

Cosmic Frontier Experimental Program Status and Funding Opportunities

DPF-Pheno 2024

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U.S. DEPARTMENT OF
ENERGY

Office of
Science



- **SC Statement of Commitment** – SC is fully and unconditionally committed to fostering safe, diverse, equitable, inclusive, and accessible work, research, and funding environments that value mutual respect and personal integrity. <https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment>
- **Expectations for Professional Behaviors** – SC’s expectations of all participants to positively contribute to a professional, inclusive meeting that fosters a safe and welcoming environment for conducting scientific business, as well as outlines behaviors that are unacceptable and potential ramifications for unprofessional behavior. <https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Harassment>
- **How to Address or Report Behaviors of Concern** – Process on how and who to report issues, including the distinction between reporting on unprofessional, disrespectful, or disruptive behaviors, and behaviors that constitute a violation of Federal civil rights statutes. <https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/How-to-Report-a-Complaint>
- **Implicit Bias** – Be aware of implicit bias, understand its nature – everyone has them - and implicit bias if not mitigated can negatively impact the quality and inclusiveness of scientific discussions that contribute to a successful meeting. <https://kirwaninstitute.osu.edu/implicit-bias-module-series>

Outline

- HEP Program: Mission, Planning and Budgets
- Cosmic Frontier Program
- DOE/HEP Research Funding Programs



Mission of the Department of Energy (DOE)

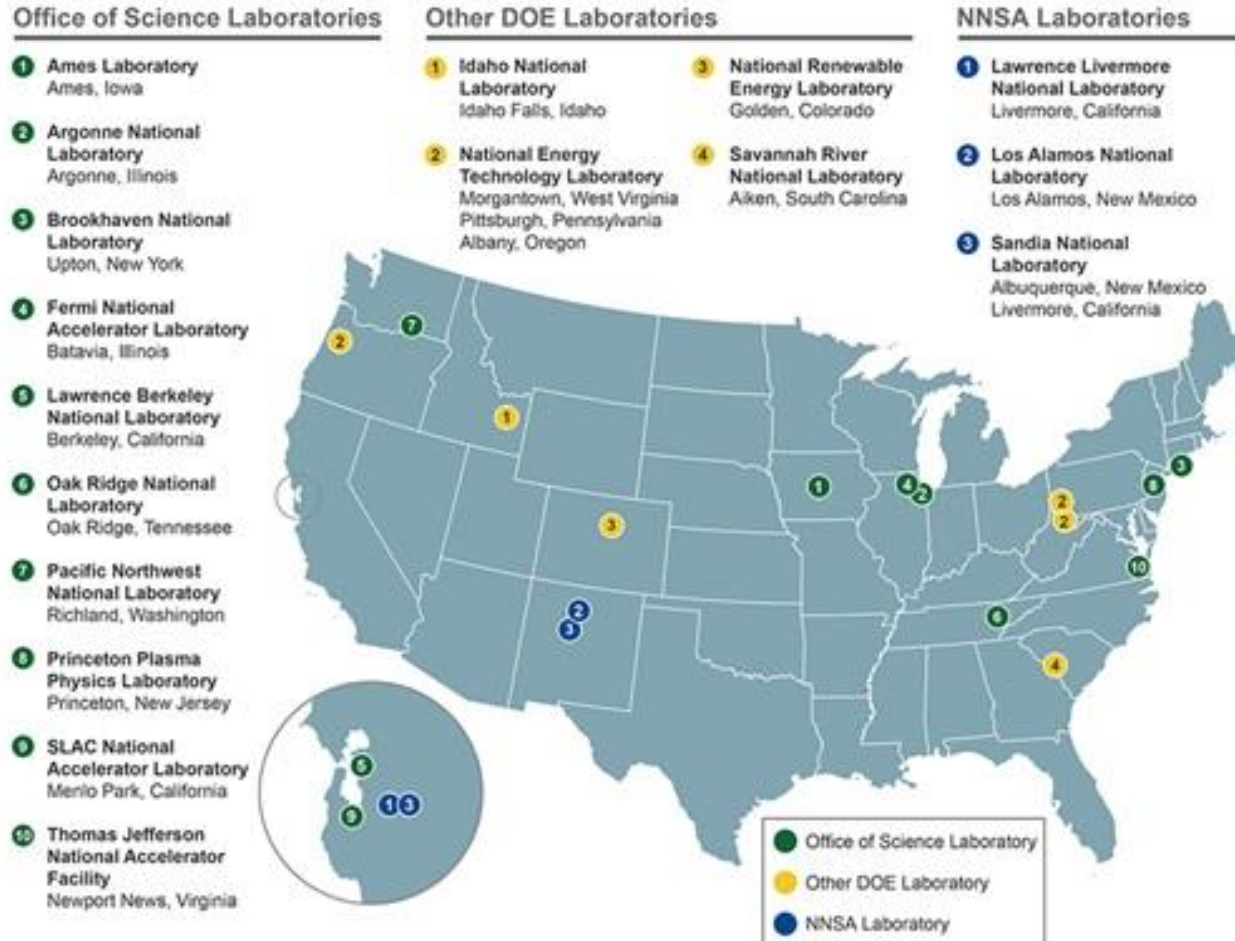
The mission of the DOE is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

- Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.
- **Maintain a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas.**
- Enhance nuclear security through defense, nonproliferation, and environmental efforts.
- Establish an operational and adaptable framework that combines the best wisdom of all Department stakeholders to maximize mission success.



DOE National Labs – Our Crown Jewels

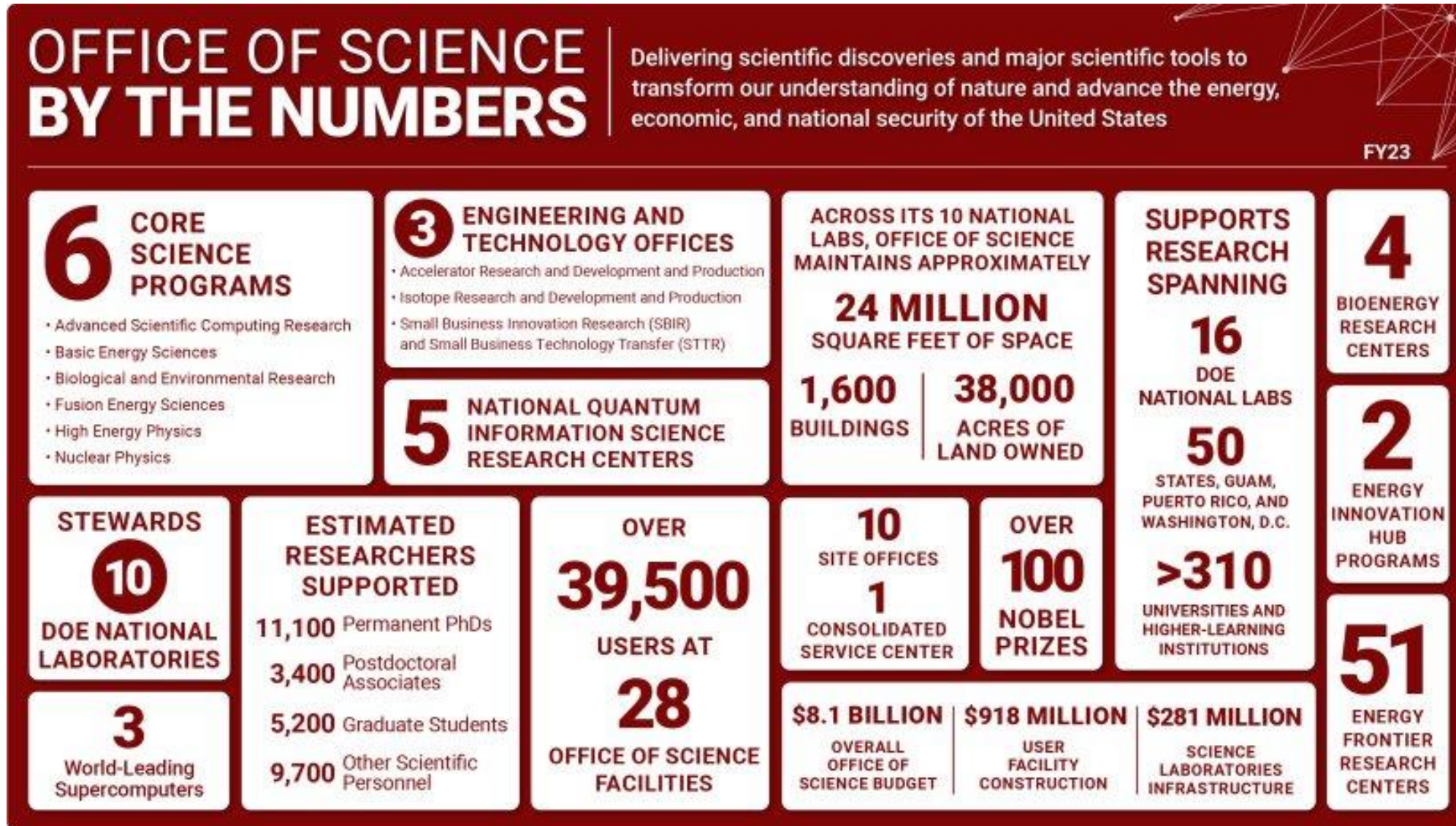
Together, the 17 DOE laboratories comprise a preeminent federal research system, providing the Nation with strategic scientific and technological capabilities.



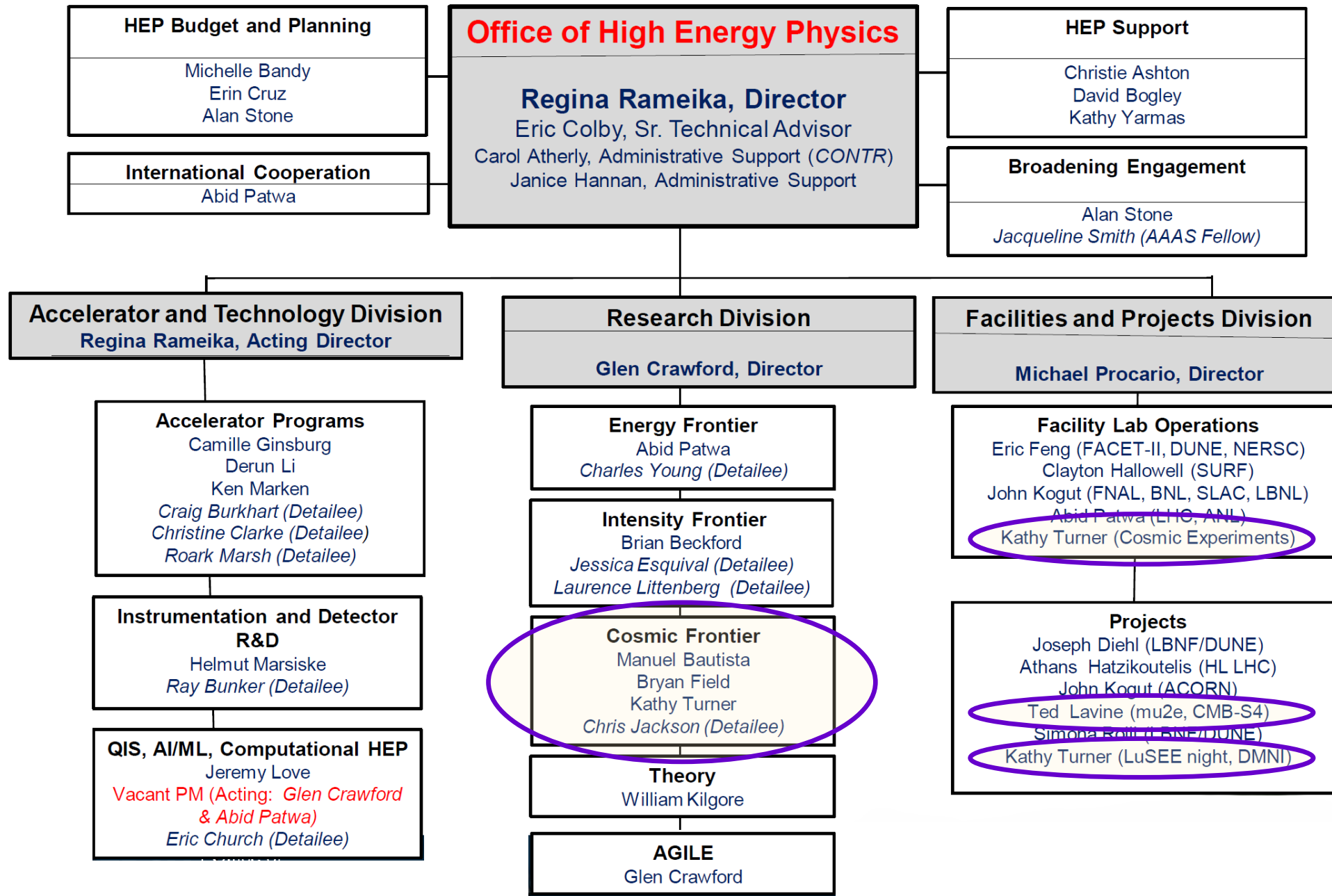
The laboratories:

- Execute long-term government scientific and technological missions, often with complex security, safety, project management, or other operational challenges;
- Develop unique, often multidisciplinary, scientific capabilities beyond the scope of academic and industrial institutions, to benefit the Nation’s researchers and national strategic priorities; and
- Develop and sustain critical scientific and technical capabilities to which the government requires assured access.

Office of Science by the Numbers (2023)



Office of High Energy Physics (HEP)

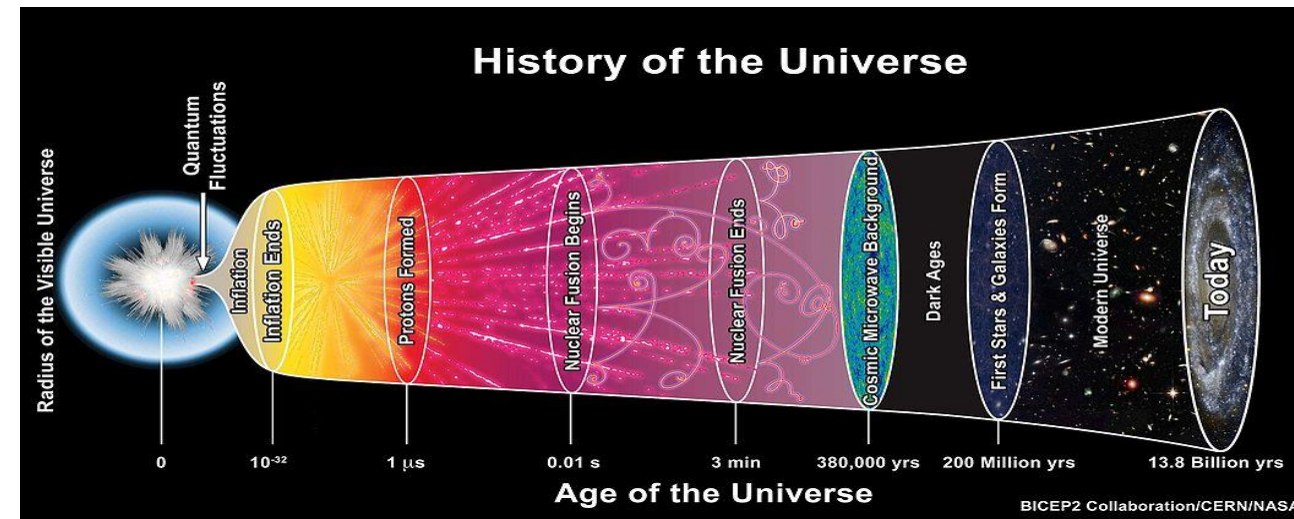
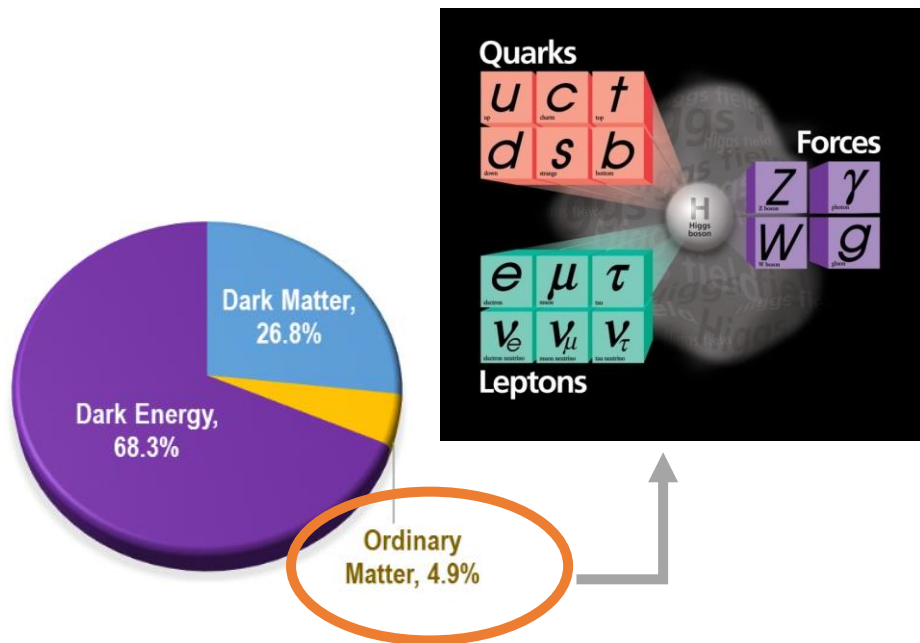


Just announced there will be a small re-org, will not affect Cosmic, breaks Research and Technology into two groups, adds Accelerator R&D and Production (ARDAP) back into the group.

DOE is a mission-oriented agency → mission includes **maintaining a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas.**

HEP's mission is to understand the universe at the most fundamental level:

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



→ Scientific Areas are intertwined: High Energy/Particle Physics, Cosmology, Astrophysics, and Astronomy.

DOE supports ~ 85% of the U.S. HEP effort (in \$) at Universities + National Labs

HEP at a Glance (FY2024 Enacted \$1.196B, FY2025 Request \$1.231B)



Largest Supporter (~85%) of Particle Physics in the U.S.



Funding at >160 Institutions, including 12 DOE Labs



Over 1,175 Ph.D. Scientists and 525 Grad Students Supported



Over 2,325 Users at 2 SC Scientific Facilities



Research: 40% Budget



~30% of Research to Universities



Projects: 30% Budget



Facility Operations: 30% Budget

HEP Program Layout

HEP is carried out along 3 Frontiers: Advancements at all 3 frontiers are needed to achieve the long-term goals of the field.

HEP is primarily a Particle Accelerator based program: Energy and Intensity Frontiers

Cosmic Frontier is an increasingly important area for discovery.

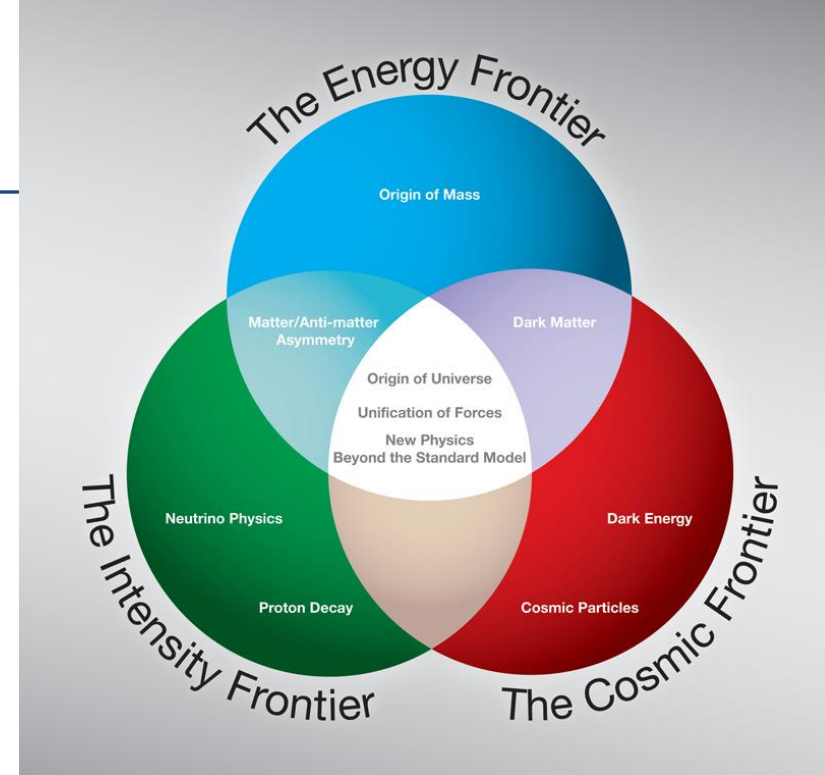
Experiments use naturally occurring data to provide additional input to the Standard Model picture: Cosmic Acceleration (Dark Energy, Inflation), search for Dark Matter particles, Neutrino properties, New Physics (e.g., relic particles, etc.)

Crosscutting HEP subprograms:

- ▶ Theoretical research, High Performance Computing and Computational HEP, Advanced Detector R&D, Quantum Information Science (QIS).

Partnerships

HEP forms partnerships with other US and International agencies (e.g., NASA, NSF, international) to help deliver our mission



HEP Program Execution

- Priorities and Collaboration Model

We use the 2009 HEPAP/PASAG Criteria to determine priorities in selecting and supporting roles & responsibilities on projects or experiments

- Select Roles & Responsibilities that make significant, coherent, contributions
 - directly aligned with HEP program and priorities, responsibilities and science goals and
 - make use of the expertise of DOE researchers and take advantage of DOE capabilities, resources and infrastructure commensurate with the science return expected (for multi-science projects)
- Achieve earliest, best, and most cost-effective U.S. science results for HEP interests in the project
- Partnerships with US international collaborators as needed & appropriate

HEP strength is our Science Collaboration Model!

- Support structured science collaborations that participate in all stages, leading to the best possible results from state-of-the art projects.
- Scientists are intimately involved and have roles and responsibilities in project design and fabrication (hardware, software), commissioning, experimental operations, science planning and data analysis
- Students and postdocs are trained by participation in all phases to gain experience and expertise; can be stationed at a lab or at the experiment site as needed.
 - **Peer Reviews reflect HEP collaboration model and work style**
 - **Priority for Research support is for efforts directly in line with HEP roles and responsibilities as well as our science goals.**

HEP Program Guidance

→ FACA panels and subpanels provide official advice

FACA: High Energy Physics Advisory Panel (HEPAP)

- Advises DOE and NSF: **Provides the primary advice for the HEP program**
- Subpanels: The **Particle Physics Project Prioritization Panel (“P5”)** provides the **Strategic Plan for HEP**; now following 2014; 2023 just completed.
 - **2014 P5 priorities (HEP community support was critical to success)**
 - Advance the High-luminosity Large Hadron Collider Accelerator and ATLAS/CMS detector upgrades
 - Advance the Long-Baseline Neutrino Facility (LBNF), Deep Underground Neutrino Experiment (DUNE)

P5 Resources for Outreach:

<https://www.usparticlephysics.org/resources/>

FACA: Astronomy and Astrophysics Advisory Committee (AAAC)

- Advises DOE, NASA, and NSF on issues of overlap, mutual interest and concern
- Subpanels: CMB-S4 Concept Definition Taskforce (2017), Gemini-Blanco-SOAR Telescopes roles (2019)


Advice Also Provided by: National Academy of Sciences (NAS)

Decadal Surveys in Astronomy and Astrophysics (Astro2020) and of Elementary Particle Physics (2023-2024)
Board on Physics and Astronomy (BPA), Committee on Astronomy and Astrophysics (CAA)

Other Input and Coordination

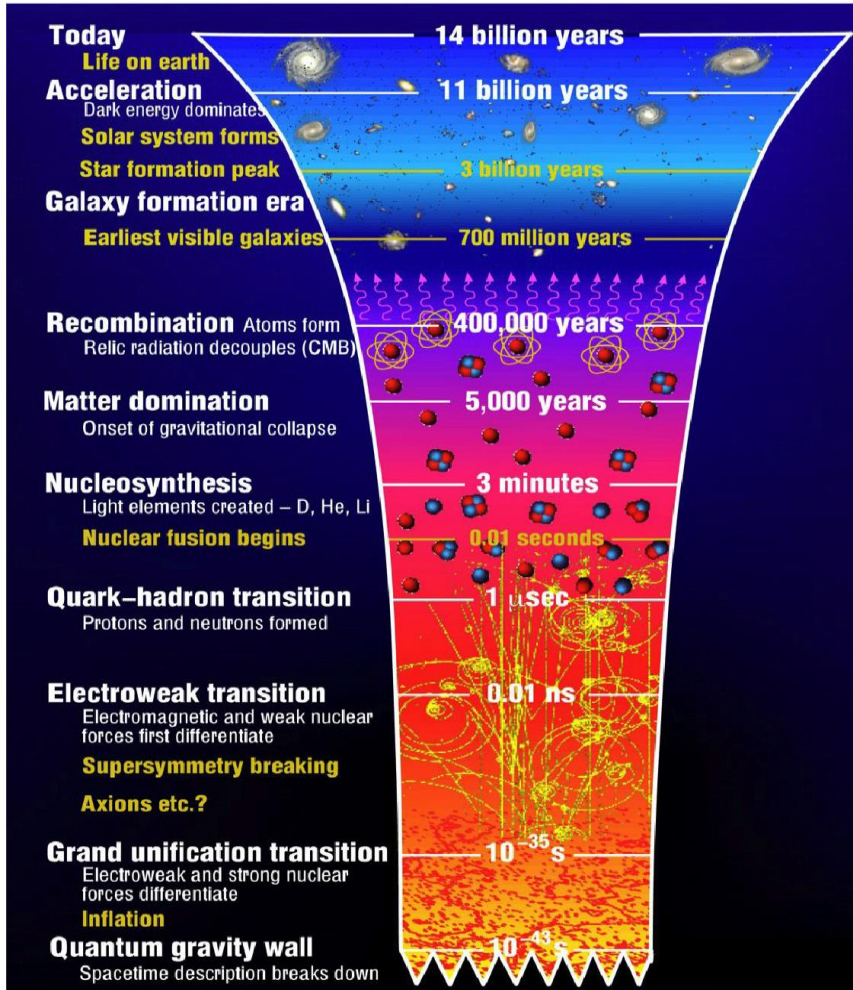
Community studies and input, e.g., Snowmass, APS/DPF, and Basic Research Needs (BRN) studies for initiatives

HEP Science Drivers

Research Frontiers				
	Energy Frontier	Intensity Frontier	Cosmic Frontier	
Particle Physics Science Drivers				
	Higgs Boson	●		
	Neutrino Mass		●	●
	Dark Matter	●	●	●
	Cosmic Acceleration			●
Explore the Unknown	●	●	●	

Cosmic Frontier – Program Status

Cosmic Frontier: Naturally occurring data is used to study of the fundamental nature of matter, energy, space and time in areas complementary to accelerator experiments.



→ **Cosmic Frontier is carrying out specific projects recommended by the 2014 P5 strategic plan.**

Cosmic Acceleration:

- Nature of **Dark Energy** using imaging and spectroscopic surveys
- Use the **CMB** to study the Inflation

Dark Matter

- Direct Detection searches for **Dark Matter** particles using a variety of methods and technologies

Neutrinos

- Constrain properties using dark energy and CMB measurements

- Partnerships w/NSF (PHY, AST, OPP), NASA (AST, ISS, CLPS), and/or International.

- Overlap with other HEP areas (e.g., Theory, Advanced Detector Development, Computational HEP, QIS, AI/ML) and other SC areas (e.g., ASCR Supercomputing)

Cosmic Frontier – Program Guidance

- Astro2010, 2014 P5, Astro2020, 2023 P5

PASAG (2009) – gave criteria for HEP roles and responsibilities

Astro2010 recommended DOE/NSF partnership on LSST (now Vera C. Rubin Observatory)

P5 (2014) recommended Cosmic Frontier science and project priorities in Dark Energy, Dark Matter (direct detection) and CMB -- This is the program we are executing now!

- **Cosmic Acceleration:**
 - **Dark Energy:** build **LSST (Rubin) and DESI**
 - **CMB:** support as part of the core program within multi-agency context; carry out multi-agency **CMB-S4** project later in the decade
 - **Dark Ages: LuSEE-Night** pathfinder
- **Dark Matter:** suite of “generation 2” direct detection experiments to detect DM particles; Dark Matter New Initiatives (DMNI) small project concepts
- **Neutrino Mass** – survey experiments provide information on neutrino properties
- **Explore the Unknown** – always of interest!

Astro2020 recommended:

- **CMB-S4** as an NSF and DOE partnership -- jointly pursue the design and implementation of the next generation ground-based cosmic microwave background experiment.
- **Dark Ages** identified as Discovery Area → cosmological probe with great potential
- Efforts on diversity, equity, inclusion, demographics, data, etc. (joint with NSF and NASA)

Future Planning → 2023 P5, NAS EPP (2024)

Research Frontiers		Energy Frontier	Intensity Frontier	Cosmic Frontier
Particle Physics Science Drivers	Higgs Boson	●		
	Neutrino Mass		●	●
	Dark Matter	●	●	●
	Cosmic Acceleration			●
	Explore the Unknown	●	●	●

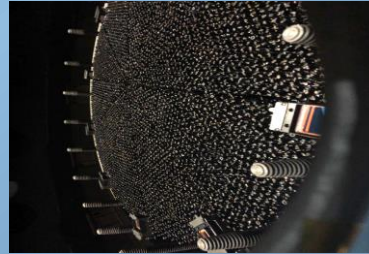
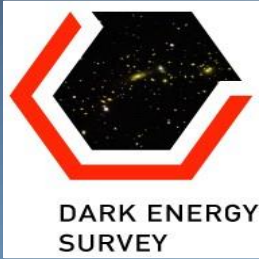


DOE/HEP joint efforts with NASA, NSF

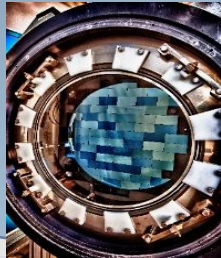
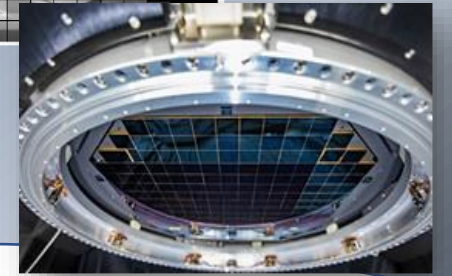
		DOE Project	DOE Operations	oversight	status
DES	NSF/AST	DECam	yes	JOG	survey completed; data processing and analysis
DESI	NSF/AST	Instrument, data management, telescope upgrades	full support of the Mayall	MOU for Mayall	Operating
Rubin, LSST, DESC	NSF/AST	LSSTCam	50/50 split	MOU; JOG	project, Camera shipping to Chile in May; operations in planning
CMB-S4	NSF	yes	yes	JOG	DOE will work with NSF & Project Team to lay out a path forward.
SuperCDMS	NSF/PHY	yes	yes	JOG	Fabrication completed; now Integration & Test; operations 2025
SPT-3G	NSF	instrument upgrade	yes		Operating
FGST/LAT	NASA/AST	LAT fabrication	yes	Int. Fin. Comm.	LAT Science Ops for 10 yrs; now critical efforts only
AMS	NASA ISS	yes	yes	MOU; meetings	support AMS PI and group
LuSEE-Night	NASA CLPS	yes	yes	MOU; meetings	fabrication started 2022; launch late 2025
Planck	NASA/AST	no	no*	MOU; meetings	supported data processing at NERSC
HAWC	NSF	yes	yes	MOU; meetings	DOE support completed
VERITAS	NSF	yes	yes		DOE support completed
Pierre Auger	NSF	yes	yes		DOE support completed

HEP Cosmic Frontier: Cosmic Acceleration

Dark Energy



Pinhole camera 3.2Gpixel image of Vera C. Rubin



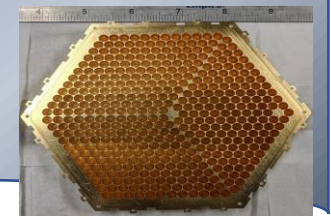
CMB



SPT-3G



CMB-S4
Next Generation CMB Experiment



Dark Ages



Dark Energy Survey (DES), Dark Energy Camera (DECam) – Stage III Imaging Survey



DARK ENERGY SURVEY

DOE-HEP & NSF-AST partnership; had JOG & joint reviews

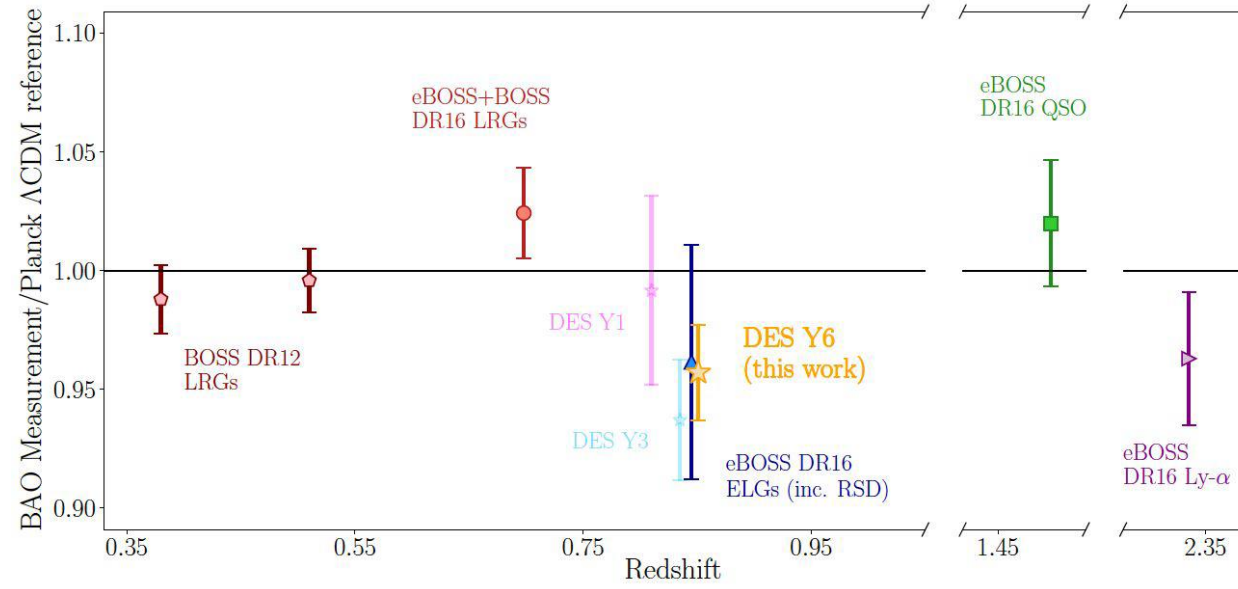
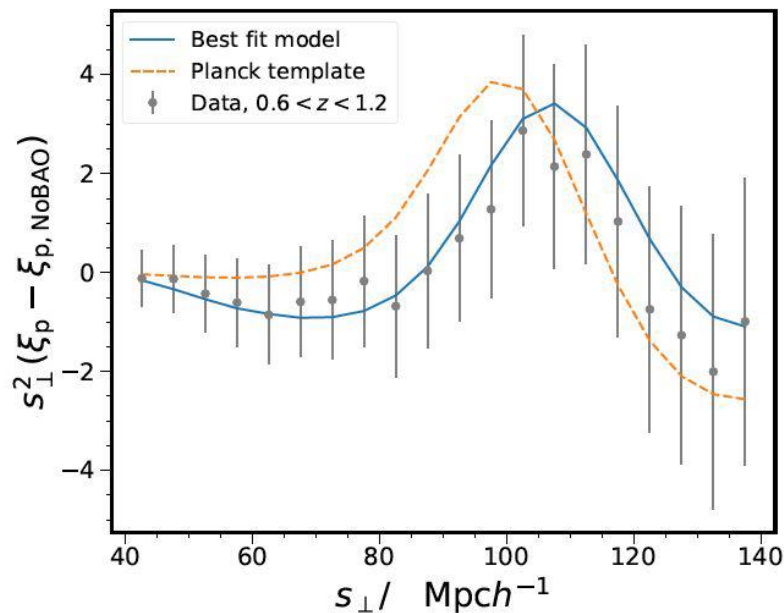
DOE (Fermilab) led fabrication of 570Mpix DECam; NSF led telescope upgrades, data management system

Operations: 6-year imaging survey of 5100 sq-deg completed Jan. 2019

Plan forward: now final data processing and analysis (> 425 publications)

Final results from all Year 3 data end of 2024; all Year 6 data ~ 2025++

➔ HEP supporting FNAL to store and publicly serve the cosmology data



“Hubble tension” - difference in results between Planck (CMB) and dark energy experiments

Dark Energy Spectroscopic Instrument (DESI)



Science: World's first Stage IV DE project → Measure spectra of > 40 million galaxies to trace the universe's history at $z < 1.5$ to study nature of dark energy, primarily using the BAO and RSD methods.

- DESI is the world's premier multi-object spectrograph w/5,000 fibers, positioned robotically
- Order of magnitude increase in results over preceding spectroscopic samples

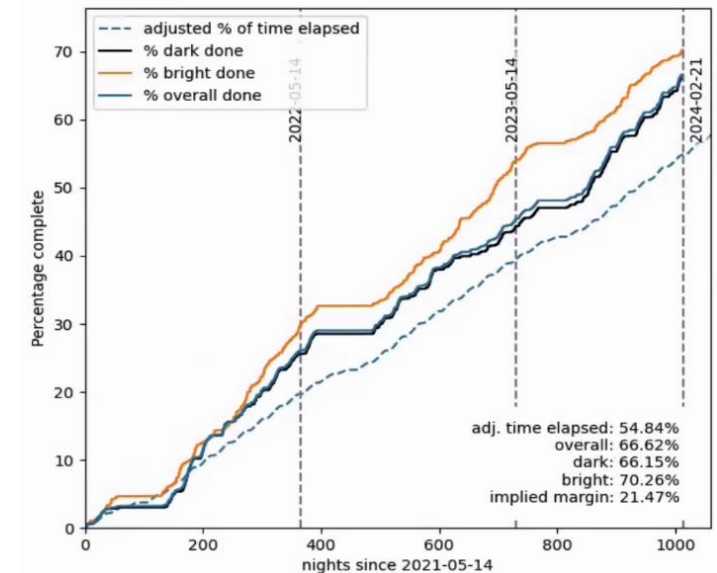
Partnership: Primarily DOE (led by LBNL), with international and NSF-AST contributions;

Project: HEP Instrumentation, Data Management System, and Upgrades of NSF's Kitt Peak Mayall telescope (incl. MOSAIC camera).

Operations: DOE provides full support, including for Mayall operations via "lease" with NSF

→ The 5-year survey started May 2021; requesting to run through mid-2028 to fill out holes in the survey for ELG's and add 3K sq deg area to overlap more w/ Rubin.

→ NERSC is their computing platform – simulations, processing, analysis, serving data.



DESI is and continues to remain the most competitive instrument for wide-field spectroscopic surveys on the planet! Excellent operations and science results coming out.

Dark Energy Spectroscopic Instrument (DESI) Experiment – operating since May 2021

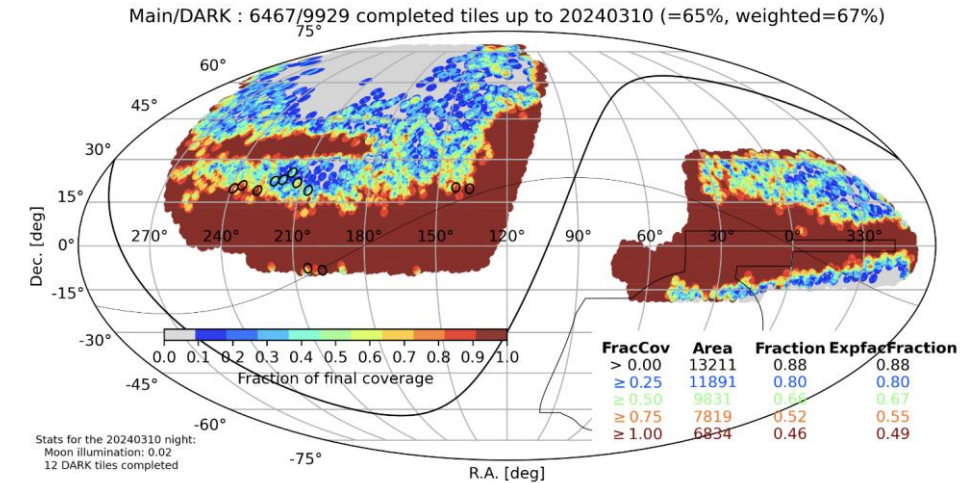


Science Status: On track to carry out key science analyses and release data on schedule. World leading results from a very strong team (> 1200 members)!

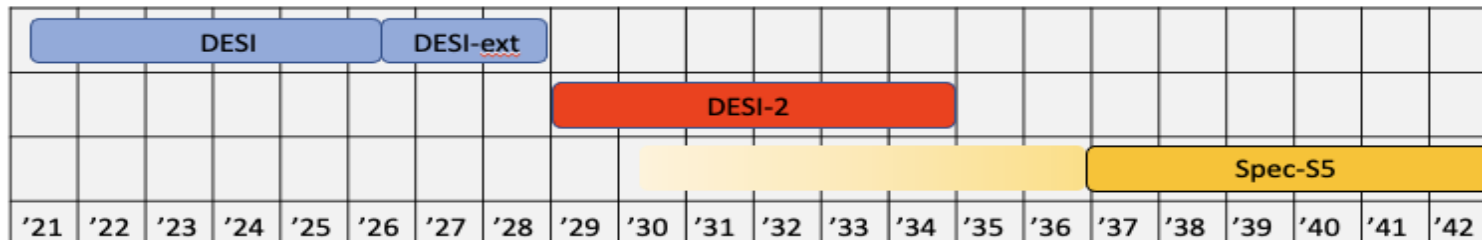
- Jan. 2021 to Mar. 2024., DESI has published 81 refereed papers
- Year-1 analyses performed on fully blinded measurements and showed excellent robustness of the BAO to all modeling choices
→ combined theoretical, observational and modeling systematic error of 0.25% on isotropic BAO measurement
- Collaboration unblinded the Year-1 data for the Ly- α , BGS, LRG, ELG, and quasar BAO measurements
→ **Cosmology results were presented at the APS meeting on April 4th**
→ **Huge media response: 1,229 popular articles in 33 languages in first week**

Collaboration's future planning – see 2023 P5 recommendations

- **DESI-2:** extended operations for higher redshift (inflation physics)
 - Early dark energy and growth of structure, now in a matter-dominated phase of the universe
- **Spec-S5** – Next generation spectroscopic survey
 - Primordial physics: inflationary physics (complementary to CMB), late-time cosmic acceleration, light relics, neutrinos masses and dark matter



As of end February 2024, DESI is running ~ 6.2 months ahead of schedule. The dark time coverage is shown in the figure above





Vera C. Rubin Observatory w/LSSTCam and Simonyi Survey Telescope



Science: A next-generation, ground-based facility, providing repeated imaging of faint and time-variable astronomical objects across the entire southern sky every few nights for ten years

→ Stage IV dark energy imaging survey

NSF (AURA) and DOE (SLAC) partnership, with private, international contributions

DOE/NSF 2012 MOU for Project, Operations, Science. JOG and joint reviews

Construction/Commissioning Project:

NSF: observatory, telescope, data management, EPO, commissioning

DOE:

- **LSST Camera fabrication** completed Sept. 2021; all key performance parameters demonstrated
- **Commissioning roles** - LSST Camera assembly, test, shipment, then integration, commissioning in Chile; 9-CCD Commissioning Camera (ComCam) efforts; data quality and verification studies; overall Project roles

DOE's science interests are led by the Dark Energy Science Collaboration (DESC), which uses NERSC as its platform. Over 100 DESC collaborators are also part of the Rubin Commissioning team.

Rubin Observatory: Facility Operations

Rubin Observatory will conduct a 10-year deep, wide, fast, optical imaging Legacy Survey of Space and Time (LSST) using DOE's LSST Camera and the Simonyi Survey Telescope

Facility Operations - DOE/NSF ~50/50 split

DOE (SLAC) is primarily responsible for the US Data Facility (USDF), Camera maintenance and operations, and have overall operations management roles and efforts in commissioning and data quality studies.

Phases:

- Pre-operations planning and activities started 2017;
- Ten-year prime survey operations phase starts ~ late 2025
- Two-year archival consolidation process, including final LSST data release.

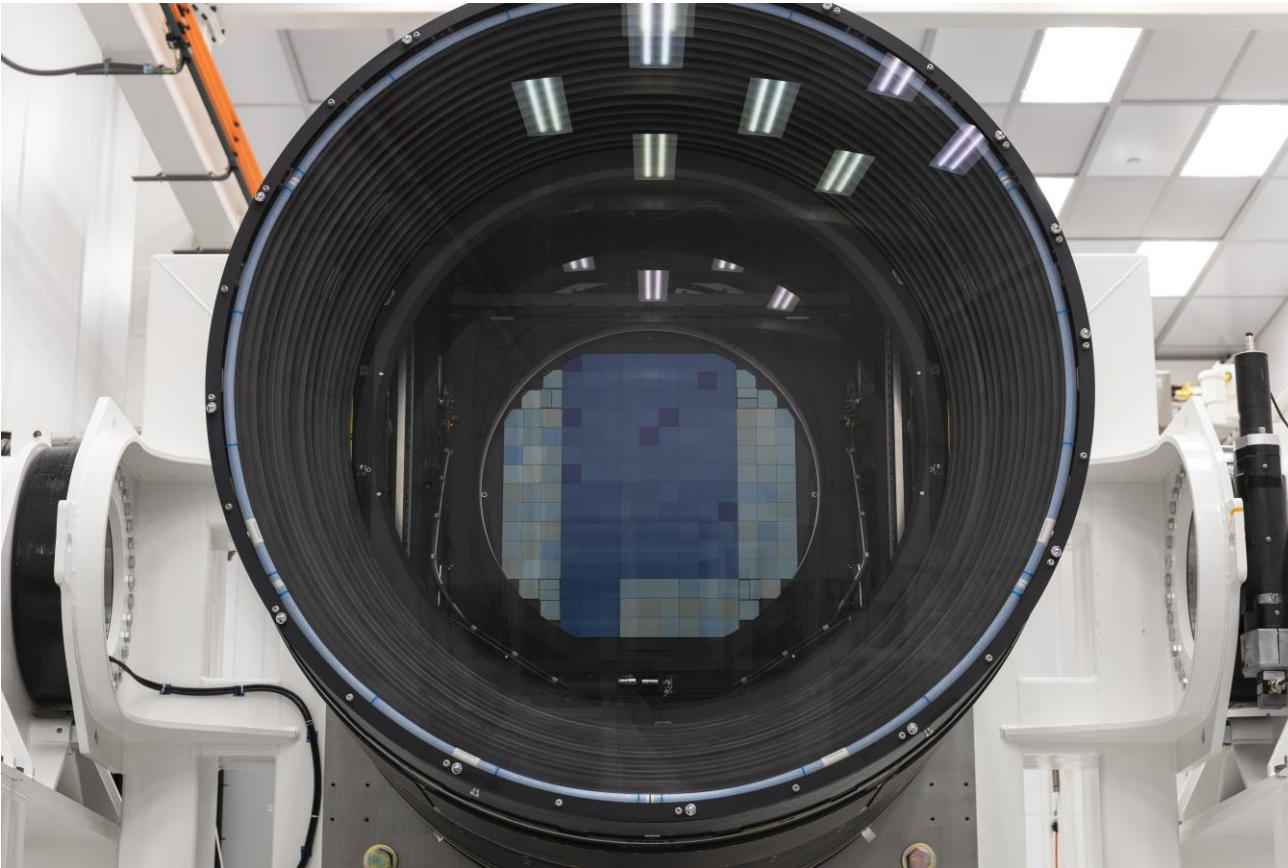
Planning is in full swing:

- International in-kind contributions (all US and Chilean scientists already have rights)
 - in exchange for early access to data; Data Rights Agreements are in process
- Data management, data facility planning

Carrying out Data Previews in 2024 and 2025 (DP 0.1, 0.2, 0.3 use simulated data; DESC is providing some of the simulations). DP-1 and 2 will use commissioning data.



LSST Camera Integration, Test and Commissioning – at SLAC



- Completed!
- Huge media response!
- Planning final details for shipping last part of May 2024



US Data Facility (USDF)

The USDF is at the SLAC Shared Science Data Facility (S3df) in the Stanford Research Computing Facility II (SRCF)

→ Modern datacenter: 6 MW capacity

- Ultimately 80-100k cores; 30 PB/yr; 200 PB by 10 yrs

USDF Model:

- Hybrid model with hardware and initial services at SLAC.
- Rubin has a multi-site processing model → SLAC plus annual catalog processing also in the UK and France; transfers of test data demonstrated
- Rubin Science Platform (user access) in the Google Cloud

Current efforts:

- Initial testing of realistic data transfers from summit
- Delivering AuxTel data from the summit and doing prompt processing
- Preparing for multi-site processing using HSC precursor data
 - Using LHC tools for workflow (PanDA) and data mgmt (Rucio)

S3df/SRCF: SLAC Shared Science Data Facility in the Stanford Research Computing Facility



Vera C. Rubin Observatory and the Dark Energy Science Collaboration (DESC)

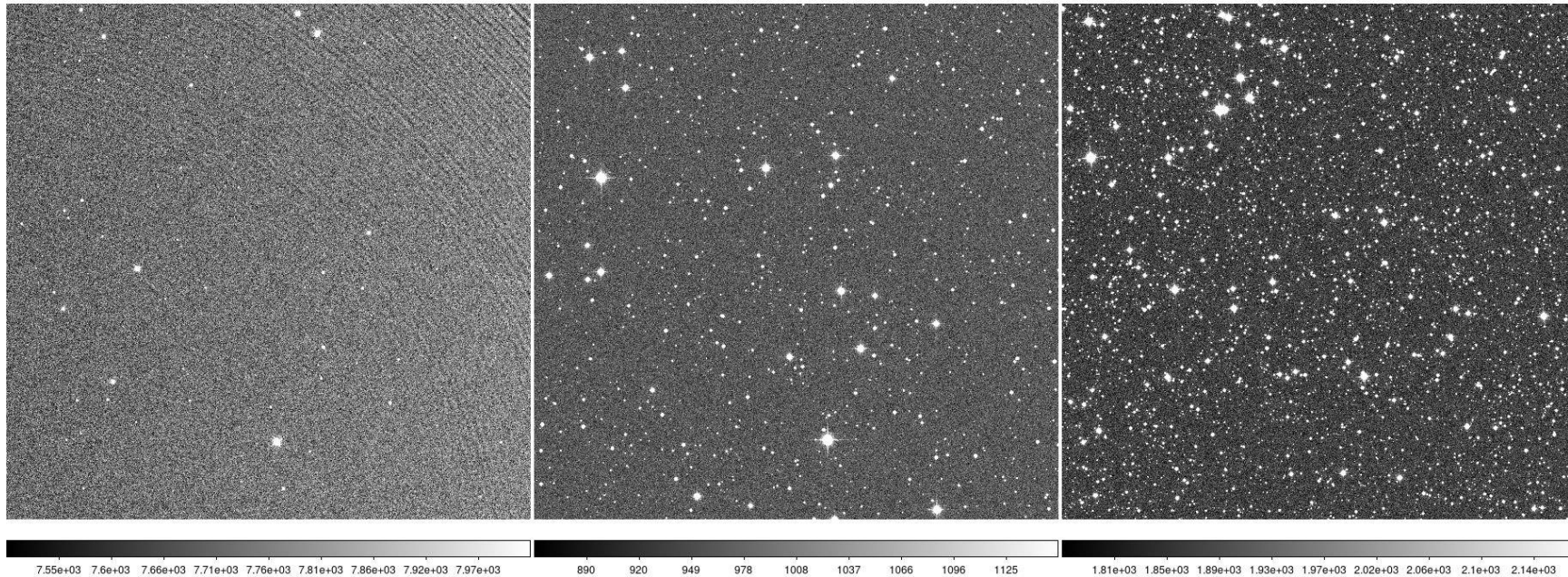


DOE's research interests are carried out by the DESC

→ Preparing for data arrival with simulated and precursor data

- Fruitful collaboration between DESC and Rubin on many fronts including development of image simulation (imSim) code, being used for ComCam
- Simulations being used for Rubin Data Preview 0.X
- Many DESC collaborators (>100) also on Rubin Commissioning team
- Planning for ComCam on-sky this summer

1250+ members w/250 full members; from 20+ countries.
• 87 publications overall, 30 in 2023, 8 more submitted



Worked with Nancy Grace Roman groups to do joint LSST-Roman simulations on Argonne Leadership Computing Facility (ALCF) supercomputer.

CMB-S4 goal: cross critical science thresholds, including definitive tests of Inflation

“The NSF Director has determined that the South Pole is essentially closed for any significant new construction of scientific equipment beyond what is already committed for at least the next 10 years, declines to approve moving CMB-S4 into the Major Facilities Design Stage.”

Chris Smith (NSF-AST) at the NAS Board on Physics and Astronomy 2024 Spring Meeting, May 7, 2024

“After extensive analysis, NSF has made the decision not to move the CMB-S4 project in its current form into the NSF Major Facility Design Stage at this time. The agency must prioritize the recapitalization of critical infrastructure at the South Pole so that the groundbreaking research it enables can continue to thrive.

NSF is committed to cosmic microwave background science and will continue to support current CMB activities at the South Pole and in Chile. We are in active discussions with DOE and the CMB-S4 Project about the path forward. NSF will work with the community to explore possible options for future CMB science.”

Jean Cottam-Allen (NSF-OPP) at the HEPAP Spring 2024 Meeting, May 9, 2024



HEP will continue to work closely with NSF and the project team to investigate a path forward to address the science goals.

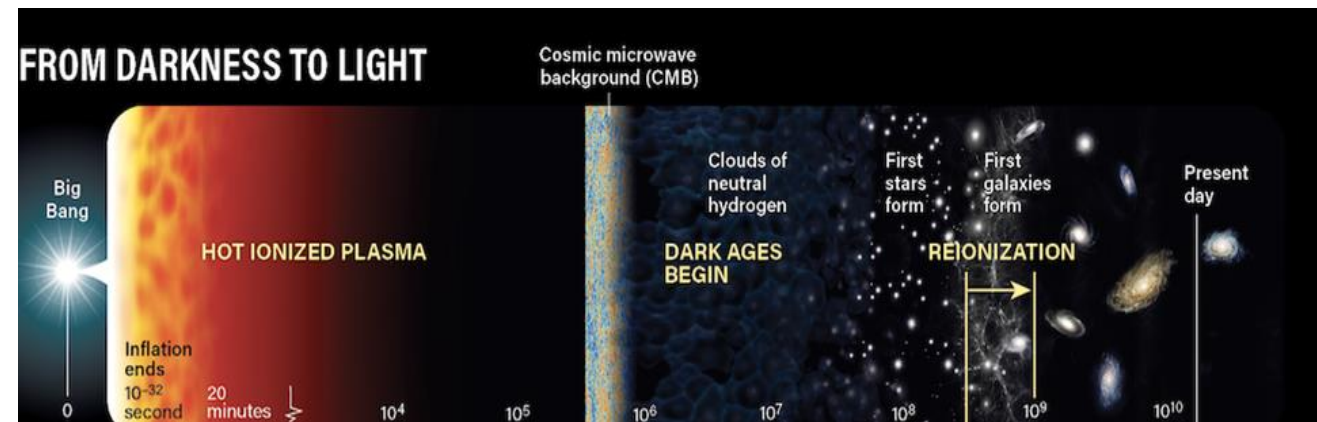
The Panel on Cosmology identified 4 Questions:

- What set the hot Big Bang in motion?
- What are the properties of dark matter and the dark sector?
- What physics drives the cosmic expansion and large-scale evolution of the universe?
- How will measurements of gravitational waves reshape our cosmological view?

The **Panel on Cosmology** identified as a **Discovery Area** using the **Dark Ages as a cosmological probe with great potential**. “The panel sees 21 cm and molecular line intensity mapping of the Dark Ages and reionization era as both the discovery area for the next decade and as the likely future technique for measuring the initial conditions of the universe in the decades to follow.”

→ The Dark Ages signal has never been observed. A first discovery would be a significant step in understanding this phase after CMB and when stars and galaxies form.

- Detecting and characterizing the Dark Ages monopole dip in the 21cm radiation is the first step in the exciting program to explore Dark Ages
- Measurements of the low-frequency (<50MHz) radio sky are sensitive to 21cm emission from neutral hydrogen at high redshift ($z>30$)”



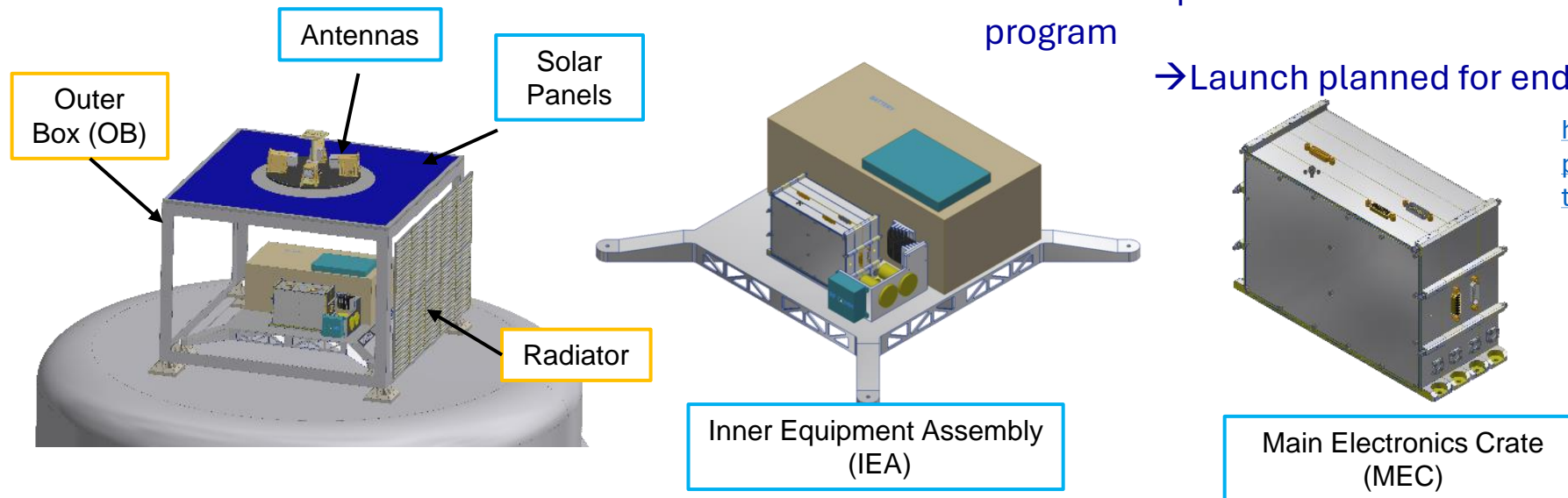
DOE/NASA Partnership on LuSEE-Night → Pathfinder to the Dark Ages

- LuSEE-Night is a pathfinder mission to place the most sensitive constraints to date on the **Dark Ages signal**
- Capability to measure the radio environment and observe the long-wavelength radio signal through the lunar night.
- UCB/SSL is overall lead (for LuSEE-Night and LuSEE-Light)
- DOE/HEP → LuSEE-Night Major Item of Equipment Project (led by BNL) started in FY 2022; Planned to deliver to SSL summer 2024.

→ See NASA's Press Release (3.14.23) – Firefly Aerospace was selected as part of their Commercial Lunar Payload Service program

→ Launch planned for end of 2025

<https://www.nasa.gov/press-release/nasa-picks-firefly-aerospace-for-robotic-delivery-to-far-side-of-moon>



BNL is also leading the
Science Collaboration

Dark Matter Generation 2



Axion search 0.6-2MHz at U.Wash; started 2017

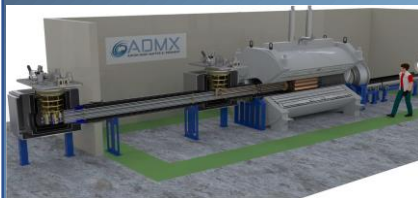


WIMP search at SURF (SD); started FY22

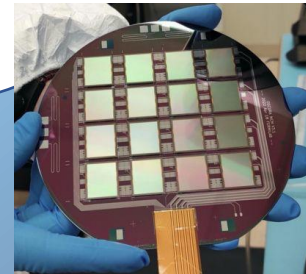
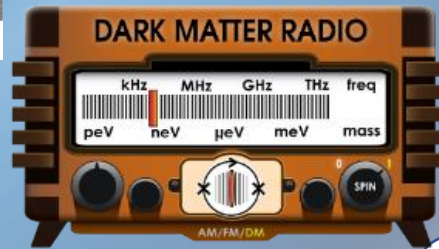


WIMP search at SNOLAB (Canada); partial data-taking starts 2023; full data-taking 2025

Dark Matter New Initiatives

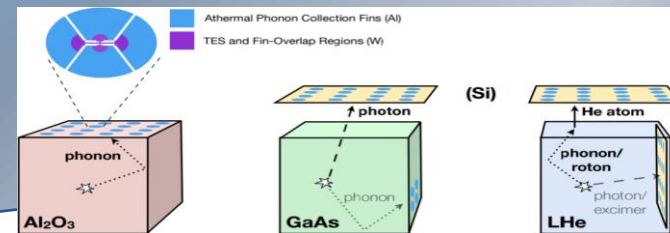


Axion search 2-4 GHz



OSCURA

TESSERACT



Direct Detection Dark Matter Generation 2 (DM-G2)

The 2014 P5 recommended a DM-G2 suite using a variety of methods and technologies to search for dark matter particles

ADMX-G2 operating since Feb. 2017 at U.Wash

- Search for QCD axions, Ten-trillionth of the mass of an electron, using a haloscope experiment, in which an axion would convert to a photon in the presence of a strong magnetic field



LZ operating since Dec. 2021 underground at SURF in S. Dakota

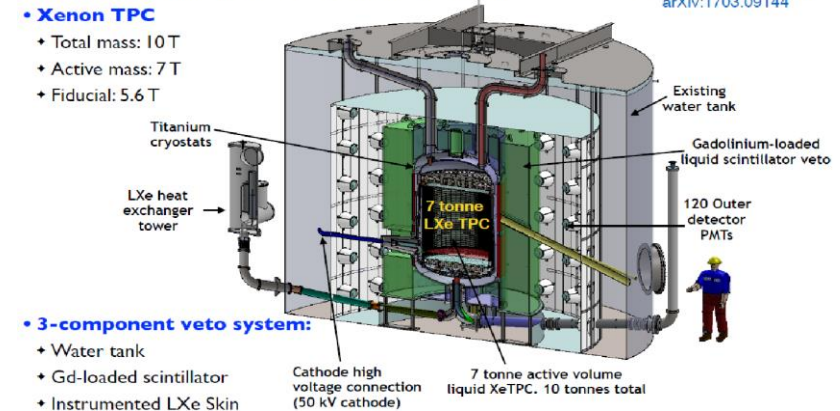
- Search for WIMPs 10-1000 GeV mass using Time Projection Chamber with 7 tons liquid Xenon

• LZ experiment at SURF, in Lead SD (~1 mile underground)

• Xenon TPC

- Total mass: 10 T
- Active mass: 7 T
- Fiducial: 5.6 T

Technical Design Report:
arXiv:1703.09144



• 3-component veto system:

- Water tank
- Gd-loaded scintillator
- Instrumented LXe Skin



SuperCDMS SNOLAB underground in Sudbury, Canada

- Installation/testing now; Data-taking starts in 2025
- Search for WIMPs 1-10 GeV mass using cryogenic solid-state crystal germanium and silicon detectors



Exploring the Unknown – Search for New Physics

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

Fermi/GLAST - Large Area Telescope (LAT) (w/NASA)

- Space-based gamma-ray observatory, launched in 2008
- Continues successful operations; approved for 2023-2025
- HEP/SLAC led the fabrication of the LAT; Continues to support critical efforts at the LAT Instrument Science Ops Center at SLAC

AMS (w/NASA)


- Launched and mounted on International Space Station in 2011
- DOE-HEP is responsible for management of the science program, led by Prof. Ting (MIT) and has roles in operations; Can continue through 2028+
- Multi-purpose particle-physics spectrometer detects cosmic-rays up to multi-TeV; search for anti-matter, dark matter etc.

Neutrino Mass: Unique constraints from Dark Energy and CMB experiments



NERSC is the primary scientific computing facility for the DOE Office of Science.

- HEP allocations follow the programmatic priorities established by P5.



HEP SubProgram	AY22 CPU	AY23 CPU	AY23 GPU
Energy	1,159k	710k	127k
Theory	1,090k	430k	430k
Cosmic	906k	878k	293k
GARD	354k	242k	59k
Intensity	222k	167k	152k
Comp+QIS+Other	65k	151k	51k
Total	3,795k	2,487k	1,112k



HEP/ Cosmic Frontier allocations include the efforts for LZ, DES, DESI and DESC as a priority since they're dependent on it.

- **NERSC** has done a large fraction of the international CMB computing for decades, including Planck.

Cosmic Frontier – Planning Ahead 2023 P5 Recommendations

As the highest priority independent of the budget scenarios, complete construction projects and support operations of ongoing experiments and research to enable maximum science. We reaffirm the previous P5 recommendations on major initiatives:

- The Vera C. Rubin Observatory to carry out the Legacy Survey of Space and Time (LSST), and the LSST Dark Energy Science Collaboration, to understand what drives cosmic evolution.

In addition, we recommend continued support for the following ongoing experiments at the medium scale (project costs > \$50M for DOE and > \$4M for NSF), including completion of construction, operations and research on:

- DarkSide-20k, LZ, SuperCDMS, and XENONnT (determine the nature of dark matter)
- DESI (understand what drives cosmic evolution).

Note: Only the recommended initiatives with Cosmic Frontier support are shown

2023 P5 Recommendations. Recommendation 2

Construct a portfolio of major projects that collectively study nearly all fundamental constituents of our universe and their interactions, as well as how those interactions determine both the cosmic past and future. These projects have the potential to transcend and transform our current paradigms. They inspire collaboration and international cooperation in advancing the frontiers of human knowledge.

- **CMB-S4**, which looks back at the earliest moments of the universe ... It is critical to install telescopes at and observe from both the South Pole and Chile sites to achieve the science goals.
- Re-envisioned **second phase of DUNE** with an early implementation of an enhanced 2.1 MW beam, a third far detector, and an upgraded near detector complex as the definitive long baseline neutrino oscillation experiment of its kind.
- An **off-shore Higgs factory**, realized in collaboration with international partners... Once a specific project is deemed feasible and well defined, the US should aim for a contribution at funding levels commensurate to that of the US involvement in the LHC and HL LHC, while maintaining a healthy US on shore program in particle physics.
- An **ultimate Generation 3 (G3) dark matter** direct detection experiment reaching the neutrino fog, in coordination with international partners and preferably sited in the US.
- IceCube Gen2 for study of neutrino properties using non beam neutrinos complementary to DUNE and for indirect detection of dark matter covering higher mass ranges using neutrinos as a tool.

Create an improved balance between small--, medium--, and large-scale projects to open new scientific opportunities and maximize their results, enhance workforce development, promote creativity, and compete on the world stage.

- Implement a new small project portfolio at DOE, Advancing Science and Technology through Agile Experiments (ASTAE), across science themes in particle physics with a competitive program and recurring funding opportunity announcements. This program should start with the construction of experiments from the Dark Matter New Initiatives (**DMNI**) by DOE HEP.
- Continue Mid Scale Research Infrastructure (MSRI) and Major Research Instrumentation (MRI) programs as a critical component of the NSF research and project portfolio.
- Support **DESI-II** for cosmic evolution, LHCb upgrade II and Belle II upgrade for quantum imprints, and US contributions to the global Cherenkov Telescope Array (CTA) Observatory for dark matter.

HEP's General Response to Recommendations 1, 2, and 3 → from Regina Rameika's talk at HEPAP on 5/9/24

Recommendation 1 :

- DOE fully supports this recommendation and puts it as the **highest priority** in planning our allocation of funding.

Recommendation 2 :

- DOE forwarded each of the projects listed in red on slide 36 to the Facilities sub panel
- These are all large undertakings and will comment on each one separately

Recommendation 3 :

- DOE will implement and execute a plan to address the ASTAE recommendation
- DOE will NOT support scope towards the LHCb Upgrade II
- DOE will continue to meet its on going commitments to Belle II; contributions towards SuperKEKB will be considered in the context of accelerator R&D toward e^+e^- luminosity improvements
- DOE will work with the DESI Collaboration to carefully decide a scope, schedule and cost envelope for the DESI-II upgrade

From P5 Report recommendation #3: Implement a new small project portfolio at DOE, Advancing Science and Technology through Agile Experiments (ASTAE), across science themes in particle physics with a competitive program and recurring funding opportunity announcements. This program should start with the construction of experiments from the Dark Matter New Initiatives (DMNI) by DOE HEP.

DOE response and actions :

- DOE will initiate fabrication of 1 - 3 DMNI projects (5 projects remain under consideration).
- The key word for new projects is AGILE

P5's call for *agile* implies that we should complete these experiments quickly, and shift course when it comes time to start new ones.

To do this:

- Keep FOA's and # of reviews limited. Select a few (2?) concepts at a time to develop into projects.
- Short R&D/design phase to finalize technology, concept development.
- Keep projects within a set funding envelope and schedule.
- We expect the lead laboratories to develop project execution plans to keep the initiatives on track and within budget

Concept	DM type	Mass range	Est. Fab. cost (\$ M)
ADMX-EFR	Axions	9-17 μeV	\$20
DM-Radio	Axions	$< \mu\text{eV}$	\$24
LDMX	Accelerator-produced DM particles	$< 1 \text{ GeV}$	\$21
OSCURA	WIMPs	1MeV-1GeV	\$15
TESSERACT	WIMPs	$> 10 \text{ MeV}$	\$10
SUM			90

- These are the remaining DMNI proposals
 - CCM at LANL was funded, fabricated and is operating
- The French have funded a proposal to host TESSERACT.
- DOE has decided to fund TESSERACT starting in FY25 based on its cost effectiveness and the French offer to host
 - These considerations made it the ideal concept to go next
- We are still working on the process to select other DMNI proposals
 - Most likely will be in FY26
- HEP will try to select 2 additional DMNI's to move to fabrication, with the rest folded into the ASTE program competition. This will allow new dark matter proposals to be considered.

From P5 Recommendation 2, Priority 4 out of 5 :

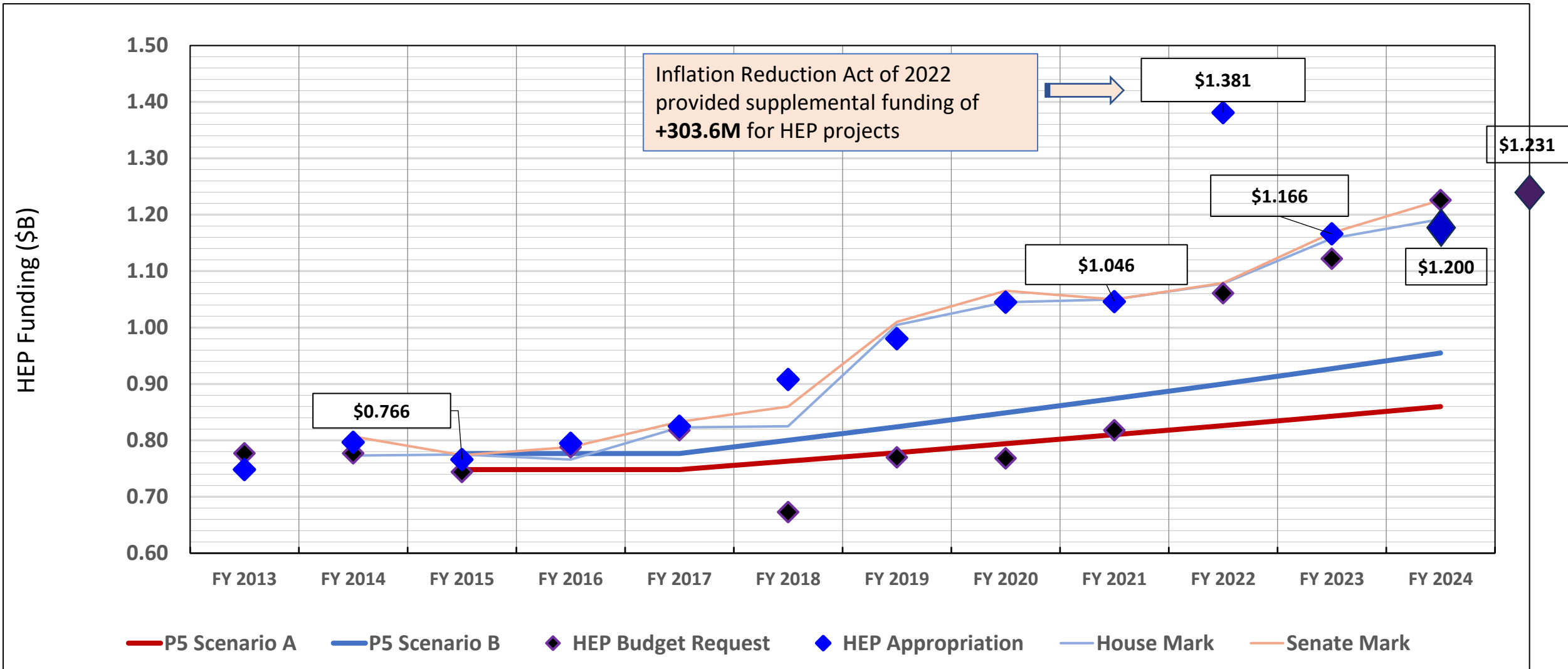
- An ultimate Generation 3 (G3) dark matter direct detection experiment reaching the neutrino fog, in coordination with international partners and preferably sited in the US.

DOE response and actions :

- At the present time, based on the Snowmass Community Summer Study, there have been two proposals for G3 Dark Matter detectors: XLZD and ARGO
- Each concept has explored potential sites both within the US and off-shore.
- At the present time, DOE is supportive of the development of the off-shore concepts.
- DOE will entertain proposals by U.S. groups for pre project R&D consistent with experiment deployment at an off-shore site.

HEP Budget

HEP Budget History 2013 to Present



- U.S. Congress continues to show strong support for executing the 2014 P5 strategy, and for accelerating the pace of projects

HEP Budget FY23-25

	FY23 Enacted	FY24 Request	FY24 Approved March 2024	FY25 Request March 2024
Energy Frontier	180.833	161.533		150.268
Intensity Frontier	273.199	266.241		275.209
Cosmic Frontier				
Res	51.552	49.512		36.301
Ops	56.550	61.830		57.210
MIE	1.000	9.000		4.500
Theory	171.746	173.746		186.714
Adv Tech R&D	133.120	128.472		115.566
Res, Ops, R&D, MIE	868.000	850.334	824.000	825.768
Construction	298.000	376.000	376.000	405.000
HEP Total	1,166.000	1,226.334	1,200.000	1,230.768
SC TOTAL	8,100.000	8,800.400	8,240.000	8,583.000

HIGH ENERGY PHYSICS

The agreement provides not less than \$35,000,000 for the Sanford Underground Research Facility and not less than \$5,000,000 for the Accelerator Controls Operations Research Network.

Cosmic Frontier Budget FY2021 – FY2025

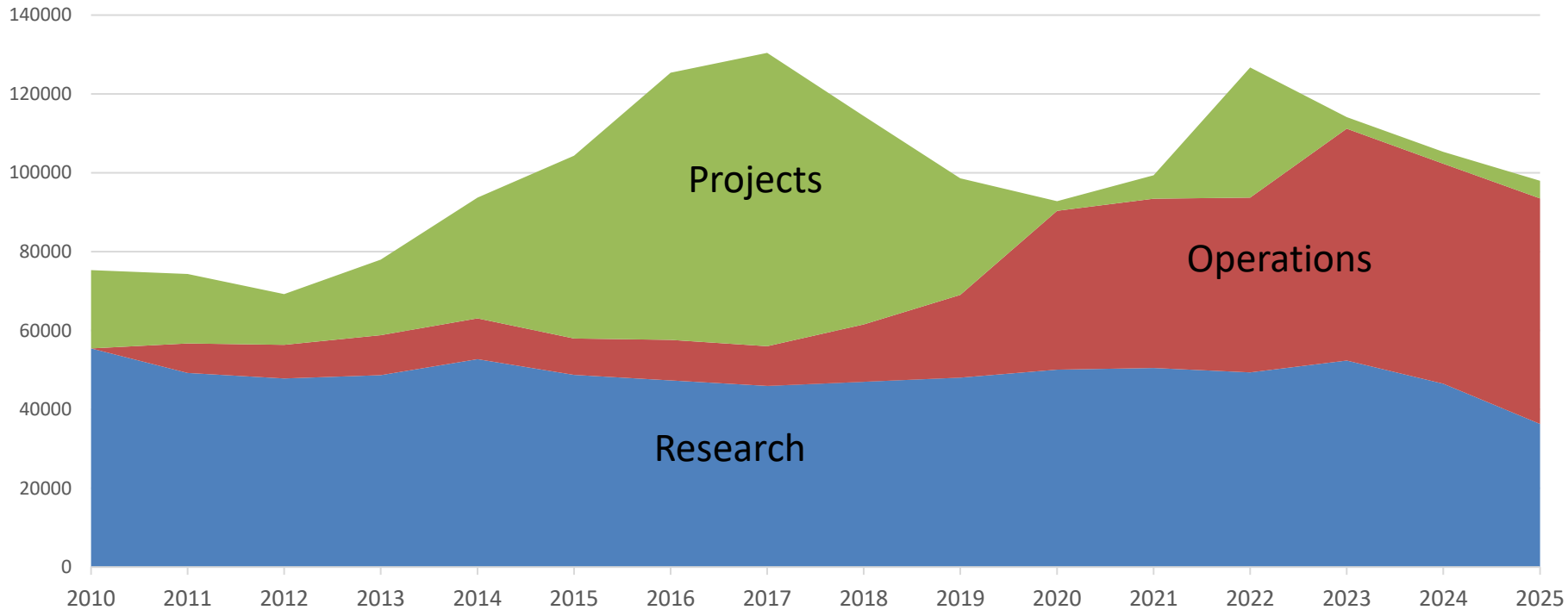
Cosmic Frontier (\$K)	FY2021 Actual	FY2022 Actual	FY2022 Inflation Reduction Act	FY2023 Actual	FY2024 Request	FY2024 Current (in CR)	FY2025 Request
Research	50,521	49,395		52,417	48,048	46,511	36,301
Research (Univ+Lab)	43,901	42,513		45,698		39,560	
Future R&D	1,700	1,475		1,979		1,986	
AI/ML Research	4,920	5,407		4,740		4,965	
Exp. Ops.	42,880	44,350		58,810	61,830	55,780	57,210
Projects: CMB-S4, LuSEE-Night (FY22)	6,000	23,000	11,893	1,000	9,000	3,000	4,500
Total	99,401	116,745	11,893	108,227	120,342	105,291	98,011

NOTES:

- The amounts shown in the table do not include workforce costs or SBIR/STTR funds.
- FY 23 Request was \$92.9M

Cosmic Frontier Budget History

Cosmic Frontier Budget History (\$K)
FY10-23 Actuals, FY24 Current (in CR), FY25 Request



FY22 Project includes funds from the Inflation Reduction Act

- **Research:** Scientist support for efforts in design, construction, operations and data analysis
- **Experimental Operations:** Commissioning and data-taking operations
- **Projects:** CMB-S4 planning, LuSEE-Night (all funds in FY22); SuperCDMS completed in FY23
- **Future opportunities:** Compelling Cosmic Frontier Projects will be considered and supported within available overall HEP project funds. Guidance from Astro2020, Snowmass, P5 (2023)

HEP Research Support

Cosmic Frontier Research DOES support →

Research funds support **scientists at universities and DOE labs working on all phases of projects and experiments in the Cosmic Frontier program.**

- Includes scientist efforts on all phases of an experiment - design, fabrication, operation and experimental data planning and analysis, primarily as part of the Collaboration; also planning for the future.
- Support research efforts directly in line with program and project priorities, responsibilities and science goals
- Critical, leadership efforts to carry out our roles and responsibilities on the projects and/or experimental operations are especially valued.
- Priority is to support efforts to plan and carry out priority science topics on our experiments, i.e., need to make sure the science it was designed for is carried out and the experiment delivers the best science!

Note: Distribution of efforts across areas will necessarily change to support changing priorities

Not everything cosmic or “dark sector” is considered for Cosmic Frontier support!

Cosmic Frontier Research Does NOT Support :

- Science topics on our projects/experiments besides those used for our selection
- Significant operations and/or project-related activities:
Engineering, materials, supplies, consumables, computer professionals, etc.
- Experiments that are not part of the HEP Cosmic Frontier program (i.e., supported by other agencies).
- Astrophysics/cosmology topics that are not part of the HEP Cosmic Frontier program, e.g., Gravitational waves (LIGO), Astronomy, Heavy Ion (RHIC), AMO, Planet searches, etc.
- General “cosmic” or “dark sector” research outside of a Cosmic Frontier experiment may still be within HEP under the Detector R&D or Theory Research programs.

- Generic Detector R&D efforts not for a specific Cosmic Frontier are supported by the Advanced Detector R&D program.
 - However, Cosmic Frontier may support the faculty salary, while ADRD supports the group, technical personnel etc.
- Theory/simulations/phenomenology/computational efforts are supported by the Theory research program.
 - However, these efforts that ARE in direct support of the Cosmic Frontier experiments can be supported; typically, the person is participating in and carrying out efforts prioritized by the Collaboration (not publishing efforts on his/her own).

- **Faculty PI (or PIs) and their group of postdocs and students are supported on the Research grants**
 - Typically, the *full* research time of the faculty member throughout the whole year is supported by providing two months summer salary and support for the group. Summer support should be adjusted according to percentage of time the faculty is on research effort. Should take commensurate support from the grant if they have other grants.
 - Associated expenses, travel (though sometimes the experiment's operations team funds this), personal computers, etc.
 - Faculty needs to justify the group personnel and size needed, e.g., what are your responsibilities and why do they need a postdoc and two grad students, etc. Funding is not prioritized for independent students and postdocs.
- **Research Scientists can be part of the group but typically face a higher hurdle**
 - Need to be carrying out research efforts that support the Cosmic Frontier program
 - Support may be provided, but due to long-term expectations, need to consider case-by-case on merits: whether the roles and responsibilities are well-matched with individual capabilities and cannot be fulfilled by a term position, i.e., postdocs
 - Efforts should be related towards research; not *long-term* operations and/or project activities

Typical HEP researcher:

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

- Has an experimental program that may involve operations and data analysis on one experiment while planning, designing or constructing the next experiment.
- Makes **long term commitments** to our experiment/project/science as a **closely integrated** member of the collaboration.
- These responsibilities may evolve over time as the experiment progresses through phases and may change depending on needs of the experiment.
- Even if your grant was for particular responsibilities and efforts, it is fine to spend a fraction of your time on planning for the future.

For calibration: Faculty typically “ramps-up” to a level*** of one graduate student and one postdoc after they’ve been funded several rounds and have excellent reviews. It may take several rounds for new faculty to be funded.

*** Of course, this is based on funding availability, review, programmatic priorities

A Note on Program Stability:

- In the HEP Model, our university scientists have Roles and Responsibilities on all phases of a Project/Experiment. Peer reviews typically support this mode → Grants are “renewed” if they review well and are doing excellent work, that is critical and timely. In this way, the **Project/Experiment can count on the PI for the long term.**

Model for new PIs starting to work in the field to get an HEP Cosmic Frontier grant:

- 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)
- Lots of science topics may be in, e.g., dark energy plan or related to dark energy, but need to think of what is the **priority** and main efforts needed and which are needed now!
- Have responsibilities for the experiment – not just your own science simulations and analysis.
- Many people have programs 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 to take the time to really learn the field and take on responsibility first

HEP Program Managers are happy to talk to you to helping you navigate the process!

Contact us when you are starting out or at any time.

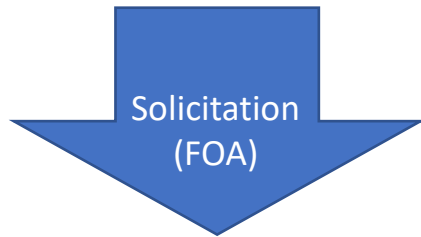
Funding Opportunities and Reviews



Bill Kilgore's Talk (5/13) on the entire FOA Process!

Alan Stone's Talk (right now!) on other funding!

HEP University Research Grants - Process



Drafted by HEP
Reviewed in SC-HQ by Grants and Contracts and Budget
Then handed to procurement channel
Additional reviews by dollar level
DOE Leadership (Secretary, Deputy Secretary, Undersecretary, SC Director) may exercise oversight
Published by contracting officer (STRIPES to FedConnect) and SC Grants and Contracts (grants.gov, PAMS, SC Website)



Proposal submitted via Grants.gov. (Institutions submit on behalf of PI)
Proposal transfers to PAMS (S2S integration)
Grants and Contracts validates submission, assigns to program manager
Program Manager conducts initial review, oversees merit review
May be multiple stages
Recommendation recorded in PAMS
Silent negotiation (revised budget, aims, scope) and selection statement
Declination justification



Recommendation for funding transfers from PAMS to STRIPES as a requisition
Chicago Office negotiates and finalizes award
Funds transferred from HQ to Chicago outbound account
Award issued



Normal events ensue—continuations, prior approval actions, renewals, supplements
Ultimately, closeout
Final reports (progress, inventions, financial, property)

This is the most important SLIDE!

There is no longer a **HEP Call*** there is only the **Open Call****.

*Research Opportunities in High-Energy Physics

**Continuation of Solicitation for the Office of Science Financial Assistance Program

The FY2025 FOA is ALREADY posted! The dates for the FY2025 were included in the FY2024 Open Call! (page 49)

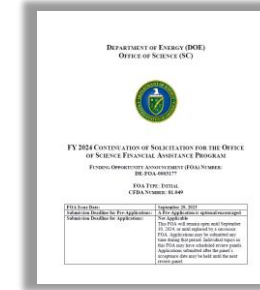
FY 2025 HEP Comparative Review: HEP expects to convene merit review panels in November 2024 for proposals received before September 5, 2024!

Applicants are strongly encouraged to submit pre-applications (letter of intent) prior to August 1, 2024.

This is a rolling call and includes new grants, renewals, supplemental, and conference funding.

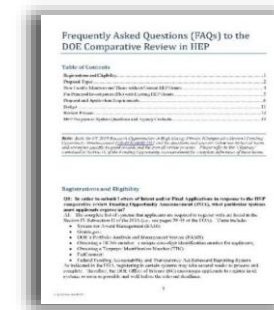
FY 2025 HEP University Research – “Comparative Review” FOA and FAQ

- ▶ **DE-FOA-0003177** issued **September 29, 2023**
- ▶ **Six HEP research subprograms**
 - ▶ Energy, Intensity, and Cosmic Frontiers
 - ▶ HEP Theory, Accelerator Science and Technology R&D, and Detector R&D
- ▶ **Letter of Intent (strongly encouraged) due: August 1, 2024**
- ▶ **Final Proposal deadline: September 5, 2024**
- ▶ **Review process: September 2024 – February 2025**



PIs and university SROs should read the FOA carefully to comply with all requirements prior to submitting a proposal.

- ▶ **In addition to the FOA, an FAQ will be available to address topics:**
 - ▶ Registration and eligibility requirements
 - ▶ Proposal types and requirements;
 - ▶ Guidance for new faculty and those without current grants
 - ▶ Guidance for PIs with existing HEP grants
 - ▶ Budget information and guidance on scope of request(s)
 - ▶ Letter of Intent
 - ▶ Information on overall scientific merit review process
 - ▶ Contacts for program- or system-related questions



Both the FOA and FAQ will be available at: <https://science.osti.gov/grants/FOAs/Open>

- **All Research proposals submitted to DOE Office of Science (SC) must have a Data Management Plan (DMP)**
 - Includes HEP comparative review and Early Career but not proposals for conferences, workshops, operations, or projects
 - Any thrust in a proposal without a DMP will **be declined without review**
 - A DMP that is blank or states “not applicable” will not be accepted
- **All Research proposals submitted to DOE Office of Science (SC) must have a PIER Plan**
 - Promoting Inclusive and Equitable Research. This should be tailored to your group, not the department or University/Lab.
 - Includes HEP comparative review and Early Career but not proposals for conferences, workshops, operations, or projects
 - Any thrust in a proposal without a PIER plan will **be declined without review**
- **All Renewal proposals must submit “proposal products” (publications, etc.) after the application is submitted**
 - PIs are notified via PAMS and typically have about 7-10 days to respond
 - We cannot review incoming renewal proposals until this step is completed
 - These ‘products’ are captured with your annual Progress Report, but for this review process, applicants can update their entries prior to merit review process
- **Recurring submissions of research applications (*initiated in FY 2018*)**
 - *“A previously declined application may be resubmitted to this FOA, but **only after it has undergone substantial revision**. An application submitted to this FOA that has not clearly taken into account the major concerns from prior DOE reviews may be **declined without review and will not be considered for funding.**”*
- **Each FOA has different eligibility, technical requirements, page limits, etc.**
 - **Prior to any proposal submission, please read the specific FOA carefully**

- Proposed research reviews best if closely aligned with the DOE/HEP mission, its program, and current P5 strategy
- Investigators in experimental HEP research frontiers [Energy, Intensity, Cosmic] review best if they are closely integrated into HEP collaborations and have key roles and responsibilities
- “Generic” research that is not carried out as part of a specific HEP experimental collaboration should be directed to the Detector R&D or HEP Theory programs, as appropriate
- **Read the FOA carefully** and follow the requirements on content, length, etc.
 - **Several requirements in the FOA are set from outside the DOE/HEP office, and there is little to no flexibility to modify. Non-compliant proposals submitted to the FOA will not be reviewed.**
 - In recent years, ~3-5% of incoming proposals are declined without review. Requirements most often missed or overlooked include:
 - DMPs, page limits, separate budget sheets (if needed) for each research subprogram or thrust, and inclusion of Personally Identifiable Information (PII)

Merit review criteria and corresponding questions are given in Section V of the FOA

Program Policy Factors, which are also used in selections for an award – including those pertaining to the availability of funds – are given in Section V of the FOA

During and prior to the proposal submission, work with your university sponsored research/program office to ensure all FOA requirements are met

The word “proposal” denotes something for the future. You should provide content on your past work to show your capabilities and experience, but the bulk of the proposal should be on your future efforts. Narrative is typically 9 pages per PI.

In your proposal:

- Explain your **long-term program** (past 3 years), how it progresses over time and 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).
- Describe your overall time commitment – 50% of your research time?

- Supporting 2 months summer salary is typically considered for efforts that 100% of research time throughout the year.

- Don’t just answer the merit questions! **Provide a research plan!**

- **AI/ML continues to be a priority in the Administration and the U.S. Congress**
 - Dedicated funds since the FY 2020 appropriation for DOE/HEP Research Program to advance AI/ML initiatives
- **Development and implementation of machine (or deep) learning tools, techniques, and algorithms are part of many analyses and project design efforts.**
- **Typically, two categories in a proposal narrative for AI/ML-based activities**
 1. PIs and research team explicitly lead efforts to develop ML tools and algorithms for the collaboration to enhance sensitivity in physics studies, improve triggers, etc.
 2. End-user: PIs and research team are implementing ML-based algorithms in an analysis, which was developed by other collaborators on the experiment
- **FY 2023 FOA plans to continue encouraging investigators to narrate in the proposal any of the research group's AI/ML efforts, where applicable**
 - Prefer a proposal's narrative to describe aspects of the above category #1 in research proposals
 - Identify any personnel and resources (e.g., students, postdocs, etc.) devoted to efforts
- **During panel deliberations, reviewers are encouraged to provide any input on AI/ML activities of a group on an experiment**

- Applications where an investigator is proposing to conduct research across multiple HEP research subprograms during the project period are planned to be considered
- PIs are encouraged to submit only one application describing:
 - Overall research activity, including fractional time planned in each subprogram
 - **Plan to continue for the FY 2023 FOA:** in proposal's budget material (*i.e.*, a dedicated Appendix), include a level-of-effort table for any transitions of efforts during the next project period
- As part of their overview of the subprogram and review process, DOE Program Managers (PMs) will provide the panel with details regarding such research plans across multiple HEP thrusts
- Reviewers with appropriate topical expertise in the research area(s) will assess the full scope, relevance, and impact of the proposed research in the merit review process — *e.g.*, merit review questions consider:
 - Are plans for such cross-cutting efforts reasonably developed and balanced?
 - Does the scope of the full proposed program provide synergy or additional benefits to the HEP mission beyond the individual thrusts?
 - Will PI's overall efforts across multiple thrusts add value to HEP program goals and mission and have impact?

Comparative Merit Review Criteria

MERIT REVIEW CRITERIA	REVIEW CRITERIA SUB-QUESTIONS FOR MERIT REVIEWER'S EVALUATIONS
SCIENTIFIC AND/OR TECHNICAL MERIT OF THE PROJECT	<ul style="list-style-type: none"> • What is the scientific innovation of the proposed research? • What is the likelihood of achieving valuable results? • How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research? • How does the proposed work compare with other efforts in its field, both in terms of scientific and/or technical merit and originality? • Is the DMP suitable for the proposed research? To what extent does it support the validation of research results? To what extent will research products, including data, be made available and reusable to advance the field of research?
APPROPRIATENESS OF THE PROPOSED METHOD OR APPROACH	<ul style="list-style-type: none"> • How logical and feasible are the research approaches? • Does the proposed research employ innovative concepts and methods? • Are the conceptual framework, methods, and analyses well justified, adequately developed, and likely to lead to scientifically valid conclusions? • Does the applicant recognize significant potential problems and consider alternative strategies?
COMPETENCY OF APPLICANT'S PERSONNEL AND ADEQUACY OF PROPOSED RESOURCES	<ul style="list-style-type: none"> • What is the past performance and potential of the research team? • How well qualified is the research team to carry out the proposed research? • Are the research environment and facilities adequate for performing the research? • Does the proposed work take advantage of unique facilities and capabilities? • Are the senior investigator(s) or any members of the research group that are being reviewed leaders with the proposed effort(s) and/or potential future leaders in the field? • For senior investigator(s) proposing to work across multiple research thrusts, are the plans for such cross-cutting efforts reasonably developed and will the proposed activities have impact?

Comparative Merit Review Criteria

MERIT REVIEW CRITERIA	REVIEW CRITERIA SUB-QUESTIONS FOR MERIT REVIEWER'S EVALUATIONS
REASONABLENESS AND APPROPRIATENESS OF THE PROPOSED BUDGET	<ul style="list-style-type: none"> • Are the proposed budget and staffing levels adequate to carry out the proposed research? • If multiple research thrusts are proposed, is the balance of proposed efforts reasonable and well-matched to the proposed research goals? • Is the budget reasonable and appropriate for the scope?
ALIGNMENT OF THE PROPOSED RESEARCH TO THE PRIORITIES ESTABLISHED IN THE P5 STRATEGIC PLAN	<ul style="list-style-type: none"> • How does the proposed research of each senior investigator specifically contribute to the mission, science goals, and programmatic priorities of the subprogram in which the application is being evaluated? • Is the proposed research consistent with the priorities and strategic plan described in the P5 report? • For multi-thrust proposals, does the scope of the full proposed program provide synergy or additional public benefits within HEP's Congressionally-authorized mission-space beyond the individual thrusts? • How likely is the research to impact the direction of the overall HEP program? • For applications proposing work and/or a transition across multiple research thrusts, will the overall efforts add value in the broader context of the program goals described in the P5 strategic plan?
QUALITY AND EFFICACY OF RECRUITMENT AND MENTORING PLAN	<ul style="list-style-type: none"> • What is the past performance of the investigator(s) for mentoring and advancing career opportunities of students and other early-stage personnel in the research team? • Does the proposed plan to recruit and retain students and early-stage investigators provide sufficient mentorship, either towards completion of a degree or advancing their career? • Are the plans proposed for recruiting additional scientific and/or technical personnel including new senior staff, students, and postdocs reasonable, justified, and appropriate? • Is the proposed plan likely to lead to satisfactory outcomes and an advancement in career opportunities for students and other early-stage personnel? • Does the proposed plan by the team help ensure a diverse, equitable, and inclusive research environment?

Comparative Review – Reviewer Considerations

- Comparative Review: head-to-head reviews of PIs working in similar areas
- Panels discuss relative strengths and weaknesses of individual proposals and PIs

- Many factors weigh into final funding decisions
 - Compelling research proposal for next ~3 years
 - ✓ Interesting? Critical responsibility? Significant? Plausibly achievable?
 - ✗ Incremental? Implausibly ambitious? Poorly presented?

 - Significant *recent* contributions in last ~3 years
 - Synergy and collaboration within group (as appropriate)
 - Contributions to the research infrastructure of experiments

 - Alignment with programmatic priorities

Comparative Review → Applicant Feedback

At the end of the process, the PI of the grant will get a review report that contains individual reviews and panel summary

We encourage reviewers to provide feedback about what did and did not work in a proposal.

- Excessively terse reviews (“Good proposal from a strong group. Fund it.” or “I see nothing new here.”) do nothing to help the applicants/Pis make sense of how to improve future proposals.

Panel summaries capture the context of discussions that would otherwise be invisible to the applicant.

- Where did the proposal rank overall? (Be descriptive but do not give a numerical rank e.g., “Good but not among the best, because ...”. Do not state “14th of 23”.)
- Did a reviewer comment get amplified by the discussion; was a new issue raised; ...?
- What assets/flaws of the proposal featured in the discussion?
- How could they improve

HEP Program Managers may also write a summary at the end of the review document; e.g., to give more info on what did/didn’t review well, explain why a proposal was declined or why it was funded at a level below the request, and provide other information.

***** You are always welcome to meet with the program manager (e.g., at the annual PI meeting) to discuss details of the review and outcome.**

Proposals: What To Do

Do Follow Instructions and Guidelines

Read the current FOA thoroughly, as well as any supporting materials, e.g., FAQ, PI meeting slides

SC rules and procedures and HEP program requirements are regularly updated

Do seek out advice and support from trusted colleagues and mentors

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

Request a pre-review of the proposal. There are resources at most institutions; and/or seek guidance from collaborators

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

Funds are awarded to the institution. Understand direct and indirect rates, benefits, and restrictions

Establish a relationship with your budget office or sponsored research office. Remember they submit the proposal for you!

Do follow through on any past reviewer feedback

Give weight to the critical reviews

Arguing with HEP that 3 out of 5 reviewers thought your proposal was excellent does not address the 2 reviewers who had a different opinion

Read the panel summaries from past reviews. Those contain the panel discussions of your proposal

Do be clear and follow proper English grammar and composition

Be clear: avoid reviewers guessing about your research plan; Careless editing will annoy or confuse reviewers

Have someone proof-read your proposal

Do ask for what you reasonably need

Standard research requests

- Salary (PI and co-PIs)
- Other Personnel including post-docs, students, etc.
- Travel (domestic and foreign)
- M&S, Tuition remission

Realistic funding expectations

- Early Career >\$150k Univ > \$500k Lab
- 50% FTE to proposal
- Stagger personnel

Proposals: What Not To Do

Do **Not** submit a proposal late

You should assume that applications received after the deadline will not be reviewed or considered for award

Use the weeks or months after the FOA is made public to prepare and then submit your proposal early

Do **Not** brag or exaggerate

Be professional and objective.

Fully list your accomplishments in the bio-sketch; Include your mentoring.

Accurately and reasonably describe research plan

Do **Not** bury the message

The narrative should be accessible to a review panel with a wide range of expertise

Avoid jargon when possible. Same with acronyms.

Describe in clear and concise language.
Tell a story...

Do **Not** overly dwell on the past

General rule of thumb (1/3:2/3).
No more than one-third of proposal devoted to past efforts; Future since DOE funds are meant for next period

Majority of proposal narrative should be forward looking

Do **Not** submit a sloppy budget or budget justification

The budget sheets and justification should be prepared with the same care as the narrative

Reviewers will call out any:

- Excessive or inappropriate requests
- Arithmetic errors
- Poorly justified expenses
- Start guessing if not adequately explained

Do **Not** be discouraged

Competition is strong.

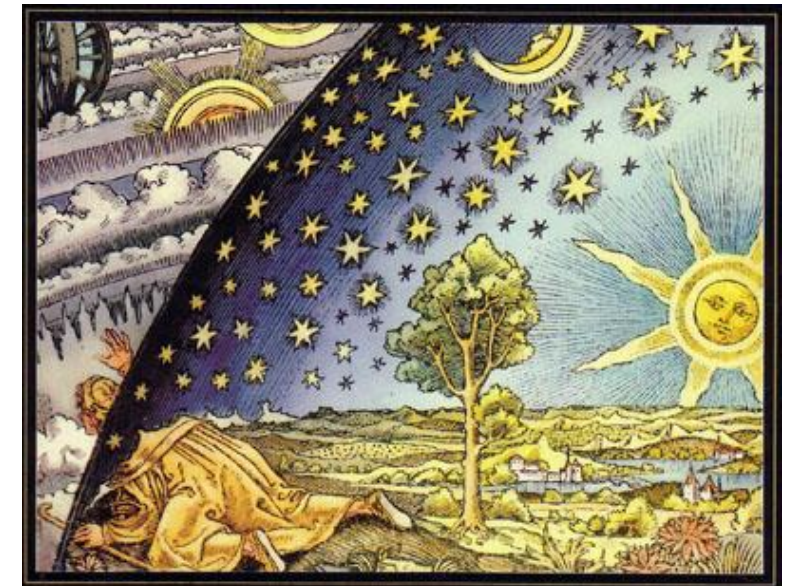
Some very good proposals are declined due to limited resources.

That first feedback is so valuable.

Summary

- HEP continues to carry out the 2014 P5 strategic plan
 - We are transitioning to the 2023 P5 plan

- Bryan and Manuel are here to answer your questions, please come by our room for a 1-on-1 question session or email us for a short Zoom session.





U.S. DEPARTMENT OF
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Science

Other Funding Opportunities

- Early Career Research (open to lab and university PIs within 10 years of their PhD)
- Reaching a New Energy Sciences Workforce for High-Energy Physics (RENEW)
- Funding for Accelerated, Inclusive Research (FAIR)
- Building EPSCoR-State/National Laboratory Partnerships
- Workforce Development for Teachers and Scientists (WDTS)
 - Science Undergraduate Laboratory Internships (SULI)
 - Community College Internships (CCI)
 - Visiting Faculty Program (VFP)
 - Office of Science Graduate Student Research (SCGSR)
 - Pathways Program

- **Plan to issue a FY2025 FOA around the Fall of 2024 for the next round of Early Career applicants**
Stay tuned for further updates at: <https://science.osti.gov/early-career>

- **In addition to the merit review criteria in the FOA, the following guidance should be considered while preparing the proposal narrative:**
 - What challenges/problems are you trying to solve? Communicate this in the proposal.
 - Is someone else doing it already?
 - Alternatively, aren't those research activities already being funded elsewhere?
 - *i.e.*, if you carry-out these efforts, discuss why are they unique and require “you”?
 - How does your research plan exploit/engage the unique capabilities of your institution?
 - What resources are needed to complete the project?
 - Does your proposal address a **5-year timeline** with key deliverables and personnel profiled during this project period?
 - If funded, what will be the **outcome after 5-years**?

 - Leadership:
 - Have you **led the activities** that you are proposing?
 - Why are you a **future leader in HEP**? For e.g., identify past and present leadership activities in the Collaboration; any in HEP, your institution, or the broader scientific community?
 - **Update your CV** (bio-sketch) that is part of the overall proposal

SC Efforts in Broadening Participation – Initiatives and Programs

RENEW initiative – started in FY2022

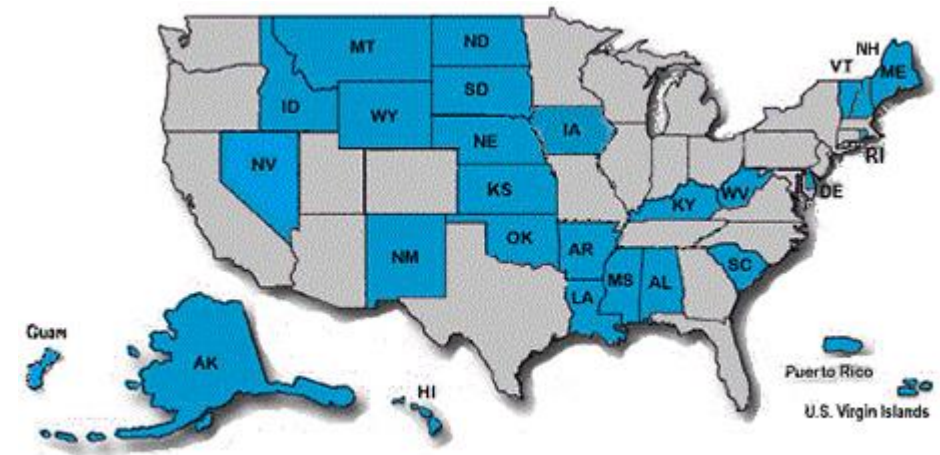
Reaching a New Energy Sciences Workforce (RENEW) provides research opportunities to historically underrepresented groups in STEM and diversify American leadership in the physical and climate sciences through internships, training programs, and mentor opportunities.

FAIR initiative – started in FY2023

Funding for Accelerated and Inclusive Research (FAIR) is aimed at undergraduate students and faculty to address place-inspired R&D and loss points of personnel in the field.

EPSCoR-State/National Lab Partnerships

Funding is designed to enhance the capabilities of designated states and territories to conduct sustainable and nationally competitive energy-related research.



- **Workforce Development (WDTs) programs:** <https://science.osti.gov/wdts>
 - **Office of Science Graduate Student Research fellowships (SCSGR)**
 - Supports grad student research at a DOE lab, 3 to 12 months
 - Two calls per year, usually Feb/Aug
 - Applications typically due May/Nov for following Fall or Summer start
 - **Science Undergraduate Laboratory Internships (SULI)**
 - Supports undergraduate research at a DOE lab, 10 to 16 weeks
 - Three calls per year, for following Spring/Summer/Fall terms
 - **Visiting Faculty Program**
 - Summer research support for faculty/students from historically underrepresented institutions
 - One call per year, usually in Oct. Applications due in Jan.
 - **Community College Internships (CCI)**
 - Provides technical training for community college students at DOE laboratories; 10 weeks
 - Three separate internship terms: Summer, Fall, Spring

*Available funds have
been increasing!*

There are several career opportunities available at DOE (not just HEP, also other SC offices and DOE or government-wide programs):

- **Internships for undergrads and graduate students:**
 - DOE Scholars (formerly *Pathways*) for US citizens who are current or recent students in a STEM field : orise.orau.gov/doescholars/
 - Minority Educational Institution Student Partnership Program (MEISPP) for all US citizens who are full-time students; not limited to MSI students, underrepresented groups, or STEM: doemeispp.org
- **Fellowships for post-graduates**
 - AAAS Science and Technology Policy Fellowship for US citizens with a PhD in science or a MS in engineering, 1 yr renewable : aaas.org/page/fellowship-areas
 - Presidential Management Fellowships for advanced degree recipients, US gov't-wide, 2 yr program, convertible to Fed staff position : pmf.gov
- **Federal jobs (variable education requirements, see individual postings)**
 - All posted on usajobs.gov. Can be entry-level or more advanced.
 - Some agencies (NASA, NIST) have both research scientist (i.e., active research) positions as well as program management positions; others (DOE, NSF) have only program management with limited opportunities for independent research. Read job description carefully and consult with agency contacts if you have questions.