



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# High Energy Physics Program Status

**Jim Siegrist**

**Associate Director**

**Office of High Energy Physics**

**Office of Science, U.S. Department of Energy**

# Outline

---

- **Overview**
- **Program Status and Accomplishments**
- **HEP Budget and Issues**
- **HEP Funding Opportunities**
- **Office News**



# Take-Away Messages

---

- **HEP is global**
  - P5 strategic plan explicitly recognizes this fact, as does DOE implementation
  - Highest priority major projects are LHC upgrades (near-term) and LBNF (mid-term)
    - LBNF will be the first truly international experiment hosted by the U.S., with management modeled after the successful LHC scheme
- **We share the community's enthusiastic response to the P5 strategic plan**
  - We are moving forward with implementation in targeted areas
  - But given the current fiscal environment, full implementation of the plan will take some time
- **2015 will be an important year**
  - First results from LHC Run 2, NO $\nu$ A
  - Further development of short- and long-baseline neutrino program
  - International agreements start coming into view






# HEP PROGRAM STATUS

# Science Drivers and Research Frontiers

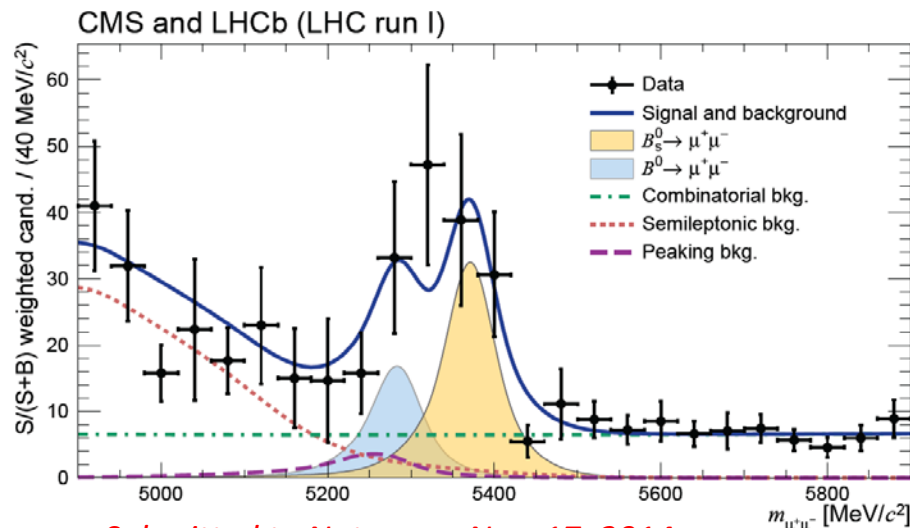
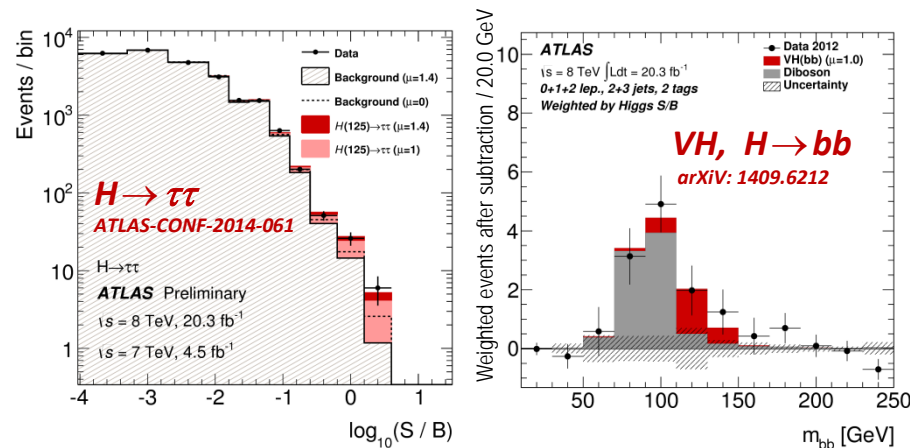
Science drivers identify the scientific motivation while the Research Frontiers provide a useful categorization of experimental techniques

	Energy Frontier	Intensity Frontier	Cosmic Frontier
Higgs Boson	●		
Neutrino Mass		●	●
Dark Matter	●	●	●
Cosmic Acceleration			●
Explore the Unknown	●	●	●

# Energy Frontier Highlight:

Over 360 LHC Run 1 papers submitted for publication by *each* of ATLAS & CMS!

- Recent ATLAS results on the decays of Higgs to fermions:
  - October 2014  $H \rightarrow \tau\tau$  result: observed  $4.5\sigma$  significance excess [3.5 $\sigma$  expected for SM Higgs]
  - September 2014  $VH, H \rightarrow bb$  result: observed  $1.4\sigma$  significance excess [2.6 $\sigma$  expected for SM Higgs]
- Joint CMS-LHCb paper submitted to Nature provides:
  - First observation of the  $B^0_s \rightarrow \mu^+\mu^-$  decay, at  $6\sigma$  significance, and best measurement of its branching fraction to date
  - Evidence for  $B^0 \rightarrow \mu^+\mu^-$  decay at  $3\sigma$  significance
  - Measurements statistically compatible with SM predictions
    - Imposes stringent constraints on several theories beyond the SM



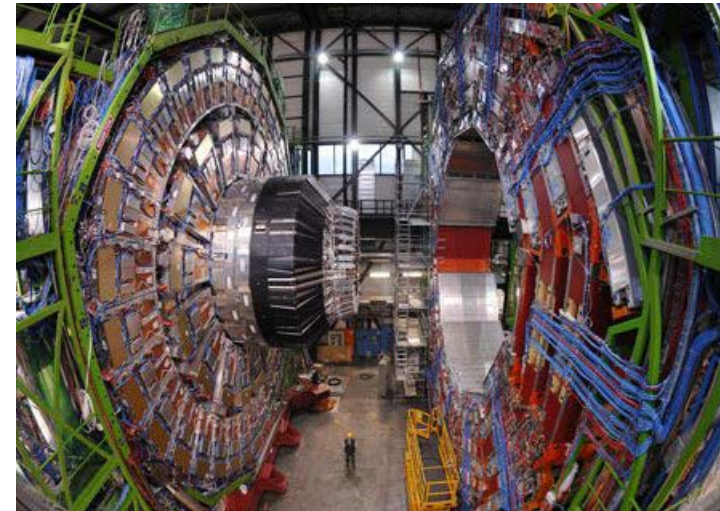
# Energy Frontier Status

## Current program

- **LHC will resume operations in Spring 2015 at collision energies of 13+ TeV**
  - Higher energy will increase the reach into search for new physics in high-impact topics
    - SUSY, dark matter, extra dimensions, ...
- **The U.S. will continue to play a leadership role in LHC discoveries and is actively executing the initial upgrades (Phase-I) to the LHC detectors**
  - Phase-I U.S. CMS/ATLAS upgrades received CD-2/3 approval on November 12, 2014

## Planned program

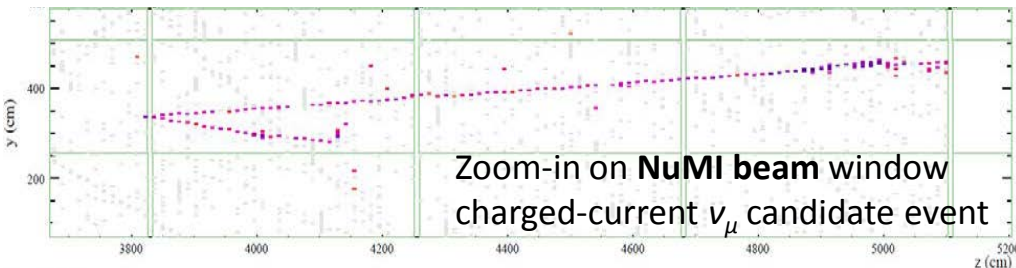
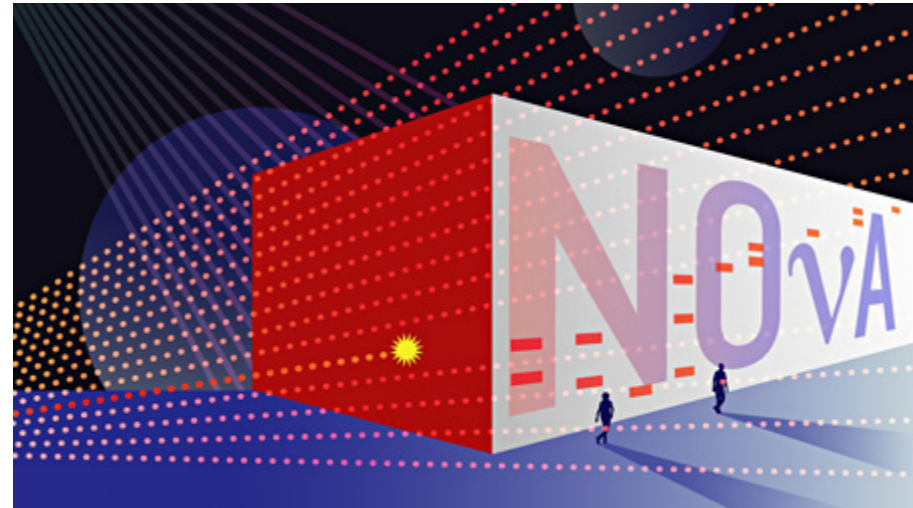
- **Considering high-luminosity LHC upgrade around 2023 to extend discovery reach**
  - Increase luminosity by 10 times LHC design value to explore new physics at TeV energies
  - DOE/HEP actively working with US-CMS/ATLAS to begin mounting HL-LHC Detector Upgrade Project
- **The new CERN-DOE-NSF Cooperation Agreement undergoing final review by all parties**
- **Very modest investments in R&D for future options:**
  - Lepton colliders
  - Very high energy hadron colliders



# Intensity Frontier Highlight:

## NOvA Experiment Taking Data

- NOvA now taking data using the world's most powerful neutrino beam and the world's longest baseline
  - NuMI beam sent 500 mi from Fermilab to Ash River, MN
  - Project completed on time and under budget in September 2014
  - Now beginning planned six-year run





# Intensity Frontier Highlight:

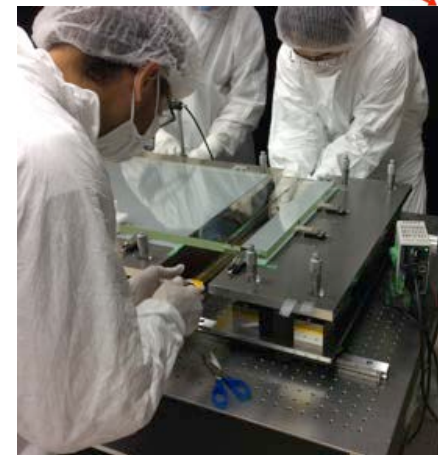
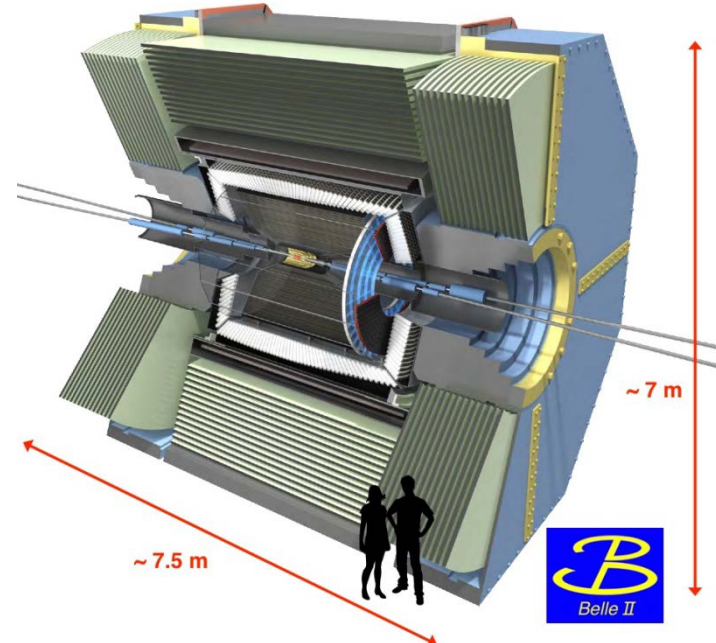
## Belle II Experiment Construction Progress

KEKB upgrade will deliver 100x luminosity of PEP-II

- Belle II Collaboration: 600 members, 99 institutions, 23 countries
  - More U.S. institutions on Belle II than any other country, including Japan
- Key U.S. contributions:
  - Belle II Detector Systems
  - Distributed Computing
  - Technical & Reconstruction Software
  - PNNL serving as U.S. project lead

Progress since Belle II project CD-3 reached in April 2014:

- 1<sup>st</sup> sector of  $K_L$ /muon detector system installed and integrated into DAQ
- 1<sup>st</sup> of 16 modules for Imaging Time-Of-Propagation (iTOP) system for Barrel particle identification assembled
- Detector system to evaluate backgrounds during accelerator commissioning phase
  - Micro-TPCs developed to provide fast neutron directionality using recoil track



Aligning and gluing iTOP optics



Micro-TPC for fast neutron directionality

# Intensity Frontier Status

## Exploring the unknown through precision measurements

- Precisely measure charged leptons properties and search for rare particle interactions
  - Program based on muon beams at Fermilab:
    - *Muon g-2*: Cryogenic test of the superconducting magnet system will be completed before baselining
    - *Mu2e*: Follow-up review in February to determine if project is ready for CD-2/3b in Q2 of FY 2015
- Precision studies of *K* mesons, *c/b* quarks and  $\tau$  leptons to search for new states of matter
  - Small program being carried out at foreign labs:
    - *Belle II*, *KOTO*

## Identify the physics of dark matter

- Intense particle beam based searches for dark matter
  - *APEX*, *Heavy Photon Search*

# Intensity Frontier Status *(continued)*

## Pursuing the physics associated with neutrino mass

- **Current program aims to determine neutrino mass hierarchy & measure neutrino properties**
  - Experiments at Fermilab, China, Japan and underground:
    - *Daya Bay, MicroBooNE, MINERvA, MINOS+, NOvA, Super-K, T2K*
- **Planned program seeks to determine if there are sterile neutrinos and if neutrinos violate CP**
  - Neutrino program planning underway:
    - Fermilab short-baseline neutrino (SBN) Working Group established; Fermi PAC will consider proposal(s)
    - BNL will host a workshop in February 2015 focused on intermediate term SBN program
    - Progress is being made on internationalizing the Long Baseline Neutrino Experiment (*see later talk...*)
  - *See Fermilab talk on Tuesday for more details on Fermilab SBN program and LBNE status*



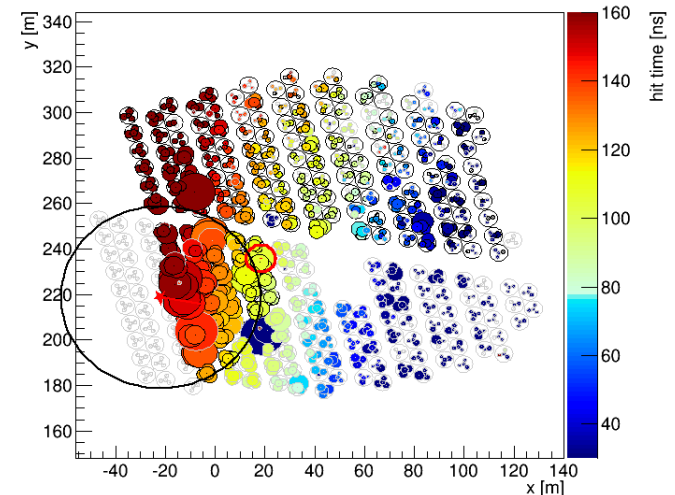
# Cosmic Frontier Highlight:

## HAWC-250 Array Taking Data

- **High-Altitude Water Cherenkov Observatory (HAWC) in Sierra Negra, Mexico, is now taking data**
  - Joint project between DOE, NSF and CONACYT (Mexico)
  - Will perform high-sensitivity synoptic survey of the sky at wavelengths between 100 GeV and 100 TeV
  - Instantaneous aperture covers >15% of the sky and will be exposed to 2/3 of the sky each day
- **Currently running with 250 tanks in place**
  - Entire HAWC-300 array will be completed by February 2015
  - Filling at 4-5 tanks per week



Run 2105, Time slice 140025, Event 89



# Cosmic Frontier Status

## Dark Energy

- **Operating:**
  - *BOSS* (spectroscopic) ends FY14, *DES* (imaging) started FY13, SN surveys
- **Fabrication:**
  - *Large Synoptic Survey Telescope* (LSST, Stage IV imaging)
    - LSST-camera CD-3a approved June 2014, CD-2 review in November 2014, CD-2 approval planned for January 2015
- **Planning:**
  - *Dark Energy Spectroscopic Instrument* (DESI, Stage IV spectroscopic)
    - CD-1 review Sept. 2014; Planning for fabrication start FY16

## Dark Matter (direct detection)

- **Operating:**
  - 1<sup>st</sup> generation (DM-G1) experiments:
    - ADMX, LUX, CDMS-Soudan, DarkSide, COUPP
- **Planning:**
  - DOE and NSF announced in July 2014 selection of DM-G2 experiments to move forward to fabrication phase: *ADMX-G2, LZ, SuperCDMS-SNOLab*
    - LZ & SuperCDMS-SNOLab MIE projects are planning for fabrication start in FY16



# Cosmic Frontier Status *(continued)*

---

## Cosmic-ray, Gamma-ray

- **Operating:**
  - *Fermi/GLAST, VERITAS, Auger, AMS*
    - DOE operations efforts completed by FY16 for VERITAS and Auger
- **Fabrication:**
  - *HAWC* gamma-ray observatory began taking data in late November 2014

## Cosmic Microwave Background (CMB)

- **Operating:**
  - *South Pole Telescope polarization (SPTpol)*
- **Fabrication:**
  - *SPT-3G* had successful review of DOE roles/responsibilities in September 2014
- **Planning:**
  - Community planning for a CMB Stage IV experiment



# INTERNATIONAL AGREEMENTS

*See International Status talk later today...*



# HEP BUDGET AND ISSUES



# FY 2015 High Energy Physics Budget

HEP Funding Category (\$ in K)	FY 2013 Current	FY 2014 Current	FY 2015 Request	Explanation of Changes (FY15 vs. FY14)
Energy Frontier	149,446	154,687	153,639	<i>Reduction for Tevatron completion offset by LHC upgrade activities</i>
Intensity Frontier	274,412	275,043	251,245	<i>Reductions for NOvA project completion, Belle II offset by increase for beam line ops &amp; refurbishment at FNAL</i>
Cosmic Frontier	80,063	99,080	101,245	<i>Ramp-up of LSSTcam</i>
Theoretical and Comp.	66,398	62,870	58,850	<i>Reduced to offset investments in future facilities</i>
Advanced Technology R&D	142,291	122,291	114,242	<i>Reduced to offset project increase, shift towards directed R&amp;D</i>
Accelerator Stewardship	3,132	9,931	19,184	<i>Support new R&amp;D efforts, open accelerator test facilities to industry</i>
Construction	11,781	51,000	25,000	<i>Mu2e on profile; LBNE reduced in FY15 req. (req. made during P5 report development)</i>
SBIR/STTR	0	21,619	20,595	
<b>Total</b>	<b>727,523</b>	<b>796,521</b>	<b>744,000</b>	
<b>DOE Office of Science (SC):</b>	<b>4,681,195</b>	<b>5,066,372</b>	<b>5,111,155</b>	

- **FY 2015 is currently in a 72-day Continuing Resolution (CR) until Dec. 11, 2014**
  - Total HEP funding level based on FY 2015 President's Request (\$744M)

# Table of FY15 Request vs. Senate & House

Funding in \$K	FY 2014 Current	FY 2015 Request	FY 2015 House Mark	FY 2015 Senate Mark
Energy Frontier	151,926	153,639	157,888	156,069
Intensity Frontier	251,032	251,245	266,691	244,939
Cosmic Frontier	101,371	101,245	103,056	106,641
Theoretical and Computational	64,298	58,850	60,670	60,416
Advanced Technology R&D	147,124	114,242	125,605	119,638
Accelerator Stewardship	8,169	<b>19,184</b>	<b>3,000</b>	<b>19,184</b>
Construction	51,000	25,000	37,000	47,000
SBIR/STTR	0	20,595	21,090	20,595
<b>Total</b>	<b>774,920</b>	<b>744,000</b>	<b>775,000</b>	<b>774,482</b>

- **House & Senate marks are similar in total funding, above Pres. Request**
  - House includes MIEs for US-ATLAS/CMS Phase-1 upgrades and DM-G2
- **Accelerator Stewardship very different between House & Senate marks**

# Implementing the P5 Plan

---

- DOE HEP has updated the staff in the House and Senate about how the P5 report strategy affects our plans for FY15
- Current Continuing Resolution (CR) ends December 11 (*this week*)
- Plans for implementing our program depend on the final appropriation:
  - A CR at the FY15 Request level creates complications, but should enable us to implement Scenario A of the P5 report strategy
  - A full appropriation or CR at the House/Senate markup level would allow us to begin implementation of Scenario B of the P5 report strategy



# Implementing the P5 Plan *(continued)*

---

- We are working through project profiles with the laboratories to ensure the P5 priorities are respected and there is no damage to the program under the possible funding scenarios
  - Projects that are baselined or nearly baselined will be fully funded
    - This includes the LHC Phase I upgrades, Mu2e, and LSST
  - High-priority near-term efforts like DM-G2 experiments will get enough funding to keep them going through the CR
    - We will try to enhance their funding after an appropriation is passed
- Laboratories have been asked to defer costs in anticipation of shortfalls
- University research may also be impacted
  - CR at current level (FY15 Request) would lead to 3-5% reductions in university grant support
  - Will try to restore this to “flat cash” in the case of an appropriation near Congressional marks

A close-up, high-angle shot of a vast number of US one-cent coins (pennies) scattered across the frame. The coins are densely packed, with many overlapping. The lighting is warm and golden, creating a rich, textured appearance. The coins are oriented in various directions, showing both the obverse (Lincoln) and reverse (Union Shield) sides. The overall effect is one of abundance and value.

# HEP FUNDING OPPORTUNITIES

# Funding Opportunity Announcement Status

---

- **Scientific Discovery through Advanced Computing (SciDAC) FOA is open (High Energy Physics joint with ASCR) – will close Jan 7, 2015**
  - [http://science.energy.gov/~media/grants/pdf/foas/2015/SC\\_FOA\\_0001210.pdf](http://science.energy.gov/~media/grants/pdf/foas/2015/SC_FOA_0001210.pdf)
- **The HEP research FY2015 Funding Opportunity Announcement (FOA) is closed and we are performing the comparative review**
  - Review process underway and PIs will start to be informed of funding decisions in January
- **The Accelerator Stewardship FOA is now closed**
  - Reviews completed, consulting with partners in SC and other agencies
  - Final decisions will not be made until after FY15 appropriation
- **Early Career Research Program FOA is now closed**
  - Proposals were due by November 20, and we are now preparing for review
- **DOE Office of Science Graduate Student Research (SCGSR) Program is now closed**
  - Review process near completion and award notifications planned to be sent out in December

A stack of newspapers and magazines is shown on the right side of the image. The papers are stacked in a way that shows the edges of many pages, some with colorful markings. A grey horizontal bar with a slight gradient is positioned on the left side, extending towards the stack. The text 'OFFICE NEWS AND MISCELLANY' is written in bold, yellow, uppercase letters on this bar.

**OFFICE NEWS AND MISCELLANY**

# HEP Program Status Updates

---

- **New Assignments**

- Abid Patwa is managing U.S. LHC Operations

- **Comings and Goings**

- William Kilgore (Detailee) is now helping in Theoretical Physics
- Eric Linder (Cosmic IPA) will begin in January 2015
- New Contractors and IPA (Intensity) identified, starting soon
- David Boehnlein (Energy Frontier IPA), Peter Kim (Detector R&D Detailee), and Larry Price (Computing Detailee) finish their terms in early 2015
- Working on new Fed staff position TBA
- Additional help welcome to aid with P5 implementation!
  - Interested parties should contact HEP management



# HEP S&T Connections Thrust

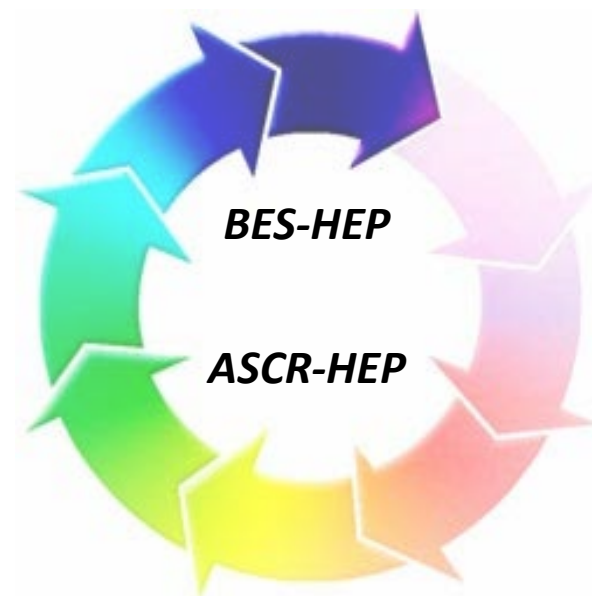
---

- **Aim of thrust is to strengthen connections with other SC Programs and the broader national Science & Technology enterprise**
  - Advance our mission by probing new windows to discovery by synergistic collaborations
  - Accelerate science productivity by drawing on unique expertise and strengths within partnering disciplines
- **Near-term plans include:**
  - Exploit designer materials capabilities for HEP science and technology
  - Discover research techniques using expertise from partnering programs
  - Explore condensed matter & atomic systems that advance HEP science and verify models
  - Pursue Quantum Information Systems as a window to the Universe
  - Broaden the user communities for HEP facilities through new applications outside HEP



# Current Connections Activities

- HEP Connections with Basic Energy Sciences (BES) have begun, following discussions between BES and HEP at Office of Science
- Talk Today by Mike Norman On Materials by Design
  - Connections Question is: *Can the HEP Community use this transformative technique for specialized detector or other materials?*
- Other Activities Initiated Include:
  - ASCR-HEP Study Group
  - BES-HEP Roundtable
- **Program Manager for HEP Connections:**
  - Lali Chatterjee [lali.chatterjee@science.doe.gov](mailto:lali.chatterjee@science.doe.gov)



# Take-Away Messages

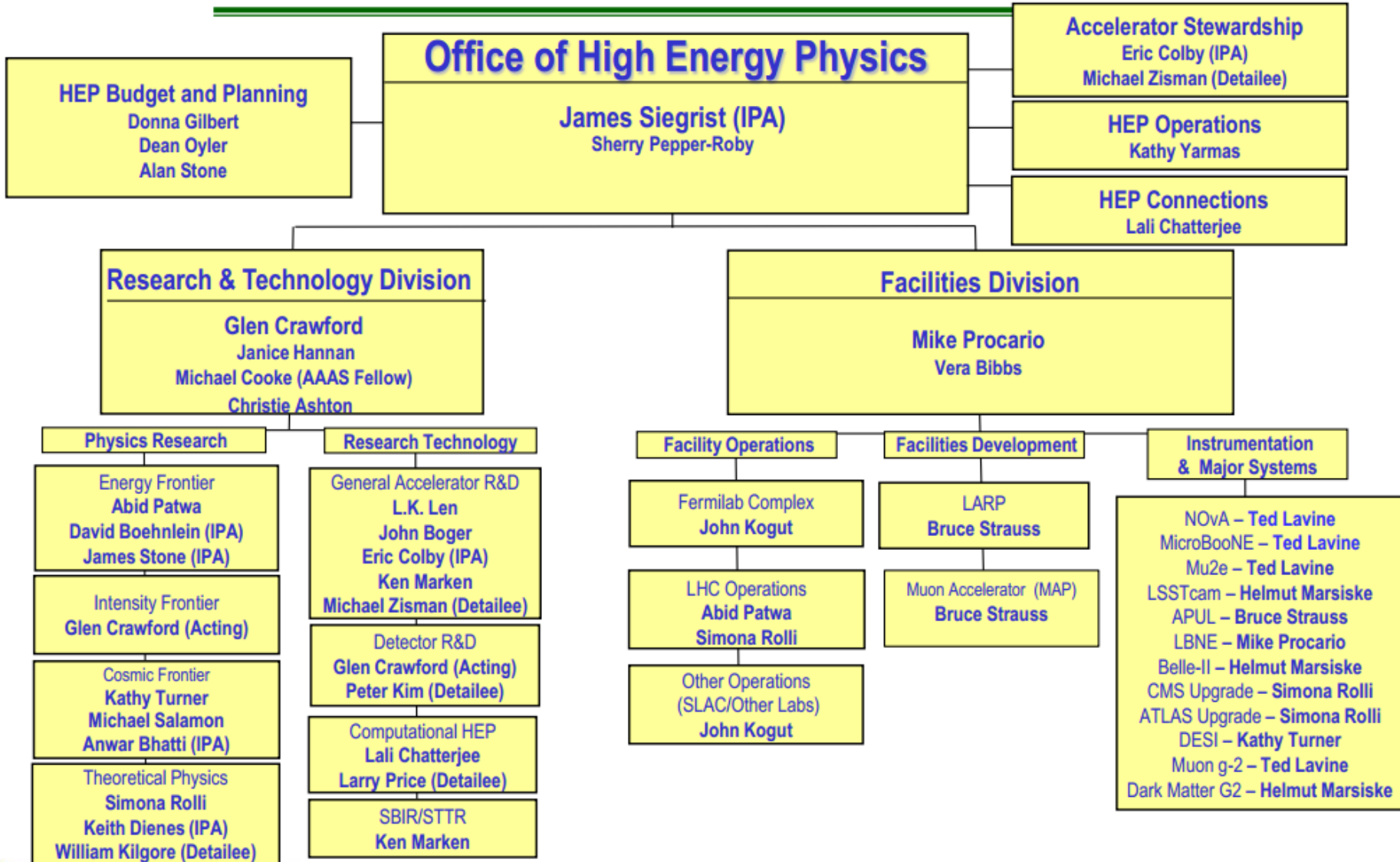
---

- **HEP is global**
  - P5 strategic plan explicitly recognizes this fact, as does DOE implementation
  - Highest priority major projects are LHC upgrades (near-term) and LBNF (mid-term)
    - LBNF will be the first truly international experiment hosted by the U.S., with management modeled after the successful LHC scheme
- **We share the community's enthusiastic response to the P5 strategic plan**
  - We are moving forward with implementation in targeted areas
  - But given the current fiscal environment, full implementation of the plan will take some time
- **2015 will be an important year**
  - First results from LHC Run 2, NO $\nu$ A
  - Further development of short- and long-baseline neutrino program
  - International agreements start coming into view



**BACKUP**

# DOE Office of High Energy Physics Organization Chart



# Accelerator Stewardship

- **Authorized for the first time in FY 2014 as a redirection of funds**
  - An initial Stewardship program was identified in discussions with SC/BES and SC/NP composed of 10 existing university grants, the BNL-ATF program, and the Facilities Pilot Program
- **Program elements for FY 2015 awaiting appropriations**
  - **First Accelerator Stewardship call for proposals for FY 2015**
    - **Three applied R&D topic areas recommended by the Accelerator Task Force, and developed by subsequent workshops**
      - **Particle Beam Therapy Improvements**
      - **Ultrafast Laser R&D**
      - **Energy Efficiency Improvements for SC Accelerators**
    - **A basic R&D category for long-term generic accelerator R&D**
    - **Merit review process underway now**
    - **Awards subject to available funding**
  - **Accelerator Test Facility Pilot Program for FY 2015**
    - **Will gauge demand and nature of “outside” uses of SC accelerator R&D infrastructure**
    - **Defining agreement signed this summer. Will implement in FY 2015, subject to available funding**



# Office of Science (SC) Digital Data Management Statement

---

- 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.
  - Funding Opportunity Announcements (FOAs) issued after October 1, 2014, will require a Data Management Plan (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
  - <http://science.energy.gov/hep/funding-opportunities/digital-data-management/>
  - HEP will be working with the DOE National Laboratories to make available accessory information about individual experiments and projects led by respective laboratories
  - For more information please contact Dr. Lali Chatterjee and/or your Program Manager



# HEP Science & Technology Connections

## Thrust

### P5 noted the importance of our Benefits and Connections to Society

- **HEP has initiated discussions internally with some of the other SC Programs to start building stronger connections**

- Explore new experimental systems and techniques
- Exploit transformative capabilities available in adjacent scientific disciplines

With aims to advance HEP science drivers, test our models and contribute to our S&T environment

- **Thanks to those who submitted Nominations for an HEP Connections Committee**
  - We are not forming this HEP specific committee at this time
  - We will keep your nominees in mind as planning progresses with potential partner communities
- **For more information contact Lali Chatterjee:**  
[lali.chatterjee@science.doe.gov](mailto:lali.chatterjee@science.doe.gov)





# HEP Forum for Computational Excellence (FCE)

---

- **HEP-FCE is a pilot project to strengthen scientific computing within our field as part of DOE HEP's response to P5 Recommendations on Computing**
  - Explore next-generation hardware and data-science software and foster more cross-laboratory and university-laboratory collaboration
  - Current website: <http://press3.mcs.anl.gov/hepfce/>
- **FCE Roles**
  - Computing planning input
  - R&D portfolio focused on cross-cutting tasks
  - Computational support for smaller experiments
  - Cross-cutting knowledge/capability base
  - Training/Workshop activities
  - Data archiving/curation/management contact point
  - Strategic connectivity for DOE HEP program
  - Build HEP-FCE community hub
- **FCE Organization**
  - Directors: S. Habib (ANL) and R. Roser (FNAL)
  - Advisory Panel Members: D. Asner (PNNL), P. Avery (Florida), A. Boehnlein (SLAC), C. Tull (LBNL), T. Wenaus (BNL), + Additional University Members.
- **Currently, three FCE working groups are looking at cross-cutting HEP computing needs**

