U.S. DEPARTMENT OF ENERGY | Office of Science

Office of High Energy Physics (HEP) → Budget & Program Update

AAAC Meeting

June 3, 2019

Kathleen Turner

Program Manager for the Cosmic Frontier

Office of High Energy Physics

Director of DOE Office of Science

- Chris Fall Confirmed as Director of DOE Office of Science on May 23, 2019; sworn in May 31, 2019.
  - Previously served as Principal Deputy Director of Advanced Research Projects Agency–Energy (ARPA-E)
  - Also served in White House Office of Science and Technology (OSTP) and in the Office of Naval Research, including as acting chief scientist

DOE Office of Science Statements on Diversity, Equity, and Inclusion

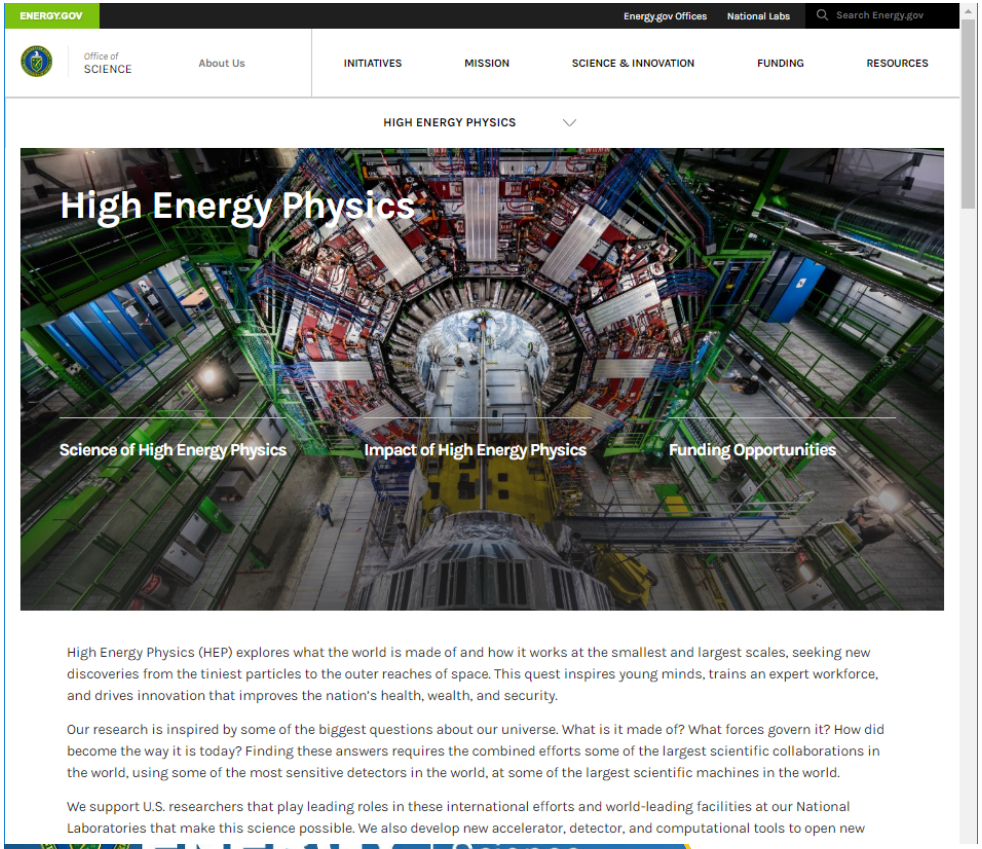
- The DOE Office of Science (SC) is fully committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity.
  - Effective stewardship and promotion of diverse and inclusive workplaces that value and celebrate a diversity of people, ideas, cultures, and educational backgrounds is foundational to delivering on the SC mission. The scientific community engaged in SC-sponsored activities is expected to be respectful, ethical, and professional.
  - https://science.energy.gov/sc-2/research-and-conduct-policies/diversity-equity-and-inclusion/
- Office of Science Statement of Commitment
  - The DOE Office of Science (SC) is fully and unconditionally committed to fostering safe, diverse, equitable, and inclusive work, research, and funding environments that value mutual respect and personal integrity.
  - https://science.energy.gov/sc-2/research-and-conduct-policies/diversity-equity-and-inclusion/sc-statement-of-commitment/
- Office of Science Statement on Harassment
  - Harassment of any kind, including sexual and non-sexual harassment, bullying, intimidation, violence, threats of violence, retaliation, or other disruptive behavior is not tolerated in the federal workplace, including Department of Energy (DOE) site offices, or at DOE national laboratories, scientific user facilities, academic institutions, other institutions receiving Office of Science funding, or at locations where activities are funded by the DOE Office of Science.
  - https://science.energy.gov/sc-2/research-and-conduct-policies/diversity-equity-and-inclusion/harassment/

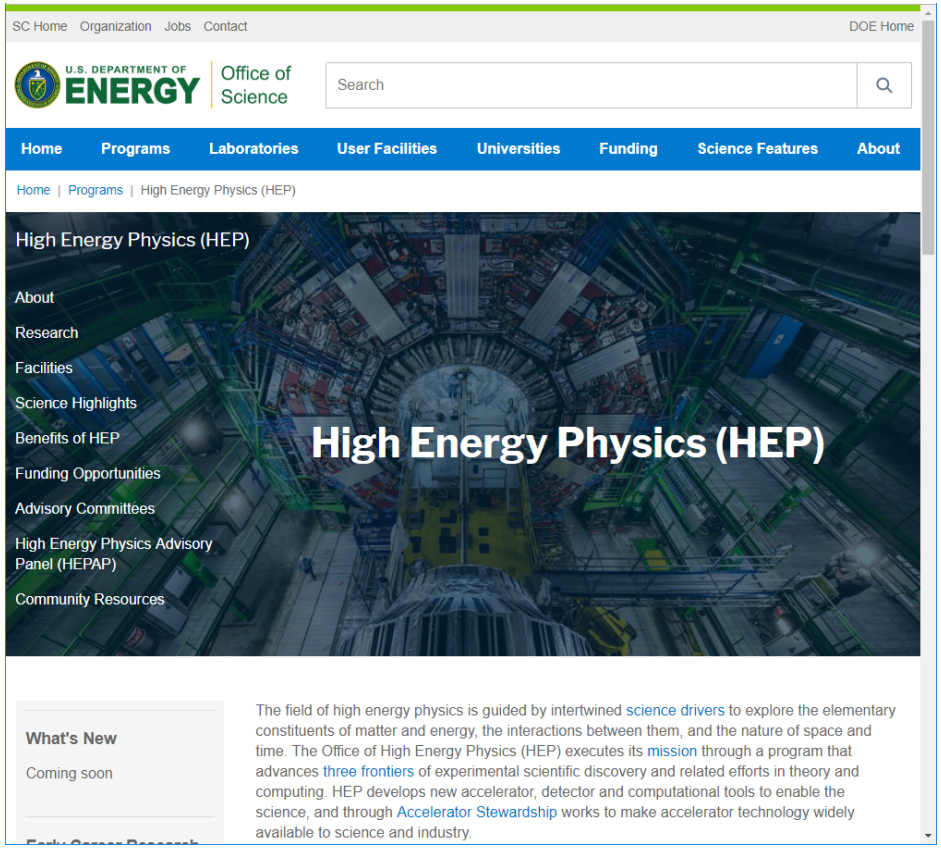
Office of Science Website Updates

- The old science.energy.gov site has been replaced with:
  - A public-oriented energy.gov with Science Highlights, Program News, and more
  - A PI-oriented OSTI site (previous science.energy.gov content) with FOAs, etc.

https://www.energy.gov/science/hep

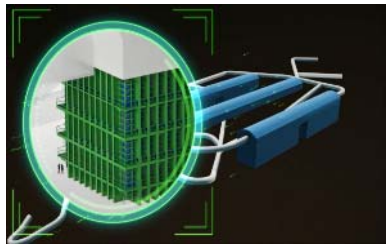
https://science.osti.gov/hep





U.S. Strategy in High Energy Physics

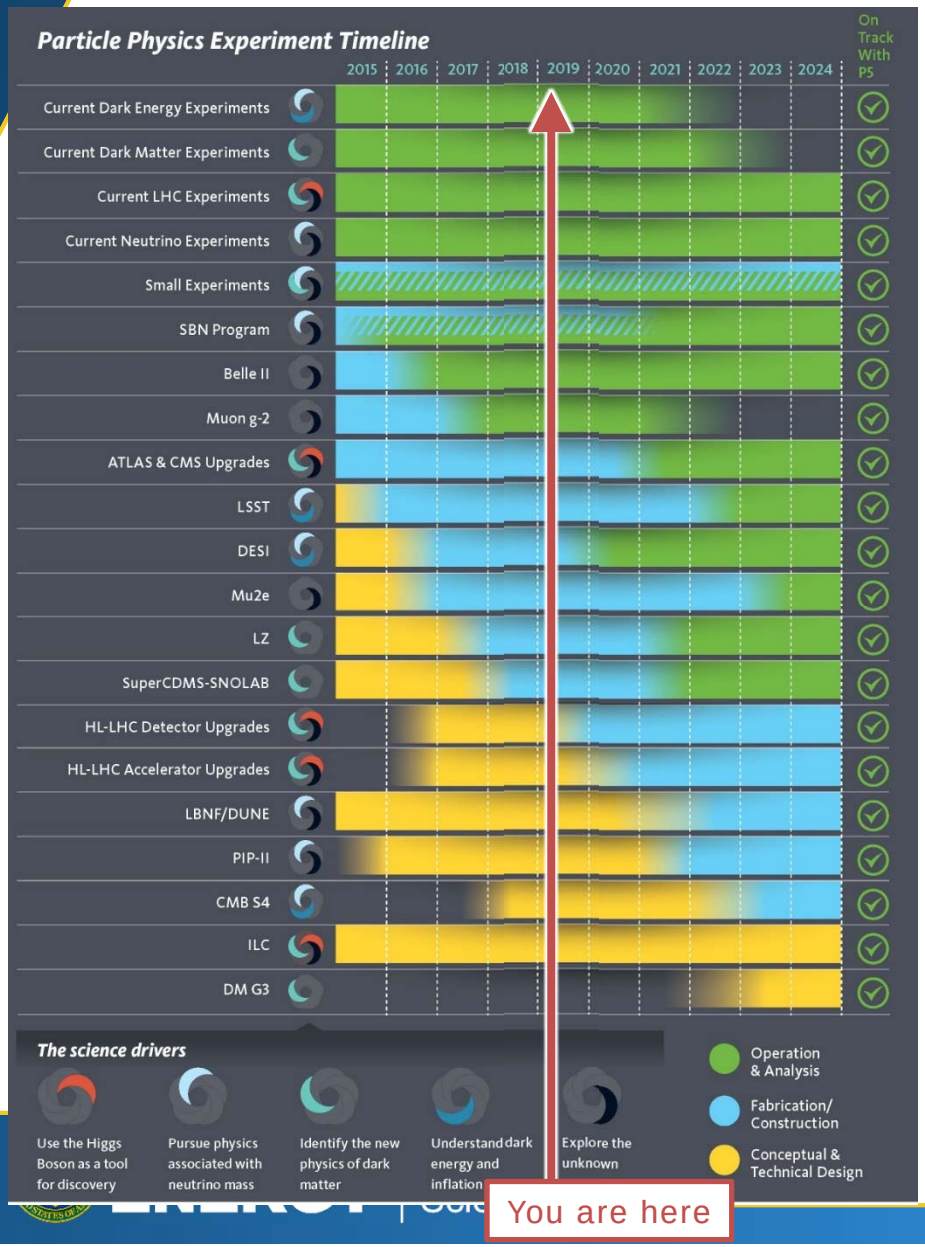
- The global vision presented in the 2014 Particle Physics Project Prioritization Panel (P5) report is the culmination of years of effort by the U.S. particle physics community
  - 2012 – 2013: Scientific community organized year-long planning exercise ("Snowmass")
  - 2013 – 2014: U.S. High Energy Physics Advisory Panel convened P5 to develop a plan to be executed over a ten-year timescale in the context of a 20-year global vision for the field
- P5 report enables discovery science with a balanced program that deeply intertwines U.S. efforts with international partners
  - **U.S. particle physics community** strongly supports strategy
  - **U.S. Administration** has supported implementing the P5 strategy through each President's Budget Request
  - **U.S. Congress** has supported implementing the P5 strategy through the language and funding levels in appropriations bills
  - **International community** recognizes strategy through global partnerships



Big Picture: P5 Strategic Plan is a Success!

- When the P5 report was released in May 2014, the FY 2015 budget was already in Congress and the FY 2016 budget was being formulated. First impact (success!) of the P5 report was not seen until FY 2016, and continues today…
- Language in Congressional appropriations reports have consistently provided strong support for executing the P5 report strategy
- In the last 3-4 years, HEP budget situation has changed dramatically
  - 20-25% growth in bottom-line
  - Funding ramping up for major projects: High Luminosity LHC and Long Baseline Neutrino Facility (LBNF)/Deep Underground Neutrino Experiment (DUNE)
  - New DOE/SC initiative(s) for Quantum Information Science (QIS), plus Machine Learning & Artificial Intelligence (ML/AI) in FY20 Request (with real HEP roles)

P5 Implementation Status – FY 2019



All projects on budget & schedule

- Projects fully funded as of FY19
  - Muon g-2: 1st beam 2017
  - LHC detector upgrades: on track for 2019/20 installation
  - Mu2e : 1st data in 2020
  - **LSST: full science operations 2023**
  - **DM-G2 (SuperCDMS & LZ): 1st data 2020**
  - **DESI: 1st light on lenses April 1, 2019**
- HL-LHC accelerator and detector upgrades started on schedule
- LBNF/DUNE & PIP-II schedules advanced due to strong support by Administration & Congress
- **CMB S4**: developing technically-driven schedule to inform agencies, NAS Astro 2020 Decadal Survey
- **DM-G3**: R&D limited while fabricating G2
- ILC: cost reduction R&D while waiting for decision from Japan
- Broad portfolio of small projects running

P5 Progress & Challenges

Progress on P5 Implementation

- Many projects with significant international partnerships; Agreements being made
- Completion of "pre-P5" projects (Belle II, Muon g-2) and initial data-taking
- Planned mid-scale P5 projects are on schedule: Completing soon (LHC Phase I upgrades, **DESI, Dark Matter Gen 2**'s); In fabrication: **LSST**, SBN, Mu2e.
- Existing experiments continue to produce exciting results, including small experiments, e.g. **Axion Dark Matter eXperiment Generation 2 (ADMX-G2), and South Pole Telescope Generation 3 (SPT-3G).**

Challenges

- Most of the recent HEP budget growth is in Projects (fabrication/construction).
- Balancing Research and Experimental Operations with Projects requires careful planning & consideration due to a number of effects:
  - Costs have increased significantly over the years, reducing the buying power.
  - The community has grown to support the plan…more competition.
  - Research efforts necessary to support large projects are increasing.
  - Operations costs are increasing as projects are successfully completing and starting to take data.

International Partnerships

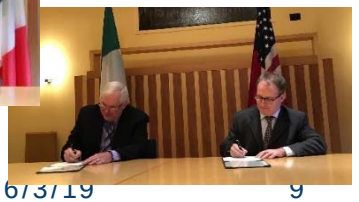
→ Strengthening existing collaborative partnerships in High Energy Physics between DOE and global partners and building new ones

- Since P5 report we have new international agreements or implementing arrangements concerning HEP with:
  - CERN
  - UK
  - India
  - Italy
- Several more “in the works”
- Active interagency working group

CERN

UK

India



Italy

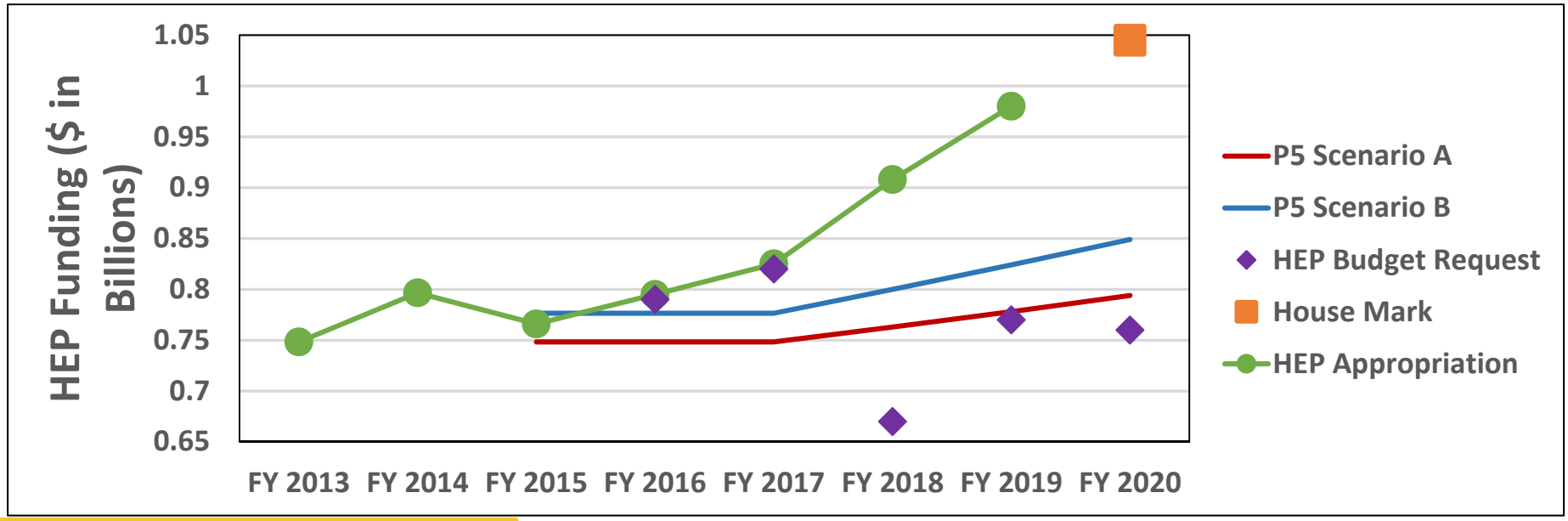
HEP Budget: FY 2019 Enacted & 2020 Request

HEP Funding Category ($ in K)	FY 2018 Actual	FY 2019 Enacted	FY 2020 Request	FY 2020 vs. FY 2019
Research	359,177	380,847	301,357	-79,490
Facilities/Operations	270,488	260,803	239,746	-21,057
Projects	278,335	338,350	226,935	-111,415
Total	**908,000**	**980,000**	**768,038**	**-211,962**

- **FY 2019 Enacted Budget continues support for P5-guided investments in mid- & long-term program**
  - "Building for Discovery" by supporting highest priority P5 projects to enable future program
  - Research support advances P5 science drivers and world-leading, long-term R&D in Advanced Technology, Accelerator Stewardship, and Quantum Information Science
  - Operations support enables world-class research at HEP User Facilities
- **FY 2020 Request supports balanced program of world-leading research, facilities and projects**
  - Quantum Information Science: SC-wide initiative to accelerate discovery
  - Artificial Intelligence (AI)-Machine Learning (ML) research to tackle challenges across HEP
  - Cosmic Microwave Background Stage 4 (CMB-S4) R&D to develop large-scale project

U.S. Congress Supports P5 Strategy

- Congressional appropriations reflect strong support for P5
- Recent appropriations reports include language recognizing community's efforts:
  - FY19 Senate EWD: "Four years into executing the P5, the Committee commends the Office of Science and the high energy physics community for achieving significant accomplishments and meeting the milestones and goals set forth in the strategic plan…"



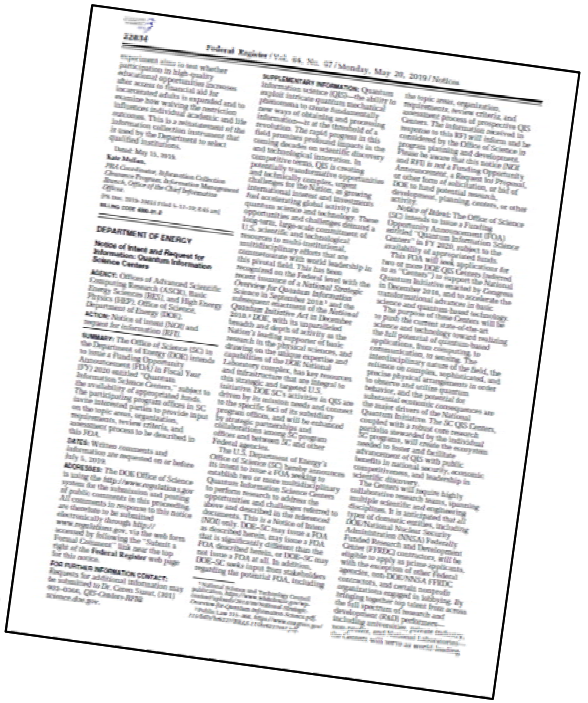
FY 2020 House Marks

- DOE Office of Science: **$6.87B**
  - $285M above FY19 enacted and $1.32B above FY20 request
    - Supports Artificial Intelligence (AI)
- High Energy Physics: **$1.045B**
  - [*HEP Core Program*]—Within available funds, the recommendation provides $25,000,000 for the Sanford Underground Research Facility, not less than $50,000,000 for Accelerator R&D, and $97,975,000 for the HL–LHC Upgrade Projects.
  - The Committee strongly urges the Department to **maintain a balanced portfolio** of small, medium, and large scale experiments, and to **ensure adequate funding for research** performed at universities and the national laboratories. The Committee encourages the Department to fund facility operations at levels for **optimal operations**.

HEP ($ in K)	FY19 Enacted	FY20 Request	FY20 House Mark	HM vs Request		HM vs FY19 Enacted	
HEP Core Program	800,000	648,038	814,000	165,962	25.6%	14,000	1.8%
Line Item Construction	180,000	120,000	231,000	111,000	92.5%	51,000	28.3%
PIP-II	*20,000*	*20,000*	*60,000*	*40,000*	*200%*	*40,000*	*200%*
LBNF/DUNE	*130,000*	*100,000*	*171,000*	*71,000*	*71.0%*	*41,000*	*31.5%*
Mu2e	*30,000*	*……*	*……*	*……*	*……*	*-30,000*	*-100.0%*
Total	**980,000**	**768,038**	**1,045,000**	**276,962**	**36.1%**	**65,000**	**6.6%**

Quantum Information Science Centers

- The FY2020 budget request includes funds in HEP, BES (Basic Energy Sciences), and ASCR (Advanced Scientific Computing Research) for at least one jointly-supported and multidisciplinary QIS Center, as per the National Quantum Initiative Act signed into law in December 2018
- Recently (May 20th), DOE published a notice in the Federal Register (FR) with two components:
  - A Notice of Intent (NOI) indicating that DOE-SC is considering issuing a Funding Opportunity Announcement in FY2020 for Quantum Information Science Centers
  - A Request For Information (RFI) seeking stakeholder input on the topic areas, organization, requirements, review criteria, and assessment process for prospective QIS Centers
- Comments are due on or before July 5th
  https://www.federalregister.gov/documents/2019/05/20/2019-10427/notice-of-intent-and-request-for-information-quantum-information-science-centers
  (or search "quantum" on the FR homepage)



Timeline for Updating the U.S. Strategy

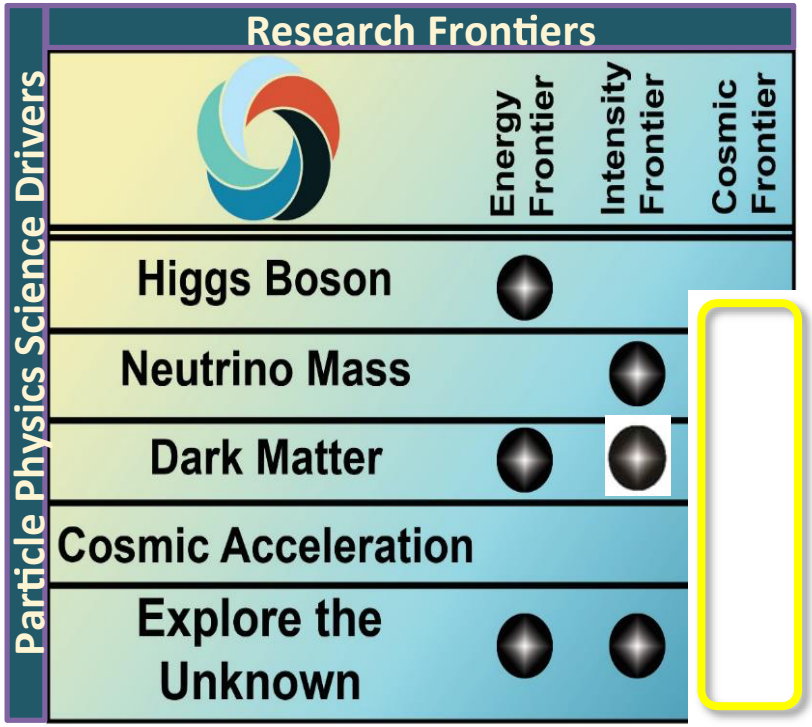
- **The May 2014 P5 report was successful because it was well informed by the science community**, including information from:
  - 2010 New Worlds, New Horizons in Astronomy and Astrophysics
  - 2012 Report of the Subcommittee on Future Projects of High Energy Physics (Japan)
  - 2013 European Strategy for Particle Physics Report
  - 2013 U.S. Particle Physics Community-driven "Snowmass" process
- **The timeline of processes that impact the next strategic plan:**
  - 2018-20: NAS Astronomy and Astrophysics Decadal Survey for 2020
  - 2019: Start of European Strategy for Particle Physics process
  - 2019/20: Anticipated Japanese decision on ILC
  - 2020: Release of updated European Strategy for Particle Physics
  - 2020: Earliest opportunity for National Science Board to approve obligating HL-LHC MREFC
- **From a DOE perspective, the earliest that new APS/DPF Snowmass, NAS Elementary Particle Physics Decadal Survey, and P5 strategic plan processes could begin is 2020**
  - **Relative timing of Snowmass, P5, and NAS EPP Decadal Survey to be determined**
  - **Enables receiving next P5 recommendations by March 2023, in time to inform FY 2025 budget formulation**

Cosmic Frontier Experimental Research Program

→ Through ground-based telescopes & arrays, 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 Areas:

- Study the nature of **Dark Energy**
- Direct Detection searches for **Dark Matter** particles
- **CMB** – Inflationary Epoch, Dark Energy, Neutrino Properties
- **Cosmic-ray & Gamma-ray studies** – indirect searches for dark matter particles



→ **Strong interaction with Theory, Detector R&D, Computational HEP, QIS**

Interagency Coordination

Formal advice:

HEPAP – advises DOE & NSF

AAAC – advises NASA, NSF, DOE

National Academy of Science – Decadal Surveys, BPA, CAA etc.

Interagency Coordination:

DOE-HEP, NSF-AST, -PHY, -OPP

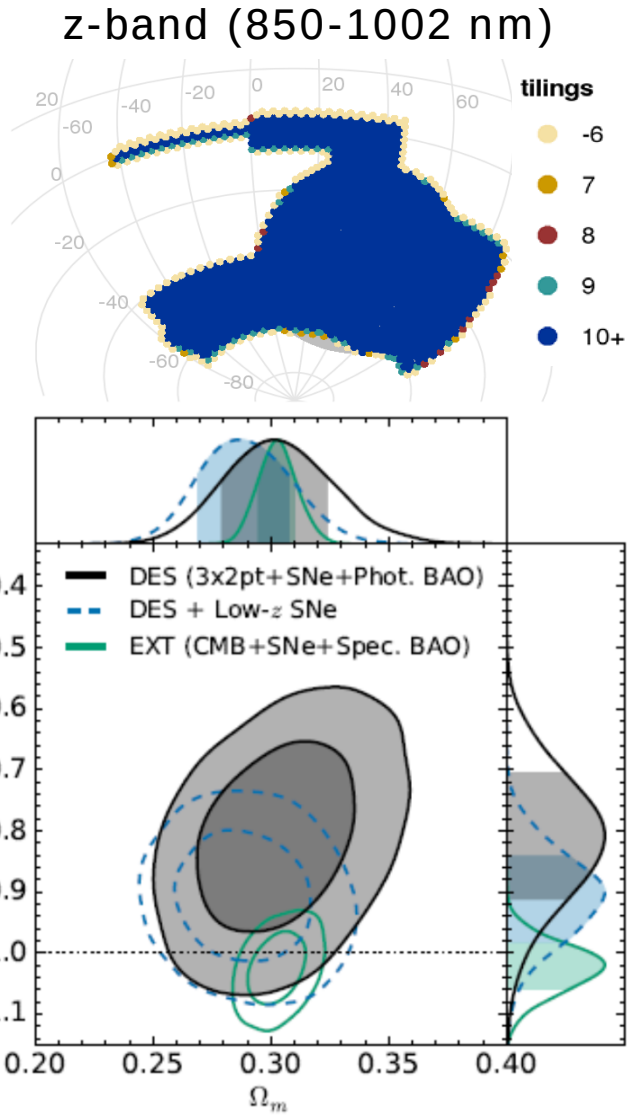
- Full HEP Office has meetings about 2 times/year w/NSF
- Many more focused meetings or efforts as needed, e.g.
  - Joint Oversight Group (JOG) or Joint Coordination Group (JCG) meetings and close coordination of planning/issues for particular projects or experiments.
  - Invited to each other's reviews, program planning, meetings.

DOE-HEP & NASA - Meetings and coordination as needed.

Three Agency Group (TAG)

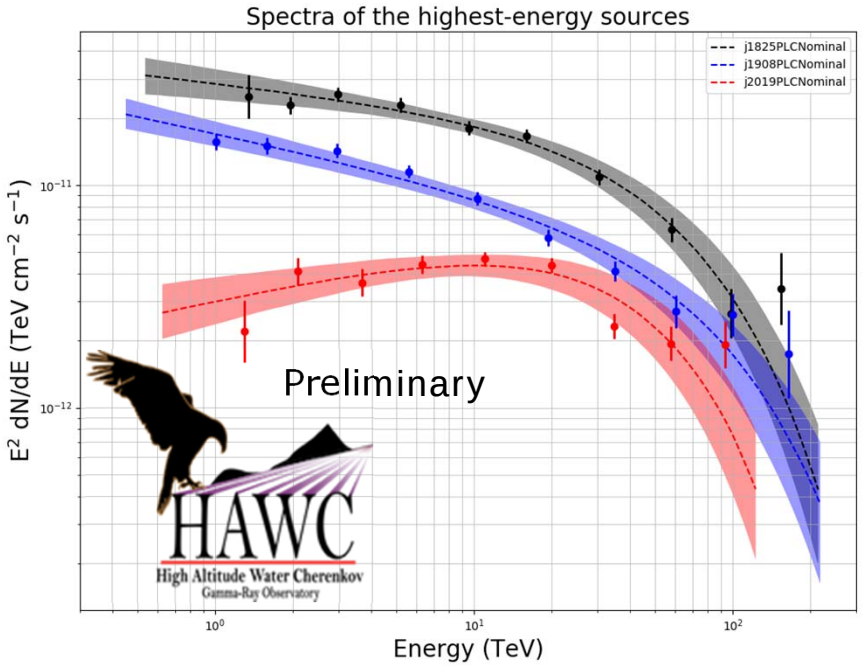
Dark Energy Survey

- **DOE-HEP partnership with NSF-AST**
- Completed Observations Jan 9, 2019
  - Year Six included observations and processing of “Deep Fields” to 10x DES wide-field depth
  - Will reduce weak lensing systematics through improved calibration of photometric redshift and characterization of blending of neighboring galaxies in DES wide-field data
- Many cosmology results, including:
  - Combined analysis of DES-Y3 supernovae (SNe), DES-Y1 photometric baryonic acoustic oscillation (BAO), and DES-Y1 weak lensing + galaxy clustering (3x2pt) **detects Dark Energy at 4σ from DES alone**
    - T. Abbott et al. 2019 (PRL)
- Now concentrating on cosmology through Y3 and on producing Y6 data products for analysis; Y6 cosmology to follow



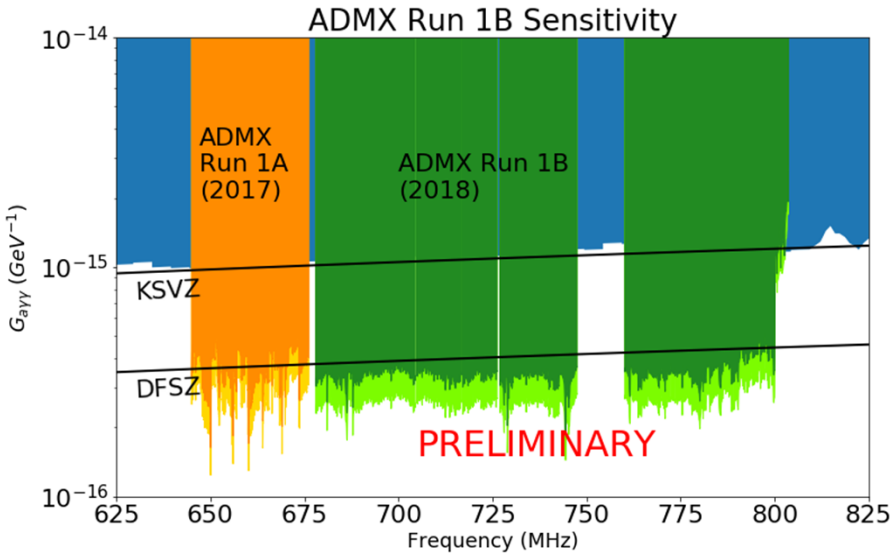
High Altitude Water Cherenkov (HAWC) Experiment

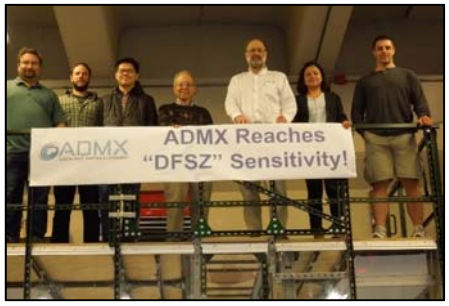
- HAWC gamma/cosmic-ray observatory located on the Sierra Negra mountain in Mexico
  - 5 year ops. started early 2015
  - Partnership with NSF-PHY, Mexico
- New result: Testing Lorenz Invariance with Highest Energy gamma rays
  - If Lorenz Invariance is violated, then gamma-rays can decay into e^+e^- pairs
  - HAWC's proof of the existence of gamma-rays >100 TeV provides more than an order of magnitude better constraints on superluminal Lorentz Invariance

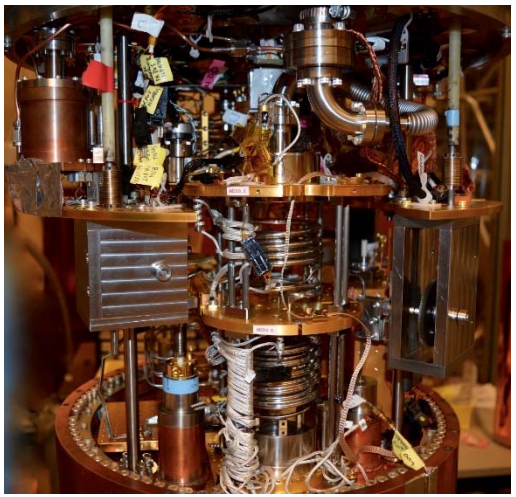


ADMX-G2

- Axion Dark-Matter eXperiment Generation 2
  - Located at University of Washington, managed by Fermilab
  - Primarily DOE supported with contributions from the UK, Germany and Australia; R&D support from the Heising-Simons Foundation
- Uses a strong magnetic field and resonant cavity to convert dark matter axions into detectable microwave photons
  - Operations approved to cover range 0.5 to 2 GHz (~ 2 to 8 micro-eV mass) – started Aug. 2016; planned to complete ~ Jan. 2022
  - **Run 1A** (2017) & **Run 1B** (2018) – both reached "invisible" axion (DFSZ model) sensitivity!
  - Run 1C starting soon







[Right] ADMX experiment insert showing the RF cavity (bottom), dilution refrigerator (above cavity), and frequency-tuning mechanism (left).

See recent article in National Geographic: https://www.nationalgeographic.com/science/2018/10/news-admx-dark-matter-detector-physics/

Cosmic Frontier Budget Status

COSMIC FRONTIER Funding ($K)			FY18 Sept.2018	FY19 Oct.2018	FY19 May.2019
		Last Funding	Actual	Initial	Current
Research - Univ	Early Career awards		1,500		
Research - Univ			12,198	11,430	11,510
Research - Lab			33,310	32,692	34,117
Exp. Operations			14,570	20,528	20,748
Future Project R&D			1,535	1,500	2,500
Project MIE	LSST	FY18	9,800	0	0
Project MIE	LZ	FY19	14,100	14,450	14,450
Project MIE	SuperCDMS-SNOLAB	FY19	7,400	2,550	2,550
Project MIE	DESI	FY19	20,000	9,350	9,350
TOTAL			**114,413**	**92,500**	**95,225**

Dark Energy

Precision measurements to differentiate between cosmological constant or new fields, or modification to General Relativity

Staged, complementary suite of imaging and spectroscopic surveys to determine its nature (in partnership with NSF-AST)

Completed Data-Taking:

– *eBOSS* (spectroscopic) started in 2015, ended Feb 2019

– *DES* (imaging) started 5-year survey in late FY13, ended Jan 2019

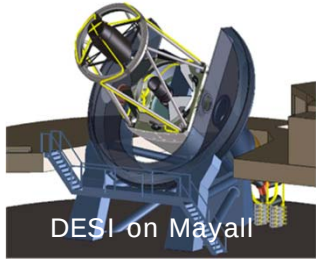
In Fabrication phase:

– *Large Synoptic Survey Telescope* (LSST, Stage 4 imaging)

– *Dark Energy Spectroscopic Instrument* (DESI, Stage 4 spectroscopic)

Planning for the Future

- Cosmic Visions Group
- Three Agency Group (TAG)



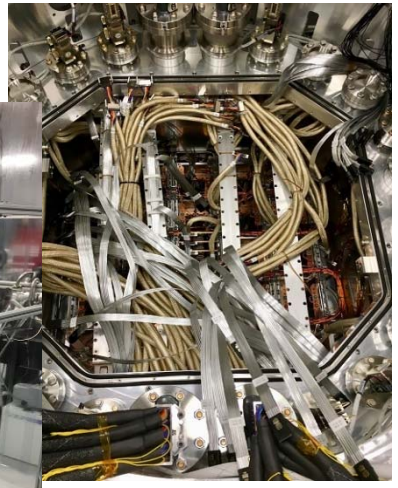
Large Synoptic Survey Telescope (LSST) - Status

DOE-HEP & NSF-AST partnership:
- NSF/DOE Facility Operations review Dec 2017
- NSF/DOE Project Status & Commissioning review Aug.2019

Funding: HEP MIE LSST Camera project funding completed in FY18; Integration & Commissioning as part of overall LSST project will be funded with non-MIE funds.

Status:
- FY18 Commissioning support started; funded on Ops budget); FY19 Facility Ops support started
- LSSTcam Project in fabrication (92% complete); Deliverables complete 2/21; CD-4 3/22
- **Sensors:** ITL and e2v have completed and delivered all sensors per their contracts.
- **Science Rafts:** 5 ready for installation starting June
- **Commissioning Camera:** final testing underway; shipping June 2019

View of top of cryostat



Raft module in construction at BNL

Dark Energy Science Collaboration (DESC):
- Set up to carry out planning and eventual data analysis for DOE HEP science goals
- Operations Plan review held May 2018; planning continues
- Data Challenge 2 Run 2.0 production underway on Theta at ANL, Cori at NERSC, and CC-IN2P3
- CosmoDC2 input catalog available for catalog studies

Dark Energy Spectroscopic Instrument (DESI) - Status

DOE-led experiment, mounted and operated on the NSF's Mayall telescope at Kitt Peak.

- Spectroscopic Survey – for Baryon Acoustic Oscillation and other studies
- HEP has MOU w/NSF-AST to "lease" the Mayall telescope
- HEP MIE project funding completes in FY19
- Full support for Mayall dark energy ops starting FY19

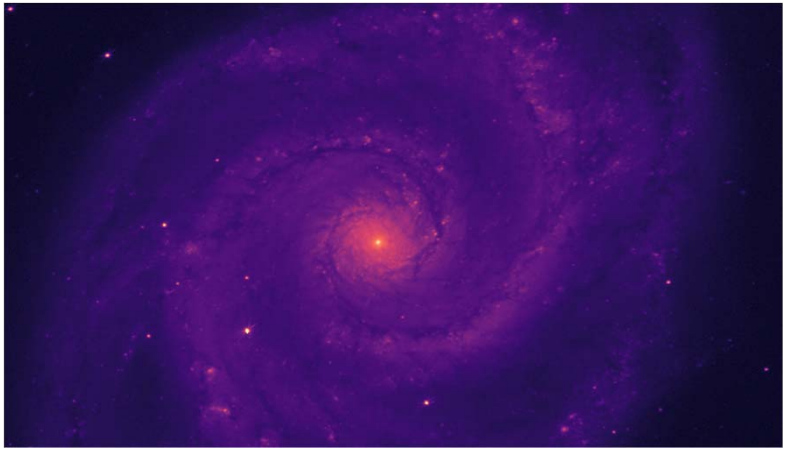
Status:

- Project in fabrication (88% complete); Deliverables complete 2/20; CD-4 9/21
  - Project status & Operations plan review, Fall 2018
  - Installation & Commissioning phase has started!
  - Full dark energy survey operations starting FY20
  - Recent: 6th spectrograph completed & tested; 10th spectrograph assembly completed

Targeting: Legacy Surveys – completed March 2019
http://legacysurvey.org/ covering 15000 deg^2 in g,r,z + 4 IR bands

- Mayall z Band Legacy Survey (MzLS), Beijing-Arizona Sky Survey (BASS) on Bok, DECam Legacy Survey (DECaLS) on Blanco
- **Data Release 8 April 2019**

Mock Focal plane installation at Mayall



Commissioning instrument (first light) on 4/1/19; Whirlpool galaxy

Cosmic Frontier: Dark Matter

➔Direct Detection (primary method)

Staged suite of complementary direct detection experiments with multiple technologies to search for dark matter particles

- High- and low-mass WIMPs; Axion (meV mass) search

Operating: ADMX-G2 axion search at UWash (HEP)

Projects in Fabrication phase: Dark Matter Generation 2

LZ at Homestake Mine in South Dakota (HEP)

- WIMP search through dual phase liquid Xe; ~10-1000 GeV mass range
- Project in fabrication (86% complete); Deliverables complete 7/20; CD-4 3/22
- Operations planning and funding started
- Operations Plan Review March 2019

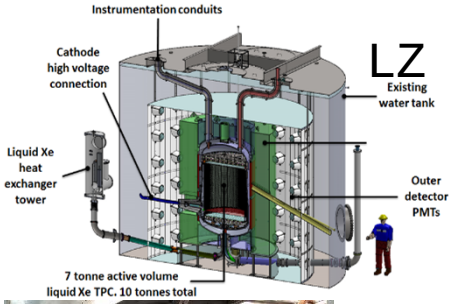
SuperCDMS-SNOLab in Canada (HEP+NSF-PHY partnership)

- WIMP search using cryogenic solid-state crystals; ~1-10 GeV mass
- Project in fabrication (76% complete); Deliverables complete 2020; CD-4 2021
- Operations planning and funding started; Pre-operations 2019
- Operations Plan Review June 2019

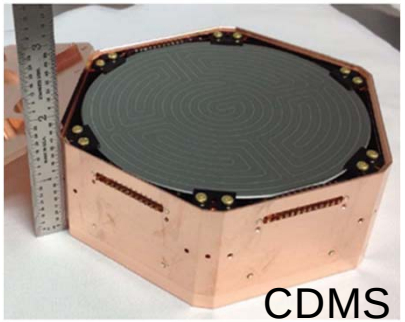
Future Planning: Dark Matter New Initiatives– small projects

➔Indirect Detection searches

Gamma-ray & Cosmic ray experiments: Fermi, HAWC, AMS



LZ PMT array May.2019

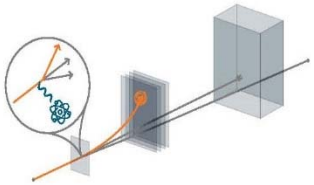


New Initiatives in Dark Matter

- P5 recommended the search for dark matter particles as a high priority & also that the program should include small projects
  - March 2017: Community-led workshop collected new ideas
  - 2018-19: Basic Research Needs study (workshop Oct.2018)
    - Chaired by Rocky Kolb & Harry Weerts
    - Charged to assess the science landscape for dark matter particle searches and identify which high impact science areas would be suitable to be pursued with small projects in the HEP program, using DOE lab infrastructure & capabilities
    - Final report identified 3 priority Physics Research Directions (PRD)
  - Funding Opportunity Announcement to develop experimental designs

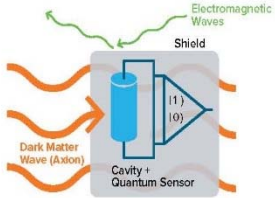
https://science.energy.gov/hep/community-resources/reports/

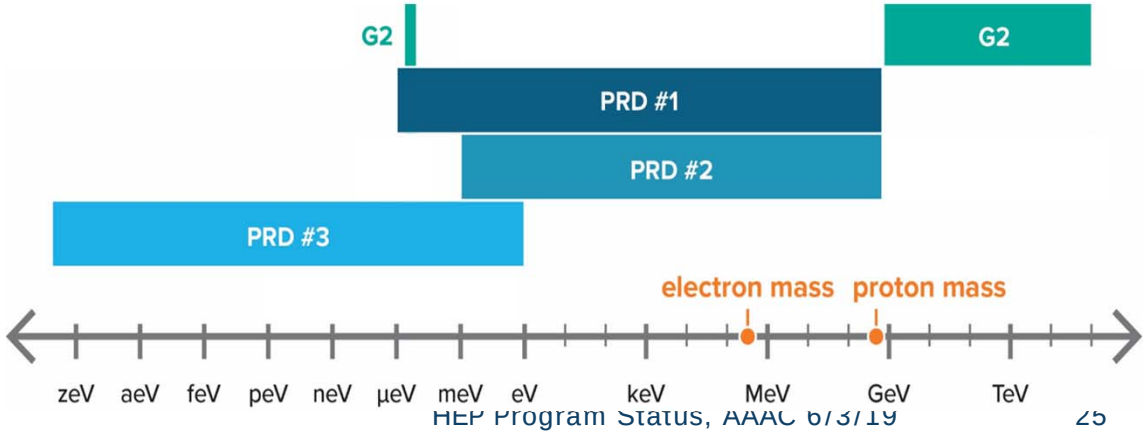
PRD 1
Create and Detect DM at Accelerators.



PRD 2
Detect Galactic DM Underground.

PRD 3
Detect Wave DM in the Laboratory





Notional Timeline for Dark Matter new initiatives

- March 2017: Community-led workshop collected ideas
  - White paper at https://arxiv.org/abs/1707.04591
- Late 2018 – Early 2019: Basic Research Needs (BRN) study for Dark Matter New Initiatives
  - Identified three Priority Research Directions for exploring new ideas in DM with small experiments
  - Report available at: https://science.osti.gov/hep/Community-Resources/Reports
- 2019: Support development of small projects through dedicated FY2019 FOA/LAB Announcement
  - Aim to develop small project designs that respond to high impact opportunities described in the BRN
    - Can include near-term technology R&D,
    - By the end of award period, should be ready to be considered for moving to next step (project fabrication)
- 2020+: Select concept(s) for fabrication (possibly in stages)
  - Continue to support theory studies, research efforts, tech. R&D needed to support project(s) as necessary and appropriate

Cosmic Microwave Background

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

Current Experiments:

- *SPT-3G* – HEP provided support for major upgrade of the camera to greatly increase sensitivity; operations started Feb 2017 (NSF-led)

➔**CMB-S4 Community-based Collaboration brought together ground based community to plan future**

- Notional array of several telescopes in Chile & South Pole with on the order of 0.5 M detectors
- Needs scale-up of detector fabrication, testing, and readout

***CMB-S4 Collaboration* Science, Technology Books:**
https://arxiv.org/abs/1610.02743 ; https://arxiv.org/abs/1706.02464

Ongoing Planning:

- **As recommended by P5, HEP is planning to participate in CMB Stage 4**
  - HEP labs already heavily involved in R&D to align with P5
- **CMB-S4 is the last remaining P5 project to start**
- **HEP coordinating planning with NSF AST/OPP/PHY**

CMB-S4 Project and Collaboration

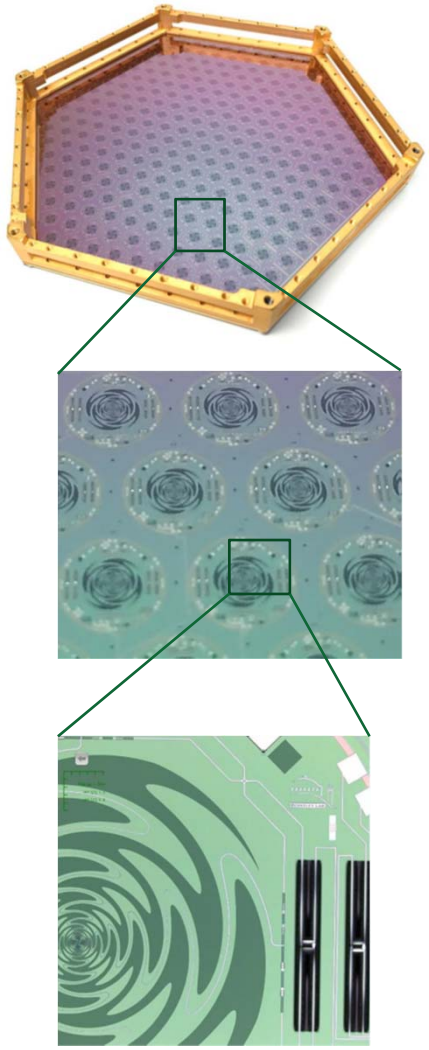
- CMB-S4 collaboration progress
  - Focusing on July submission(s) to NAS Astro2020 decadal survey
  - Continuing work on science, design, and project development

- CMB-S4 project continuing preparation
  - Following Concept Definition Taskforce, pre-Project Design Group (pPDG) set up
  - Current: Integrated Project Office (IPO) has been set up under Jim Yeck
  - Detector fabrication & readout issues at the forefront of R&D/planning

- IPO and Collaboration are working together to plan concept with technically driven schedule and for submission of plans to Astro2020, agencies, etc.

- Interagency (NSF-DOE) coordination group meeting bi-weekly to share information, monitor, and review.
  - HEP, NSF-AST, NSF-OPP, NSF-PHY

- **At DOE:**
  - CD0 (almost) signed; waiting for ESAAB to be scheduled; aiming for mid-June.
  - HEP working with IPO to fund near term R&D for planning and design. (FY18, FY19 funds provided)



Exploring the Unknown

Use ground-based arrays, space telescopes, and an experiment on the International Space Station to explore the unknown, e.g. indirect searches for dark matter

Many significant inter-agency & international partnerships

Operations continuing:

Fermi/GLAST (w/NASA)

- HEP is supporting the Instrument Science Ops Center at SLAC;
- In coordination with NASA, HEP is planning to continue support of critical efforts at SLAC if operations > 10 years

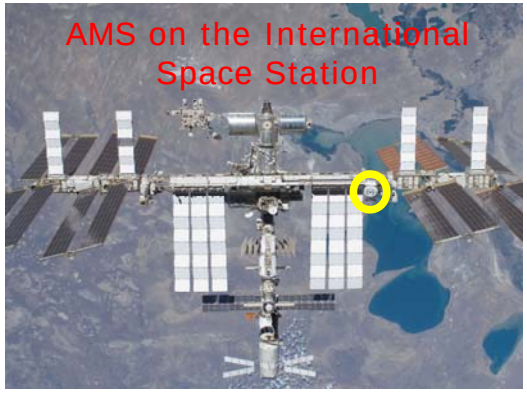
AMS (w/NASA)

- Operations continuing on ISS

HAWC (w/NSF)

- 5 year operations started early 2015

Lower program priority for new experiments



HEP Funding Opportunity Announcements (FOA)

FY19 National Lab Program Announcement (NLA): *"US-Japan Science and Technology Cooperation Program in High Energy Physics"* [LAB 19-1902], for the FY 2019 US-Japan cooperative R&D program; proposals due December 14, 2018

FY19 US-Japan Student Exchange Program

- proposals due January 15, 2019

FY19 Research Opportunities in High Energy Physics ("Comparative Review"): Main funding source for university research grants; proposals due January 22, 2019

2019 Research Opportunities in Accelerator Stewardship

- Supports basic accelerator research of broad benefit; conducted with 11 federal agencies; Proposals due April 23, 2019

2019: Quantum Information Science Enabled Discovery

- Proposals due April 16, 2019

2019: Dark Matter New Initiatives

- **Project design & near-term tech R&D aligned w/Physics Research Directions in the Basic Research Needs report;** Proposals due May 30, 2019

2019 DOE Traineeship in Accelerator Science & Engineering

- Student support; Proposals due May 31, 2019

Note: Lab programs are primarily funded via a separate Field Work Proposal process & review.

Many thanks to community members who are helping review proposals from these announcements

SC-wide Funding Opportunity Announcements (FOA)

Early Career Research: https://science.energy.gov/early-career/ for Labs & Universities

- ***FY19 "Early Career Research Program"*; Proposals due April 29, 2019**

SC General" FOA (typically a new FOA annually; "always open")

- HEP uses this primarily for conferences and unforeseen circumstances (e.g. supplements)

Science Undergraduate Laboratory Internships (SULI); Applications due January 10, 2019

Community College Internships (CCI); Applications due January 10, 2019

Visiting Faculty Program (VFP); Applications due January 10, 2019

Office of Science Graduate Student Research Program (SCGSR)

- Two annual solicitations in May and November

Albert Einstein Distinguished Educator Fellowship; Applications due November 15, 2018

2019 HEP PI Meeting

- The 2019 HEP University PI Meeting will be held in parallel to the APS DPF 2019 Meeting
  - HEP overall program talks & Program Manager talks on each subprogram (e.g. Cosmic Frontier)
  - Opportunities for one-on-one meetings with Program Managers

Basic Research Needs (BRN)

Basic Research Needs Studies/Workshops are playing a growing role in shaping aspects of the program

- Community is encouraged to continue participating in generating & responding to the BRN reports

A primary goal of the **Basic Research Needs Studies/Workshops** is to develop the case(s) for additional HEP funding to support such new initiatives in the future.

- BRN Process and Structure
  - Targeted topics defined by, and workshop charge issued by, SC program office
  - Attendance is limited and by invitation
  - Typical structure: Opening plenary sessions, panel breakout sessions that develop priority research directions, closing plenary session, and extended writing session – draft report completed before departure!
  - Prompt output: final report released typically 60-90 days after the workshop
- BRN reports are expected to serve as reference documents with a long shelf life, and to be readily accessible
  - Post-workshop outreach activities often include communication of the results to the broader community by co-chairs and the SC program, and briefings by federal staff to other interested federal parties (within and beyond DOE)
  - BRNs may, individually or collectively, serve as the basis for subsequent funding opportunities
- Next HEP BRN will focus on opportunities in Detector R&D
  - Aiming for workshop in late 2019

HEP Basic Research Needs studies

Accelerator R&D Community-driven Roadmaps, since 2015

- Guiding investments in the General Accelerator R&D (GARD) program & provide input on pressing challenges to be addressed to move the field forward and milestones aligned to the most compelling science
- Superconducting High Field Magnets
- Advanced Accelerator Concepts: Laser-driven plasma wakefield acceleration (LWFA), Particle-beam-driven plasma wakefield acceleration (PWFA), Dielectric wakefield acceleration (DWFA)
- Radiofreqency Acceleration Technology: superconducting & normal conducting RF, RF sources

Dark Matter – Small Projects New Initiatives, Oct. 2018

- Assessed the science landscape for DM particle searches, identify which high impact science areas would be suitable to be pursued with small projects in the HEP program, using DOE lab infrastructure & capabilities

Compact Accelerators for Security and Medicine, May 2019

- Long history of applying accelerator technology to address national security and medical issues
- Co-sponsored by DOE-SC, NIH-NCI, DHS-CWMD, DOE-NA21, DOE-NA22, and DOD-ONR
- Develop R&D Business Case and Priority Research Directions for six application areas in security and medicine identified by sponsors

Detector R&D, BRN workshop in late 2019

HEP Computing Challenges

- P5 recommended a program of challenging scientific experiments that have equally challenging computing needs
  - As an example, this year NERSC requests were up 50% over 2018
  - ASCR's Exascale Computing project will play an important role in satisfying this demand, but much of HEP code is not ready for Exascale
- We have charged the Center for Computational Excellence (CCE) to be a matchmaker between HEP and ASCR experts to look at several example codes
- The HEP Computing Infrastructure Working Group was formed in 2017 to develop a strategy for meeting the computing needs
  - **See Eric Colby's talk at HEPAP, 5/31/19**
- Successfully addressing computing challenges will require continued effort from the community and coordination with ASCR and NSF's Institute for Research and Innovation in Software for High-Energy Physics (IRIS-HEP) which is tackling similar issues from the university perspective

Closing Remarks

- Excellent science results continue to be produced from our operating experiments!
- Broad support is enabling us to implement the P5 strategic plan and achieve its vision
  - Thanks to DOE Management, Administration, and Congress for support
- The particle community continues to perform well on delivering projects, a foundation of the long-term strategy
- Community continues to be unified in support of P5 strategy

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