

NSF Physics Division Report

Jim Shank presenting for

- Keith Dienes (EPP Theory, Particle Astro/Cosmo Theory)
- Jim Shank, Kaushik De (EPP Experiment)
- Camillo Mariani, Nigel Sharp, Helio Takai , William Wester (Particle Astro Experiment)

National Science Foundation, Division of Physics



Overview

- NSF Physics Division
 - New personnel
- Overview of EPP, PA programs
- NSF and the International Benchmarking Panel Report
- Funding Opportunities



Division of Physics – Core Research Programs

Atomic, Molecular, & Optical Physics

Experiment: John Gillaspy, Kevin Jones, Mark Beck
Theory:

Plasma Physics

Slava Lukin,
Jeremiah Williams

Elementary Particle Physics

Experiment: Jim Shank , Kaushik De
Theory: Keith Dienes

Particle Astrophysics

Experiment: Camillo Mariani, Helio Takai, William Wester
Theory (+cosmology): Keith Dienes

Gravitational Physics + LIGO research

Pedro Marronetti

Nuclear Physics

Experiment: Allena Opper; Vicki Greene
Theory: Bogdan Mihaila

Physics of Living Systems

Krastan Blagoev, Angel Garcia

Quantum Information Science

Alex Cronin, Mark Byrd

Physics at the Information Frontier
Bogdan Mihaila

Integrative Activities in Physics
(REU Sites, MRI, CAREER, BP)
Kathy McCloud , Marc Sher

Physics Frontiers Centers
Mike Cavagnero, Kathy McCloud

Large Facilities
(On-going search)

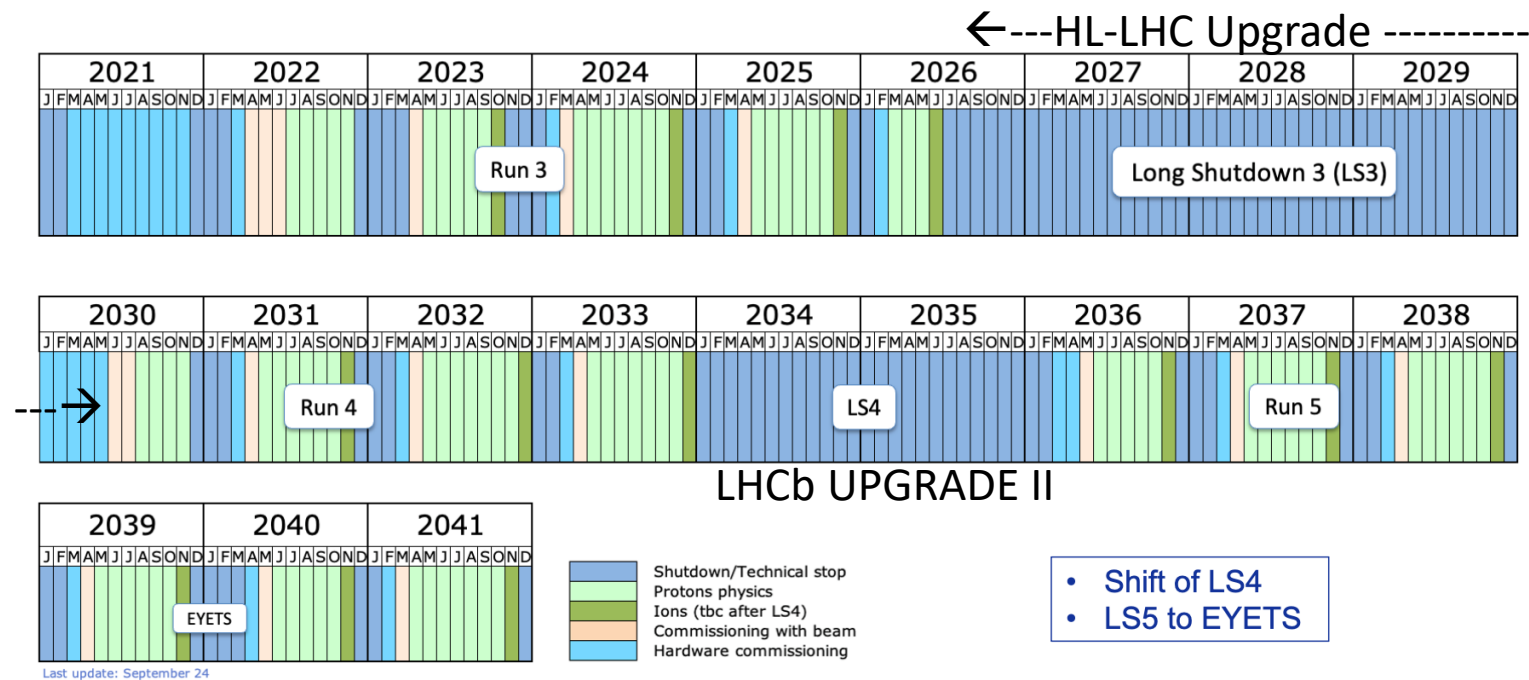
HEPAP Dec 2024



The LHC

- ATLAS and CMS operations are funded through April 2025.
- The HL-LHC upgrade projects funded also to April 2025

Proposed Long Term LHC Schedule



Experimental EPP Program

- Elementary Particle Physics (EPP) Program, which primarily supports particle physics at accelerators and advances in detector development.
- Range of program coverage:
 - High Energy Physics (ATLAS, CMS,...)
 - Precision Experiments (Neutrinos, LHCb, Rare-K, EDMs, ...), LHCb M&O
 - Tools for Particle Physics (Artificial Intelligence, Instrumentation,...)

Program Directors: K. De, J. Shank

EPP Program	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Awards issued	19	12	7	18	15	15	20	18	16	16
CAREER awards	1	2	1	1	0	3	0	0	1	0



The EPP experiment FY2024 Portfolio:

Science Thrust	No. Proposals
ATLAS	5
CMS	3
LHCb	3
Neutrino	3
HiFieldQED	1
Belle II	1
Grand Total	16



Theoretical HEP and Particle Astro/Cosmology Programs

- Particle Theory is essential to the success of the entire Particle Physics mission. We support cutting-edge investigator-driven research in two programs:
 - Theoretical High-Energy Physics
 - Theoretical Particle Astrophysics and Cosmology
- Regular interactions with EPP, PA, Gravity Theory, Nuclear Theory, Astronomy, Materials Research, Mathematical Sciences, etc.
- Supporting individuals, RUI's, and special facilities or initiatives (Aspen Center for Physics, TASI summer school, LHC Theory Initiative, etc.)
- Trend: Large numbers of proposals, also increasing numbers of new PIs applying

Program Director: K. Dienes

Theory Programs	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Awards issued	28	30	26	32	23	32	30	30	30	35
CAREER awards	2	1	2	1	1	1	1	0	1	0

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Experimental Particle Astrophysics Programs

- Underground Physics (PA-UG): This area supports university research that generally locates experiments in low background environments:
 - Underground experiments, reactor neutrinos, coherent scattering (with ENP)
 - Neutrino mass measurements
 - Searches for the direct detection of Dark Matter
- IceCube Science Program (PA-IC): This area supports university research making use of data collected by IceCube for neutrino, cosmic ray, and particle physics
- Cosmic Phenomena (PA-CP): This area supports university research that uses astrophysical sources and particle physics techniques to study fundamental physics:
 - Astrophysical sources of cosmic rays, gamma rays, neutrinos

Program Directors: C. Mariani, H. Takai, W. Wester, N. Sharp

Particle Astrophysics	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY2020	FY2021	FY2022	FY2023	FY2024
Awards issued	27	21	20	26	16	23	24	23	25	21
CAREER awards	2	3	1	1	1	1	2	2	3	3
HEPAP Dec 2024					Updated for consistency in award treatment					



Key Findings and Recommendations

First, NSF thanks the Panel for their hard work.

From P. McBride talk, HEPAP, 2 Nov 2023, International Benchmarking Report

1. **Scientific breadth and application:**
 1. NSF agrees, and we are using P5 as a roadmap in the context of the PHY division's mission and priorities.
 - *Strengthen investments to advance fundamental research in scientific disciplines and society.*
2. **Diversity across scales and stages:**
 2. – 4. Informed by the community, NSF follows the science. That includes small and large activities both domestic and offshore.
 - *Maintain a comprehensive portfolio of research activities and strategic balance among them, including large and core research activities.*
3. **Collaborating across the globe:**
 - *Continue support for and actively seek engagement with international collaborations and partnerships of all sizes.*
4. **Being a partner of choice:**
 - *Implement structures for hosting strong international collaborations, act with timeliness, consistently meet obligations, and facilitate open communication with partners.*



Key Findings and Recommendations (2)

From P. McBride talk, HEPAP, 2 Nov 2023, International Benchmarking Report

5. Strengthening critical capabilities

Continuously develop critical technologies in particle physics at home and abroad.

5. NSF agrees and the breadth of disciplines across the PHY Div. and NSF can be an important resource to develop new technologies and advance particle physics.

6. Advancing national initiatives:

Enhance and leverage the innovation in machine learning, quantum information science, and these national initiatives in particle physics and these national initiatives.

6. NSF agrees. The PHY division is active in multiple national Initiatives such as Quantum Information Science and Artificial Intelligence.

7. Building a Robust Workforce:

Explore frontier science using cutting-edge technologies to inspire the public and the next generation of scientists while opening new pathways to diversify the workforce and realize the full potential of the field.

7. NSF agrees. At NSF, we believe workforce development is a crucial element of the discovery and innovation ecosystem.



Funding Opportunities



Primary NSF Physics Funding Opportunities

(relevant for high-energy physics, particle astrophysics, and cosmology)



Proposal & Award
Policies & Procedures
Guide:

**Latest PAPPG
in effect May
20,2024**

<https://new.nsf.gov/policies/pappg/24-1>

- <https://new.nsf.gov/funding/opportunities/division-physics-investigator-initiated-research/nsf23-615/solicitation>: **Our general, all-purpose Solicitation for our regular base grants. Use this as your default.** Deadlines Early Dec. (now) , depending on specific program (see online).
- <https://www.nsf.gov/pubs/2014/nsf14579/nsf14579.htm>. (“RUI”) Same as above, but for applicants from primarily undergraduate institutions. Check eligibility with your SRO, deadlines same as above.
- <https://www.nsf.gov/pubs/2022/nsf22586/nsf22586.htm>: (“CAREER”) An alternative funding track for those junior (untenured) faculty who, at this point in their careers, wish to undertake a *significant education/outreach activity* in addition to their research. **Not simply a research-excellence prize, and not intended as a default for junior faculty unless you plan a major mix of research and education/outreach.** **Deadline: July 23 2025.**
- https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22604 (“LEAPS-MPS”) Grants designed to “*launch* the careers of pre-tenure faculty... at minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities ... with the goal of achieving excellence through diversity.” *Launch* = you have no prior or current NSF grants (see special exceptions). **Next deadline: January 23 2025.**
- Supplements to *existing* NSF grants to fund a *new* graduate student. Emphasis placed on “increasing the involvement by members of underrepresented groups”. **Apply anytime, fall preferred.**
 - <https://www.nsf.gov/pubs/2020/nsf20083/nsf20083.jsp>: “MPS AGEP-GRS” (only for allowed institutions).
 - <https://www.nsf.gov/pubs/2021/nsf21065/nsf21065.jsp>: “PHY-GRS” (similar, but for remaining institutions).
- <https://www.nsf.gov/pubs/2023/nsf23501/nsf23501.htm>: (“MPS-Ascend”) Fellowships to “support postdoctoral Fellows who will broaden the participation of under-represented groups”. Postdocs or graduating PhDs apply on their own after identifying a potential postdoctoral mentor. See [webinar](#), [FAQ](#)). **Next deadline: Oct.15, 2025**
- Other Divisions, such as Division of Astronomy, Math... Contact relevant Program Directors in both Divisions.

PHY Contacts:

- **Jim Shank** (jshank@nsf.gov) **Kaushik De** (kde@nsf.gov) -- HEP Experiment
- **Keith Dienes** (kdienes@nsf.gov) -- HEP Theory & Particle Astro/Cosmo Theory
- **Helio Takai, Camillo Mariani, William Wester** ([PA group](#)) -- Particle Astro Experiment
- **Kathy McCloud** (kmcccloud@nsf.gov) **Marc Sher** (mtsher@nsf.gov) (for LEAPS and Ascend)

CISE AI Inst. Solicitation (**NSF 23-610**)

- **AI for the Astronomical Sciences**
 - In partnership with Simons Foundation, 2 awards made:
 - **NSF-Simons AI Institute for the Sky (SkAI Institute)**
 - **PI: Vassiliki Kalogera; Northwestern U.**
 - **NSF-Simons AI Institute for Cosmic Origins**
 - **PI: Stella Offner; University of Texas at Austin**
- **AI for Discovery in Materials Research (Anticipated funding in FY2025)**
 - In partnership with Intel, 1 award anticipated, proposal processing ongoing.
- **Strengthening AI (Anticipated funding in FY2025)**
 - Relevant to recent progress in generative models
 - Make AI understand concepts more deeply, instructible by users, and aligned with human/societal intentions
 - Encouraging focus on domains of broad significance to collective wellbeing
 - Multiple awards/flexible commitments for directorates and partners
 - Proposal processing ongoing
- **PHY Division AI Institute: IAIPI, PI: Jesse Thaler, Inst. MIT.**
 - Entering fifth year, expecting to receive a renewal proposal in 2025.

Precision Measurements Update

- [NSF 23-129](#) released June 30, 2023
- Dear Colleague Letter: Searching for New Physics Beyond the Standard Model of Particle Physics Using Precision Measurements
- This DCL encourages interdisciplinary research across the domains of Physics aimed at developing new small-scale experiments and techniques that could complement large EPP facilities.
- Some 2024 awards:
 - BSM-PM: Precision Measurements and Fundamental Symmetries: Muon $g-2$, Electric Dipole Moments, and Optical Magnetometry, U Michigan.
 - BSM-PM: Molecular Ion Quantum Logic: A New Frontier for Quantum Interactions and Fundamental Physics, UCLA.



Research Infrastructure



Research Infrastructure Opportunities

	Project Cost (approx. in \$million)		Funding Source		
Solicitation	From	To	R&D/Planning	Operations	Scope of Competition
Individual program	0	~1.0	EPP or PA	EPP or PA	Program (within EPP or PA)
MRI; No cost sharing	~0.2	5.7	n/a	n/a	PHY (<1.0 M) NSF (>1.0 M)
<u>Midscale RI-1</u>	0.6-6.0	20	EPP or PA or Midscale RI-1	EPP or PA	NSF
<u>Midscale RI-2</u>	20	70 100	EPP or PA or Midscale RI-1	EPP or PA	NSF
MREFC*	70	--	EPP or PA	EPP or PA	NSF

*You must consult the [RIG](#)



Mid-Scale Research Infrastructure

- Research Infrastructure [Webinar Series](#).
- Mid-Scale RI-1 Solicitation: [24-598](#)
- Preliminary Proposal Deadline: Nov. 18, 2024.
- **Full Proposal Deadline Date: March 19 2025** (By Invitation Only)
- Upcoming RI-1 deadlines: Prelim: Sep. 1 2026; Full: Feb. 8 2027
- Mid-Scale RI-1 Implementation projects Total cost: \$4M - \$20M
- Mid-Scale RI-1 Design projects Total cost: \$400k - \$20M
- Mid-Scale RI-2 Solicitation: [23-570](#)
- Mid-Scale RI-2 Projects Total cost: \$20M - \$100M
- Consult the Research Infrastructure Guide [NSF 21-107](#)

Letter of Intent Due
Date(s) (required) (In 2025, not released yet)
Preliminary Proposal Due
Date(s) (required) Full
Proposal Deadline(s) by invite only

