



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Status of the DOE High Energy Physics Program

*High Energy Physics Advisory Panel
November 2017*

*Jim Siegrist
Associate Director for High Energy Physics
Office of Science, U.S. Department of Energy*

DOE Under Secretary for Science

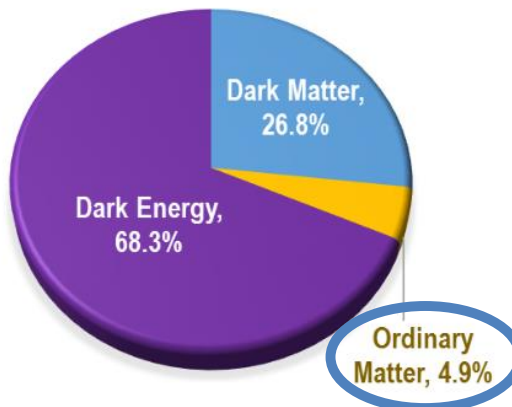
- ▶ Mr. Paul Dabbar was confirmed as DOE Under Secretary for Science on November 2, 2017



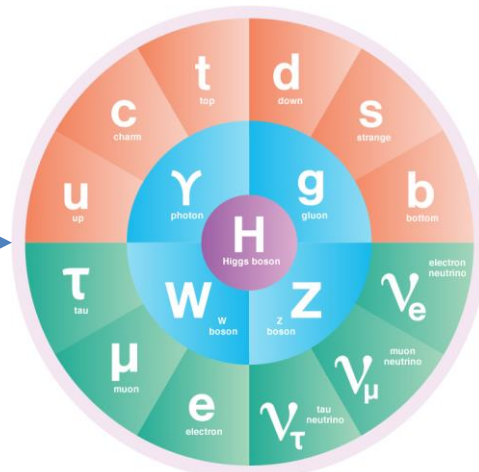
The High Energy Physics Program Mission

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

- ▶ Discover the elementary constituents of matter and energy
- ▶ Probe the interactions between them
- ▶ Explore the basic nature of space and time
- ▶ The DOE Office of High Energy Physics fulfills its mission by:
 - ▶ Building **projects** that enable discovery science
 - ▶ Operating **facilities** that provide the capability for discoveries
 - ▶ Supporting a **research** program that produces discovery science



● QUARKS ● LEPTONS ● BOSONS ● HIGGS BOSON



HEP Budget Status

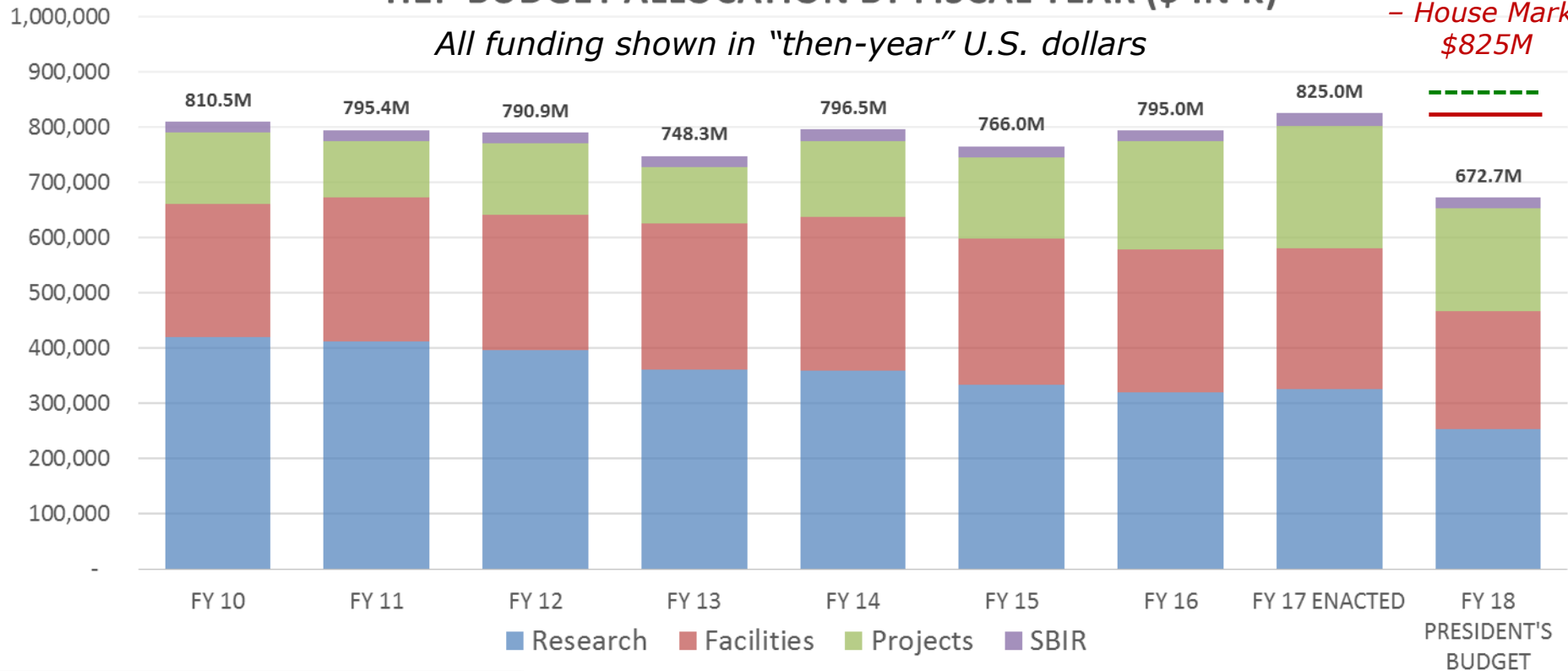
- ▶ Continuing Resolution at the FY 2017 level through December 8
- ▶ Congressional Marks are budget indicators, but final appropriation bill and report language directs program implementation

-- Senate Mark: \$860M

- House Mark: \$825M

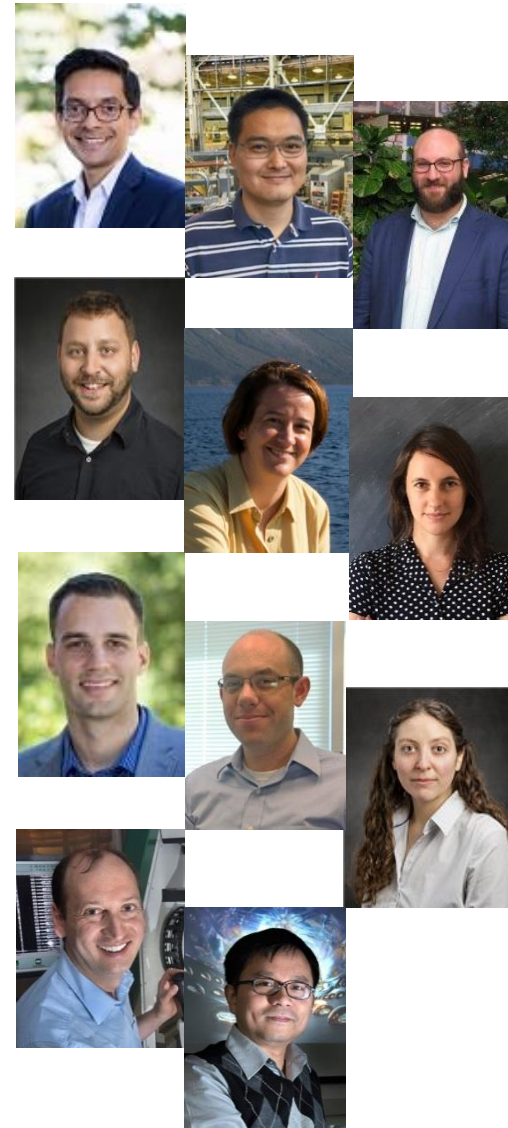
HEP BUDGET ALLOCATION BY FISCAL YEAR (\$ IN K)

All funding shown in "then-year" U.S. dollars



Early Career Research Program FY17

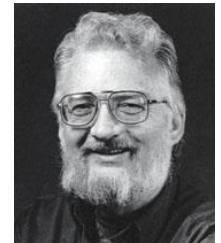
- ▶ **Zeeshan Ahmed (Detector, SLAC)** Development of High-density Microwave-multiplexed Transition Edge Sensor Bolometers for next-generation CMB Cameras
- ▶ **Qiang Du (Accelerator, LBNL)** Scalable Control of Multidimensional Coherent Pulse Addition for High Average Power Ultrafast Lasers
- ▶ **Alexander Himmel (Intensity, FNAL)** Seeing Neutrinos: The Physics Potential of Photon Signals in DUNE
- ▶ **Ben Hooberman (Energy, UIUC)** Probing Naturalness with Searches for Supersymmetric Higgs Partners at the LHC
- ▶ **Anja von der Linden (Cosmic, SUNY SB)** Towards Precision Cluster Cosmology with LSST
- ▶ **Marilena Loverde (Theory, SUNY SB)** Discovering dark energy, dark matter and neutrino properties with cosmic structure
- ▶ **Emilio Nanni (Accelerator, SLAC)** High-Gradient Accelerators at THz Frequencies
- ▶ **Michael Schneider (Cosmic, LLNL)** Dark Energy Constraints from Weak Gravitational Lensing in the Large Synoptic Survey Telescope (LSST)
- ▶ **Jessie Shelton (Theory, UIUC)** Hidden sectors from cosmos to colliders
- ▶ **Alessandro Tricoli (Energy, BNL)** Unveiling the electroweak symmetry breaking mechanism at ATLAS and at future experiments with novel silicon detectors
- ▶ **Chao Zhang (Intensity, BNL)** Optimization of Liquid Argon TPCs for Nucleon Decay and Neutrino Physics



Honors and Awards

- ▶ 2017 AAAS Fellows in Physics:
 - ▶ Todd Adams, *Florida State U.*
 - ▶ R. Michael Barnett, *LBNL*
 - ▶ Marcela Carena, *Fermilab/U. Chicago*
 - ▶ Chang Kee Jung, *Stony Brook U.*
 - ▶ Terry L. Schalk, *UC Santa Cruz*

- ▶ 2018 Henry Primakoff Award for Early-Career Particle Physics:
 - ▶ Eric Dahl, *Northwestern U./Fermilab*



IEEE Milestone for Tevatron Technology

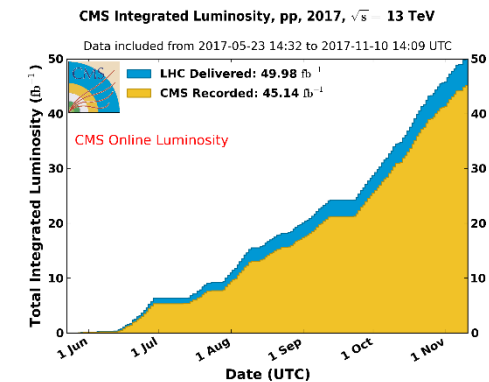
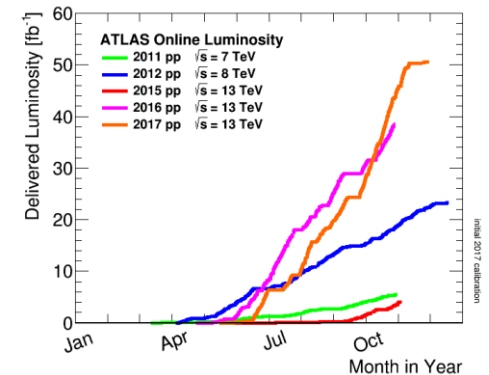
- ▶ On Nov. 13, the Institute of Electrical and Electronics Engineers (IEEE) recognized the technological innovations driven by the Tevatron with a prestigious IEEE Milestone Award for the development of the accelerator's superconducting magnets
 - ▶ During construction, 95% percent of the world's niobium-titanium production went into the Tevatron's 774 superconducting magnets

"The first large-scale use of superconducting magnets enabled the construction of the Tevatron. By 1985, the Tevatron achieved energy above 1 Tera electron-volt (TeV) in proton-antiproton collisions, making it the most powerful particle collider in the world until 2009. The Tevatron construction established the superconducting wire manufacturing infrastructure that made applications such as Magnetic Resonance Imaging (MRI) viable."



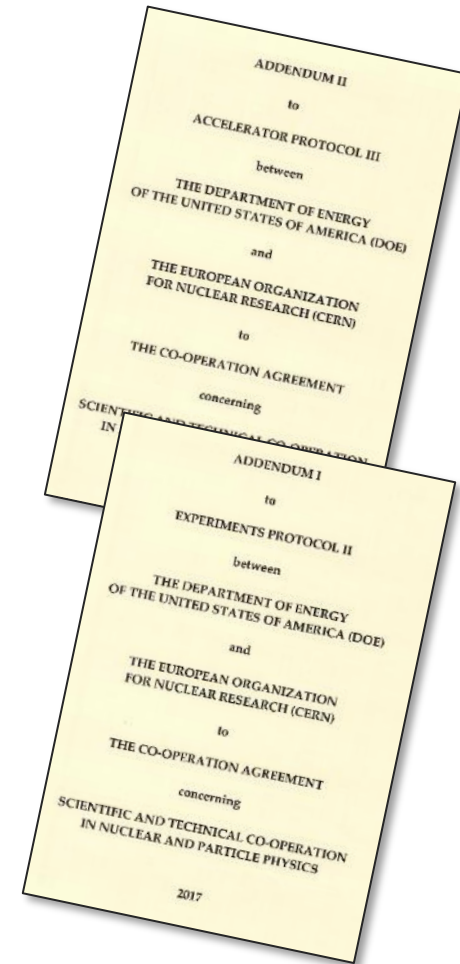
Energy Frontier Highlight: LHC Performance

- ▶ Over 690 LHC Run 1+2 papers submitted by each of the CMS and ATLAS Collaborations
 - ▶ Excellent showing at the 2017 conferences and workshops
- ▶ LHC set performance records during 2017 run
 - ▶ Unprecedented peak instantaneous luminosity of $\sim 2.06 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ exceeded design by a factor of 2!
- ▶ Delivered $\sim 50 \text{ fb}^{-1}$ of data in 2017, exceeding 45 fb^{-1} goal!
 - ▶ **Congratulations to the CERN accelerator team and to the experiments for the excellent work!**
- ▶ ATLAS and CMS detector [Phase-I] upgrades for 2019-2020 progressing
 - ▶ An (early) DOE CD-4a in September 2017 for the U.S. CMS upgrade project
 - ▶ Installation and commissioning activities for the U.S. ATLAS-built deliverables began in FY 2017 and will continue through Long Shutdown 2 (2019-2020)



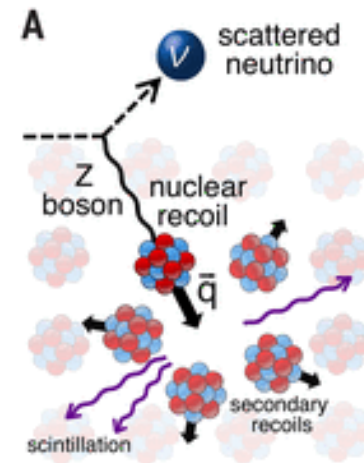
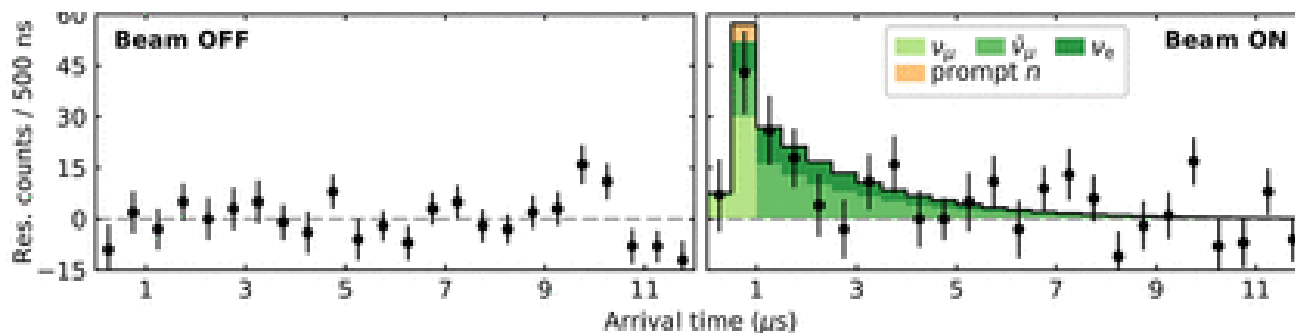
DOE HL-LHC Project Schedules

- ▶ **HL-LHC Accelerator Upgrade Project**
 - ▶ DOE CD-0 (Mission Need) in April 2016
 - ▶ DOE CD-1/CD-3a (Long-lead Procurement) Reviews held in August 2017 went well; DOE CD-1/CD-3a approved in October 2017
 - ▶ Project is advanced technically and management team is transitioning well from the LARP R&D mode to DOE project execution with a strong project office at Fermilab
 - ▶ Project likely to go for CD-2 (Project Baseline) in the second half of 2018
- ▶ **HL-LHC ATLAS and CMS Detector Upgrade Projects**
 - ▶ DOE CD-0 in April 2016
 - ▶ U.S. projects are finalizing resource-loaded schedules, including scope contributions and contingency estimations
 - ▶ DOE working with U.S. ATLAS (BNL) and U.S. CMS (Fermilab) project offices to understand funding profiles in preparation for next DOE CD-1 milestone, which is planned for spring 2018



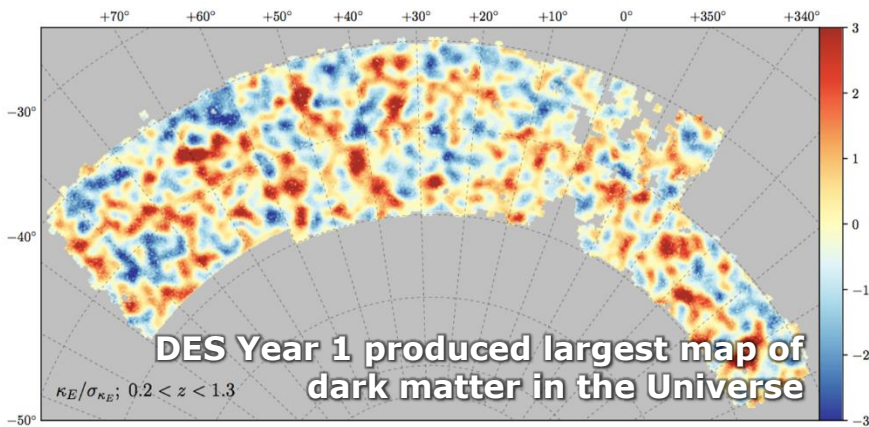
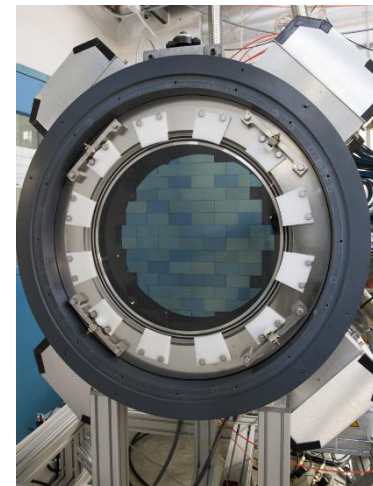
Intensity Frontier Highlight: COHERENT Observes CEvNS

- ▶ COHERENT experiment uses the world's smallest neutrino detector to search for coherent elastic neutrino-nucleus scattering (CEvNS)
 - ▶ 14.6-kg CsI[Na] scintillator operating at Oak Ridge National Laboratory's Spallation Neutron Source (SNS)
- ▶ 43 years after the first theoretical prediction, COHERENT observed CEvNS at a 6.7σ confidence level
 - ▶ "Observation of coherent elastic neutrino-nucleus scattering" published in Science, August 3, 2017
 - ▶ Characteristic signatures in energy and time, predicted by the Standard Model for this process, are observed in high signal-to-background conditions

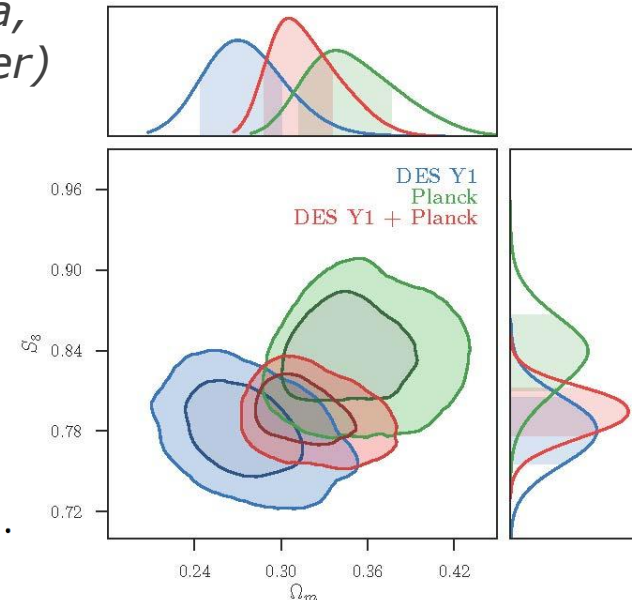


Cosmic Frontier Highlight: Dark Energy Survey (DES) Y1 Results

- ▶ DES studies Dark Energy via survey of 300 million galaxies, 3,000 supernovae with 570-megapixel Dark Energy Camera on Blanco telescope in Chile
- ▶ Data Release 1 (first 3 years of data) planned for Jan. '18
- ▶ Cosmology results from Year 1 data (Aug. 2017)
 - ▶ 10 DES papers, from galaxy clustering & weak lensing, provide constraints competitive with Planck CMB
 - ▶ 100+ papers submitted (*most distant supernova, Milky Way dwarf satellites to constrain dark matter*)



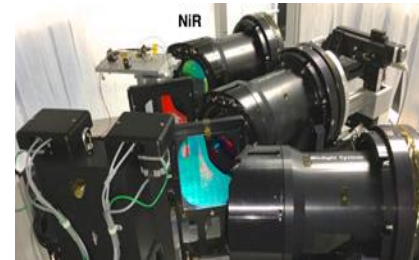
DES Year 1 cosmology results from galaxy clustering and weak lensing

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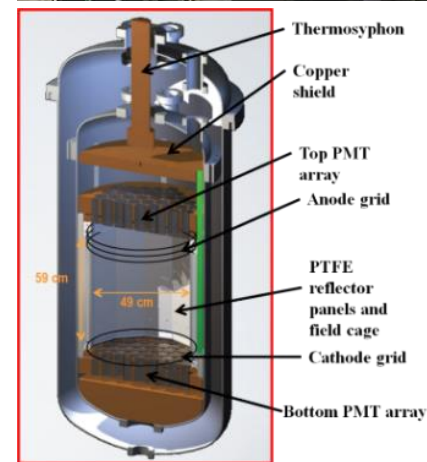
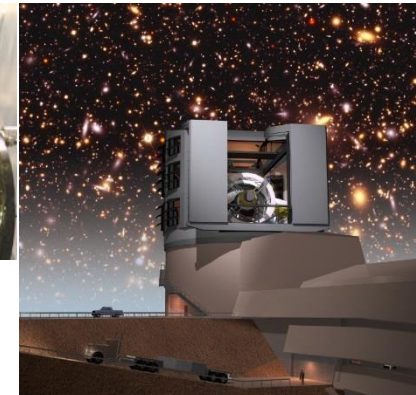
Cosmic Frontier Status

- ▶ Operating experiments continue to advance, produce science results
 - ▶ Data-taking, analysis continues for ADMX-G2, AMS-02, DES, eBOSS, FGST, HAWC, SPT-3G
- ▶ Projects: Priority is executing P5 recommended projects
 - ▶ Dark energy (DE): DESI, LSST
 - ▶ Dark matter (DM): LZ, SuperCDMS-SNOLAB
 - ▶ Super CDMS-SNOLAB CD-2/3 review Jan. '18
- ▶ Future Planning
 - ▶ CMB-S4 CDT report approved
 - ▶ See C. Lawrence's HEPAP talk tomorrow
 - ▶ DOE and NSF meeting to discuss path forward
 - ▶ Collaboration, DOE labs setting up Pre-Project Design Group to develop options and plans
 - ▶ Laying groundwork for small DM projects
 - ▶ Community study at LBNL in Nov. 2017 for DE in the DESI/LSST era and beyond

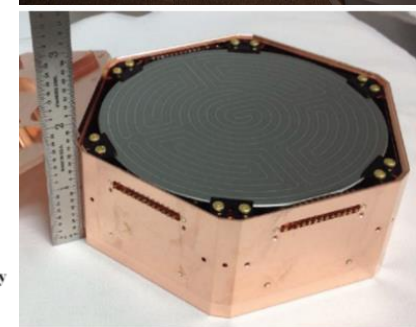
DESI



LSST



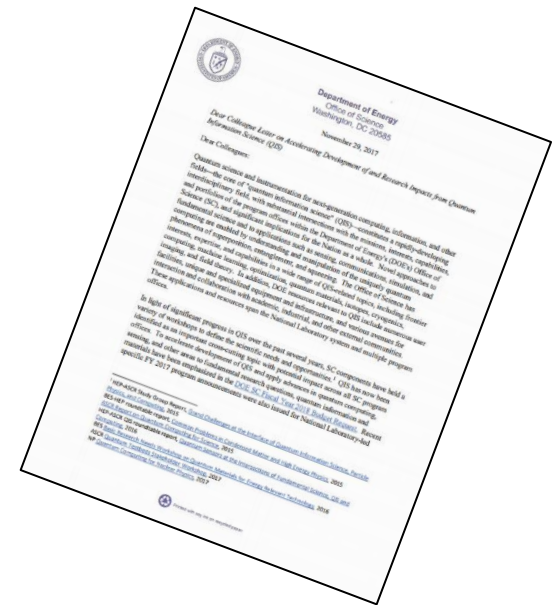
LZ



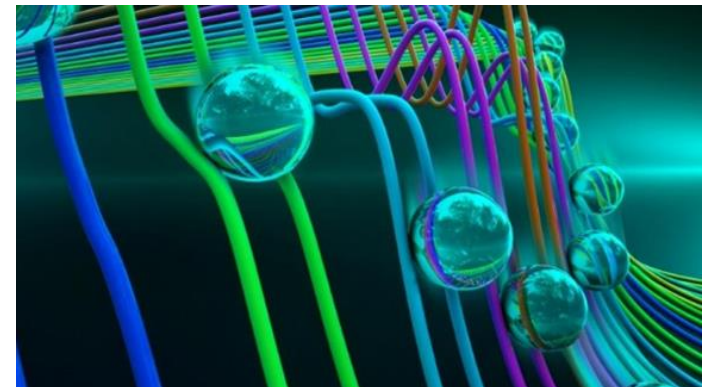
SuperCDMS-SNOLAB

SC Dear Colleague Letter on QIS

- ▶ Office of Science (SC) Dear Colleague Letter was released Nov. 29, 2017
- ▶ Quantum Information Science (QIS) identified as an important cross-cutting topic with potential impact across all SC program offices
- ▶ Should be taken as a statement of interest in encouraging activity in this field
- ▶ Encourages submission of innovative research ideas in QIS via any appropriate existing mechanism
- ▶ The DCL is not a solicitation and does not add to the scope of, or change the review criteria of, any published announcement



For full text, see "What's New" at:
<https://science.energy.gov/sc-2>



Funding Opportunity Announcements

- ▶ FY18 HEP Comparative Review [DE-FOA-0001781]
 - ▶ FOA closed September 12, 2017
 - ▶ Review panels held in November 2017
 - ▶ Selection for an award by DOE expected by spring 2018
- ▶ U.S.-Japan Science and Technology Cooperation Program in High Energy Physics [LAB 18-1802]
 - ▶ Proposals due **December 15, 2017 at 5 PM ET**
 - ▶ **Laboratory only announcement**; institutions encouraged to partner with laboratory if interested
 - ▶ Supports U.S. investigators in bilateral cooperative research activities as part of the U.S.-Japan Science and Technology Cooperation Program in High Energy Physics
 - ▶ Scope of work must involve substantial collaboration with Japanese investigators
 - ▶ The period of performance for awards is one year, commencing in FY 2018



DOE HEP Portfolio Review

- ▶ Independent peer review of currently operating experiments supported by HEP
- ▶ Will focus on scientific impact and productivity of HEP-supported contributions
- ▶ HEP will use the results of this review to define a detailed implementation plan for P5 strategic vision
- ▶ All currently-supported HEP experiments that have taken physics data for at least two years, and are expected to request significant DOE support for operations, or related activities (e.g., computing) beyond FY 2018 are subject to this review

More information in Glen Crawford's HEPAP Presentation



Laboratory Optimization

- ▶ A systematic analysis of the five largest HEP lab programs has been completed, with the goal of positioning the labs for outstanding science for decades to come
 - ▶ A deliberative, negotiated process was developed jointly with the labs
 - ▶ Labs formulated 10-year visions of their HEP programs
 - ▶ HEP Lab programs resolved into 275 distinct capabilities and 52 distinct classes of activities
 - ▶ Data calls to the lab, the community, and to HEPAP provided quantitative data on the merit, cost, internal & external demand, and priority of each activity of each capability
 - ▶ Capabilities were examined in light of P5 recommendations and the vibrancy of long-term R&D, with both local goals (e.g. efficiency) and global goals (e.g. execute P5 plan) in mind.
 - ▶ Through a two month deliberative process, OHEP identified more than 50 distinct realignment actions to strengthen the HEP program
 - ▶ Labs will begin ramping into these actions immediately, full implementation beginning FY 19
 - ▶ Some issues not adequately resolved; further homework and realignment actions will follow
- ▶ The actions are significant, encompassing 5-10% (on a dollar basis) of the lab programs, and impact every aspect of the HEP program
 - ▶ Details about the process and outcomes will be given in a report later today
 - ▶ HEPAP discussion of the systemic issues encountered will be welcome

More information in Eric Colby's HEPAP Presentation



Communications

- ▶ Community groups and Steve Ritz are working to update content on usparticlephysics.org
 - ▶ Share your thoughts or feedback with: DPF Executive Committee, Fermilab UEC, SLUO, and USLUA
- ▶ DOE provides opportunities to highlight results or amplify articles
 - ▶ University Research stream on Office of Science Webpage
 - ▶ DOE will amplify your University's content if you recognize DOE support in your article!
 - ▶ Science Highlights articles
 - ▶ Original content builds a library of DOE results accessible to non-technical audiences
 - ▶ Experiments encouraged to work with host lab's Office of Communications to draft
 - ▶ Contact: Michael.Cooke@science.doe.gov



U.S. Particle Physics: Building for Discovery

U.S. Particle Physics Strategy *Education and Outreach Site*



Particle physics is a dynamic, successful, and global field. The U.S. particle physics community has come together to develop a clear vision for the future. These carefully chosen investments will enable discovery and maintain U.S. leadership in key areas.



Building for Discovery
The PS Report provides the strategy and priorities for U.S. Investments in particle physics for the coming decade.

Particle Physics is Discovery
Exploring the Universe

Particle Physics Makes a Difference in Your Life
Generational Impact



HEP Office Comings & Goings

- ▶ Incoming:
 - ▶ New Detailee for Cosmic Frontier *coming January 2018*
- ▶ “Hiring freeze” has lifted but no DOE Federal positions open at this time
- ▶ We are actively pursuing an IPA/Detailee to assist with critical tasks in the Intensity Frontier subprogram
 - ▶ Interested parties should contact HEP Management!





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