

NSF Physics Division Report

Jim Shank presenting for
Program Directors for Particle Physics:
Keith Dienes, Darren Grant, Jim Shank, Kaushik De,
William Wester
National Science Foundation
Division of Physics



Overview

- NSF Physics Division
 - New personnel
- Overview of EPP, PA programs
- Funding Opportunities
 - DEI



Division of Physics – Core Research Programs

Atomic, Molecular, & Optical Physics

Experiment: John Gillaspay; Kevin Jones,
Theory: Robert Forrey

Plasma Physics

Slava Lukin, TBN

Elementary Particle Physics

Experiment: Jim Shank, Kaushik De
Theory: Keith Dienes

Particle Astrophysics

Experiment: Darren Grant, William Wester
Theory (+cosmology): Keith Dienes

Gravitational Physics + LIGO research

Pedro Marronetti

Nuclear Physics

Experiment: Allena Opper;
Alfredo Galindo-Uribarri
Theory: Bogdan Mihaila

Physics of Living Systems

Krastan Blagoev, Angel Garcia

Quantum Information Science

Alex Cronin

Newest faces:
Mike Cavagnero

Physics at the Information Frontier
Bogdan Mihaila

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

Physics Frontiers Centers
Mike Cavagnero, Kathy McCloud

Large Facilities
TBN???



NATIONAL SCIENCE FOUNDATION SUMMARY TABLE

FY 2024 BUDGET REQUEST TO CONGRESS

(Dollars in Millions)

NSF by Account	FY 2022 Actual ¹	Disaster Relief Supplemental					FY 2023 Estimate Total	FY 2024 Request REVISED	FY 2024 Request REVISED change over:			
		FY 2023 Estimate Base ²	Base	CHIPS and Science	RI Damage Mitigation	FY 2023 Estimate Total			FY 2022 Actual		FY 2023 Base Total ³	
									Amount	Percent	Amount	Percent
BIO	\$831.615	\$831.73	\$25.25	-	-	\$856.98	\$972.41	\$140.80	16.9%	\$115.43	13.5%	
CISE	1,014.72	1,010.57	40.00	-	-	1,050.57	1,172.14	157.42	15.5%	121.57	11.6%	
ENG	774.53	774.80	34.00	-	-	808.80	970.00	195.47	25.2%	161.20	19.9%	
GEO	1,580.40	1,577.42	35.89	-	-	1,613.31	1,801.98	221.58	14.0%	188.67	11.7%	
GEO: OPP	544.68	545.16	-	-	-	545.16	565.60	20.92	3.8%	20.44	3.7%	
U.S. Antarctic Logistics Activities	85.00	94.20	-	-	-	94.20	102.00	17.00	20.0%	7.80	8.3%	
MPS	1,615.26	1,612.90	70.44	-	2.50	1,685.84	1,835.79	220.53	13.7%	152.45	9.1%	
SBE	285.86	285.82	27.38	-	-	313.20	360.60	74.74	26.1%	47.40	15.1%	
TIP	413.09	450.00	220.00	210.00	-	880.00	1,185.63	772.54	187.0%	515.63	77.0%	
SBIR/STTR, including Operations	235.68	46.54	220.00	-	-	266.54	304.18	68.50	29.1%	37.64	14.1%	
OISE	54.23	61.32	8.00	-	-	69.32	71.21	16.98	31.3%	1.89	2.7%	
IA	393.30	399.83	147.20	-	-	547.03	646.37	253.07	64.3%	99.34	18.2%	
U.S. Arctic Research Commission	1.66	1.75	-	-	-	1.75	1.77	0.11	6.6%	0.02	1.1%	
Research & Related Activities	\$6,964.66	\$7,006.136	\$608.16	\$210.00	\$2.50	\$7,826.80	\$9,017.90	\$2,053.24	29.5%	\$1,403.60	18.4%	
STEM Education	\$1,146.72	\$1,154.00	\$92.00	\$125.00	-	\$1,371.00	\$1,496.18	\$349.46	30.5%	\$250.18	20.1%	
Major Res. Equip. & Fac. Construction¹	\$120.60	\$187.23	-	-	-	\$187.23	\$304.67	\$184.07	152.6%	\$117.44	62.7%	
Agency Operations & Award Mgmt.	\$420.21	\$463.00	-	-	-	\$463.00	\$503.87	\$83.66	19.9%	\$40.87	8.8%	
Office of Inspector General	\$18.89	\$23.39	-	-	-	\$23.39	\$26.810	\$7.92	41.9%	\$3.42	14.6%	
National Science Board	\$4.52	\$5.09	-	-	-	\$5.09	\$5.25	\$0.73	16.2%	\$0.16	3.1%	
Total, NSF Discretionary Funding	\$8,675.61	\$8,838.85	\$700.16	\$335.00	\$2.50	\$9,876.51	\$11,354.68	\$2,679.07	30.9%	\$1,815.67	19.0%	
STEM Education - H-1B Visa	278.48	192.54	-	-	-	192.54	198.84	-79.64	-28.6%	6.30	3.3%	
Donations	25.94	40.00	-	-	-	40.00	40.00	14.06	54.2%	-	-	
Total, NSF Mandatory Funding	\$304.42	\$232.54	-	-	-	\$232.54	\$238.84	-\$65.58	-21.5%	\$6.30	2.7%	
Total, NSF Budgetary Resources	\$8,980.03	\$9,071.39	\$700.16	\$335.00	\$2.50	\$10,109.05	\$11,593.52	\$2,613.49	29.1%	\$1,821.97	18.6%	

Totals exclude reimbursable amounts.

¹ Excludes \$360.65 million provided by the American Rescue Plan supplemental appropriation and \$23.45 million provided by the "Extending Government Funding and Delivering Emergency

² Reflects the proposed transfer of \$15.0 million from R&RA to AOAM as part of the Current Plan request, still pending prior to publication. This information differs from what is shown in the

³ Captures both the FY 2023 Omnibus appropriation and the Disaster Relief Supplemental base.



MPS Funding
(Dollars in Millions)

	FY 2022 Actual ¹	Disaster Relief Supplemental			FY 2023 Estimate Total	FY 2024 Request	Change over FY 2023 Base Total ²	
		FY 2023 Estimate Base	RI Damage Mitigation	FY 2023 Estimate Total			FY 2024 Request	Amount
Astronomical Sciences (AST)	\$283.61	\$283.57	\$8.76	-	\$292.33	\$303.33	\$11.00	3.8%
Chemistry (CHE)	265.19	264.46	4.37	-	268.83	279.83	11.00	4.1%
Materials Research (DMR)	338.75	338.78	0.63	-	339.41	350.41	11.00	3.2%
Mathematical Sciences (DMS)	248.32	247.99	4.00	-	251.99	262.99	11.00	4.4%
Physics (PHY)	309.89	308.90	4.23	-	313.13	324.13	11.00	3.5%
Office of Strategic Initiatives (OSI) ³	169.50	169.20	48.45	2.50	220.15	315.10	97.45	44.8%
Total	\$1,615.26	\$1,612.90	\$70.44	\$2.50	\$1,685.84	\$1,835.79	\$152.45	9.1%

¹ Excludes \$80.70 million in American Rescue Plan supplemental funding.

² Captures both the FY 2023 Omnibus appropriation and the Disaster Relief Supplemental base.

³ Formerly titled Office of Multi-Disciplinary Activities (OMA)



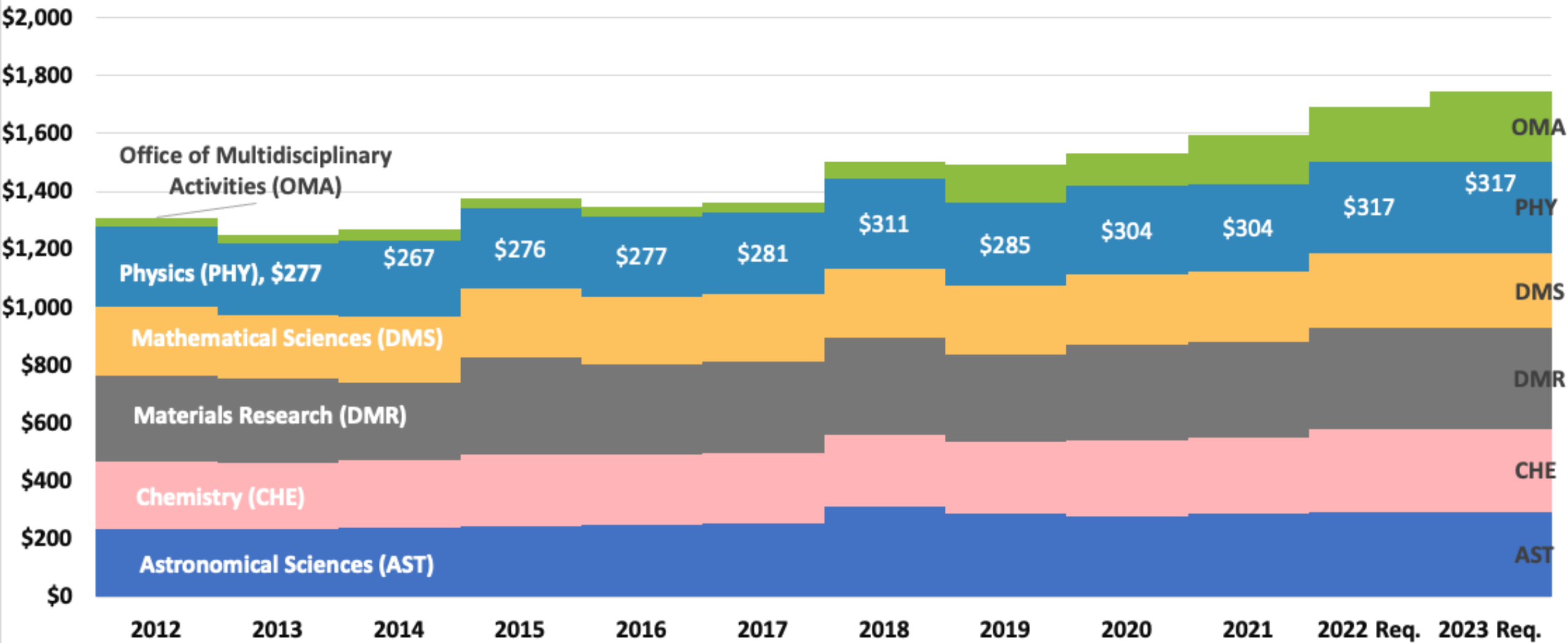
Major Research Equipment Account

FY2024 President's budget request

MREFC Account Funding, by Project								
(Dollars in Millions)								
	FY 2020 Actual	FY 2021 Estimate ¹	FY 2022 Request	FY 2023 Estimate	FY 2024 Request	FY 2025 Estimate	FY 2026 Estimate	FY 2027 Estimate
Antarctic Infrastructure Recapitalization	\$48.78	\$90.00	\$90.00	\$60.00	\$60.00	TBD	TBD	TBD
DKIST	-	-	-	-	-	-	-	-
HL-LHC Upgrade	33.00	33.00	36.00	33.00	38.00	-	-	-
Leadership-Class Computing Facility (LCCF)					93.00	Est. TPC 520-620		
Mid-scale Research Infrastructure ²	-	76.25	76.25	76.25	76.25	76.25	76.25	76.25
RCRV	25.00	-	5.00	1.98	-	-	-	-
Vera C. Rubin Observatory	46.35	40.75	40.75	15.00	7.61	-	-	-
Dedicated Construction Oversight	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total	\$154.84	\$241.00	\$249.00	\$187.23	\$155.25	\$77.25	\$77.25	\$77.25



Directorate of Mathematical and Physical Sciences by Fiscal Year (Actual or Pres. Req.) \$M



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
Awards issued	19	12	7	18	15	15	20	18	TBD
CAREER awards	1	2	1	1	0	3	0	0	1



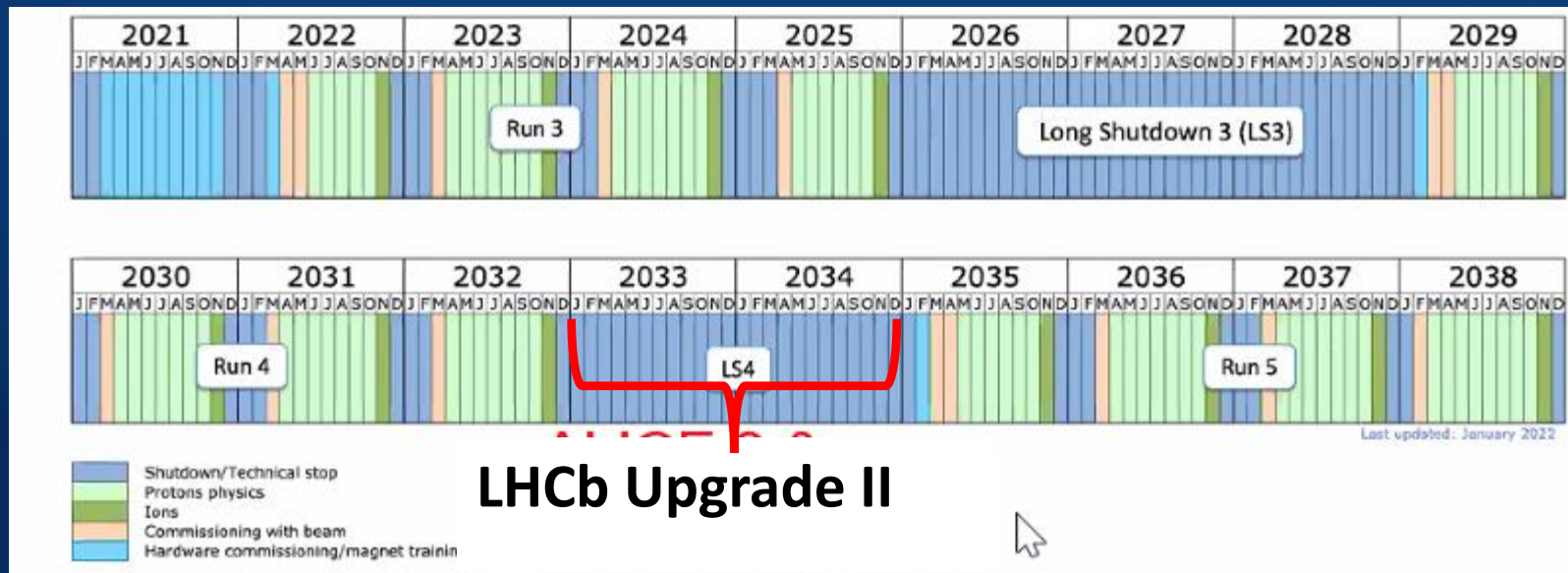
The EPP experiment FY2022 Portfolio:

Science Thrust	No. of Sr. Pers.	No. Awards	FY22 Amount
CMS	45	18	39.75%
ATLAS	35	18	31.25%
Neutrino	17	10	15.50%
LHCb	10	5	8.51%
Computing	6	2	1.98%
FASER	4	3	0.00%
Precision	3	3	1.06%
Workshop	2	1	0.09%
Neutrino: Design/Production TPC Wire Planes	1	1	0.00%
Precision MoEDAL	1	1	0.00%
Precision: NA62	1	1	0.00%
NASEM	1	1	0.00%
DarkMatter	1	1	1.87%
Precision: Belle II	1	1	0.00%
Precision: strong QED	1	1	0.00%
LHCb Ops & Comp.	1	1	0.00%
AI	1	1	0.00%
MUonE	1	1	0.00%
Grand Total	132	70	100.00%



The LHC

- ATLAS and CMS operations are all in good shape with respect to funding for FY 2023.
 - Rebaselining reviews of the HL-LHC NSF scope took place in Spring 2023.
 - Successfully accounted for external conditions (Pandemic, War, etc.) which affected the cost and schedule since the baselining in 2019. Approx. \$10M increase in estimated cost to complete for each experiment
 - NSF now in the process of officially allowing the TPC to increase: ATLAS TPC = \$83M, CMS TPC = \$88M
 - Preparing to fund (in Sept. 2023) the next tranche which will cover all expenses planned for 2024



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: Dramatic increase in numbers of proposals, also huge 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
Awards issued	28	30	26	32	23	32	30	30
CAREER awards	2	1	2	1	1	1	1	0



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: D. Grant, W. Wester

Particle Astrophysics	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY2020	FY2021	FY2022
Awards issued	26	16	17	25	18	28	27	16
CAREER awards	2	3	1	1	1	0	1	2



PA Highlights since last HEPAP

- IceCube sees high-energy neutrinos from the Galactic plane (Science, <https://www.science.org/doi/10.1126/science.adc9818>)
- HAWC discovers TeV gamma rays from the Sun (PRL, <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.131.051201>)
- First dark matter search results from XENONnT and L-Z (PRLs, <https://physics.aps.org/articles/v16/s106>)



Funding Opportunities



Primary NSF Physics Funding Opportunities

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



- <https://www.nsf.gov/pubs/2021/nsf21593/nsf21593.htm>: **Our general, all-purpose Solicitation for our regular base grants. Use this as your default.** Deadlines Early Dec., 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
- <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 just passed: July 26, 2023.
- 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 25, 2024.
- 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](#)). **Next deadline: Oct. 18, 2023**
- Other Divisions, such as Division of Astronomy, Math... Contact relevant Program Directors in both Divisions.

Proposal & Award
Policies & Procedures
Guide:

**New PAPPG
in effect in
Jan 2023!**

<https://beta.nsf.gov/policies/pappg/23-1>

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
- **Darren Grant / William Wester** (dgrant@nsf.gov / wwester@nsf.gov) -- Particle Astro Experiment
- **Kathy McCloud** (kmcccloud@nsf.gov) -- for LEAPS-MPS and MPS-Ascend

CISE AI Inst. New Solicitation Published ([NSF 23-610](#))

- **AI for the Astronomical Sciences**
 - In partnership with Simons Foundation, 2 awards anticipated
 - Preliminary proposals due Oct. 31, 2023
- **AI for Discovery in Materials Research (Anticipated funding in FY2025)**
 - In partnership with Intel, 1 award anticipated
- **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
- Program/theme leads will plan a webinar for early Sep

DEI

- Making progress on Diversity, Equity, and Inclusion has been an NSF priority for a long time. Over the past few years we have taken additional steps in order to enhance our goals in these areas.
- NSF now offers a large number of funding opportunities aimed at broadening participation in our field (new PIs, new institutions). Some of these have been in existence for a while, others are new.
 - **New Investigator Workshops**: learn about grant writing, meet Program Directors, etc.
 - **MPS-ASCEND**: postdoctoral fellowships, cohort-building across MPS subdisciplines
 - **LEAPS-MPS**: entry grants for faculty to initiate research, to provide alternate entry portal into the funding stream
 - **MPS-HIGH**: for current NSF PIs, bring targeted high-schoolers into your research
 - **AGEP-GRS** and **PHY-GRS**: for current NSF PIs, Supplements to bring extra grad students into your group
 - **PREP**: partnerships between MSIs and our Physics Frontier Centers
 - Likewise with AI Institutes: [ExpandAI](#)
 - Physics Division also has special **Broadening Participation (BP) funds**
 - New additional programs being formulated....



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.
- From 2021:
 - PM: Electron and Positron Magnetic Moments from a Quantum Cyclotron
 - PM: CeNTREX, A Search for Nuclear Time-Reversal Symmetry Violation with Quantum-State-Controlled TIF Molecules
 - PM: Precision Low-Energy Quantum Electrodynamical Theory and Fundamental Processes
- 2022:
 - PI: Collar, Juan. Inst: University of Chicago Title: PM: Search for a Cosmologically Relevant Boson in Antimuon Decay



New Limited Opportunity in EPP-exp Program

- **NSF 22-097** Dear Colleague Letter: Partnership in Experimental Elementary Particle Physics and STEM Education Research to Promote Broadening Research Participation
 - Partnership between PHY and Division of Undergraduate Education (DUE)
 - With this Dear Colleague Letter (DCL), PHY and DUE encourage proposals that involve collaboration between an experimental physicist(s) involved in research with the ATLAS or CMS detector and an educator(s) conducting research in STEM education. This partnership between the investigators should enable them to concurrently carry out research in experimental elementary particle physics (EPP) and advance educational practice and education research at the undergraduate (college/university) level within state-of-the-art research environments in physics. NSF is especially interested in receiving proposals from collaborations that have these goals and expected outcomes:
 - Exhibit strong intellectual merit for both the experimental particle physics research and the STEM education research at the undergraduate (college/university) level,
 - Strengthen diverse participation in physics research, and
 - Increase the diversity, quantity, and quality of the next generation of STEM professionals.
 - This is a pilot initiative. It is anticipated that no more than two projects will be funded in FY 2023.



Research Infrastructure



Research Infrastructure Opportunities

Solicitation	Project Cost (approx. in \$million)		Funding Source		Scope of Competition
	From	To	R&D/Planning	Operations	
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
Midscale RI-2	20	70	EPP or PA or Midscale RI-1	EPP or PA	NSF
MREFC	70	Now 100	EPP or PA	EPP or PA	NSF

First Awards in FY19 →

Four awards in FY21 →



Mid-Scale Research Infrastructure

- Webinar from July 2022: [weblink](#)
- Mid-Scale RI-1 Solicitation: [22-637](#)
- Preliminary Proposal Deadline Date: January 5, 2023
- **Full Proposal Deadline Date: May 5, 2023 (By Invitation Only)**
- 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: [21-570](#)
- Mid-Scale RI-2 Projects Total cost: \$20M - \$100M
- Consult the Research Infrastructure Guide [NSF 21-107](#)

