NSF Physics Division Report

Jim Shank presenting for

- Keith Dienes (EPP Theory, Particle Astro/Cosmo Theory)
- Jim Shank, Kaushik De (EPP Experiment)
- William Wester (Particle Astro Experiment)

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 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: Nigel Sharp*, 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

Job Opening in Particle Astr.
Deadline: 30 May.

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)

*Acting

NATIONAL SCIENCE FOUNDATION SUMMARY TABLE
FY 2025 BUDGET REQUEST TO CONGRESS
(Dollars in Millions)

NSF by Account	FY 2023 Base Plan[1]	FY 2024 (TBD)	FY 2025 Request	Change over FY 2023 Base Plan Amount	Change over FY 2023 Base Plan Percent
BIO	$844.91	-	$862.93	$18.02	2.1%
CISE	1,035.90	-	1,067.58	31.68	3.1%
ENG	797.57	-	808.14	10.57	1.3%
GEO	1,591.79	-	1,662.50	70.71	4.4%
GEO: OPP	*538.62*	-	*588.83*	*50.21*	*9.3%*
U.S. Antarctic Logistics Activities	*94.20*	-	*106.00*	*11.80*	*12.5%*
MPS	1,659.95	-	1,681.63	21.68	1.3%
SBE	309.06	-	320.41	11.35	3.7%
TIP	664.15	-	900.00	235.85	35.5%
SBIR/STTR, including Operations	*266.54*	-	*279.21*	*12.67*	*4.8%*
OCRSSP	9.85	-	15.52	5.67	57.6%
OISE	68.43	-	68.43	-	-
IA	531.39	-	518.69	-12.70	-2.4%
U.S. Arctic Research Commission	1.75	-	1.78	0.03	1.7%
Mission Support Services	116.27	-	137.71	21.44	18.4%
Research & Related Activities[2]	**$7,631.02**	**-**	**$8,045.32**	**$414.30**	**5.4%**
STEM Education[2]	**$1,229.28**	**-**	**$1,300.00**	**$70.72**	**5.8%**
Major Res. Equip. & Fac. Construction	**$187.23**	**-**	**$300.00**	**$112.77**	**60.2%**
Agency Operations & Award Mgmt.	**$463.00**	**-**	**$504.00**	**$41.00**	**8.9%**
Office of Inspector General	**$23.39**	**-**	**$28.46**	**$5.07**	**21.7%**
National Science Board	**$5.09**	**-**	**$5.22**	**$0.13**	**2.6%**
Total, NSF Discretionary Funding	**$9,539.01**	**-**	**$10,183.00**	**$643.99**	**6.8%**
Advancing Scientific Discovery: Artificial Intelligence	-	-	50.00	50.00	N/A
STEM Education - H-1B Visa	192.54	-	138.93	-53.61	-27.8%
Donations	40.00	-	40.00	-	-
Total, NSF Mandatory Funding	**$232.54**	**-**	**$228.93**	**-$3.61**	**-1.6%**
Total, NSF Budgetary Resources	**$9,771.55**	**-**	**$10,411.93**	**$640.37**	**6.6%**

Totals exclude reimbursable amounts.

[1] Reflects the anticipated transfer of $15.0 million of carryover within the R&RA account to the AOAM account to be completed in FY 2024.

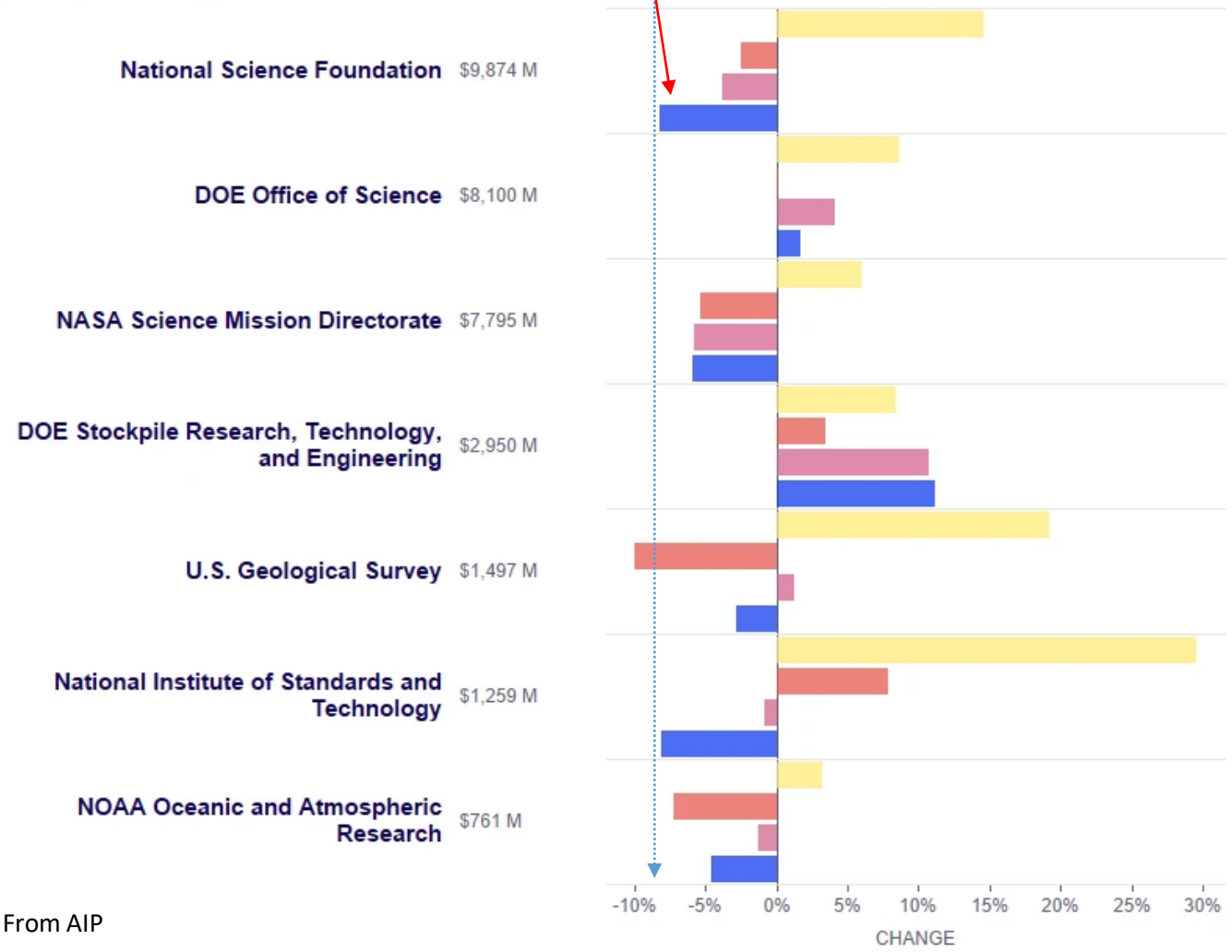
[2] FY 2023 R&RA and STEM Education accounts are restated to show consolidation of NSF mission support activities within R&RA comparably with FY 2025; STEM Education account shifts $16.72 million to R&RA in FY 2023 display column.

FY24 Appropriations: Selected Science Agencies

FY23 enacted amount ($ millions)
% change over enacted

REQUEST SENATE
HOUSE FINAL

The impact of this has not trickled down to the PHY division yet, so we can say nothing about 2024.



From AIP

Major Research Equipment Account

FY2025 President's budget request

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION ACCOUNT (MREFC) **$300,000,000**

Major Research Equipment and Facilities Construction Funding
(Dollars in Millions)

FY 2023 Base Plan	FY 2024 Request	FY 2025 Request	Change over FY 2023 Base Plan Amount	Percent
$187.23	$304.67	$300.00	$112.77	60.2%

Overview

The MREFC account supports the acquisition, construction, and commissioning of major facilities and larger mid-scale research infrastructure that provide unique capabilities at the frontiers of science and engineering. Initial development and design and post-construction operations and maintenance are funded through the R&RA account.

MREFC Account Funding, by Project
(Dollars in Millions)

	FY 2023 Base Plan	FY 2024 Request	FY 2025 Request	FY 2026 Estimate	FY 2027 Estimate	FY 2028 Estimate	FY 2029 Estimate	FY 2030 Estimate
Antarctic Infrastructure Recapitalization (AIR)	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
HL-Large Hadron Collider Upgrade	33.00	38.00	-	-	-	-	-	-
Leadership-Class Computing Facility (LCCF)	-	93.00	154.00	226.00	47.00	-	-	-
Mid-scale Research Infrastructure, Track 2[2]	76.25	105.06	85.00	90.00	100.00	100.00	100.00	100.00
Regional Class Research Vessel (RCRV)	1.98	-	-	-	-	-	-	-
Vera C. Rubin Observatory (Rubin)	15.00	7.61	-	-	-	-	-	-
Future Priority Projects[3]	-	-	-	8.00	206.00	264.00	289.00	339.00
Dedicated Construction Oversight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total	**$187.23**	**$304.67**	**$300.00**	**$385.00**	**$414.00**	**$425.00**	**$450.00**	**$500.00**

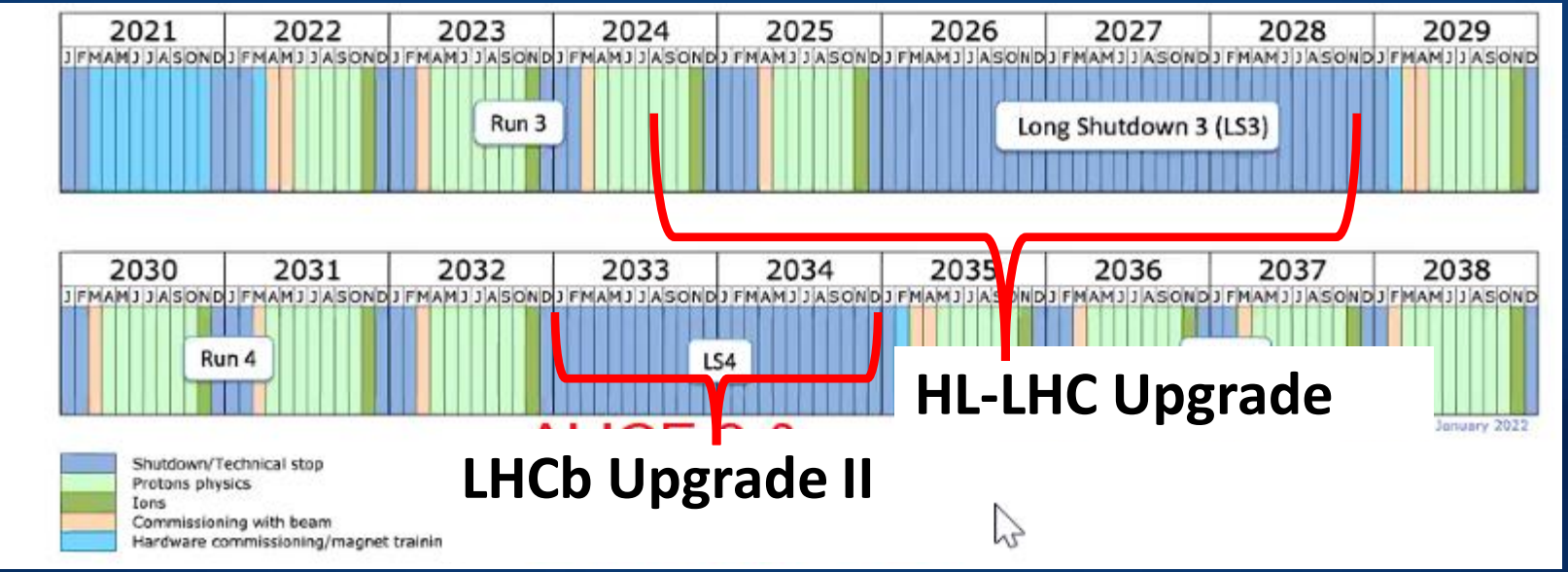
[1] A total of $361.32 million was carried forward from FY 2023 to FY 2024: $74.04 million for Mid-scale RI, $209.76 million for AIR, $8.53 million for RCRV, $39.07 million for HL-LHC Upgrade, $20.89 million for Rubin, and $1.58 million for Dedicated Construction Oversight. The remaining $7.45 million consists of funds from recoveries from old projects not funded in FY 2023.

[2] Outyear amounts are for planning purposes only. NSF will evaluate Mid-scale RI in the context of agency priorities for future budget submissions.

[3] Represents escalating funding amounts increasing NSF's MREFC portfolio to a total of $500.0 million by the end of the decade and does not reflect policy decisions on project-specific investments. Increases reflect both anticipated growth in cost of major research infrastructure, as well as NSF's intent to increase investments in facilities to maintain U.S. leadership in key science and engineering research areas.

The LHC

- ATLAS and CMS operations are funded for now. Last tranche for FY2024 awaits final PHY budget.
- 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 has officially approved the TPC to increase: ATLAS TPC = $83M, CMS TPC = $88M
- Funded most of FY2024 expected costs—one more tranche for ATLAS



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	16
CAREER awards	1	2	1	1	0	3	0	0	1

The EPP experiment FY2023 Portfolio:

Science Thrust	No. Awards	FY23 $
ATLAS	5	46%
CMS	4	24%
LHCb	2	11%
Neutrino	2	9%
Precision	1	6%
NASEM	1	4%
Partnership DUE	1	0%
Grand Total	**16**	**100%**

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
Awards issued	28	30	26	32	23	32	30	30	30
CAREER awards	2	1	2	1	1	1	1	0	1

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: TBD, W. Wester

Particle Astrophysics	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY2020	FY2021	FY2022	FY2023
Awards issued	27	21	20	26	16	23	24	23	25
CAREER awards	2	3	1	1	1	1	2	2	3

HEPAP May 2024

Updated for consistency in award treatment

Funding Opportunities

Primary NSF Physics Funding Opportunities

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

- 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., 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 24 2024**.
- 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). **Next deadline: October 16 2024**
- Other Divisions, such as Division of Astronomy, Math... Contact relevant Program Directors in both Divisions.

Proposal & Award Policies & Procedures Guide:

New PAPPG in effect May 20,2024!

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

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
- **TBN / William Wester** (wwester @nsf.gov) -- Particle Astro Experiment
- **Kathy McCloud** (kmccloud@nsf.gov) **Marc Sher** ( )(-- for LEAPS-MPS and MPS-Ascend)

CISE AI Inst. 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
  - **May 17 2024** - Deadline date

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.
    - Broadening Participation workshop July 7-9 2024
  - 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 TlF Molecules
  - PM: Precision Low-Energy Quantum Electrodynamic Theory and Fundamental Processes
- 2022:
  - PI: Collar, Juan. University of Chicago, Title: PM: Search for a Cosmologically Relevant Boson in Antimuon Decay

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)**
Midscale RI-1	**0.6-6.0**	**20**	**EPP or PA or Midscale RI-1**	**EPP or PA**	**NSF**
Midscale RI-2	**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: 22-637
- Preliminary Proposal Deadline Date: Next deadline: 2025, exact date TBD
- **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: 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