

2023 Summer CMB-S4 Collaboration Meeting at SLAC

DOE/HEP Cosmic Frontier Funding Opportunities · August 1, 2023

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U.S. DEPARTMENT OF
ENERGY

Office of
Science



- **Introduction: High-Energy Physics at the Department of Energy**
- **What is the Cosmic Frontier?**
- **Funding Opportunities (FOA rhymes with Noah)**
 - HEP FOA
 - Early Career Research Program
 - Renew/FAIR/EPSCOR
 - ASCR Funding Opportunities
 - Undergrad and SCGSR
 - AI/ML and QIS
- **HEP PI Meeting – August 15 and 16, 2023 (virtual)**
- **Questions**

Missions at 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.
- Mission of the DOE Office of Science (SC)
 - The SC mission is to deliver the scientific discoveries and major scientific tools that transform our understanding of nature and advance the energy, economic, and national security of the United States.
- DOE supports approximately 85% of the US High-Energy Physics effort (measured in dollars) at Universities and National Labs.
- 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.



OFFICE OF SCIENCE BY THE NUMBERS

Delivering scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States

FY22

6 CORE SCIENCE PROGRAMS

- Advanced Scientific Computing Research
- Basic Energy Sciences
- Biological and Environmental Research
- Fusion Energy Sciences
- High Energy Physics
- Nuclear Physics

3 ENGINEERING AND TECHNOLOGY OFFICES

- Accelerator Research and Development and Production
- Isotope Research and Development and Production
- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)

ACROSS ITS 10 NATIONAL LABS, OFFICE OF SCIENCE MAINTAINS APPROXIMATELY

24 MILLION
SQUARE FEET OF SPACE

1,600
BUILDINGS

38,000
ACRES OF
LAND OWNED

SUPPORTS RESEARCH SPANNING

16
DOE
NATIONAL LABS

50
STATES, PUERTO RICO,
AND WASHINGTON, D.C.

>340
UNIVERSITIES AND
HIGHER-LEARNING
INSTITUTIONS

4

BIOENERGY
RESEARCH
CENTERS

2

ENERGY
INNOVATION
HUB
PROGRAMS

STEWARDS

10

DOE NATIONAL
LABORATORIES

ESTIMATED
RESEARCHERS
SUPPORTED

10,300 Permanent PhDs

3,200 Postdoctoral
Associates

4,900 Graduate Students

9,000 Other Scientific
Personnel

OVER
38,500

USERS AT

28

OFFICE OF SCIENCE
FACILITIES

10

SITE OFFICES

1

CONSOLIDATED
SERVICE CENTER

OVER

100

NOBEL
PRIZES

\$7.5 BILLION

OVERALL
OFFICE OF
SCIENCE BUDGET

\$857 MILLION

USER
FACILITY
CONSTRUCTION

\$291 MILLION

SCIENCE
LABORATORY
INFRASTRUCTURE

51

ENERGY
FRONTIER
RESEARCH
CENTERS

- Program Model: Science Mission-driven
- Develops and support a specific portfolio of projects with emphasis placed on planning, building experiments, operating, and publishing results
- HEP carries out the DOE mission and objectives through a balanced portfolio to work at the cutting edge of science
 - Make significant, coherent contributions to project design & construction
 - Operate experiments and facilities that provide discovery capability
 - Supporting scientific research to produce discovery science
 - HEP model is to support science collaborations in all stages, leading to the best possible science results
 - Support R&D for the future including detector technologies, QIS, etc.
 - Theoretical efforts provide the vision and the mathematical framework for understanding and extending our knowledge of fundamental matter & energy.

High-Energy Physics Layout at DOE

▪ HEP is carried out along 3 Frontiers

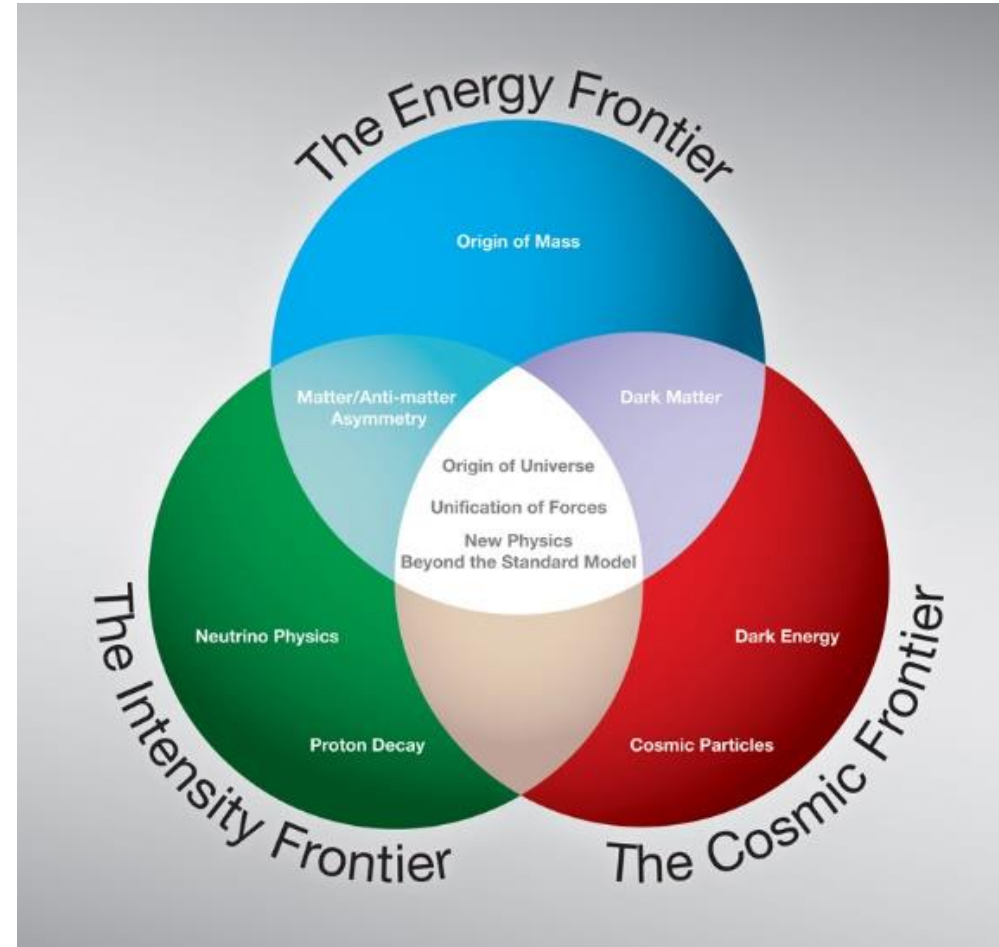
Official guidance from Advisory Panels such as AAAC, HEPAP and subpanels (P5)

Get recommendations from NAS studies we request, like Astro2020, EPP2022

Other input from community studies, e.g., Snowmass

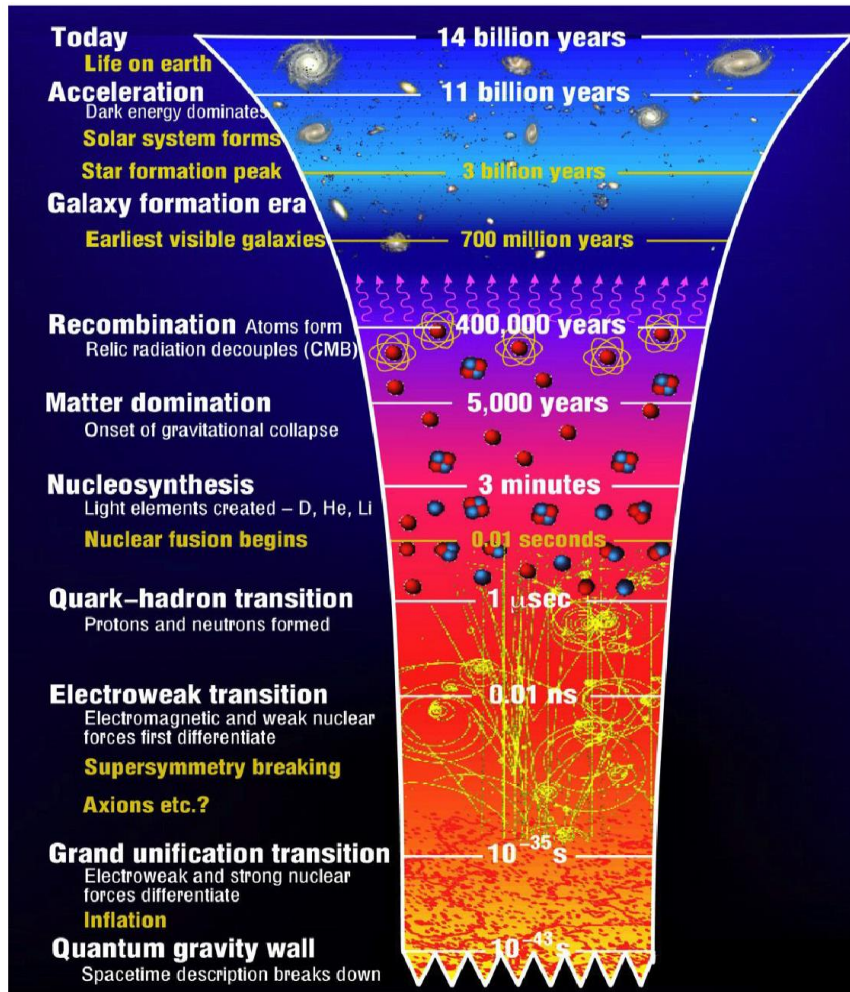


Research Frontiers			
	Energy Frontier	Intensity Frontier	Cosmic Frontier
Higgs Boson	●		
Neutrino Mass		●	●
Dark Matter	●	●	●
Cosmic Acceleration			●
Explore the Unknown	●	●	●



What is the Cosmic Frontier?

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.



Experiments to reveal the nature of **dark energy** and search for **dark matter** particles, comprising ~95% of the universe, understand the **cosmic acceleration** caused by dark energy and inflation, infer **neutrino** properties, and explore the unknown.

- **Cosmic Acceleration:**

- **Dark Energy: LSST (Rubin) & DESI**
- **CMB:** carry out multi-agency **CMB-S4** project
- **Dark Ages: LuSEE-Night** pathfinder – small project

- **Dark Matter:** suite of “generation 2” direct detection experiments to detect DM particles; Dark Matter New Initiatives (DMNI) concept development for small projects
- 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)

- **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 & experimental data planning & analysis, primarily as part of the Collaboration; also planning for the future.
 - Support research efforts directly in line with program & project priorities, responsibilities & 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 build and operate our projects **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!
- **Not everything cosmic or “dark sector” is considered for Cosmic Frontier support!** Theoretical studies should be proposed to the Theory Frontier

- Confused? Unsure? Have questions?
 - Shoot us an email or schedule a brief Zoom call
 - Don't get all your information from the playground...
- Master List
 - <https://science.osti.gov/hep/Funding-Opportunities>
- High-Energy participates in several FOAs each year (90 – 150 pages)
 - FY202X Research Opportunities in High-Energy Physics
 - FY202X Continuation of Solicitation for the Office of Science Financial Assistance Program
 - FY202X Early Career Research Program
 - Reaching a New Energy Sciences Workforce for High-Energy Physics (RENEW-HEP)
 - ...



You must carefully read the FOA in its entirety...

- Did you read the FOA?
- This is the best way to learn the details of what is needed and when for a proposal.
- These are updated every year and there can be significant changes (for instance, PIER plans).
- Ignore at your own peril, you could be marked “non-compliant” and rejected without review.
- Details are important, for instance, some FOA require a Letter of Intent, some don’t, and so on...



Most grants must be submitted by your Office of Sponsored Research. Most are submitted via the DOE’s Portfolio Analysis and Management System (PAMS) or [Grants.gov](https://www.grants.gov). This process takes time, talk to your grant office for a successful timeline!

This is the “big one”

- This is for “research” funds to support scientists doing all phases of design, to build and operate, data simulations, analysis, etc. Our “project fabrication” or “experimental operations” funds typically support engineers, techs, as well as materials and supplies.
- The call comes out in the late summer or early fall.
 - <https://science.osti.gov/hep/Funding-Opportunities>
- Compliant proposals are sent out to “mail in” reviewers and in-person panelists. A panel is convened over 3–5 days in the DC area. The proposals are discussed and compared with each other and then put into tiers such as top, middle, and low.
- These categories are the basis for the funding recommendations by the Program Manager(s). Our recommendations are presented up the chain and approved. Guidance letters are circulated, budgets are revised, and eventually money is routed.



Leads to Comparative Review

This FOA has a time constraint

- What do you mean by, “early career?” Time since your PhD was awarded.
- To address special circumstances and challenges due to the COVID-19 pandemic, the Office of Science (SC) is extending the eligibility window for this competition from 10 to 12 years for all applicants.
- CHECK THIS! It may revert to 10 years in FY2024.
 - https://science.osti.gov/hep/Funding-Opportunities/-/media/grants/pdf/foas/2023/SC_FOA_0002821.pdf
 - <https://science.osti.gov/-/media/early-career/pdf/Early-Career-FAQ-FY-2023-final.pdf>
- The minimum award size is approximately \$875,000 for five years for universities and approximately \$2,500,000 for five years for national laboratories or SC User Facilities.
- You may apply for both a HEP FOA and an ECA, but if the science is the same, you will have to choose.



This is the FY2023 FOA.
There will certainly be
changes for FY2024.

This is called the “open call”

This is currently CHANGING!

- This FOA is SC’s annual, broad, open solicitation that covers all research areas in SC and is open throughout the Fiscal Year. Any research within SC’s Congressionally-authorized mission may be proposed under this FOA.
- The timing is more simplified, always starts September 30, 202X and runs for a full year.
- **Proposals received by December 1, 2023, (?) will be eligible for the FY2024 comparative review panels and proposals received by September 1 (?) will be eligible for the FY2025 comparative review.**
- HEP uses (**used to use?**) the Open Call FOA for conferences, supplements, experimental operations, etc.
 - HEP prioritizes research funding using the HEP FOA & there are usually minimal funds left to support any research proposals going to the Open Call FOA.
- In short, if you want research funds, use the HEP FOA.

 Draft language

Reaching a New Energy Sciences Workforce for High-Energy Physics (RENEW-HEP)

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.
 - <https://science.osti.gov/Initiatives/RENEW>
- The HEP RENEW FOA (\$4M in FY2022, \$8M in FY2023, \$10M requested for FY2024) is to support training and research experiences in particle physics for members of underserved communities, with the goals of supporting investigators and building research infrastructure at institutions which have not traditionally been part of the portfolio and encouraging underrepresented populations to pursue STEM careers.
 - \$50K - \$500K per year; 3-year awards
 - https://science.osti.gov/hep/Funding-Opportunities/-/media/grants/pdf/foas/2023/SC_FOA_0002949.pdf



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FAIR initiative – started in FY2023

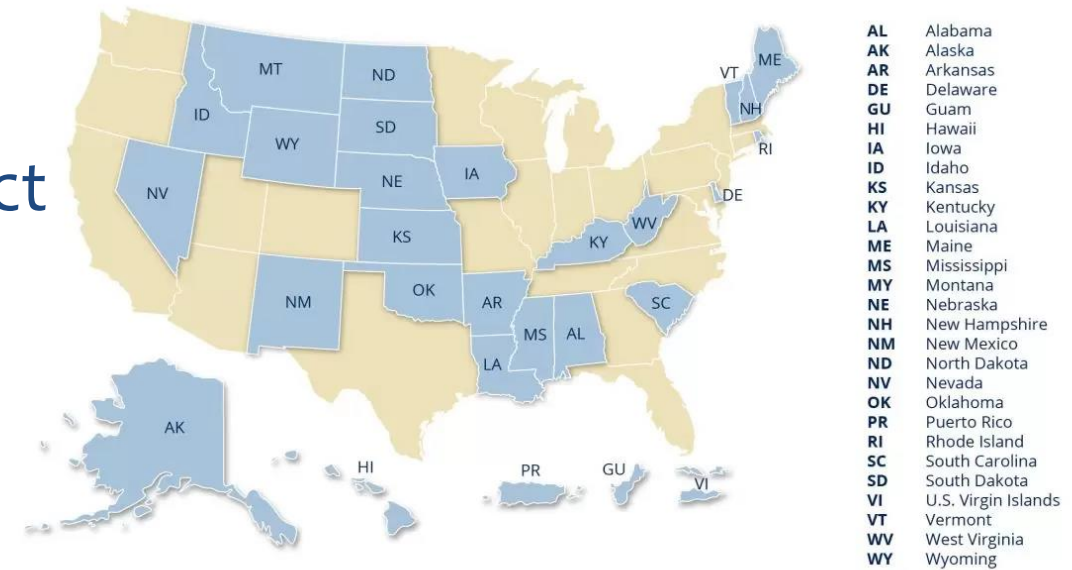
- *Funding for Accelerated and Inclusive Research (FAIR)* is aimed at undergraduate students and faculty to address place-inspired R&D and loss points of personnel in the field.
- FAIR supports mutually beneficial relationships between Minority Serving Institutions (MSIs) and Emerging Research Institutions (ERIs) with partnering institutions to perform basic research in fields supported by the Office of Science.
 - <https://science.osti.gov/Initiatives/FAIR>
 - https://science.osti.gov/hep/Funding-Opportunities/-/media/grants/pdf/foas/2023/SC_FOA_0002931.pdf



This is the FY2023 FOA. There will certainly be changes for FY2024.

Established Program to Stimulate Competitive Research (EPSCoR) Implementation Grants

- A federal-state partnership program designed to **enhance** the capabilities of designated states and territories to conduct sustainable and nationally competitive energy-related research.
- EPSCoR topics vary year to year
- For HEP, don't apply for this directly
 - EPSCoR-State/National Laboratory Partnership Grants. A maximum period of three years. Award size is up to \$750,000.
 - Implementation Grants. Renewable with a total maximum award period of 6 years. Up to \$2.5M per year.
 - DOE Office of Science Early Career Awards
 - Office of Science Annual FOA (open call)
 - Currently limited to one proposal per institution per year



Alabama, Alaska, Arkansas, Delaware, Guam, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, Vermont, US Virgin Islands, West Virginia, and Wyoming.

Advanced Scientific Computing Research (ASCR) Funding Opportunities

- The Advanced Scientific Computing Research (ASCR) program mission is to discover, develop, and deploy computational and networking capability to analyze, model, simulate and predict complex phenomena important to the Department of Energy and the advancement of science. Jeremy Love is the Program Manager.
- There is a complex ecosystem of HPC allocations.
 - <https://science.osti.gov/ascr/Funding-Opportunities>
 - <https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities>
- There are four paths to securing time on DOE supported computational user facilities:
 - Director's Discretionary Allocations [each Leadership Computing Facility (LCF) has their own rules]
 - Energy Research Computing Allocations Process (ERCAP) [Multi-year allocations for experimental collaborations]
 - ASCR Leadership Computing Challenge (ALCC) [Allocations across the ASCR HPCs for less than 5% of available time]
 - Innovative and Novel Computational Impact on Theory and Experiment (INCITE) [Large allocations intended for the top performing projects that will deliver discovery science not possible without exascale computing resources]
- HEP also gets a National Energy Research Scientific Computing Center (NERSC) allocation. For Cosmic, our priority is to ensure our experiments that use NERSC have what they need to succeed.



Workforce Development Programs

- Programs to work at a DOE lab:
 - Community College Internships (CCI); Science Undergraduate Laboratory Internships (SULI); SC Graduate Student Research fellowships (SCSGR); Visiting Faculty Program; Albert Einstein Distinguished Educator Program (K-12)
 - <https://science.osti.gov/wdts>
 - <https://science.osti.gov/wdts/scgsr>
- DOE Scholars Program – Work at DOE or a lab
 - <https://orise.orau.gov/doescholars/>

Lab Programs!

<https://science.osti.gov/grants/Lab-Announcements/Open>

HEP Traineeships

- HEP traineeship FOA's in Instrumentation, Accelerator R&D, and Computing – to address critical, targeted workforce development in areas of interest to our mission.

A few odds and ends...

■ Artificial Intelligence/Machine Learning (AI/ML)

- It is believed that A.I. is poised to be a powerful new tool for analyzing this data and deriving discoveries from it. Using basic machine learning, researchers are identifying patterns or designs that are difficult or impossible for humans to detect, at speeds that are hundreds to thousands of times faster than traditional data analysis techniques.
- Call out any AI/ML specifically in any larger HEP FOA applications.

■ Quantum Information Systems (QIS)

- Ultrahigh-Q superconducting resonators, Superconducting transmon qubits and processors, Materials science, Algorithms, simulations and benchmarking, Quantum sensing for fundamental physics, Quantum ecosystem
- There are no specific FOAs for either of these topics (right now) but there is money set aside for these topics. AI/ML is typically funded as part of a larger grant application. QIS should go through the general call.



- Open to everyone! Not just people who already have grants. Come and learn more about the process.
- To take advantage of this opportunity, we encourage you to visit the PI Meeting website and register: <https://www.orau.gov/heppi2023>
 - General presentations during a plenary Zoom session covering the overall DOE-HEP program, budgetary issues, and different HEP FOAs at DOE which PIs may apply to.
 - Parallel Zoom sessions led by individual DOE-HEP Program Managers (PMs). Parallel topics are planned to include multiple HEP research areas. These sessions will provide an opportunity for PMs to present PIs with detailed guidance on preparing applications for the DOE-HEP merit review process and discussing programmatic priorities and budgetary factors for the respective subprogram.
- Cosmic Frontier will set up a few Doodle polls so you can meet with us (Bryan, Chris, and Kathy) individually for fifteen minutes. If you didn't get an email from me (Bryan) about this, ask me to be added to the list.

Questions





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