



Winter HEPAP Meeting

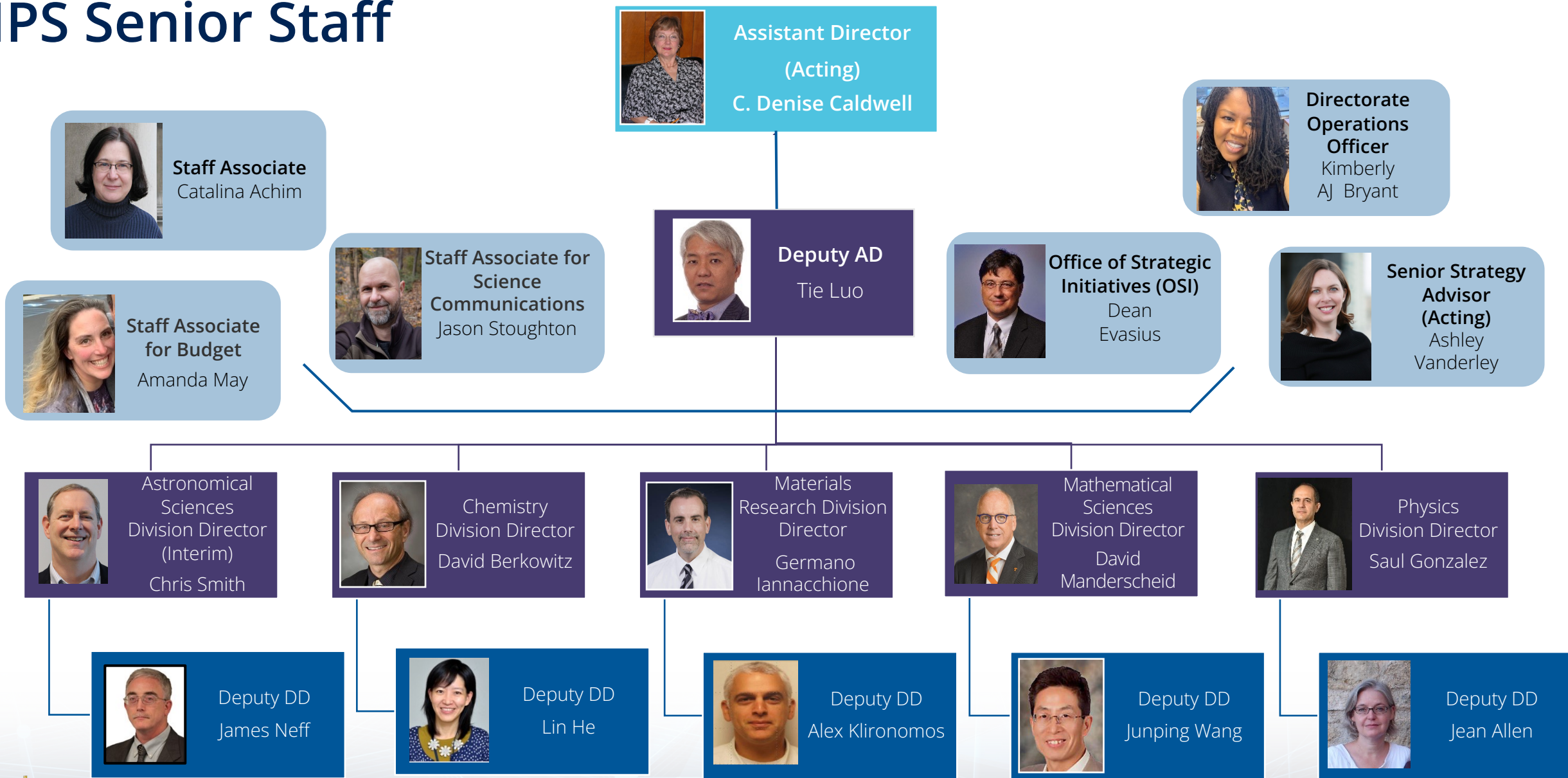
NSF OVERVIEW

DR. C. DENISE CALDWELL
ASSISTANT DIRECTOR(ACTING)



National Science Foundation
Directorate for Mathematical and
Physical Science (MPS)

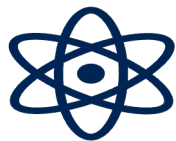
MPS Senior Staff



The Nobel Prize in Chemistry



Moungi Bawendi received a 1991 NSF Presidential Young Investigator Award, which helped support his breakthrough discovery.



Bawendi's subsequent work on the synthesis of quantum dots was directly supported by another 10 NSF awards.



Louis Brus received a grant in 2005 to investigate single-wall carbon nanotubes. In 2011, he received support through NSF's Integrative Graduate Education and Research Traineeship program to train the next generation of scientists.

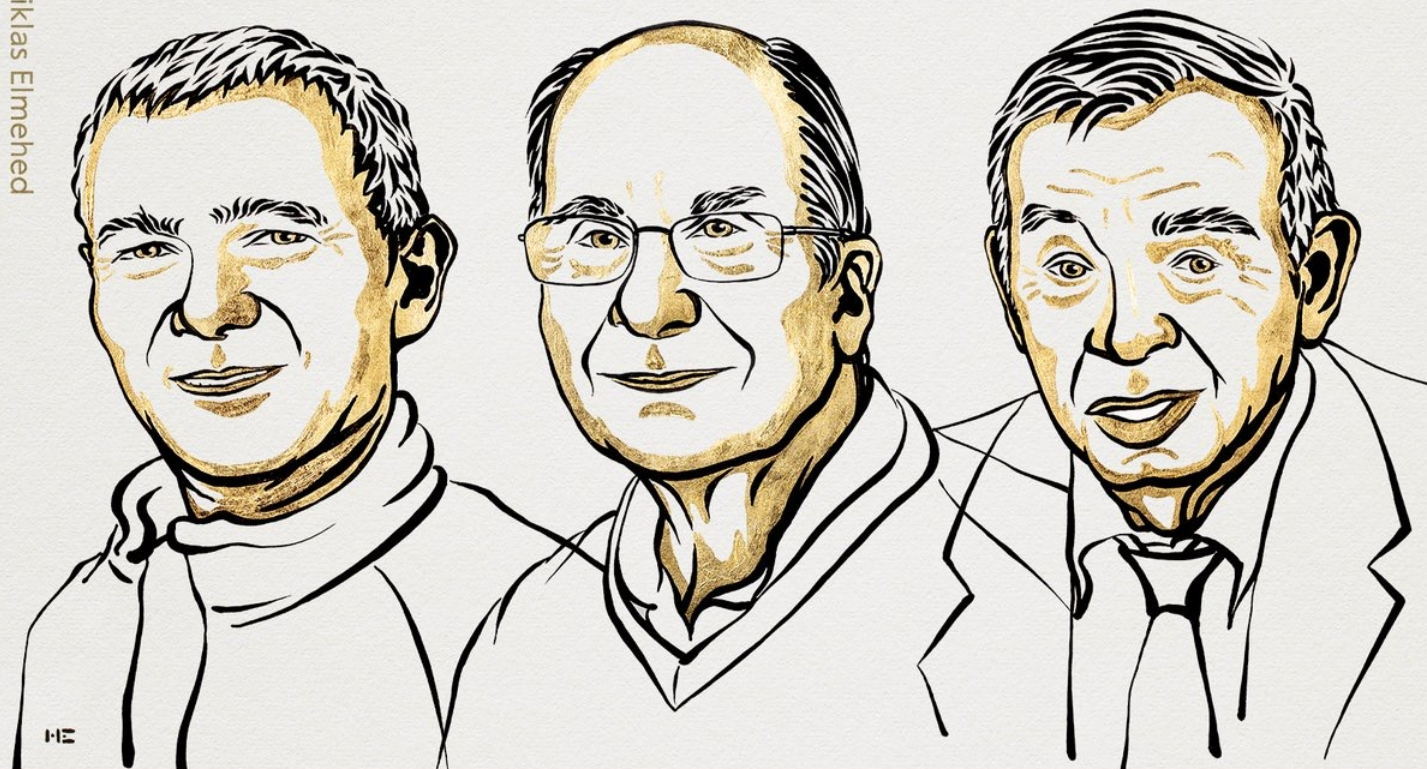


Brus and Bawendi received NSF Graduate Research Fellowships in 1966 and 1982, respectively.



Illustrations: Niklas Elmehed

THE NOBEL PRIZE IN CHEMISTRY 2023



Moungi G.
Bawendi

Louis E.
Brus

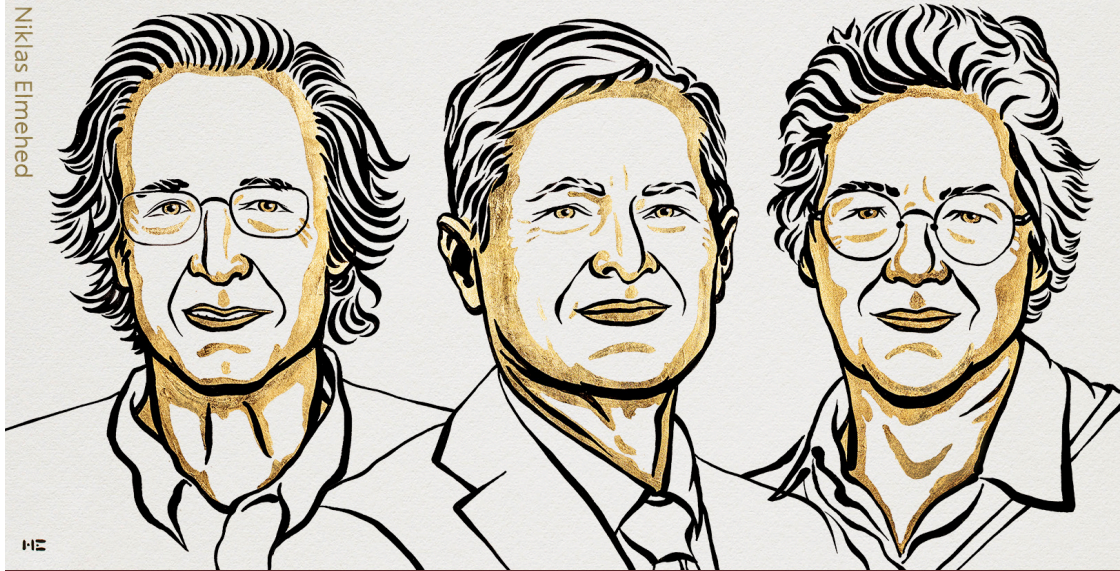
Alexei I.
Ekimov

"for the discovery and synthesis of quantum dots"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

Illustrations: Niklas Elmehed

THE NOBEL PRIZE IN PHYSICS 2023



Pierre
Agostini

Ferenc
Krausz

Anne
L'Huillier

"for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

NSF is proud to have supported the work of Pierre Agostini.

Over the course of his career, he has received four awards for his experiments in strong field physics and on the atom's response to ultra-fast bursts of electromagnetic radiation.

For decades, NSF has funded research on lasers — like the beam of light used by the laureates' during their experiments — attoseconds and the basic laws governing the physical world.



The Nobel Prize in Physics

The Three NSF Pillars

The NSF Strategic Plan 2022-2026



**Advancing the frontiers of
research and innovation**



**Ensuring accessibility
and inclusivity**



**Being a leader in the global
S&E enterprise**

NSF will pursue a vision based upon 3 pillars.

These pillars rest on a foundation of people, ideas, partnerships, and the translation of fundamental research into benefits for society.



NSF FY2024 Budget Request to Congress

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	Base	RI Damage Mitigation				Amount	Percent
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.

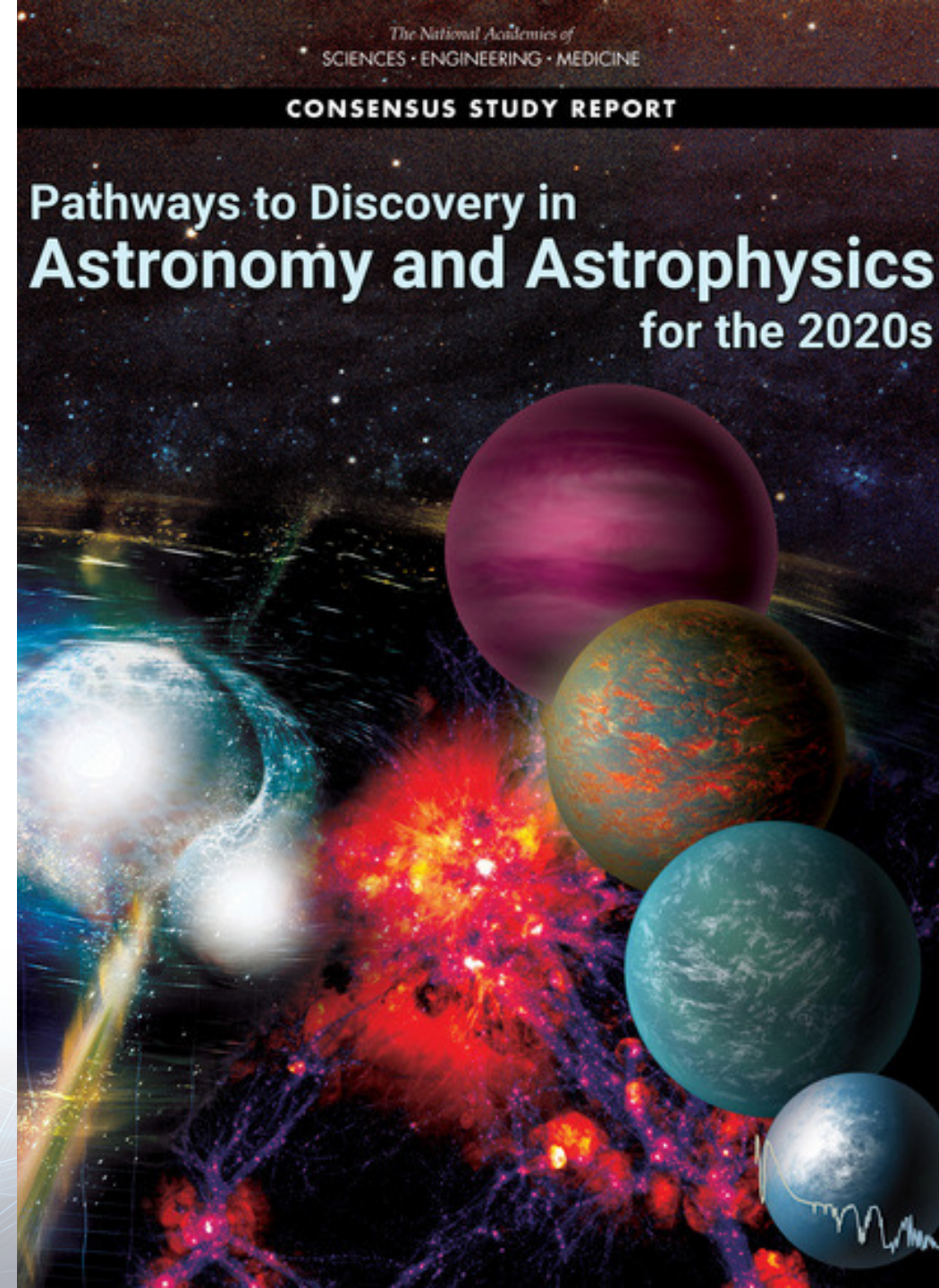
² Captures both the FY 2023 Omnibus appropriation and the Disaster Relief Supplemental base.

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

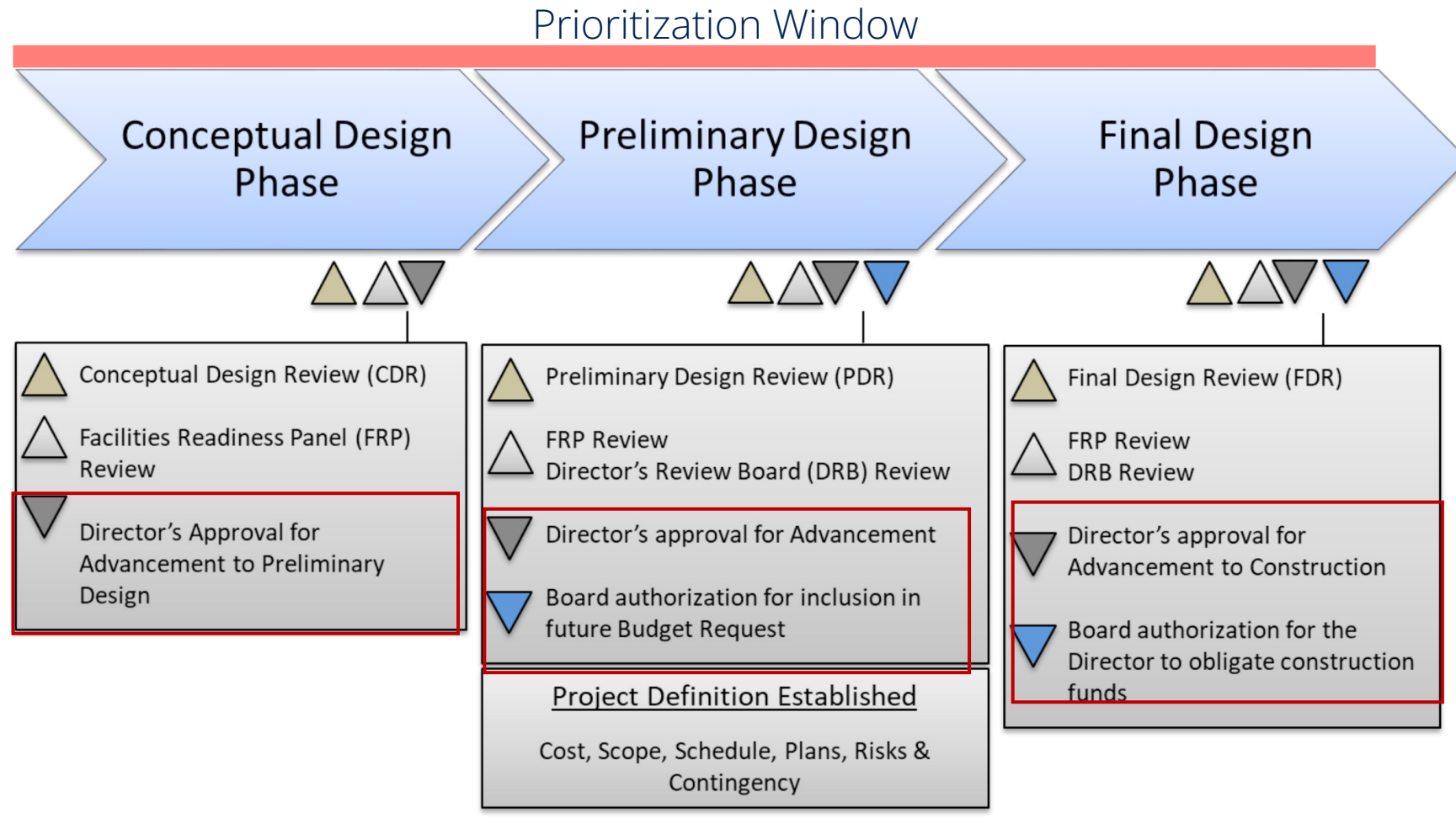


Astro2020 Recommendations: New Medium and Large Initiatives (Table 5.6)

- U.S. Extremely Large Telescope (US-ELT) Program (GMT, TMT)
- Next generation Very Large Array (ngVLA)
- Cosmic Microwave Background Stage 4 (CMB-S4)
- Augmentation of Mid-Scale Program
- Technology Development for LIGO upgrades and future observatories (next generation GW detector)
- IceCube Generation 2 (IceCube-Gen2)



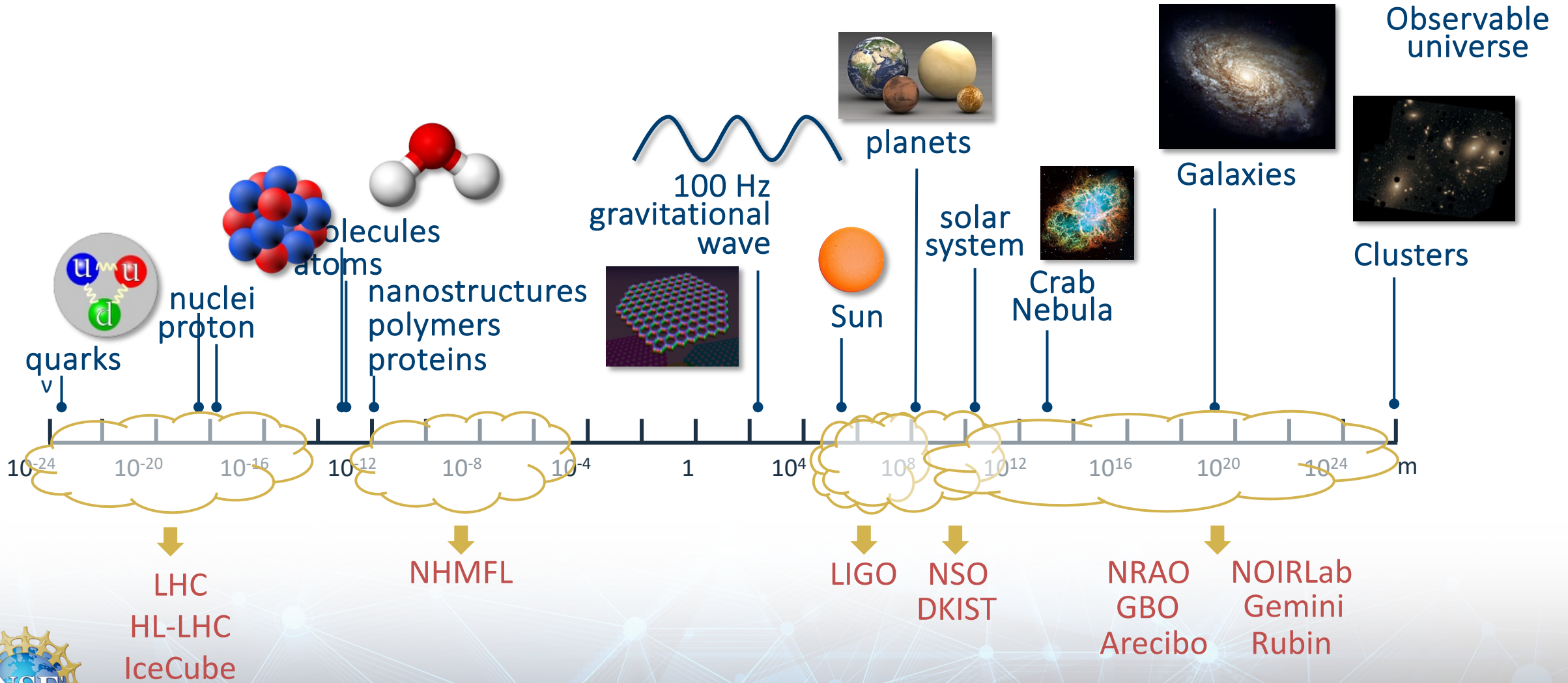
NSF's Major Facilities Design Stage



- Projects can enter at any point before PDR
- **Entry into Design Stage does NOT imply commitment to fund construction**



MPS Major Facilities Portfolio



Programmatic Updates - QISE



ExpandQISE

NSF invests \$38 million to support 22 awards.

17 Track 1 Awards. Initiating planning for a research program in QISE, \$800,000 total for up to 3 years.

5 Track 2 Awards. Team awards for 2-5 collaborators, \$5 million total for up to 5 years.

All lead Institutions are non-R1, including 6 HBCUs, 3 HSIs and 5 institutions from EPSCoR states.



QuSeC-TAQS

NSF invests \$29 million to support 18 awards.

The awardees include **4 HSIs and 3 institutions from EPSCoR states.**

Each team will receive \$1 million-\$2 million over four years to pursue new sensor technologies.



NQI Reauthorization Act

Introduced in Committee on November 3.



Strengthens student traineeship, fellowship and workforce programs at NSF.

Authorizes the creation of a coordination hub to create workforce pipelines within the quantum industry ecosystem.

Authorizes the creation of new quantum testbeds through TIP.



NSF National Quantum Virtual Laboratory (NQVL)

Quantum Science and Technology Demonstrations (QSTD): II. Design & Implementation Phases

An overarching shared infrastructure designed to facilitate the translation from basic science and engineering to the resultant technology. Using a co-design approach, the NQVL aims to begin with fundamental knowledge, and working with end users develop through a prototyping phase application-oriented quantum technologies.

Proposal deadline: *November 30, 2023*



NSF National Quantum Virtual Laboratory (NQVL)

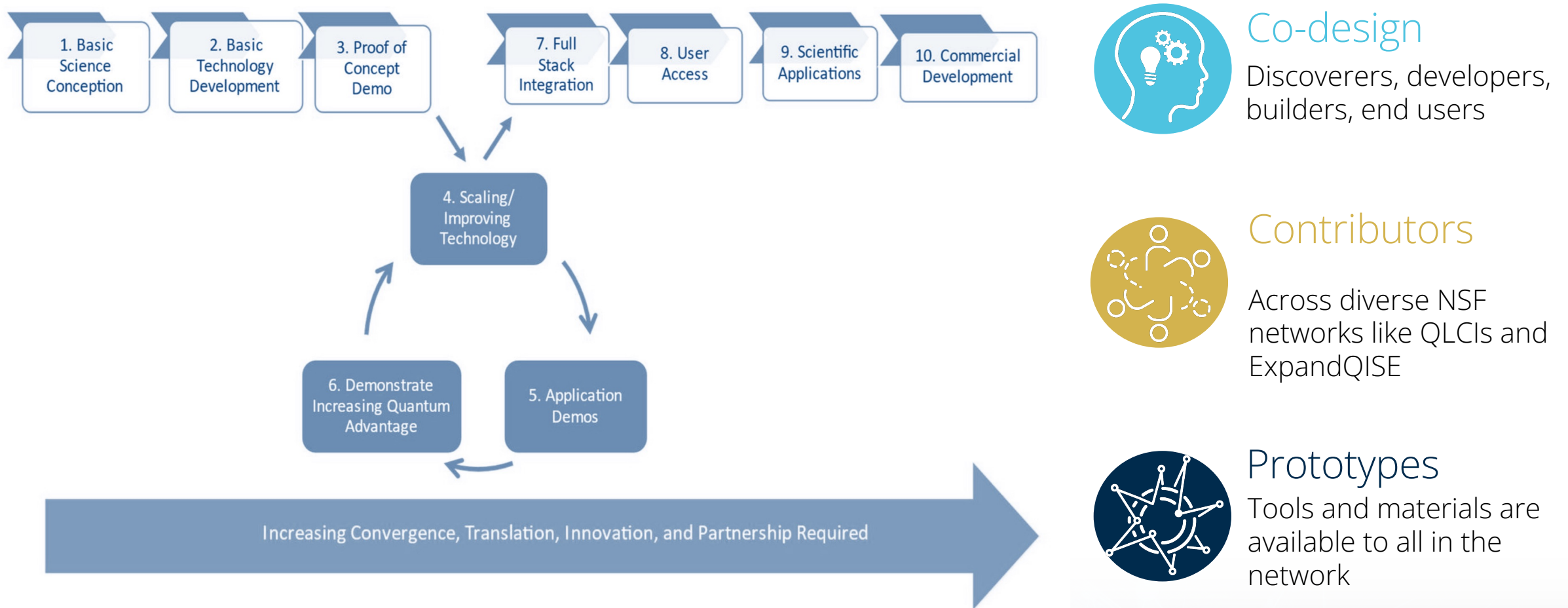


Figure 1. The quantum information development cycle.

<https://arxiv.org/abs/2210.14757>



MPS Artificial Intelligence Institutes

National Artificial Intelligence Research Institutes

Accelerating Research, Transforming Society,
and Growing the American Workforce

PROGRAM SOLICITATION

NSF 23-610

Theme for GROUP 1 Awards in FY 2024:

- AI for Astronomical Sciences
- Jointly funded with the Simons Foundation

Theme for GROUP 2 Awards in FY 2025:

- AI for Discovery in Materials Research
- Jointly funded with Intel Corporation



AI Research Institute for Fundamental Interactions



Molecule Maker Lab Institute (MMLI): An AI Institute for Molecular Discovery, Synthetic Strategy, and Manufacturing

MPS and the CHIPS and Science Act

Sec. 10350. Sustainable chemistry research and education.

- NSF shall establish a program to make awards supporting sustainable chemistry.
 - *The program has been created.*

Sec. 10362. Astronomy and satellite constellations.

- The Director shall support research and workshops and make awards that address the potential impact of satellite constellations on ground-based, optical, infrared, and radio astronomy used by NSF programs.
 - *This is ongoing through the SWIFT program.*

Sec. 10661. Quantum networking and communications.

- The Director will have NASEM conduct a study to evaluate the QIS workforce. (NSF award)
 - *As a preliminary step NSF has made a collaborative award to the University of Colorado Boulder and the Rochester Institute of Technology to perform a study of the QIS national workforce activity.*
- NSF will work to increase integration of QISE into STEM curriculum at all levels.



MPS Broadening Participation Programs

Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships (MPS-Ascend)

FY 23: 29 awards, including 24 to members of underrepresented groups.

Mathematical and Physical Sciences Ascending Faculty Catalyst Awards (MPS-AFCA) **New!**

Supports MPS-Ascending postdoctoral research fellows who transition into tenure track faculty positions

Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences (LEAPS-MPS)

FY 23: 64 awards, including 53 Emerging Research Institutions and 22 MSIs.

MPS Partnerships Programs (PAARE; PREC; PREM; PREP; PRIMES)

Supports partnerships between minority serving institutions and MPS centers, institutes, and facilities. New NRT-PREM partnership granted 11 supplemental awards to existing awardees of NSF's Research Traineeship program (NRT) and Partnerships for Research and Education in Materials program (PREM).

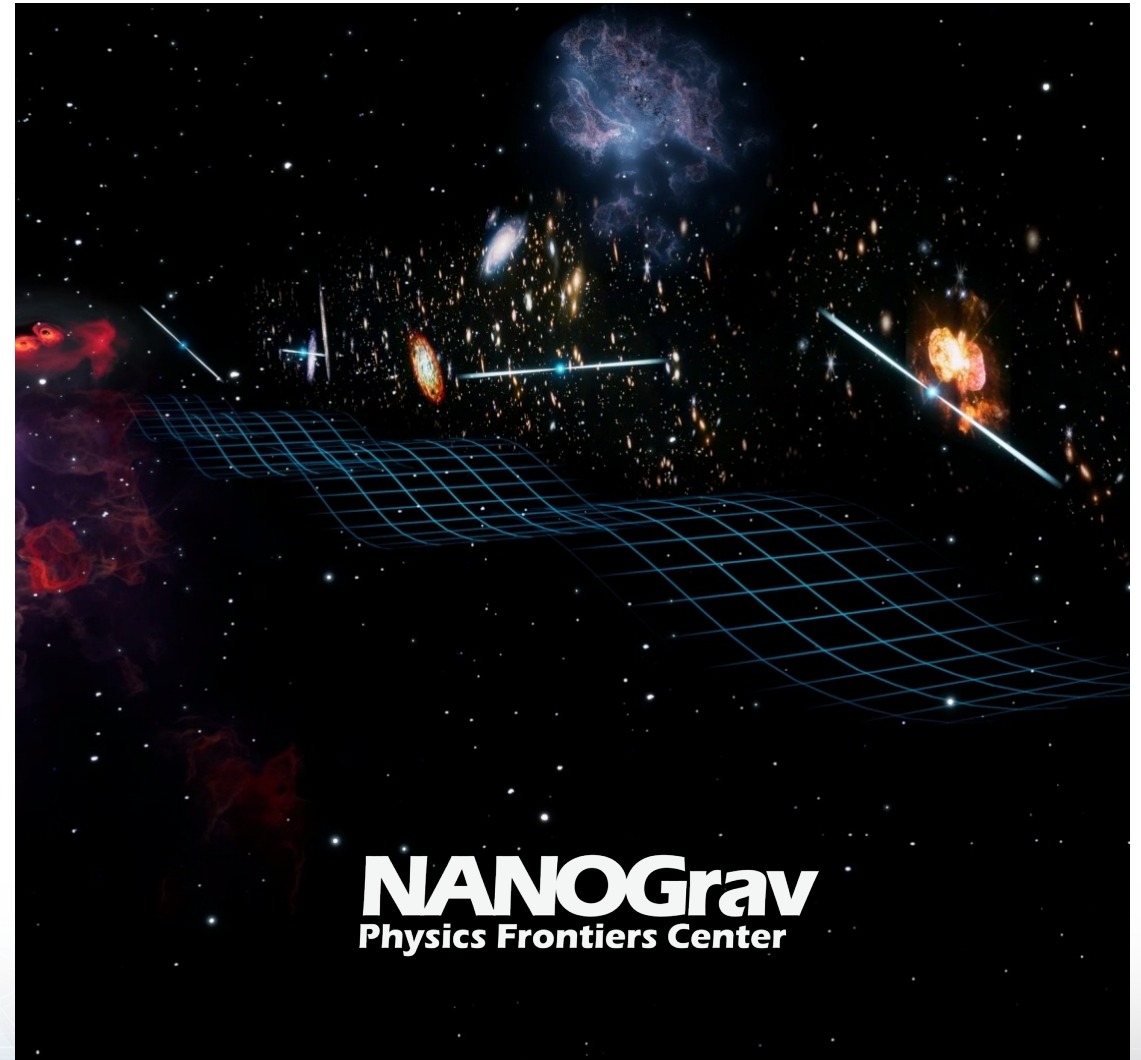


NSF NANOGrav Physics Center Detects Gravitational Waves

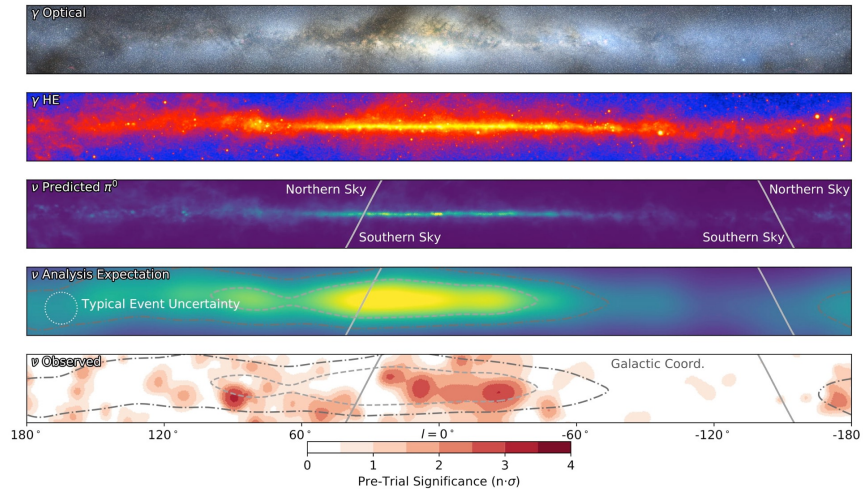
NSF observatories provide first evidence ever of low-frequency gravitational waves permeating the universe

Discovery made by over 190 researchers from more than 50 institutions in the U.S and abroad

Provides new insights into how galaxies evolve and how supermassive black holes grow and merge



Imaging the Milky Way in Neutrinos



- On June 28, 2023 IceCube unveiled the first image of the Milky Way in neutrinos.
- Naoko Kurahashi Neilson (Drexel) led the development of new techniques to extract pointing information from neutrino events and machine learning algorithms for reconstruction.

- Provides quantitative information on neutrino-“quietness” from our central black hole.
- Opens new studies of our galaxy, nearby sources of neutrinos, and the diffuse neutrino background.
- Another major advance in neutrino astrophysics!



Image Credits: IceCube Neutrino Observatory



NSF ZEUS Laser User Facility



Zettawatt Equivalent Ultrashort pulse laser System

- First dedicated open US high field user facility with the highest power laser in the U.S. (3 PetaWatt)
- Will enable exploration of fundamental physics of non-linear QED and high energy astrophysical phenomena.
- Facility Inauguration on October 16, 2023. ZEUS is now open to users.

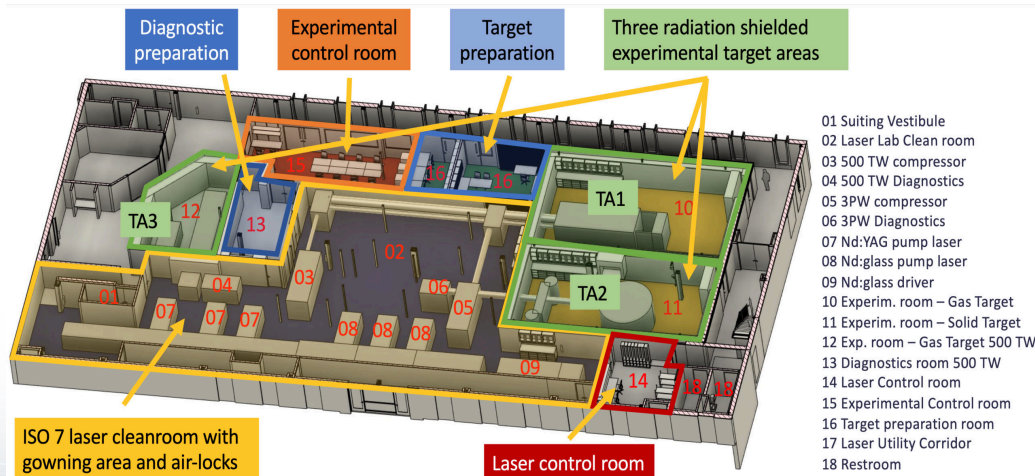


Photo Credits: University of Michigan

Anxiously awaiting the P5 report???



