f) Isotope Development and Production for Research and Applications
(g) Accelerator Research and Development for Current and Future Nuclear Physics Facilities

SCSGR Key Dates for 2016 -2017

At the submission deadline (shown in red), the online application system will close after which no additional materials will be accepted. The online application system closes at 5:00 PM Eastern Time.

	2016 Solicitation 1	2016 Solicitation 2	2017 Solicitation 1***
On-line Application Opens	February 16, 2016	August 30, 2016	February 2017
Applications Due	May 11, 2016 5:00 PM ET	November 21, 2016 5:00 PM ET	May 2017
Offer Notification Period *Begins on or around*	September 2016	April 2017	August/September 2017
*Earliest** Start Date for Proposed Project Periods	November 1, 2016	June 1, 2017	October 31, 2017
*Latest*** Start Date for Proposed Project Periods	February 28, 2017	October 2, 2017	February 28, 2018

**Proposed project periods may not begin before this date, and may be 3 to 12 consecutive months in duration.*
*** Proposed project period must begin no later than this date, and may be 3 to 12 consecutive months in duration.*

SCSGR Awardees - Intensity Frontier

- **2015 S2: Aaron Fienberg (University of Washington) "Measuring the Precession Frequency in the New Muon g-2 Experiment" Thesis Advisor: David Herzog. Collaborating Lab (Scientist): Fermilab (Chris Polly)**

- **2015 S2: Anne Norrick (College of William & Mary) "Measurement of Deep-Inelastic Scattering Neutrino Cross Section Rations of C, Fe and Pb to Ch Using MINERvA". Thesis Advisor: Jeffrey Nelson. Collaborating Lab (Scientist): Fermilab (Deborah Harris)**

- **2015 S2: Ben Messerly (University of Pittsburgh) "Measurement of Muon-Neutrino Charged Current Charged Pion Production Plastic Scintillator". Thesis Advisor: Vittorio Paolone. Collaborating Lab (Scientist): Fermilab (Deborah Harris)**

- **2015 S1: Alexander Tewsley-Booth (University of Michigan) "Precision Measurement of the Muon Anomalous Magnetic Moment" Thesis Advisor: Tim Chupp. Collaborating Lab (Scientist): Fermilab (Hogan Nguyen)**

- **2015 S1: Stephanie Su (University of Michigan) "Searching for Rare Long-Lived Neutral Kaon Decay into Pi0 nu nu-bar at J-PARC" Thesis Advisor: Myron Campbell. Collaborating Lab (Scientist): SLAC (Gunther Haller)**

- **2014: David Sweigart (Cornell University) "Measurement of the Muon Anomalous Magnetic Moment to 0.14 ppm" Thesis Advisor: Lawrence Gibbons. Collaborating Lab (Scientist): Fermilab (Brendan Casey)**

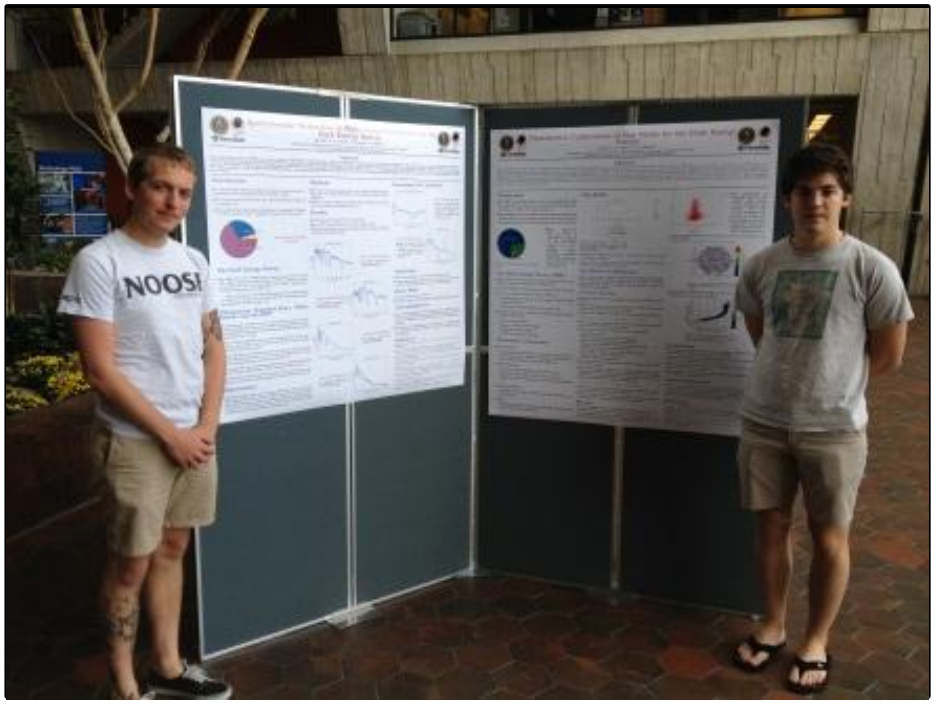
Science Undergraduate Laboratory Internship (SULI)

The SULI program places undergraduate students (from 2 or 4 year institutions) in paid internships in science and engineering research activities at 16/17 DOE Laboratories, and one National User Facility. Students work with laboratory staff scientists or engineers on projects related to ongoing research programs. This, or its predecessor programs, have been in operation since the early '90s.

- **Appointments are for:**
  - **10 weeks during the Summer Term (May through August) or 16 weeks during the Fall Term (August through December) and Spring Term (January through May).**
  - **The 2017 Spring Term application is open through October 7, 2016. The 2017 Summer application is planned to open in early October 2016.**
- **All interns have defined research projects that must be within the DOE mission space.**
- **All interns have required deliverables: A research report, an oral or poster presentation, a peer review, a general audience abstract, and pre- and post-participation surveys.**
- **Interns receive a $500 weekly stipend, travel to and from the laboratory, and possibility for a housing allowance.**
- **Eligibility**
  - **Laboratories also provide an array of seminars and professional development opportunities.**
  - **Undergraduates from 2 or 4 year colleges, in their sophomore through senior year, or recent graduates, are eligible to apply.**
  - **Must be at least 18 years old at the time of application; and a U.S. citizen or LPR.**
  - **Must have a minimum cumulative GPA of 3.0.**
  - **May participate as an intern a maximum of two times; May apply a maximum of 3 times.**
- **WDTS sponsors ~800 participants per year, majority (~600) in the Summer Term.**

Please visit http://science.energy.gov/wdts/suli/ for full details and how to apply.

VFP Student Participant Discovers New Star while working on the Dark Energy Survey



Mees Fix, left, and Sam Wyatt, presenting their project results at Fermi National Accelerator Laboratory. A presentation is one required VFP-Student participant deliverable, in addition to a research report, a peer review, and a general audience abstract. These deliverables are intended to help prepare interns for future STEM professional careers.

- **Fermilab scientists Douglas Tucker and William Wester collaborated with visiting Professor J. Allyn Smith and student interns Samuel Wyatt and Mees Fix (all from Austin Peay State University) in a research project using Fermilab's unique "the cosmos as a laboratory" capability. This research directly supports ongoing Dark Energy Survey calibration studies, an experiment with the potential of discovering the nature of dark energy.**
- **Spectrographic data from many dozens of a certain type of star were collected and analyzed, where data from one star revealed a surprise when Mees Fix discovered that the emission spectrum had two components . . . one from the parent DA (hydrogen-dominated) white dwarf and another component likely due to material from an unseen object falling into the white dwarf.**
- **The spectral data classifies the newly identified star as being a rare "cataclysmic variable star" —an object that warrants further studies.**

2015 SULI participant at Fermilab develops a general procedure for estimation of residual radiation doses

SULI intern Anthony Grebe developed an algorithm and a code system to calculate the residual radiation dose in arbitrary configurations with mentor Dr. Vitaly Pronskikh.

- This project determined the conditions for personnel from Mu2e experiment to safely enter the facility, as there was no explicit method to calculate the radiation dose acquired when walking inside rooms.
- Anthony developed a general solution, so that an arbitrary Fermilab experiment can use this algorithm and code. The Accelerator Physics Center (APC) has plans to include this system in the official MARS15 code distribution. Anthony wrote a detailed manual, and he and his mentor are working on a journal paper submission.
- The APC recognized Anthony for his enthusiasm, excellent knowledge of mathematics, and the ability to apply theoretical knowledge when solving practical problems. They also noted his ability to work in a project team that included a high school student, collaborating and splitting tasks with this student in an excellent and efficient manner.
- A rising senior studying physics at Washington University in St Louis, Anthony plans to pursue a Ph.D. in theoretical high-energy physics.

Community College Internship (CCI)

The Community College Internship (CCI) places students from community colleges in paid internships in technology based projects supporting laboratory work under the supervision of a laboratory technician or researcher. This, or its predecessor program, have been in operation since 1999.

- **Appointments are for:**
  - **10 weeks during the Summer Term (May through August) or the equivalent of 10 weeks during the Fall Term (August through December) and Spring Term (January through May).**
  - **The 2017 Spring Term application is open through October 7, 2016. The 2017 Summer application is planned to open in early October 2016.**
- **All interns have defined technical projects that are within the DOE mission space.**
- **All interns have required deliverables: A research report, an oral or poster presentation, and pre- and post- participation surveys.**
- **Interns are compensated as follows: $500 weekly stipend, travel to and from the laboratory, and a housing allowance.**
- **Laboratories also provide an array of seminars and professional development opportunities.**
- **Must be at least 18 years old; and a U.S. citizen or LPR.**
- **May participate as an intern a maximum of two times; May apply a maximum of three times.**
- **Must have a minimum cumulative GPA of 3.0.**
- **WDTS supports ~100 participants each Summer Term.**

Please visit http://science.energy.gov/wdts/cci/ for full details and how to apply.

Visiting Faculty Program (VFP)

Opportunities for faculty from academic institutions that are typically underrepresented in the DOE research community to engage in a jointly developed research project at a DOE laboratory during the Summer Term. The scope of the projects should be robustly connected to ongoing host lab research project activities. This, or its predecessor program, have been in operation since 2003.

- **Faculty may optionally invite up to two students to participate, one of whom may be a graduate student. VFP- Students must meet SULI requirements, apply separately, and only if invited.**
  - **Students must have a minimum cumulative GPA of 3.0.**
  - **Student interns have required deliverables matching those for SULI: A research report, an oral or poster presentation, a peer review, general audience abstract, and pre- and post- participation surveys.**
- **Operates during a 10-week Summer Term (May through August) - Application process for the 2016 Summer Term is closed; reopens for 2017 in early October 2016.**
- **Faculty receive stipend of $13,000 for 10 week term, undergraduates receive stipend of $500/week; all participants are provided travel to and from the laboratory, and possibility for a housing allowance.**

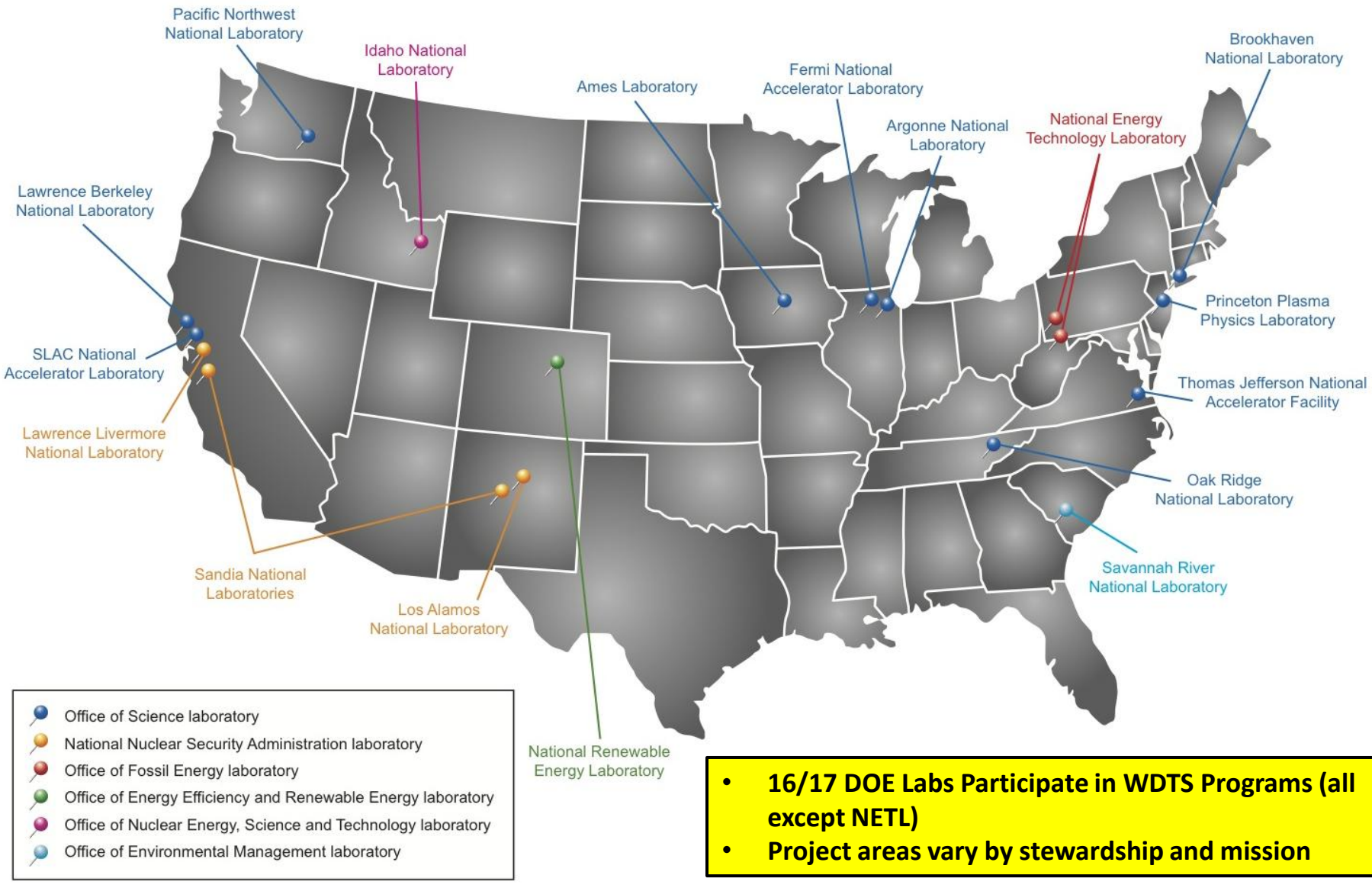
Please visit http://science.energy.gov/wdts/vfp/ for full details and how to apply.

Visiting Faculty Program (VFP), *cont*.

- Must be a full-time faculty member at an accredited U.S. degree granting, postsecondary, institution of higher education historically underrepresented in the U.S. research community, in an area of physics, chemistry, biology (non-medical), mathematics, engineering, environmental sciences, materials sciences, or computer / computational sciences (link to list of ineligible institutions from VFP webpages).
- Must be a U.S. citizen or PRA. Faculty may participate up to three terms.
- Faculty must, through their own efforts, establish a collaboration with a laboratory scientist to co-develop a 6-page research project proposal prior to applying to the program.
  - Faculty can contact host labs by using the POCs listed at: http://science.energy.gov/wdts/vfp/how-to-apply/selecting-a-host-doe-laboratory/
  - Proposal requirements are posted at: http://science.energy.gov/wdts/vfp/how-to-apply/submitting-a-proposal-to-doe/
- Students may only apply after receiving an invitation through the online system
  - Faculty, in their application, must list student(s) to receive system-generated invitation(s)
  - If a student had already applied to CCI or SULI, they must first "un-submit" this application
- WDTS supports ~ 60 faculty and ~25 students each Summer Term (this ratio is not prescribed).

Please visit http://science.energy.gov/wdts/vfp/ for full details and how to apply.

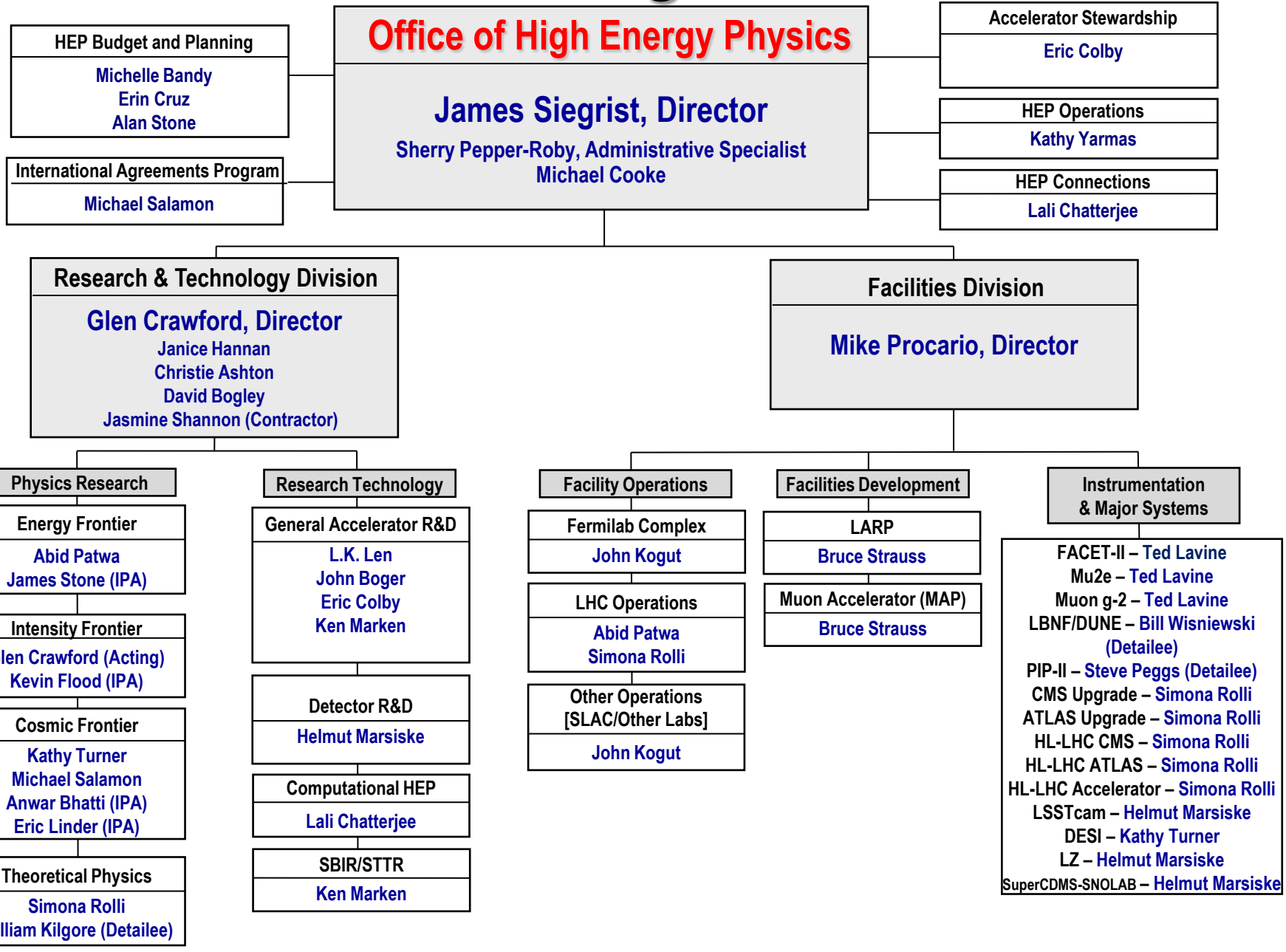
DOE National Laboratories



- **16/17 DOE Labs Participate in WDTS Programs (all except NETL)**
- **Project areas vary by stewardship and mission**

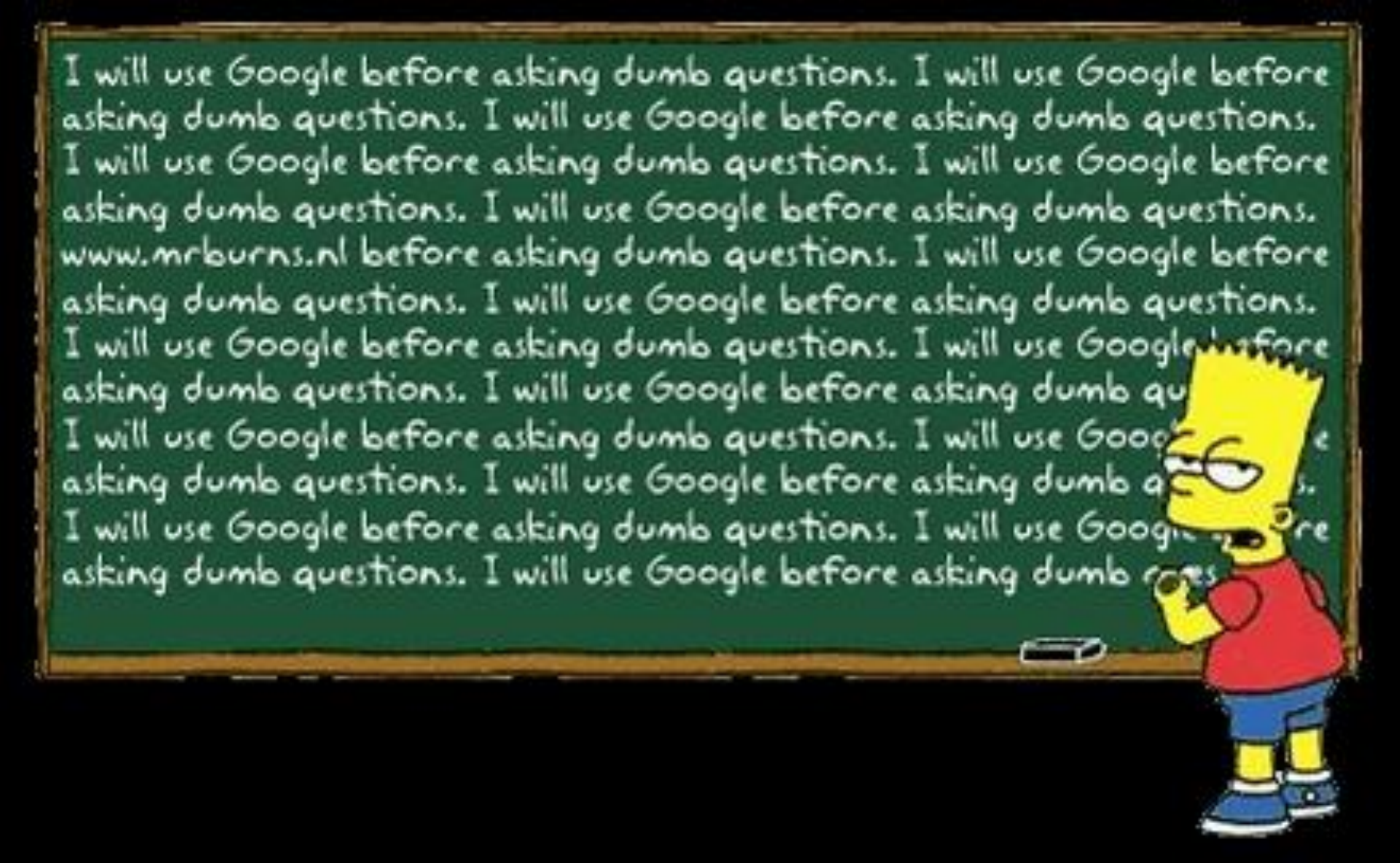
LAST WORDS

DOE HEP Organization



Conclusion

- **It is an exciting time to be doing Intensity Frontier science**
  - **A purposeful suite of experiments in the US and Asia to study and measure neutrino properties, mass heirarchy, etc.**
  - **Soon to start experiments to search for CLFV: Belle II, Muon g-2**
  - **Project development for LBNF/DUNE and Mu2e which will carry the IF program into the next decade**
- **Research dollars will remain competitive**
  - **Emphasis will be towards programmatic priorities**
  - **More attention (and funding) to the Early Career Research Program**
- **There is plenty of more work to do, and students, post-docs and/or senior scientists from any background are welcome to apply their skill sets to doing IF research**



Questions or Comments?


BACKUP

FY2017 HEP COMPARATIVE REVIEW BACKUPS

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**
  - incoming FY 2017 FOA applicants with typical 3-year university grants that plan to renew will have been reviewed at least once
  - HEP subprograms at the DOE national laboratories are also reviewed every 3-4 years
- **Process was recommended by several DOE advisory committees, including the 2010 and 2013 HEP Committee of Visitors (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."*
  - Recommendation of 2010 COV: Use comparative review panels on a regular basis;
  - and 2013 COV: Continue comparative reviews. Augment with independent mail-in reviews.

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

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 8 ½" 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 faculty) 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 that provides overview of each group's activities in different research areas to describe synergies and connections between areas
    - Proposed Project Objectives, Research Methods, Resources
    - Timetable and Level of Effort of different activities, …

Research Scientists

- **Panel will evaluate Research Scientists efforts where support is requested in a comparative review proposal**
- **Guidance to PIs given in Q&A of FAQ**
  - **Requests to support Research Scientists dedicated full-time (and long-term) to operational and/or project activities for an experiment will not be supported by respective research areas**
  - **If Research Scientist 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:**
  - **'Research Scientist conducting scope of work typically commensurate at the postdoctoral-level…'**
  - **'Research Scientist 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**

Appendix Narrative for Research Scientists

- **Per recommendation of 2013 HEP Committee of Visitors (COV), the FY16 FOA is considering to request a supporting narrative of *named* Research Scientist(s) listed in the proposal**
  - **Narrative will be part of Appendix material of the application**
    - **Must not exceed 2 pages per Research Scientist**
  - **Narrative should include brief background info as well as description of roles, responsibilities, and scope of research efforts to be conducted by the scientist**
  - **Scope should support the research activities described in proposal's project narrative**
  - **Narrative will be limited to describe scope of activities for Research Scientist(s) only and is <u>not</u> to be used by PIs to extend the length of the main project narrative**

- **In addition to the above "appendix narrative", the FOA is considering to request each *named* Research Scientist to provide a brief, 1-page biographical sketch**
  - **Info for the sketch includes:**
    - **Education & Training**
    - **Research and Professional Experience**
    - **List up to 5 publications most closely related to the proposed project**
    - **List any graduate student and/or postdoctoral mentorship that supported the RS' research activities**

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
    - Requirements for DMPs and guidelines are available at: http://science.energy.gov/funding-opportunities/digital-data-management/
    - Additional HEP-specific guidance on DMPs is available at: http://science.energy.gov/hep/funding-opportunities/digital-data-management/
- **Most experiments have developed DMPs for their collaborations**
  - When applying for financial assistance [universities] or submitting FWPs [labs] for research, PIs can cite the DMPs for their experiments with the appropriate links
    - If a DMP is cited, PIs must briefly describe how the proposed research relates to the experiment
  - Theorists need DMPs: explain how theoretical/simulated data (e.g., plots) can be accessed or validated
  - If there is no data of any sort generated by the proposed research, the DMP must state this. **A blank or a DMP stating "not applicable" is not acceptable**

Each research thrust in a proposal requesting research support and submitted to DOE, including the FY17 Comparative Review FOA, will require a DMP 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

- **Renewal Proposal Products [see Section II.G of the FY17 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 instruction set in PAMS Users' Guide, Sec. 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

Process Logistics

- **Post-FOA deadline**
  - All applications are pre-screened for compliance to FOA, includes:
    - Verification of senior investigator status
    - Compliance with proposal requirements: e.g., page limits, appendix material, use of correct DOE budget and budget justification forms
    - Responsive to subprogram descriptions
    - Data Management Plan
    - No Personal Identification Information
  - Prior to submission, all PIs should carefully follow guidelines in FOA (and read FAQ)
- **For review process, experts of panelists selected**
  - Each panelist assigned to review 3-6 proposals
    - Minimum of 3 reviews per proposal, additional reviewers added depending on the size of a research group and scope of research activities
      - External reviewers assigned per subprogram for topical expertise
    - Panels convene in mid-Nov and early-Dec to discuss each proposal and each senior investigator, provide additional reviews for proposals, and for comparative evaluation of proposals & PIs
      - Size of each subprogram's panel & length of a panel meeting depends on # of proposals to review
- **Post-Review process**
  - Assess reviews at DOE HEP on each proposal and each senior investigator in order to develop guidance and funding levels
    - In addition to reviews, solicit input from other DOE Program Managers & Grant Monitors
  - PIs given [prioritized] guidance and funding levels (~mid January 2017) and request Revised Budgets and Justifications $\Rightarrow$ route through DOE SC and Chicago Office
- **Funded grants to begin on or about April 1, 2017**

FY12-16 Review Data: Proposals & PIs

	HEP Total – by Proposals (across all 6 subprograms)				
	FY12 Review	FY13 Review	FY14 Review	FY15 Review	FY16 Review
Received	136	185	129	146	156
Declined Without Review	14	23	5	7	22
Reviewed	122	162 (58)	124 (71)	139 (79)	134 (69)
Funded	85	101 (20)	62 (17)	63 (16)	77 (20)
"Success Rate" (%) (Previous/New)	70 (—)	62 (78/34)	50 (85/24)	45 (78/20)	57 (88/29)

	HEP Total – by Senior Investigators (across all 6 subprograms)				
	FY12 Review	FY13 Review	FY14 Review	FY15 Review	FY16 Review
Received	253	504	285	326	363
Declined Without Review	21	42	8	13	54
Reviewed	232	462 (113)	277 (97)	313 (128)	309 (111)
Funded	162	338 (40)	178 (31)	174 (24)	199 (31)
"Success Rate" (%) (Previous/New)	70 (—)	73 (85/35)	64 (82/32)	56 (81/19)	64 (85/28)

NOTES:

- ( ) indicates number of proposals or PIs that did not receive DOE HEP funding the previous fiscal year.
- "Success Rate" is = # Funded/ # Reviewed.

FY12-16 IF Comp Review Data

Junior Faculty, Research Scientists, New vs PY Research

	Junior Faculty		Research Scientists	
	Total # Jr. Faculty Reviewed (New)	# Jr. Faculty Funded (New)	Total # Res. Scientists Reviewed (New)	# Res. Scientists Funded (New)
FY16	7 (6)	3 (3)	2 (0)	2 (0)
FY15	8 (5)	6 (3)	6 (2)	3 (0)
FY14	14 (7)	11 (4)	9 (2)	5 (0)
FY13	9 (5)	7 (5)	5 (0)	4 (0)
FY12	6	4	3	3

	New Proposals		Efforts funded in PY				Total
	Fund	Decline	Up	Flat	Down	No-Fund	
FY16	3	7	7	1	4	1	23
FY15	3	6	8	2	6	5	30
FY14	3	8	7	1	6	1	26
FY13	3	2	8	8	7	5	31
FY12	-	-	-	-	-	-	-

FY12-16 Review Data – Intensity Frontier

	Intensity Frontier Proposals				
	FY12	FY13	FY14	FY15	FY16
Received	19	33	26	30	27
Declined w/o Review	1	2	0	0	4
Reviewed	18	31 (5)	26 (11)	30 (9)	23 (10)
Funded	15	24 (3)	17 (3)	19 (3)	15 (3)
Declined	3	7 (2)	9 (8)	11 (6)	8 (7)
"Success Rate" (%)	**83**	**77**	**65**	**63**	**65**

- IF Research program supports ~60 University grants
- 15-20 PIs submit proposals each year to continue ongoing research, e.g. renewals
- 5-10 'new' proposals each year compete for resources (some fraction are repeat submissions)

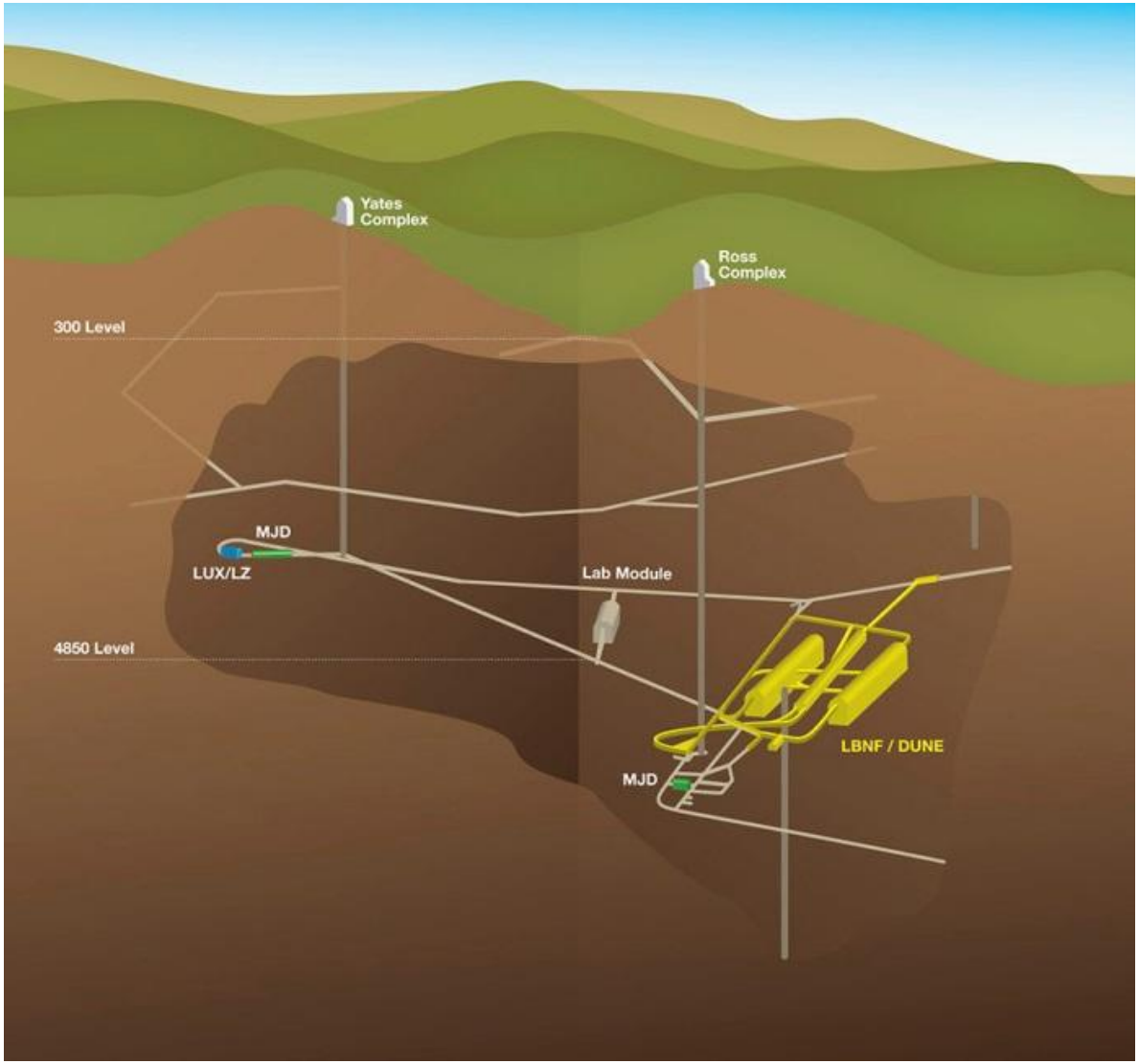
- IF Research program supports ~100 University senior investigators
- 30-40 senior investigators are PIs/co-PIs on submitted proposals each year to continue ongoing research, e.g. renewals
- 10-20 senior investigators, including new assistant professors, request research support on new Intensity Frontier scope

	Intensity Frontier Senior Investigators				
	FY12	FY13	FY14	FY15	FY16
Received	36	56	57	59	52
Declined w/o Review	2	2	0	0	10
Reviewed	33	54 (8)	57 (20)	59 (19)	42 (19)
Funded	24	43 (6)	41 (9)	40 (7)	27 (6)
Declined	9	11 (2)	16 (11)	19 (12)	15 (13)
"Success Rate" (%)	**72**	**80**	**72**	**68**	**64**

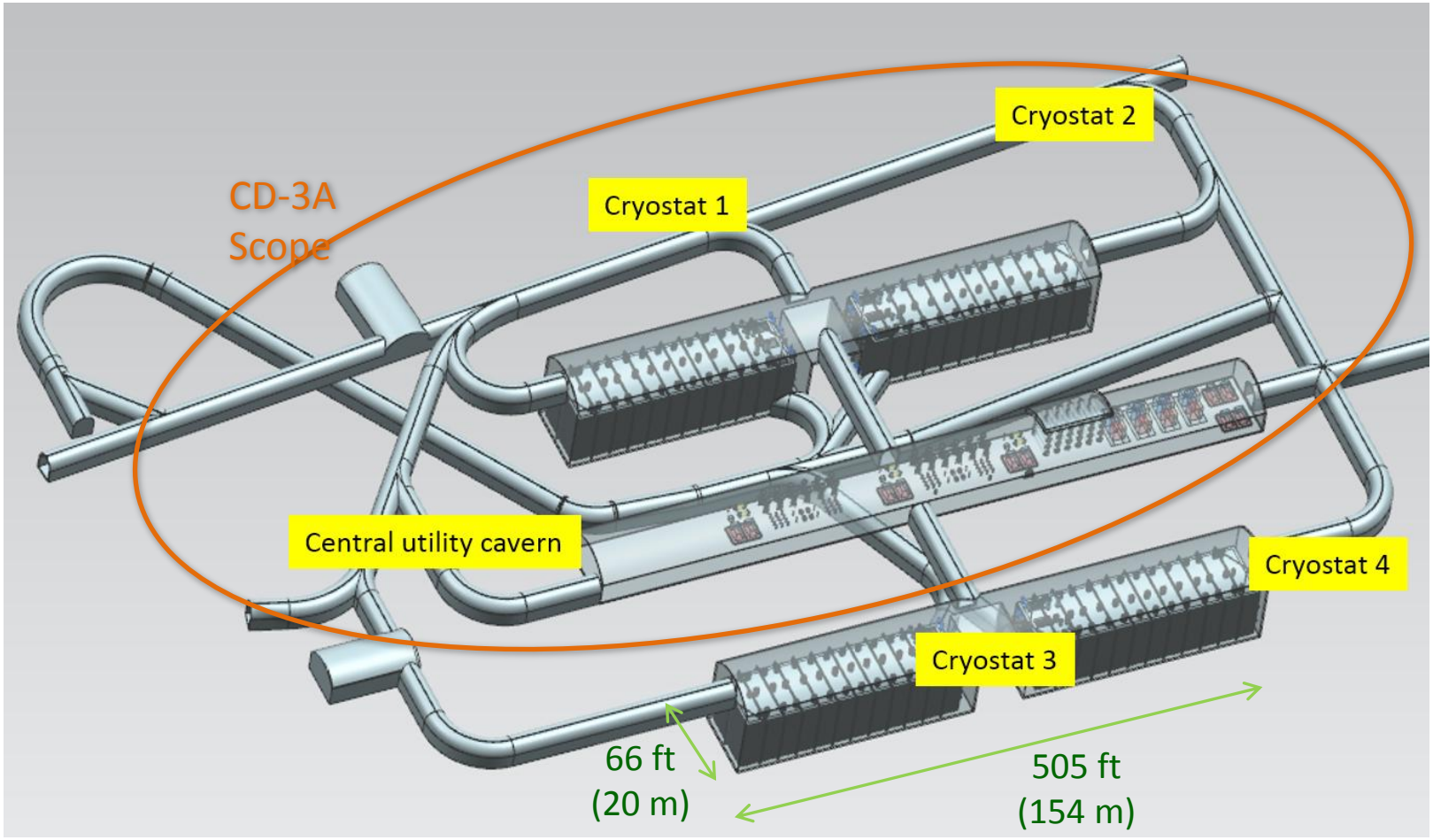
INTENSITY FRONTIER BACKUPS

Sanford Underground Research Facility

- Currently host to:
  - LUX dark matter experiment (HEP)
  - Majorana Demonstrator neutrinoless double beta decay experiment (NP)
- Proposed CD-3A scope covers civil construction needed to support the installation of the cryostats and detectors
  - $219M in base costs
  - $83M in contingency
- CD-3A underground excavation will expand the 4,850 ft. (~1,480 m) drift to create:
  - Detector chambers
  - Central utility cavern
  - Removes over 800,000 tons of rock from a mile underground!



Underground Excavation Scope of CD-3A

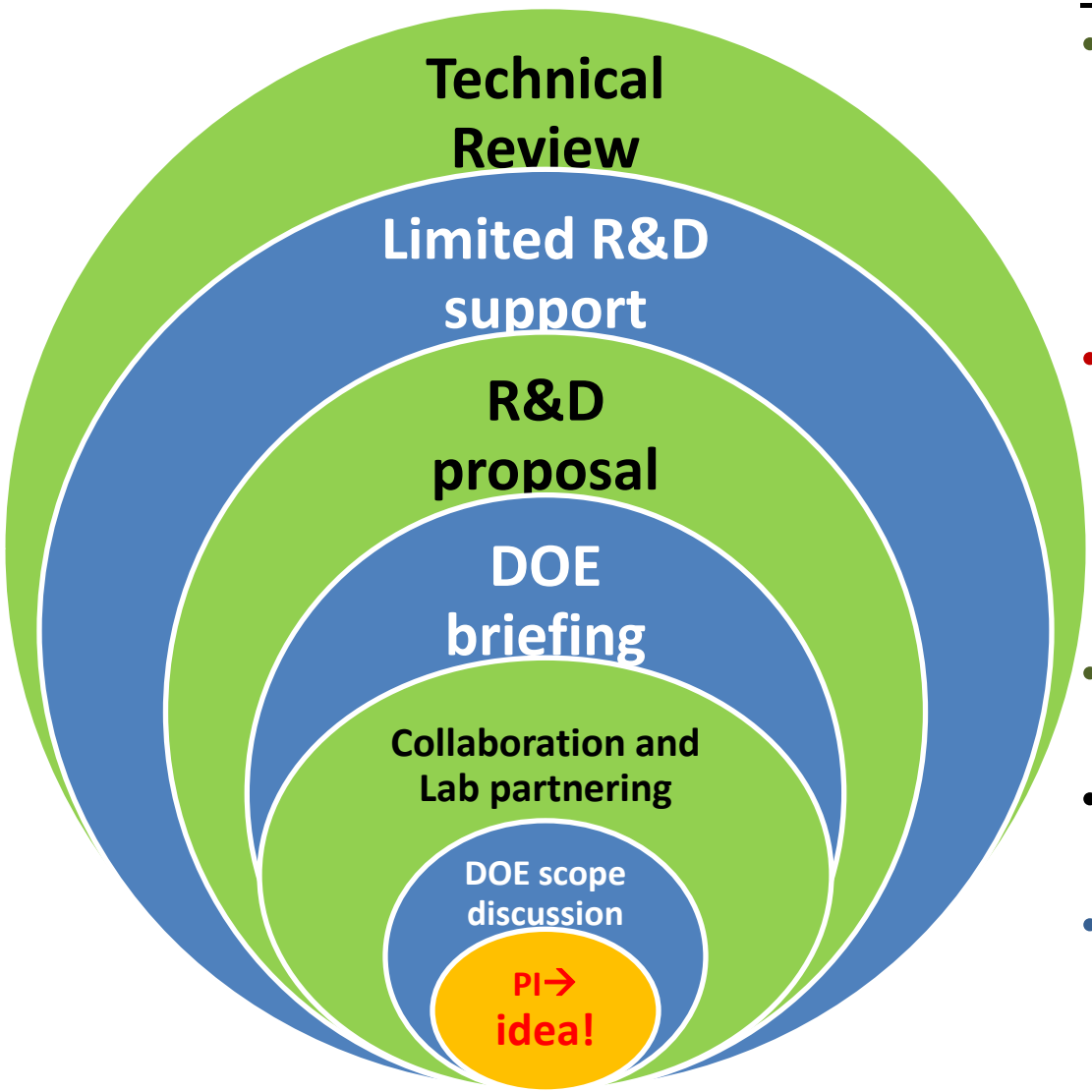


- **Excavation is $154M of proposed CD-3A base costs (remaining $65M for infrastructure)**
  - **Two of the four planned detector chambers**
  - **Central utility cavern**
  - **Drifts and ramps for access, egress, and cavern excavation**

Pointers on Intensity Frontier R&D Initiatives

- **Intensity Frontier R&D activities reviewed case by case**
  - **Target of opportunities: fast, cost-effective and compelling (discovery potential)**
- **What constitutes Intensity Frontier R&D?**
  - **Perform simulations and physics studies in support of the conceptual and preliminary design of a future experiment or project**
  - **Develop and demonstrate the technical feasibility of novel detectors or systems**
  - **Design, construct, commission, and operate a prototype experiment**
- **What are the ground rules?**
  - **Start at home. Seed support from Univ. start-up, LDRD, private foundation, etc.**
  - **There is not a separate pot of money. All funding comes out of research. Be thrifty. Be reasonable. R&D proposals should be mainly for technical support.**
  - **Form a strong & credible collaboration. Partnerships with labs and universities are preferred. International participation is encouraged.**
  - **Socialize with the funding agencies AND lab management at the earliest opportunity.**
    - **Briefings to HEP (and NSF, NP, NNSA, etc.). PAC(s) should have a voice.**
    - **How and when does this activity fit within the HEP mission and Intensity Frontier portfolio? Is this aligned with P5?**
  - **Technical proposal will be reviewed. Research will be reviewed. Separately.**

Process Schematic for Small Projects, Experiments

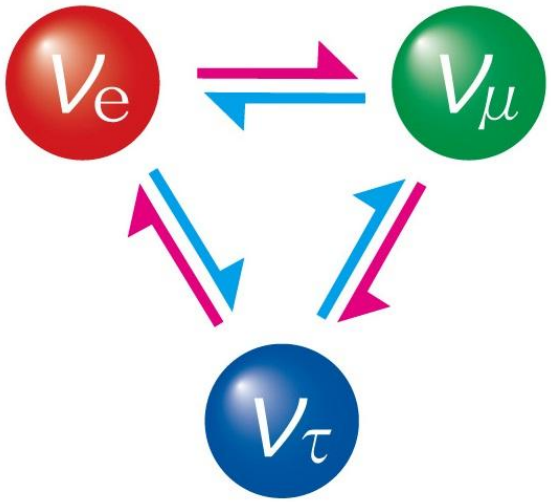


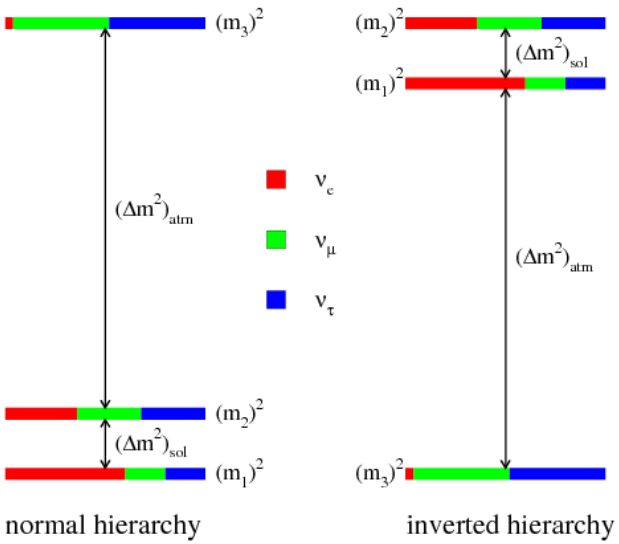
Important Thresholds:

- $2M ($5M) major item of equipment (MIE) at a university (DOE facility) called out in in federal budget. Requires about 18 months lead time.
- $10M total project cost. Critical Decision process involving Office of Project Assessment (OPA). HEP must initiate CD-0. Can be lowered by HEP or OPA.
- Labs have internal thresholds and procedures.
- HEP small projects are typically funded out of research.
- Early discussions with HEP are essential!

Measuring Neutrino Properties

- **Neutrinos are neutral and only interact via the weak force**
  - Experiments need to generate a huge number of neutrinos
    - Nuclear power plants produce antineutrinos in all directions
    - Powerful accelerators can produce copious amounts of neutrinos and antineutrinos in a directed beam to a neutrino detector
  - Experiments need very large and sensitive detectors
    - Hundreds to thousands of tons of mass help allow a neutrino interaction
    - High detector sensitivity helps record rare interactions, when they occur
- **Neutrinos are known to change types as they travel and it is not clear if there is a difference in the way neutrinos and antineutrinos interact**
  - It takes some time (distance) for neutrinos to change types (oscillate)
    - Optimal distance depends on the properties of the neutrino source
    - Some measurements require hundreds of miles between source and detector
  - Accelerators required to study difference between neutrino & antineutrino
- **Understanding the complex physics of neutrinos requires a complementary set of experiments with different sources and detectors**





What Distinguishes HEP and NP Neutrino Studies

- **HEP's Mission is to discover and understand the nature and properties of *elementary particles and their interactions***
- **NP's Mission is to discover and understand all forms of *nuclear matter (i.e. nucleons and nuclei)***
  - **These are different scientific disciplines that have different science drivers, though there are deep intellectual connections**
  - **They do share some (experimental, theoretical) techniques and technology**
- **The important intellectual connections to Nuclear Physics studies, generally involve non-accelerator-based investigations of neutrinos and fundamental symmetries**
  - **These are recognized by the respective science communities to be critical independent investigations of distinct scientific questions, the answers to which will ultimately inform and advance both programs.**

HEP Project Status

Subprogram	TPC ($M)	CD Status	CD Date
INTENSITY FRONTIER			
Long Baseline Neutrino Facility / Deep Underground Neutrino Experiment (LBNF/DUNE)	TBD	CD-1	November 5, 2015
Muon g-2	46	CD-2/3	August 20, 2015
Mu2e	273	CD-3	July 14, 2016
ENERGY FRONTIER			
LHC ATLAS Detector (Phase-1) Upgrade	33	CD-2/3	November 12, 2014
LHC CMS Detector (Phase-1) Upgrade	33	CD-2/3	November 12, 2014
HL-LHC ATLAS Detector (Phase-2) Upgrade	TBD	CD-0	May 26, 2016
HL-LHC CMS Detector (Phase-2) Upgrade	TBD	CD-0	May 26, 2016
HL-LHC Accelerator Upgrade	TBD	CD-0	May 26, 2016
COSMIC FRONTIER			
LZ	56	CD-2/3B	August 1, 2016
SuperCDMS-SNOlab	TBD	CD-1	December 21, 2015
Dark Energy Spectroscopic Instrument (DESI)	56	CD-3	June 22, 2016
Large Synoptic Survey Telescope Camera (LSSTcam)	168	CD-3	August 27, 2015
ADVANCED TECHNOLOGY R&D			
Facility for Advanced Accelerator Experimental Tests II (FACET-II)	TBD	CD-1	December 21, 2015
Proton Improvement Plan II (PIP-II)	TBD	CD-0	November 12, 2015

EARLY CAREER BACKUPS

HEP Early Career Timeline

Pre-review

- **September: Mandatory Pre-applications due. Eligibility checks. Program planning.**
- **October: Encouragement/discouragement to develop full proposals.**
- **November: Proposals received.**

Panel Review

- **December: All proposals to at least three reviewers via PAMS.**
- **January: HEP program managers select proposals for panel review.**
- **February: Panel discussion of selected proposals. Add additional reviews and make comparative reviews.**

Post-review and award

- **March: HEP selection of candidate awardees, nominations to Office of Science.**
- **May: Office of Science selects, announces awardees.**
- **June/July: Awards begin.**

Grants and Contracts

- **A grant is a form of financial assistance to a designated class of recipients authorized by statute to meet recognized needs, while a contract involves the purchase of a product or service for federal use or, as stated in the Federal Grant and Cooperative Agreements Act, for the direct benefit of the government.**
- **The chief distinction between grants and contracts is in the nature of the "deliverable" under the funding instrument. Grantees agree to provide a good or carry out a service on behalf of or in the stead of the federal government, whereas contractors agree to provide a good to or carry out a service for the federal government.**
- **Contracts are subject to the Federal Acquisition Regulation at Title 48 of the Code of Federal Regulations. Grants are governed by "common rules" in the OMB Circulars as incorporated into grantor agency regulations.**

GRANTS
• A flexible instrument designed to provide money to support a public purpose.
• Governed by the terms of the grant agreement
• Flexible as to scope of work, budget, and other changes
• Diligent efforts are used in completing research and the delivery of results
• Payment awarded in annual lump sum
• Annual reporting requirements
• Principal Investigator has more freedom to adapt the project and less responsibility to produce results

CONTRACTS
• A binding agreement between a buyer and a seller to provide goods or services in return for consideration (usually monetary).
• Governed by Federal Acquisition Regulations
• Relatively inflexible as to scope of work, budget, and other changes
• Significant emphasis placed on delivery of results, product, or performance
• Payment based on deliverables and milestones
• Frequent reporting requirements
• High level of responsibility to the sponsor for the conduct of the project and production of results

University & 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 ~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