DOE High Energy Physics (HEP) Program
Cosmic Frontier Program

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Outline

SC, HEP Program:

- **Mission, Model, Organization, Guidance**

P5 Strategic Plan

HEP BUDGETS

COSMIC FRONTIER

- **Budget, Program Status**

RESEARCH PROGRAM MODEL & SUPPORT CONSIDERATIONS

FUNDING OPPORTUNITIES

GRANTS PROCESS & RESULTS

DOE/SC/HEP PROGRAM:
MISSION, MODEL, ORGANIZATION, GUIDANCE

DOE, SC Program

The U.S. Department of Energy (DOE) Office of Science (SC) is the lead federal agency supporting fundamental scientific research for energy and the Nation's largest supporter of basic research in the physical sciences.

SC is a part of a mission agency

- Provides science leadership & support to enable significant advances in specific science areas
- Develops and supports a portfolio of selected facilities & experiments to obtain the science
- Laboratory System
  - Comprehensive resources to design, build, operate selected facilities & projects
  - Infrastructure, including computing facilities (NERSC, SCiDAC program etc)
- Interagency & International partnerships as needed to leverage additional science & expertise

The Mission Emphasis translates in to how the 6 SC Programs are planned & managed:

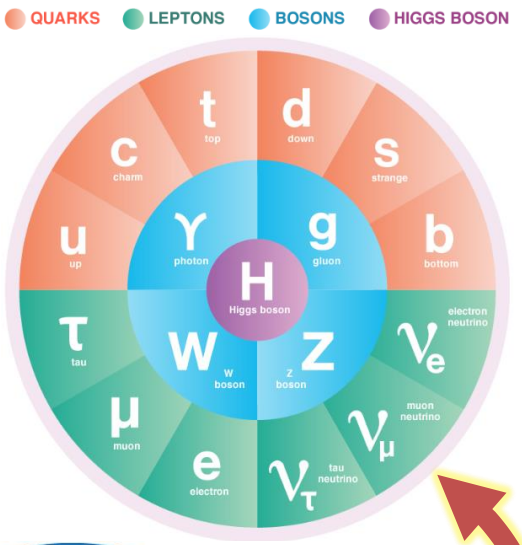
Extensive use of peer review & federal advisory committees to develop general directions for research investments, to identify priorities and select the very best scientific proposals to support.

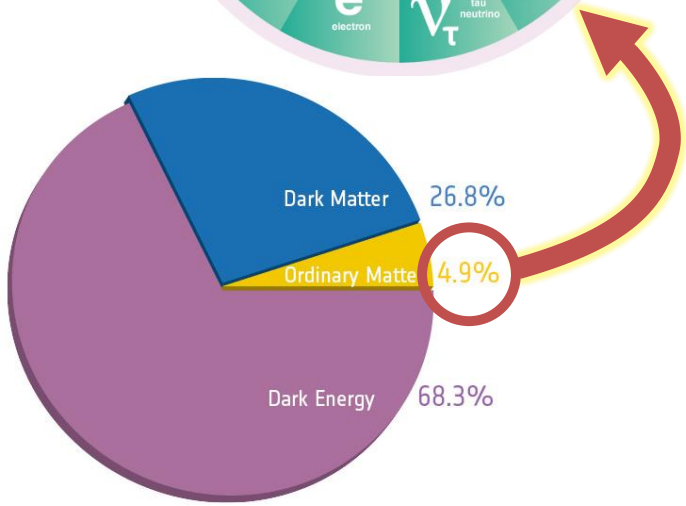
- Strategic planning process with community input to develop a plan for science drivers and a portfolio facilities and experiments to obtain significant advances in these science areas.
- **Program Offices follow the strategic plan to carry out a specific portfolio of selected facilities & experiments to obtain the science.**

The Office High Energy Physics (HEP) 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

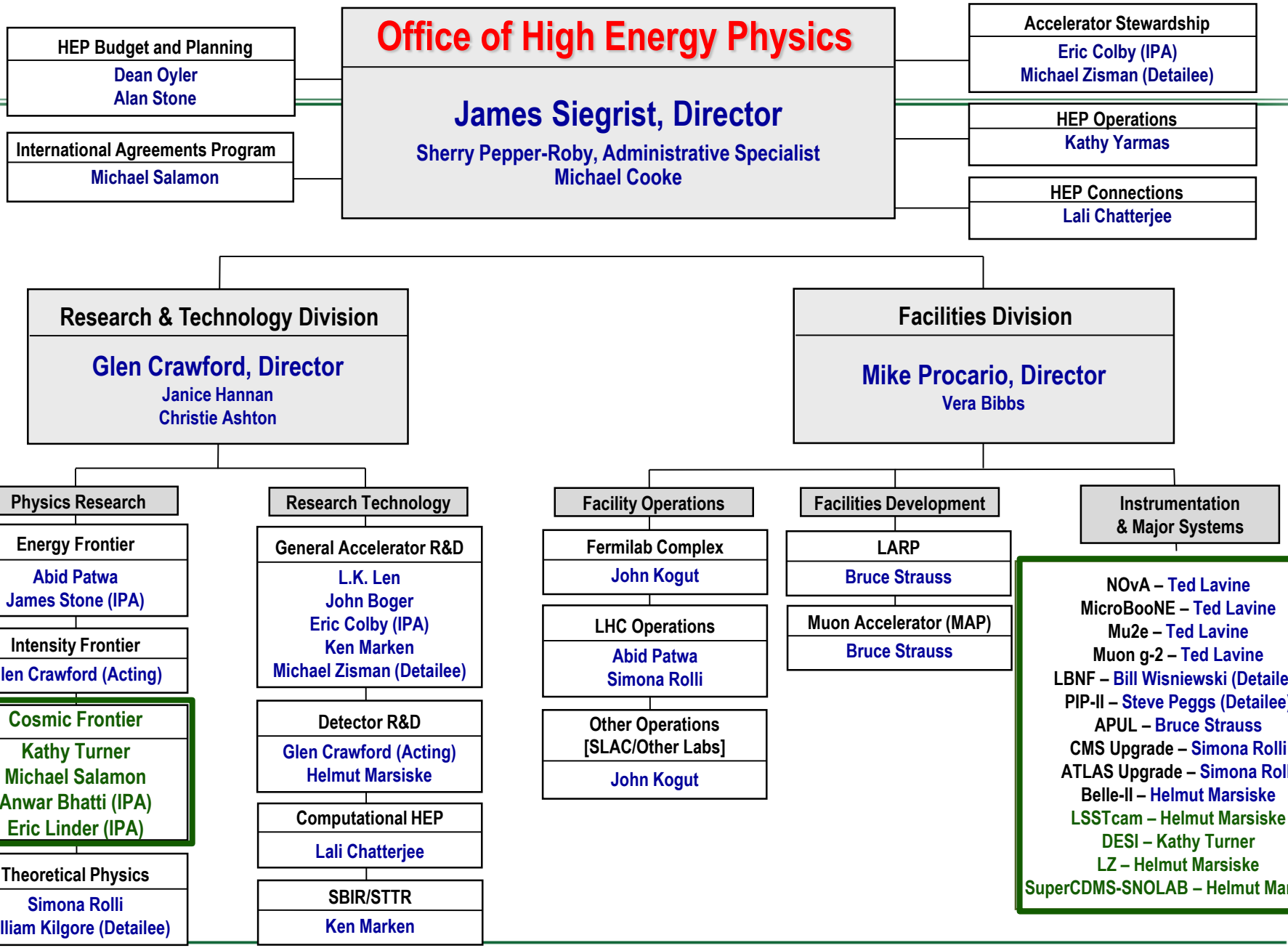




➔**HEP fulfills its mission by:**

- 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

➔**HEP follows the P5 (2014) strategic plan in developing and executing the program.**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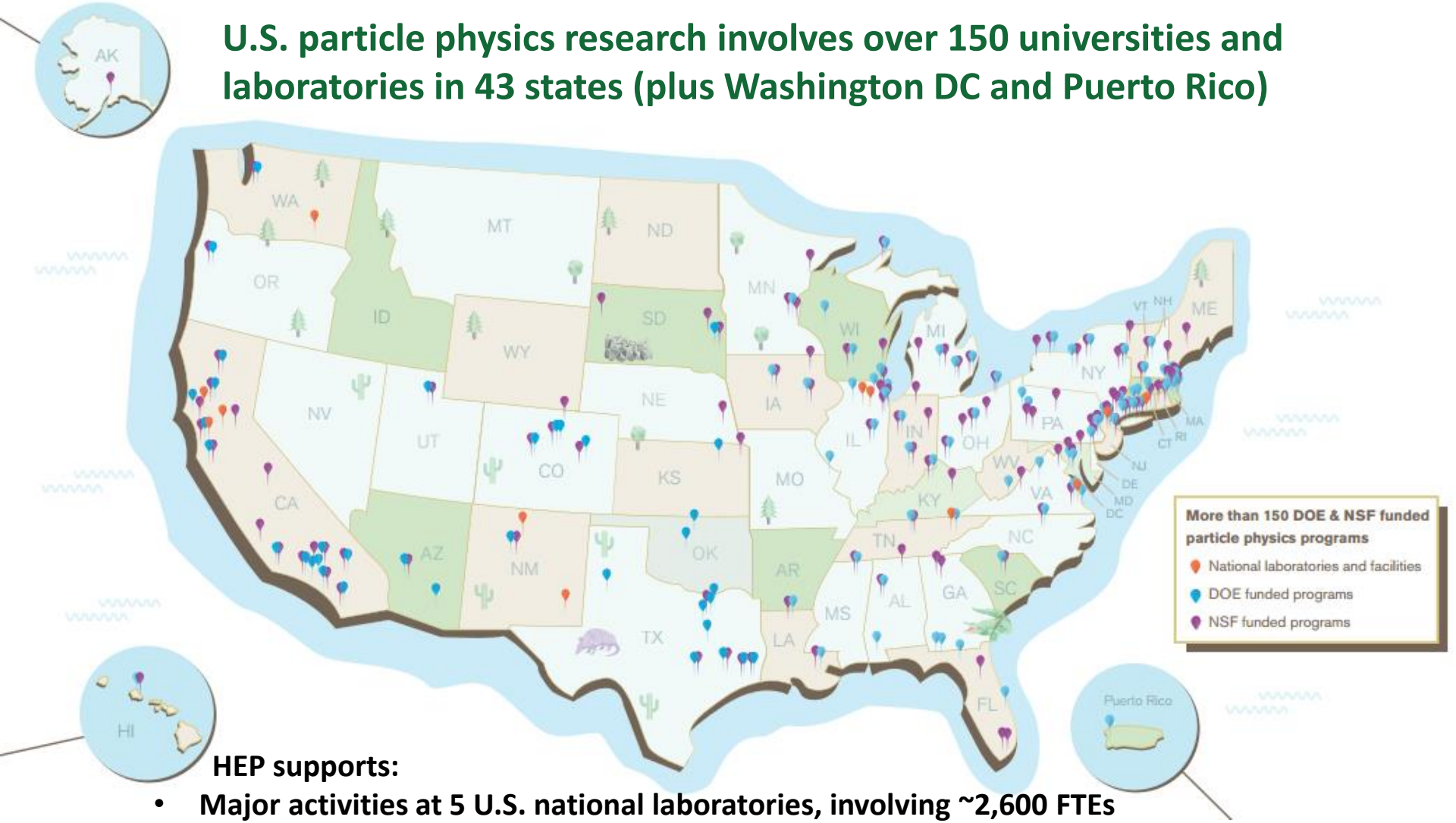
Belle-II – Helmut Marsiske
LSSTcam – Helmut Marsiske
DESI – Kathy Turner
LZ – Helmut Marsiske
SuperCDMS-SNOLAB – Helmut Marsiske
U.S. DEPARTMENT OF ENERGY
Office of Science
Cosmic Frontier

The U.S. HEP Program

U.S. particle physics research involves over 150 universities and laboratories in 43 states (plus Washington DC and Puerto Rico)



HEP supports:

- **Major activities at 5 U.S. national laboratories, involving ~2,600 FTEs**
- **University research program of ~250 active grants to >100 institutions, involving ~1,700 FTEs**

HEP Program Guidance

FACA panels & subpanels provide official advice:

- **High Energy Physics Advisory Panel (HEPAP)**
  - Jointly chartered by DOE and NSF to advise both agencies
    - **Provides the primary advice for the program**
  - Subpanels for detailed studies (e.g. Particle Astrophysics Science Assessment Group "PASAG" in 2009, **Particle Physics Project Prioritization Panel ("P5")** in 2008, 2014
- **Astronomy and Astrophysics Advisory Committee (AAAC)**
  - Advises DOE, NASA, and NSF on selected issues in astronomy & astrophysics of overlap, mutual interest and concern

Formal Advice Also Provided by:

- **National Academy of Sciences (NAS)**
  - Established by Congress in 1863 to advise the government and any department thereof on the arts and sciences
  - Reports: New Worlds New Horizons (2010), upcoming "mid-decade review" in astronomy/astrophysics (starts late 2015)
  - Ongoing committees: Board on Physics & Astronomy (BPA), Committee on Astronomy & Astrophysics (CAA)

Other:

Community science studies and input (e.g. Snowmass, Dark Energy Task Force, DPF input).

P5 STRATEGIC PLAN

2014 P5 strategic plan: Enabling the Next Discovery

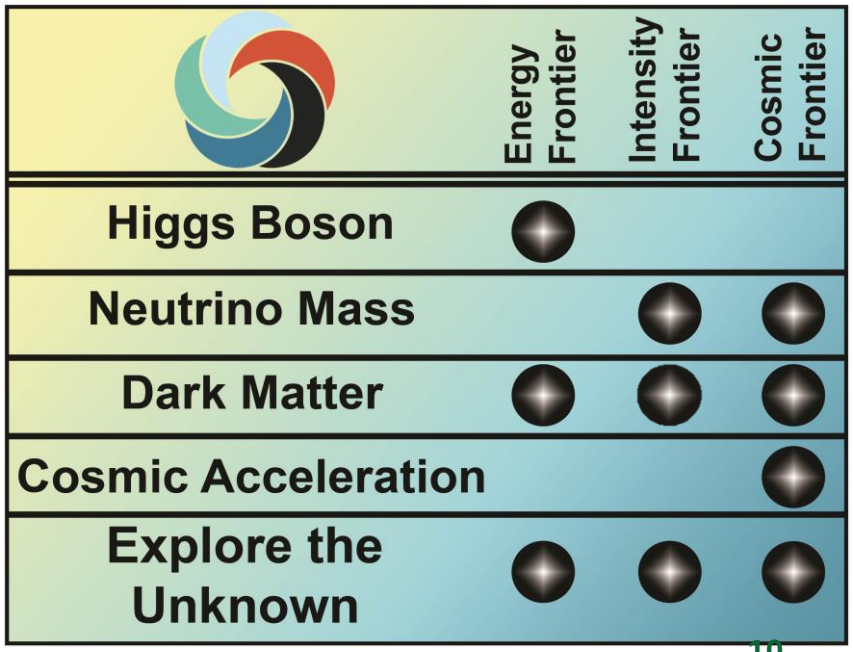
P5 plan is a compelling, unified vision for HEP:

Science drivers identify the scientific motivation

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles

Research Frontiers provide a useful categorization of experimental techniques

- **Cosmic**, Energy, Intensity Frontiers; also Theory, Detector R&D & Accelerator R&D subprograms



2014 P5 Report & Program Directions

- **P5 Report**
  - Recognizes the challenging funding landscape; choices have to be made & resources managed
  - Provided program optimization criteria for considering investments
  - Balanced approach: Time-phased, projects of different scales, science goals, on- and off-shore, short-term and longer-term

- **P5 Plan & Priorities**

  Highest priority major projects are:
  - **Large Hadron Collider (LHC) detector (ATLAS, CMS) upgrades in the near-term**
  - **Long Baseline Neutrino Facility (LBNF; aka LBNE) in the mid-term**
  - **Near term Cosmic Frontier projects are ready to go; studying the nature of dark energy & direct detection searches for dark matter particles**

- **HEP is working to align the program with the P5 recommendations**
  - Implementation strives to maintain the recommended balance
  - Construction and Major Item of Equipment (MIE) Projects are moving forward through the Critical Decision (CD) process.
  - Full implementation of the plan will take some time, due to budget status and as we work with partners and stakeholders: DOE management, HEP community, DOE Laboratories, Congress, OMB, other US and international Agencies, etc.

P5 Report – Program & Project Criteria

HEP will use P5 criteria to develop the program and determine which projects, and at what level, to invest in.

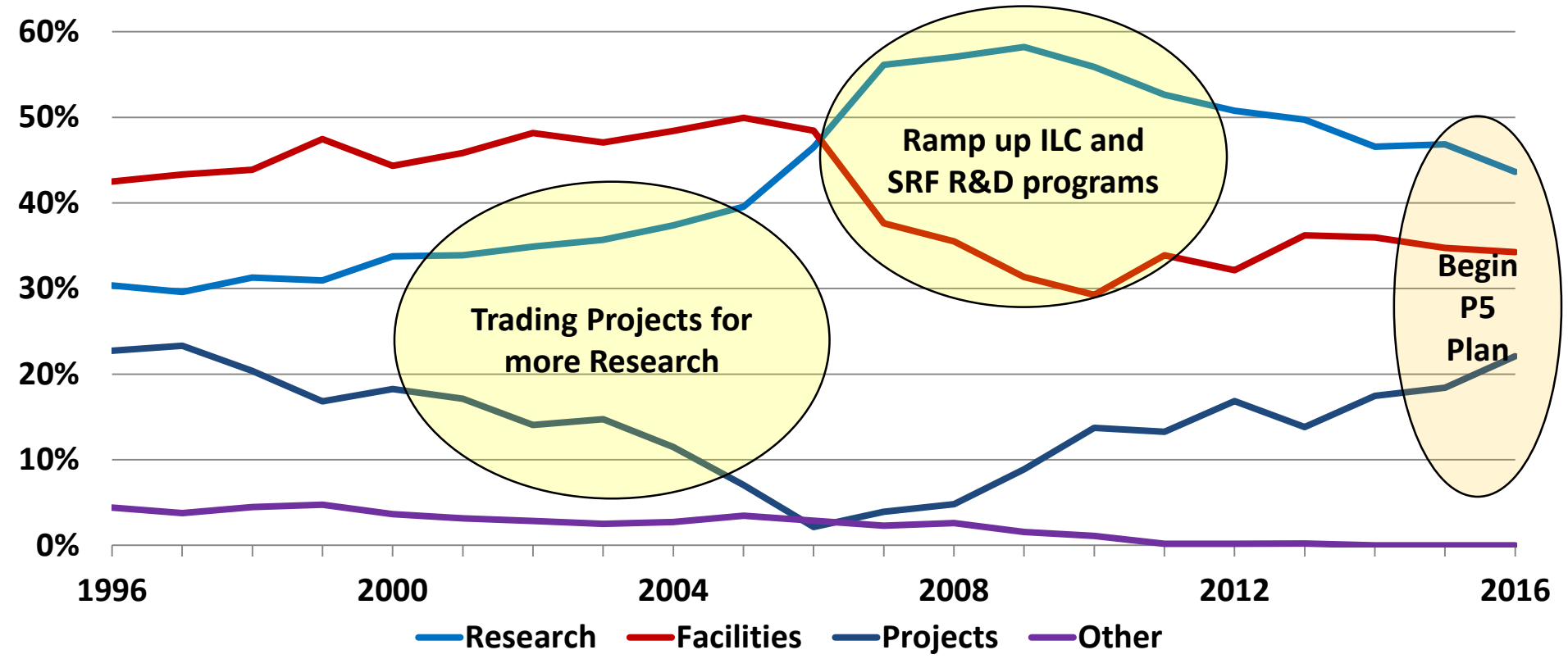
• **Program optimization criteria**
– **Science**: based on the Drivers, assess where we want to go and how to get there, with a portfolio of the most promising approaches.
– **International context**: pursue the most important opportunities wherever they are, and host world-leading facilities that attract the worldwide scientific community; duplication should only occur when significant value is added or when competition helps propel the field in important directions.
– **Sustained productivity**: maintain a stream of science results while investing in future capabilities, which implies a balance of project sizes; maintain and develop critical technical and scientific expertise and infrastructure to enable future discoveries.

• **Individual project criteria**
– **Science:** how the project addresses key questions in particle physics, the size and relevance of the discovery reach, how the experiment might change the direction of the field, and the value of null results.
– **Timing**: when the project is needed, and how it fits into the larger picture.
– **Uniqueness**: what the experiment adds that is unique and/or definitive, and where it might lead. Consider the alternatives.
– **Cost vs. value**: the scope should be well defined and match the physics case. For multidisciplinary/agency projects, distribution of support should match the distribution of science.
– **History and dependencies**: previous prioritization, existing commitments, and the impacts of changes in direction.
– **Feasibility**: consider the main technical, cost, and schedule risks of the proposed project.
– **Roles**: U.S. particle physics leadership

HEP PROGRAM - BUDGET

Funding Trends by Fiscal Year

(FY 2016 shows President's Request)



- **P5 report recommendation suggests increasing the project budget fraction to 20%–25%**
  - "Addressing the [science] Drivers in the coming and subsequent decades requires renewed investment in projects."
- **P5 report strategy has informed the HEP request in the FY 2016 DOE budget**

FY 2016 HEP Budget Request Summary

HEP is implementing the strategy detailed in the May 2014 report of the Particle Physics Project Prioritization Panel (P5), formulated in the context of a global vision for the field

- HEP Addresses the five compelling science drivers with research in three frontiers and related efforts in theory, computing and advanced technology R&D
- Increasing emphasis on international partnerships to achieve critical physics goals

- **Energy Frontier: Continue LHC program with higher collision energy (13+ TeV)**
  - The U.S. will continue to play a leadership role in LHC discoveries by remaining actively engaged in LHC data analysis and the initial upgrades to the ATLAS and CMS detectors

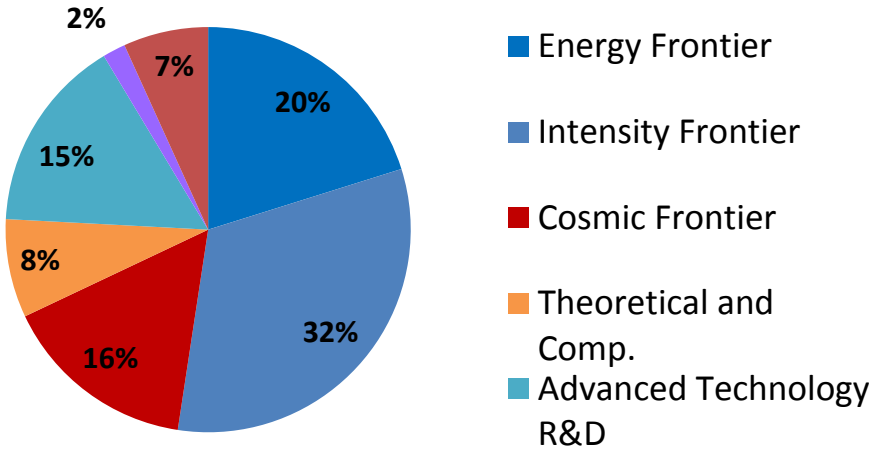
- **Intensity Frontier: Develop a world-class U.S.-hosted Long Baseline Neutrino Facility**
  - Continue the design process for an internationalized LBNF and development of a Short-Baseline Neutrino Program that will support the science and R&D required to ensure LBNF success
  - Fermilab will continue to send world's highest intensity neutrino beam to NOvA, 500 miles away to Ash River, MN

- **Cosmic Frontier: Advance our understanding of dark matter and dark energy**
  - Immediate development of new capabilities in dark matter searches by continuing development of 2nd generation direct-detection experiments; and in dark energy exploration with development of DESI and the LSST camera
  - Lay the ground work for future projects → including in CMB

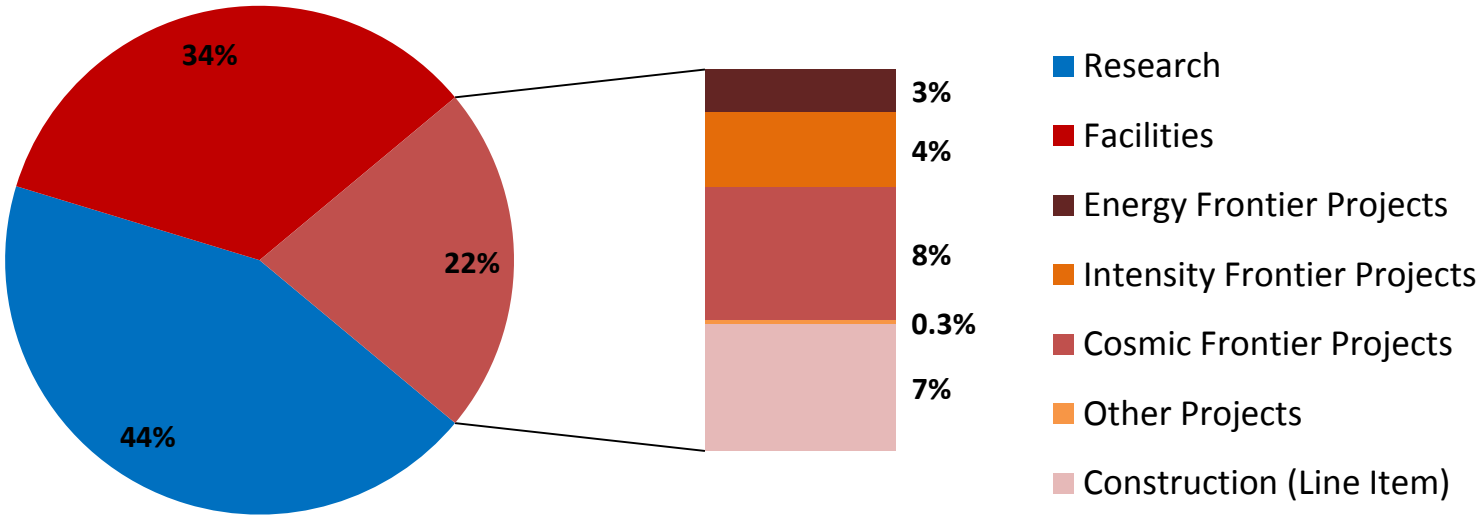
FY 2016 HEP Budget Request Overview

HEP FY16 Request is $788M

HEP FY 2016 Request Funding by Subprogram



HEP FY 2016 Request Funding by Activity



FY 2014-2016 High Energy Physics Budget Status

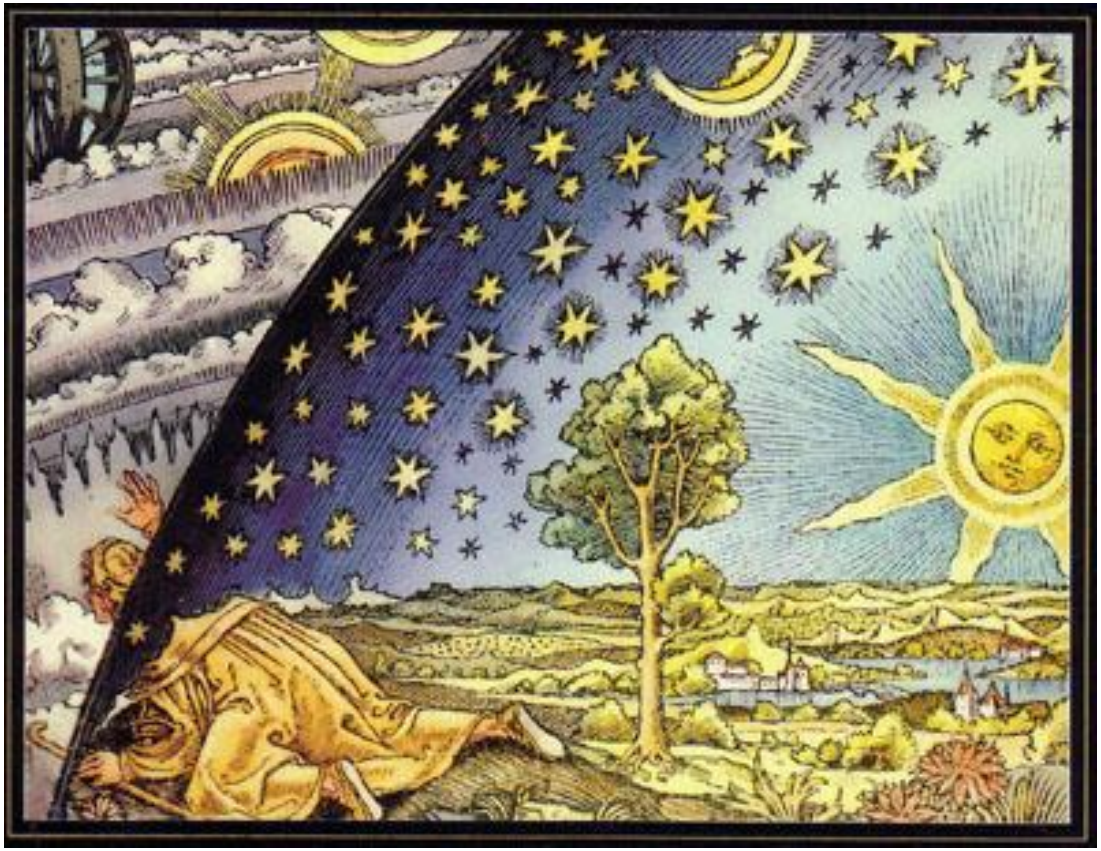
HEP Budget History ($K)	FY 2014 Request	FY 2014 Actual	FY 2015 Request	FY 2015 Enacted	FY 2016 Request	FY 2016 House Mark (~ 5/6/15)	FY 2016 Senate Mark (~ 5/27/15)
Energy Frontier	154,687	152,386	153,639	147,584	154,555		
Intensity Frontier	271,043	250,987	251,245	264,224	247,196		
Cosmic Frontier	**99,080**	**96,927**	**101,245**	**106,870**	**119,325**		
Theoretical and Computational	62,870	64,275	58,850	59,274	60,317		
Advanced Technology R&D	122,453	150,270	114,242	120,254	115,369		
Accelerator Stewardship	9,931	9,075	*19,184*	*10,000*	*14,000*		
Construction	35,000	51,000	25,000	37,000	56,100		
Total	755,064	774,920	723,405	745,206	766,862		
SBIR/STTR*	21,457	0	20,595	20,794	21,138		
HEP Total	**776,521**	**774,920**	**744,000**	**766,000**	**788,000**	**776,000**	**788,100**
Office of Science Total	5,152,700		5,111,155	5,067,738	5,339,800	5,100,000	5,143,900

*FY14 SBIR/STTR was ~ $21M, so FY2014 actual was ~ $796M.

COSMIC FRONTIER: PROGRAM STATUS, BUDGET

Research at the Cosmic Frontier

→Through ground-based telescopes, space missions, and deep underground detectors, research at the cosmic frontier aims to explore dark energy and dark matter, which together comprise approximately 95% of the universe.



Program thrusts:

- Study the nature of **Dark Energy**
- Direct Detection searches for **Dark Matter** particles
- **Cosmic-ray & Gamma-ray studi**es – particle properties, high energy acceleration mechanisms, indirect searches for dark matter particles
- **Other**: small efforts in **CMB, computational cosmology, etc.**

Future program:

- **Further develop/optimize program following the P5 report**

Cosmic Frontier Budget History

Budget History ($K)	FY 2014 Actual	FY 2015 Request	FY 2015 July 2015 "snapshot"	FY 2016 Request
Research	52,712	45,435	48,932	50,079
Grants	*13,157*	*11,422*	*12,031*	*12,565*
National Laboratories	*39,555*	*34,013*	*36,901*	*37,514*
Facility Operations and Experimental Support	10,357	7,238	9,135	7,120
Projects	30,705	41,000	45,478	58,701
MIE	*22,900*	*41,000*	*43,428*	*57,100*
LSST camera	*22,000*	*35,000*	*35,000*	*40,800*
DM-G2: LZ & SuperCDMS-SNOLab	*900*	*6,000*		*11,000*
LZ			*2,800*	
SuperCDMS-SNOLAB			*2,000*	
DESI			*3,628*	*5,300*
Small Project Fabrication *SPT-3G, ADMX-G2*			*1,025*	*1,601*
Future Project R&D *SPT-3G, ADMX-G2, Gen R&D*	*7,760*		*1,025*	
TOTAL	**93,729**	**93,673**	**103,545**	**115,900**
Other Costs	3,198	7,572	5,121	3,425
Total – Cosmic	**96,927**	**101,245**	**108,666**	**119,325**

FY15 to FY16 evolution: Cosmic Frontier - *Planned ramp-up of LSSTcam; support of DESI and 2nd generation dark matter experiments*

2014 P5 Report – Cosmic Frontier Recommendations

Dark Energy - Precision measurements to differentiate between Cosmological Constant, new fields or modification to General Relativity

- P5 #17: Complete LSST as planned.
- P5 #16: Build DESI as a major step forward in dark energy science, if funding permits
  - DESI should be the last project cut if budgets move from Scenario B to Scenario A (lowest)

Dark Matter (Direct Detection) - Learn the identity and nature of Dark Matter

- P5 #19: Proceed immediately with a broad second-generation (G2) dark matter direct detection program with capabilities described in the text. Invest in this program at a level significantly above that called for in the 2012 joint agency announcement of opportunity.
- P5 #20: Support one or more third-generation (G3) direct detection experiments, guided by the results of the preceding searches. Seek a globally complementary program and increased international partnership in G3 experiments.

Cosmic-ray, Gamma-ray Astrophysics - Explore particle acceleration mechanisms and perform indirect searches for dark matter candidates

P5 #21: Invest in CTA as part of the small projects portfolio if the critical NSF Astronomy funding can be obtained.

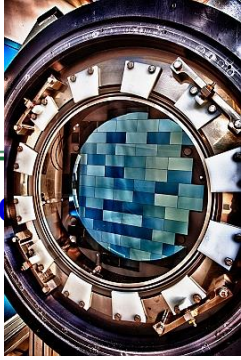
P5 comments:

- CTA has a broad science reach that transcends fields, with the dark matter detection capabilities of direct importance to particle physics
- Using P5 Criteria, a de-scoped US component should be shared by NSF-AST, NSF-PHY and DOE.

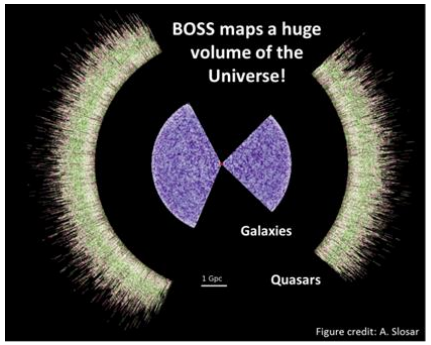
CMB - Gain insight into **inflationary epoch** at the beginning of the universe, **dark energy,** and **neutrino properties** by studying the oldest visible light.

P5 #18: Support CMB experiments as part of the core particle physics program. The multidisciplinary nature of the science warrants continued multi-agency support.

Cosmic Frontier Status – Dark Energy



Determine the nature of Dark Energy using precision measurements to differentiate between Cosmological C fields or GR modification
- Staged program of complementary suite of imaging, spectroscopy and supernova surveys



Operating:
- ***BOSS*** **(spectroscopic) ended in FY14; eBOSS started in 2015**
- ***DES*** **(imaging) started 5-year survey in late FY13**
- **Supernovae surveys continue**

Design, Fabrication:
- ***Large Synoptic Survey Telescope*** **(LSST, Stage IV imaging)**
  - Partnership with NSF-Astronomy (DOE+NSF MOA)
  - NSF is the lead – telescope facility and Data Management
  - DOE building the LSST-camera - Approved as MIE (Major Item of Equipment) project in FY14;
  - CD-2 "baseline" approved Jan 2015; CD-3 review in August 2015
  - LSST Dark Energy Science Collaboration (DESC) **– planning &** studies continue
- ***Dark Energy Spectroscopic Instrument*** **(DESI, Stage IV spectroscopic)**
  - Approved as an MIE project in FY15; CD-1 approved March 2015; CD-2 "baseline" review in July 2015
  - DOE+NSF MOA for HEP to start supporting NOAO operations costs in FY16, ramping up to full support by HEP for dark energy survey operations in FY2019

Research-only efforts: In addition to efforts to carry out responsibilities for the experiments and projects, there are research-only activities on Euclid, WFIRST, and supernova surveys

Future planning: Cosmic Visions Dark Energy planning group being set up
➔HEP & community group to coordinate R&D efforts & planning to **"complement, build upon, and extend beyond DESI & LSST in investigating the physics of dark energy."**

Cosmic Frontier - Direct Detection Dark Matter (DDDM)

Learn the identity and nature of Dark Matter using direct-detection method
- Staged program of experiments with multiple technologies

- **Operating:**
  - 1st generation (DM-G1) experiments:
    - ADMX, LUX, CDMS-Soudan, DarkSide, COUPP/PICO

- **Design, Fabrication:**
  - DOE and NSF-Physics announced in July 2014 selection of Dark Matter Generation 2 (DM-G2) experiments to move forward to fabrication phase:
    - ADMX-G2 is a small project (below MIE) and started at the end of FY14.
    - LZ had CD-1 review March 2015; approved as MIE in FY15; CD-2 planned for FY16
    - SuperCDMS-SNOLab CD-1 review planned for early FY16

P5: The overall DOE & NSF coordinated DDDM program will need to include DM-G2 project(s), operations of current experiments, background and material studies, and future R&D efforts
- HEP now concentrating on getting the DM-G2 experiment(s) successfully started.
- FY15/16 – small amount of R&D funding planned; significant R&D or DM-G3 studies assumes adequate funding and will take place later on

- **Future planning**
  - Cosmic Visions Dark Matter planning group will be set up soon
    - » HEP & community group to coordinate R&D efforts and needs as well as planning for future

Cosmic Frontier – CMB

Gain insight into the inflationary epoch at the beginning of the universe
- Probe dark energy and neutrino properties by studying the oldest visible light

Operating:

- *South Pole Telescope polarization* (SPTpol)
  - HEP provided support for outer-ring detectors

Fabrication:

SPT-3G

- major upgrade of the camera to greatly increase sensitivity
- HEP is funding R&D and fabrication phase (FY14-16)

Research efforts: In addition to efforts carrying out responsibilities for SPTpol, SPT-3G, HEP supports research-only activities on BICEP, POLARBEAR (also LDRD contributions) and had commitments for research and computing resources for Planck (through NERSC).

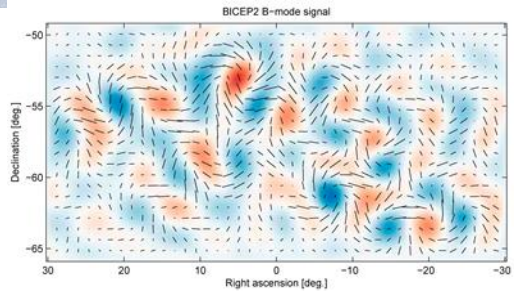
Future planning - Cosmic Visions CMB-S4 planning group has been set up

- HEP & community group to coordinate R&D & planning efforts within HEP
- HEP will coordinate our roles with NSF & NASA

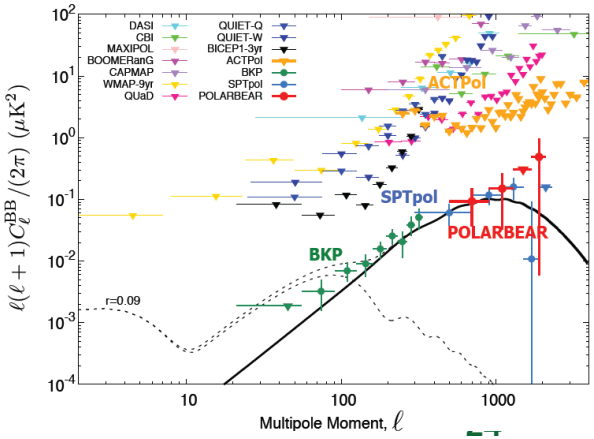
High Performance Computing

- NERSC used for analysis of many CMB experiments: in 2014 ~10 experiments with ~100 users at a time, with ~10M CPU-hours
- HEP MOU with NASA for Planck analysis – in 2014, 100M CPU-hours, NERSC Achievement Award for High-Impact Science

South Pole Telescope (SPT)



Planck view of BICEP2 field



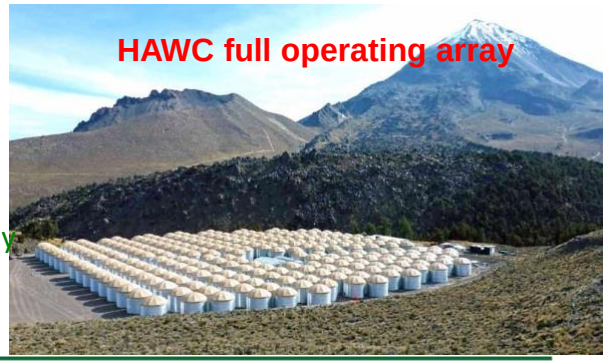
Cosmic Frontier – Cosmic-ray, Gamma-ray

Use ground-based arrays, space telescopes, and an experiment on the International Space Station to

- **Perform indirect searches for dark matter**
- **Test space-time structure (Lorentz invariance)**
- **Explore particle acceleration mechanisms**

Operating/Analysis:

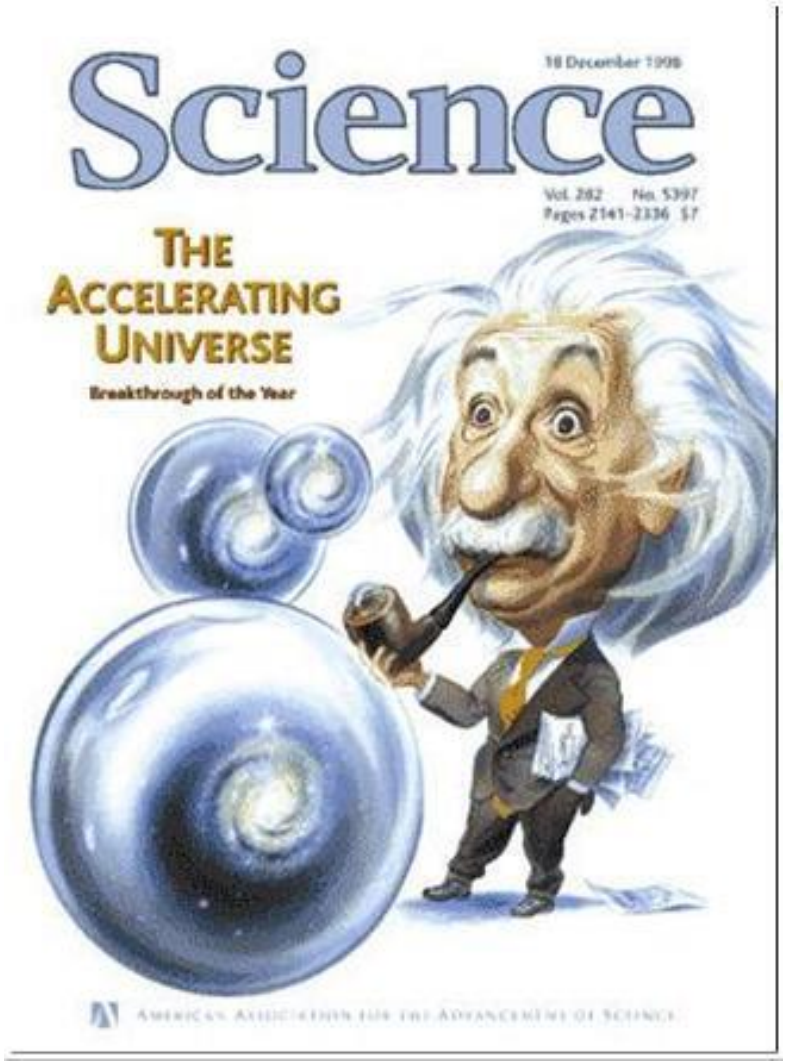
- ***Fermi/GLAST***
  - HEP participation planning in coordination with NASA; HEP expects to support operations for up to a 10 year survey
- ***VERITAS***
  - HEP participation ramping down
- ***Auger***
  - HEP participation ramping down
  - no participation planned on upgrade
- ***AMS***
  - operations continuing
- ***HAWC***
  - 5 year operations started early 2015



P5 Recommendation **- Cherenkov Telescope Array (CTA)**

- US Community **developing a plan to** participate in a European-led next generation gamma ray observatory
- HEP response to P5 recommendation, funding availability & programmatic priorities:
- **→HEP not continuing support of research, planning, R&D efforts on CTA**.

RESEARCH PROGRAM MODEL & SUPPORT CONSIDERATIONS



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 3 years
    - *e.g.,* Cosmic Frontier review at end FY13 & FY16
- **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

Cosmic Frontier – Research Program Model

The P5 criteria can also be applied to determining priorities for funding research efforts:

- **Does the proposed effort significantly advance HEP science goals?**
- **Will the effort make significant/visible/leadership impact & contributions?**

Research program priorities:

- Support efforts on HEP program's responsibilities on projects/experiments
- Support science collaboration to carry out the experiment in all phases
  →HEP Collaboration model
- Support research efforts directly in line with our project priorities and science goals
- Balance distribution across thrusts to support the priorities and projects; changing distribution as we go forward to support the changing program.

Research Priorities for funding, aligned with P5

Dark Matter :
Complete G1 operations & analysis; construct and plan G2 experiments, modest R&D

Dark Energy :
Complete BOSS analysis; DES operations & analysis; construct and plan LSST and DESI

CMB: Begin planning for CMB-S4

Other: Efforts completing on gamma-ray experiments, Auger, Holometer

Cosmic Frontier – Research Program Considerations

➔Need to sufficiently support the science collaborations to carryout our project's design, fabrication and operations & to plan and carry out data analyses to deliver the best science results.

➔Need to make sure that our experiments are adequately supported before supporting or adding to research efforts for other programs.

- Ensure some room in the research program for development of ideas for new projects that are aligned with the science drivers.
- Research efforts on projects that are aligned with P5 science drivers, but which don't have HEP participation, will also be considered, taking into account the above and based on funding availability.

Cosmic Frontier: Research Budget Support

Cosmic Frontier experimental research budget covers:

- **Scientist support for our program**
  - Faculty, research scientist, postdoc, graduate student salaries & their expenses
  - May include small technical, engineering, equipment, etc for their efforts in their lab

Faculty support

- Typically, the full research time of the faculty member throughout the whole year is supported by providing 2 months summer salary and support for the group (students, postdocs, expense). Reduced levels of effort typically have reduced support.

Research Scientists (above a postdoc, but not a tenure-track faculty position)

- Support may be provided on case-by-case basis on merits:
  - whether the roles and responsibilities are well-matched with individual capabilities and cannot be fulfilled by a term position; priorities in the program etc.

What's not supported by research grants

- **Any significant operations and/or project-related activities:**
  - Engineering, Technicians, computer programming, other project/related personnel support, top-level project management, M&S, major items of equipment, consumables
    - ➔ These are typically supported through the central Project funding
- **Non-HEP related efforts:**
  - e.g. Gravity waves (LIGO), Heavy Ion (RHIC), AMO Science, etc.

HEP – Collaborative Research model

Collaboration/Teamwork:

- Encourage and support scientific teams with expertise in required areas to participate in all phases of a project/experiment, in order to produce the best possible science results

- Long term support (funding) is needed to support long term responsibilities (so that projects/experiments can count on the effort)

- Scientists at labs and universities have long term commitments, responsibilities on the projects & experiments, in addition to data analysis, to bring everything needed to accomplish the science

→What follows is that the HEP community tends to review proposals if the person has high impact, critical, priority, and significant responsibilities & research efforts in a project or experiment and is carrying these out exceptionally well.

Collaborative Research Traditions

In practice, HEP traditionally supports teams/collaborations of scientists with the necessary expertise and responsibilities to take experiments through all phases, from R&D, Fabrication, Operations, & Data Analysis

-- Science planning is expected throughout all phases to end up with coordinated data analysis by a collaboration (One precision result rather than 100 independent, not so precise, results)

-- It is understood that people have different strengths and are involved in different aspects of project.

-- Support theory/simulations/phenomenology/computational efforts in direct support of our experiments (otherwise should be proposed to the Theory program).

Typical HEP researcher:

- Has an experimental program that may involve data taking & analysis on one experiment while planning or constructing the next experiment.
- Makes long term commitments to our experiment/project/science as a member of the collaboration.
- He/she has specific commitments (service work) & responsibilities for our projects/experiments that may include analyzing data with one experiment while constructing or planning the next one – in addition to the science analysis. These responsibilities may evolve over time as the experiment progresses through phases.

-- Not funded for one particular study or effort here and there

Cosmic Frontier - Comparative Review Proposal Considerations

Peer reviews and program planning reflect these traditions – considerations :

- Is the activity in direct support of our science/experiment and priorities?
- For experiments with broad science program, is the effort are needed to support OHEP science interests? - Need to ensure that we are concentrating on the most important efforts for HEP program (e.g. dark energy on multi-use facility).
- What are the priority efforts needed now for a particular experiment?
- What is the experience, responsibilities and commitment (% time) of the researcher? Will they have time to make significant contribution?
- Are people supporting the collaboration carrying out the project/experiment?
- Will they work in the "HEP model" by making significant, continuous contributions to the experiment, in addition to their own data analysis?
- Funding isn't optimized by funding small fractions of lots of different people that aren't making large or continuous contributions to the experiment.

Cosmic Frontier – Working in the program

Model for working in the field:

- Get involved in experiment/science and take on responsibilities for the collaboration and then submit proposal.
- Have involvement in the community so that you are part of the HEP community! (e.g. DPF meetings)
- Lot of science topics may be in dark energy plan or related to dark energy but need to think of what is the priority & main efforts needed and which are needed now!
- Have responsibilities for the experiment – not just your own science simulations & analysis.
- Many people have program working on a series of experiments (e.g.) DES operations/analysis while participating in LSST planning and construction. Not all has to be funded by HEP!
- Show track record and have responsibilities before funding starts.
- Transitioning to a new project/field requires a lot of work to get up to speed.
  - best for faculty member to take the time to really learn the field and take on responsibility first

In your proposal:

- Explain your long term program, not just your studies for next 3 years; how it progresses over time & how pieces fit together.
- Details on what you're doing the next 3 years, your responsibilities and efforts, why they're important to the project/experiment and why they're important and a priority NOW.
- Explain what fraction of time you're working on each effort (whether or not HEP funded)

FUNDING OPPORTUNITIES

DOE/HEP-based Funding Opportunity Announcements (FOA)

"FY 2015 Continuation of Solicitation for the SC Financial Assistance Program" **[DE-FOA-0001204]**

- **"General *or* open annual DOE/SC solicitation" for <u>universities</u>**
  - **SC-wide FOA that invites applications in support of work in any of six SC offices, incl. HEP research**
- **Published annually, typically at beginning of FY (October), remains open until successive issuance**
- **FOA is for: Conferences, Experimental Operations support, Supplemental awards, other invited or special-purpose applications**

NOTE: SC Annual Solicitation generally has lower programmatic priority in HEP

"FY 2016 Research Opportunities in High Energy Physics" **[DE-FOA-0001358]**

- **Issued for *new* or *renewing* grant applications from <u>universities</u>, evaluated through comparative review (CR) process**
  - Letter of Intent (LOI) requested for CR planning purposes, due August 13, 2015, 5 PM Eastern Time
  - Final application due September 17, 2015, 5 PM Eastern Time
- **FOA is for: HEP Research and Technology R&D grants (HEP experimental frontiers, HEP Theory, Accelerator R&D, Detector R&D)**

Supports Research in highest programmatic priority areas – <u>PRIMARY Research Funding Vehicle</u>

"Early Career Research Program" **[DE-FOA-0001386; LAB 15-1386]**

- **SC-wide invitation for junior investigators (within 10-years post PhD) from <u>labs or universities</u>**
  - Early career development of outstanding scientist's research programs in areas supported by DOE/SC
  - Required pre-application due Sep. 10, 2015 @ 5 PM ET, final applications due Nov. 19, 2015 @ 5 PM ET
- **FOA is for: Outstanding junior investigators from labs or universities**
  - Establish new research programs with potential for high impact and future leadership in HEP
  - ***All junior faculty/lab staff are encouraged to apply***

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

Important Changes in FY2014 to FY2016

2014:

The President signed the 2014 Consolidated Appropriations Act which requires full funding of multi-year grants and /or cooperative agreements from academic institutions with total cost less than $1M.

- "Full Forward Funding (FFF)" means that HEP must obligate the funds for the *entire award* for the grant (typically 3-year) period at the time the award is made, instead of funding year-by-year.
- There's no change to how an applicant applies for a grant or the review process. However, the FFF requirement affects how many proposals we're able to support within our funding allocations

Starting in 2016:

- **Data Management Plans (DMPs)**
  - All *Research* proposals to DOE/SC must have a data management plan
    - Includes HEP comparative review, Early Career
    - *Does not include* conferences, workshops, operations, projects
  - The requirement for a data management plan will be strictly enforced. Any research thrust in a proposal without a DMP will be declined without review.
  - Most Cosmic Frontier experiments/projects have written a Data Management Summary which can be referenced by collaboration members.
- **All *Renewal* proposals will need to also submit "proposal products" (list of recent publications and other records from DOE-supported research) after the application is submitted**
  - PIs will be notified by PAMS and have 5 days to complete, before they're eligible for review
  - In the future, this info will be taken from the annual Progress Report, but during the transition phase, you will need to enter them by-hand

HEP Proposal Review and Award Process

Pre-review

- August: Letter of Intent (LOI) received from PI (if required). 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 reviewers via DOE's Portfolio Analysis and Management System (PAMS);
- October-November: Reviewers input written reviews 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. Declinations sent out for proposals not receiving awards.
- March-April: Awards to university from DOE Chicago Operations Office.

Comparative Merit Review Criteria

(In descending order of importance. First 4 criteria are common to all SC FOAs. 5th is typical for HEP)

- **Scientific and/or Technical Merit of the Project**
  - *e.g.,* How might the results of the proposed research impact the direction, progress, and thinking in relevant scientific fields of research?
- **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?
- **Competency of Research Team and Adequacy of Available Resources**
  - *e.g.,* How well qualified is the research team to carry out the proposed research?
- **Reasonableness and Appropriateness of the Proposed Budget**
  - *e.g.,* Is the budget reasonable and appropriate for the scope?
- **Relevance to the mission of the DOE Office of High Energy Physics (HEP) program**
  - *e.g.,* How likely is the research to impact the mission or direction of the overall HEP program?
- **General Comments and Overall Impression**

GRANTS PROCESS & RESULTS

Cosmic Frontier – Statistics on Comparative Review Research Grants (Universities)

				FY12	FY13	FY14	FY15
Cosmic CR – $M request				$3.3	$7.7	$7.5	$6.8
Cosmic CR – $M funded				$1.6	$3.4	$4.4 w/FFF	$3.3 w/FFF
Cosmic CR - proposal counts							
		proposals	received	11	33	29	27
		proposals	reviewed	10	28	28	27
		proposals	funded	6	18	19	14
		proposals	success rate	60%	64%	68%	52%
Cosmic CR - PI counts							
		PI's	received	21	61	40	43
		PI's	reviewed	20	54	38	43
		PI's	funded	13	27	25	21
		PI's	success rate	65%	50%	66%	48%

Funding:

- Typically the total of all requests is for ~ twice the funds we have available.
- We typically fund the grants at less than their request.
- FY15 Cosmic requests $21.9M (for full grant period) and $6.8M for Year1.

There is a lot of pressure on the Cosmic Frontier program with respect to the support requested vs. funded. This is good! Lots of good people are interested in the program. We hope the program will grow to sufficiently support the growing portfolio of projects, as people redirect their efforts and new people join.

Cosmic Frontier – Statistics on Early Career Research Grants (Labs & Universities)

	FY10	FY11	FY12	FY13	FY14	FY15
# received - Univ	11	8	12	16	6	7
# received - Lab	10	4	7	9	7	5
# funded - Univ	**2**	**1**	**2**	**1**	**1**	**0**
# funded - Lab	**0**	**2**	**1**	**1**	**0**	**0**

Awards (5-year):

FY10
Newman (Pitt)
Mahapatra (TAMU)

FY11
Chou (FNAL)
Slosar (BNL)
Hall (Maryland)

FY12
Mandelbaum (CMU)
Padmanabhan (Yale)
Carosi (LLNL)

FY13
Bolton (Utah)
Chang (ANL)

FY14
Dahl (Northwestern)

FY15 Review Data — by Proposal

For the FY 2015 cycle, 153 proposals requesting support totaling $221.88M in one or more of the 6 HEP subprograms were received. Of these, 146 were reviewed.

	HEP Subprogram						HEP Total
	Energy	Intensity	Cosmic	Theory	Acc. R&D	Det. R&D	
Received	27	30	27	43	35	24	146
Declined w/o Review	2	0	0	0	2	3	7
Reviewed	25 (6)	30 (9)	27 (17)	43 (17)	33 (20)	21 (11)	139 (79)
Funded	19 (3)	19 (3)	14 (7)	27 (3)	7 (1)	9 (2)	63 (16)
Declined	6 (3)	11 (6)	13 (10)	16 (14)	24 (19)	12 (9)	72 (61)
"Success Rate" (%) (Previous/New)	76	63	52	63	21	43	45 (78/20)

NOTES:

- Single proposals with multiple research thrusts are counted multiple times [1 /thrust]
- ( ) indicates # proposals from research PI/groups that did not receive DOE HEP funding in FY14.
- "Success Rate" is = # Funded/ # Reviewed.
- Most proposals are not fully funded at their "requested" level.
- About 43% of the proposals reviewed were from research groups that received HEP funding in FY14.
- FY15 overall success rate of reviewed proposals for previously (newly) funded groups was 78% (20%).
- Total grant awards funded in FY15 at $32.95M [= 24.48M 'renewal' + 8.47M 'new' proposals]

Summary Remarks

- **An exciting time for HEP and the Cosmic Frontier.**
- **P5 developed compelling, realistic strategic plan with a consensus vision for US HEP**

  ➔**Cosmic Frontier priorities**: Dark Energy, Dark Matter, CMB
- **HEP is implementing a program aligned with the P5 strategic plan.**

- **Opportunities exist to apply for research funding within the DOE/HEP-supported programs**
  - Important that applicants carefully read the FOAs and corresponding FAQs for guidelines and requirements, available at: *http://science.energy.gov/hep/funding-opportunities/*

Cosmic Frontier – Program & Funding Considerations

Build Program following the P5 plan with

- Staged implementation & results
- Mix of smaller, larger projects, using multiple methods and technologies as needed
- Balance between thrusts
- Balance of speculative efforts with ones that guarantee results

Considerations when determining which Projects/Experiments to Support (P5 Criteria)

- Science goals and how it will address DOE-HEP goals?
  - Experiments which are directly-aligned with goals or in which only part of the data is of interest to the HEP program
- What does HEP Community bring to the experiment?
  - Need to bring unique, visible, leadership contributions, especially if it's an area usually supported by another agency. Typically this is expertise in instrumentation, "big data" computing facilities and expertise, and the use of science collaborations through all stages of the project, leading to science results.

Other considerations

- Are HEP project contributions in line with % of the project relevant to our science goals?
- Are roles and responsibilities on the project in line with our contributions?
- Partnerships - plusses and minuses
- Don't "mayonnaise" funds all over many small efforts.
- Domestic vs off-shore