

# Perspectives from NSF

Jim Shank presenting for  
NSF Participants @ Snowmass:  
Denise Caldwell, Division Director PHY  
PHY Division Program Directors:  
Keith Dienes, Darren Grant, Jim Shank,  
William Wester  
National Science Foundation  
Division of Physics



Snowmass Community Summer Study, Seattle, July 17, 2022

# Overview

- NSF Physics Division
- Snowmass
- The previous P5
- The NASEM study
- The near-term future perspective
- Other NSF initiatives
  - AI, QIS



# Division of Physics – Core Research Programs

Atomic, Molecular, & Optical  
Physics  
Experiment & Theory

Plasma Physics

Elementary Particle Physics  
Experiment & Theory

Particle Astrophysics  
Experiment & Theory (+cosmology)

Gravitational Physics +  
LIGO Research

Nuclear Physics  
Experiment & Theory

Physics of Living Systems

Quantum Information Science

**NSF Programs are not tightly siloed, there are many overlaps. See the Precision Measurement DCL in Weds. NSF Lunch session e.g.**

Physics at the Information Frontier

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

Physics Frontiers Centers

Large Facilities

Snowmass CSS, Seattle, July 2022



# NSF and Community-wide Panels

- Snowmass Community Study
  - Will complete at this meeting
    - Community input on the science that needs to be done
  - Reports will inform P5 and the beginning NASEM study
- The New P5 (Particle Physics Project Prioritization Panel)
  - Entering a new era.
    - Unlike last P5, null experimental results and a plethora of theoretical possibilities do not lead to a unique prediction of where to look
  - P5 report due May 2023 – NSF anxiously awaiting
- The NASEM Study
  - Independent of P5, focuses on the science that drives the field with no connection to any existing projects
  - Encourages thinking about new experimental approaches and reaching out to forming tighter connections to other disciplines to enrich the field.



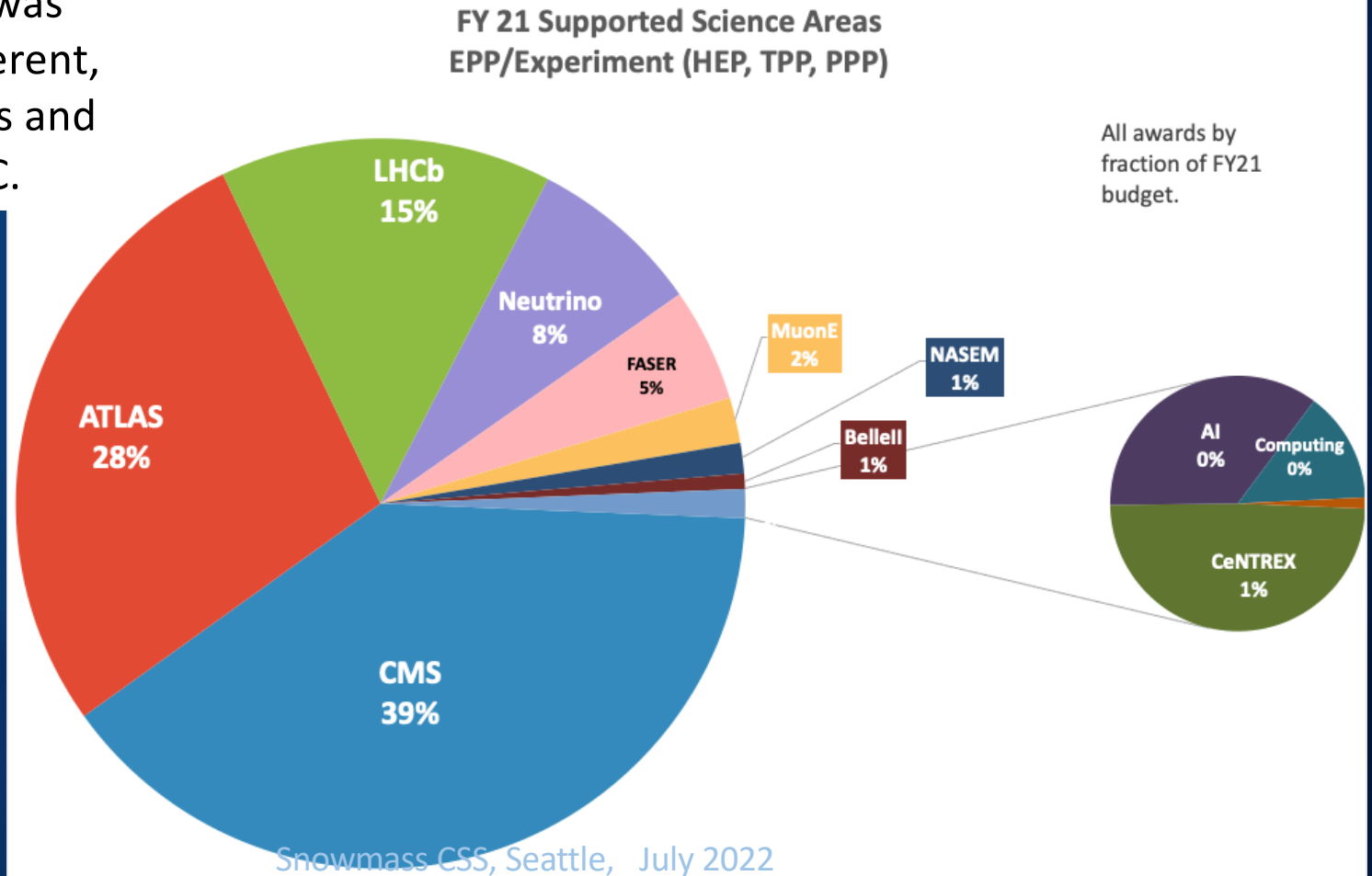
# NSF and the previous P5 (2014)

- Previous P5
  - Final report ([Building for Discovery](#)): Among many other things:
    - “The LHC upgrades constitute our highest-priority near-term large project.”
    - “LBNF is the highest-priority large project in its timeframe.”
- NSF set up NSF/MPSAC subcommittee 2014
  - Number one priority of P5 strongly impacted existing and future investment in LHC
  - This MPSAC subcommittee needed to answer a related question: what can NSF afford to do?
    - [Final report](#)
  - Led to the push for a Major Research Equipment and Facilities Construction (MREFC) 2014
    - This started the HL-LHC MREFC in 2020



# ..as further reinforcement of the 2014 P5:

The picture in 2014 was not significantly different, the EPP program was and is dominated by LHC.



# The NASEM Study

CO-CHAIRS: Maria Spiropulu, Michael S. Turner

Members:

## Elementary Particle Physics: Progress and Promise

- Nima Arkani-Hamed
- Barry C. Barish
- Philip H. Bucksbaum
- Marcela Carena
- Bonnie Fleming
- S. James Gates, Jr.
- Fabiola Gianotti
- David J. Gross
- Young-Kee Kim
- Hitoshi Murayama
- Piermaria J. Oddone
- J. R. Patterson
- Fulvia Pilat
- Chanda Prescod-Weinstein
- Natalie Roe
- Tim Tait



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# NASEM - Elementary Particle Physics: Progress and Promise

The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc committee to:

- Identify the fundamental questions in particle physics that could motivate research in the next decade and beyond, irrespective of the tools and techniques to address them.
- Distinguish which of these questions could be addressed with available experimental and theoretical tools in the coming decade and which could require new techniques or approaches.
- Suggest technical research areas that could provide particle physics with new tools needed to enable new techniques and approaches.
- Suggest different ways of thinking and alternative approaches from other areas of science that could be incorporated into and benefit the overall particle physics enterprise.



# Near-term for NSF

- We look forward to a very successful Snowmass with a thorough set of documents!
- We also eagerly anticipate the science drivers that will come out of the NASEM study and the next P5
- Of course, as usual, NSF “Responds to Proposals” – the community drives where we go.
- But we also have other initiatives...
  - NSF-wide and Administration priorities
    - The most impactful for this community are DEI, QIS and AI



# NSF Director's Initiatives

## NSF'S MISSION

To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.



### Director's Vision



Advance the frontiers of research into the future



Ensure accessibility and inclusivity



Secure global leadership

We are in a  
**DEFINING MOMENT**



Intensity of global competition



Urgent need for domestic talent



Broad support for science as path for solving global grand challenges

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We can accomplish this vision with:

**SPEED AND SCALE**



**PEOPLE**



**PARTNERSHIPS**



**TRANSLATION**



# 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
  - Physics Division also has special **Broadening Participation (BP) funds**
  - Many additional programs being formulated....
- Also new MPS-wide and NSF-wide initiatives are coming!



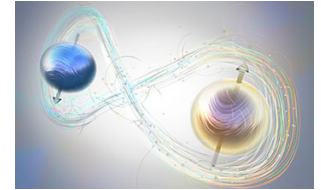
# QIS at NSF

[https://www.nsf.gov/mps/quantum/quantum\\_research\\_at\\_nsf.jsp](https://www.nsf.gov/mps/quantum/quantum_research_at_nsf.jsp)





## Quantum Information Science and Engineering at NSF – Selected Investments



**Strong disciplinary programs** in MPS/CHE,DMR,DMS,PHY; CISE/CCF; ENG/ECCS + **Centers** (PFC, STC, MRSEC)

**Infrastructure:** Facilities and Shared Laboratories (NNCI, MIP, CHESS, CHRNS, NHMFL)

**Quantum Computing Focus:** 2 awards; PFCQC: STAQ, Duke U (Ken Brown); EPiQC, U Chicago (Fred Chong)

**Quantum Networking Focus:** Engineering Research Center for Quantum Networks; U Arizona

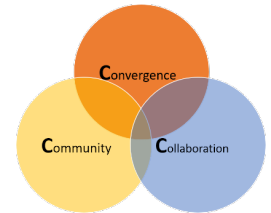
**Convergence Accelerator:** Track C; Quantum Technology: 4 phase-II awards

**Quantum Leap Challenge Institutes:** 5 awards; cover four subareas of QIS plus one in BIO

**Quantum Foundries:** 2 Q-AMASE-I awards; UC Santa Barbara and Montana State/U Arkansas

**Transformational Advances in Quantum Systems (TAQS) Series:** RAISE-TAQS; QII-TAQS; QuIC-TAQS 52 awards

**Workforce:** Triplets; Faculty Fellowships; Q-12 Education Partnership; NRT; GRFP; ExpandQISE

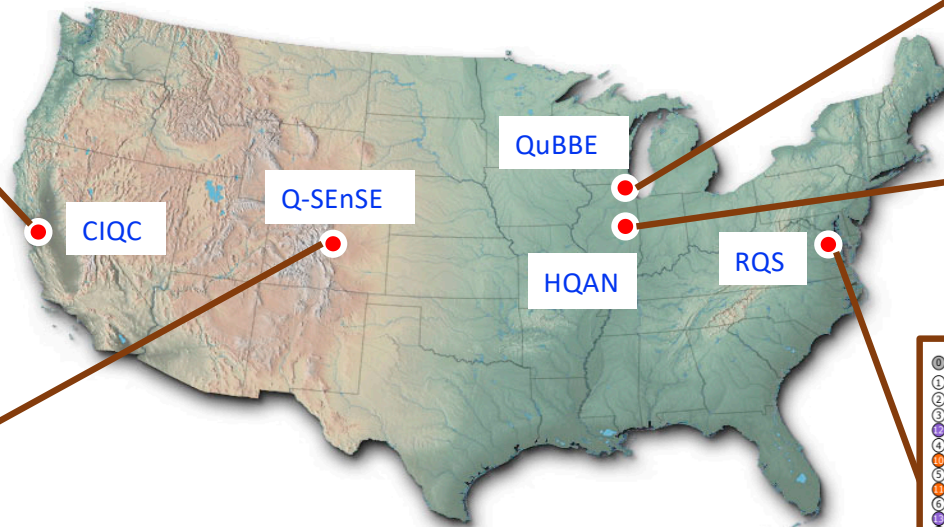
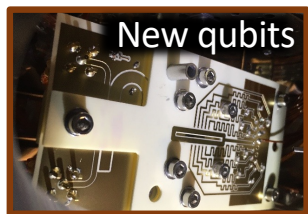
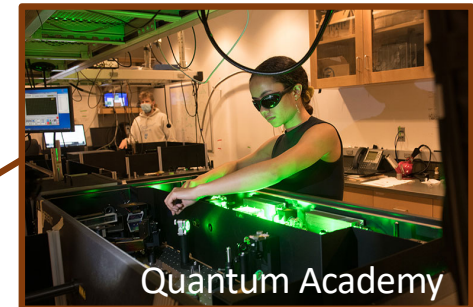


# NSF Quantum Leap Challenge Institutes

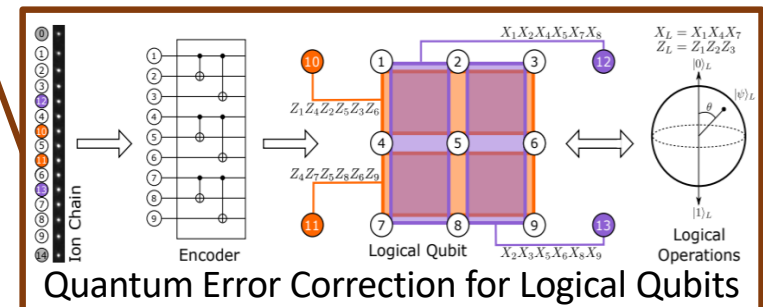
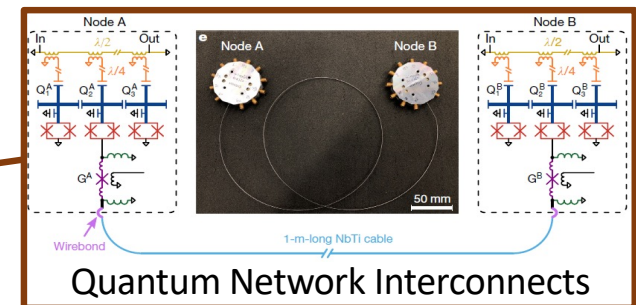


National Quantum Initiative Centers include 5 NSF Quantum Leap Institutes

- [CIQC: Challenge Institute for Quantum Computation](#)
- [Q-SEnSE: Quantum Systems through Entangled Science and Engineering](#)
- [HQAN: Hybrid Quantum Architectures and Networks](#)
- [QuBBE: Quantum Sensing for Biophysics and Bioengineering](#)
- [RQS: Institute for Robust Quantum Simulation](#)



\$125M over 5 years



# Artificial Intelligence at NSF

<https://www.nsf.gov/cise/ai.jsp>



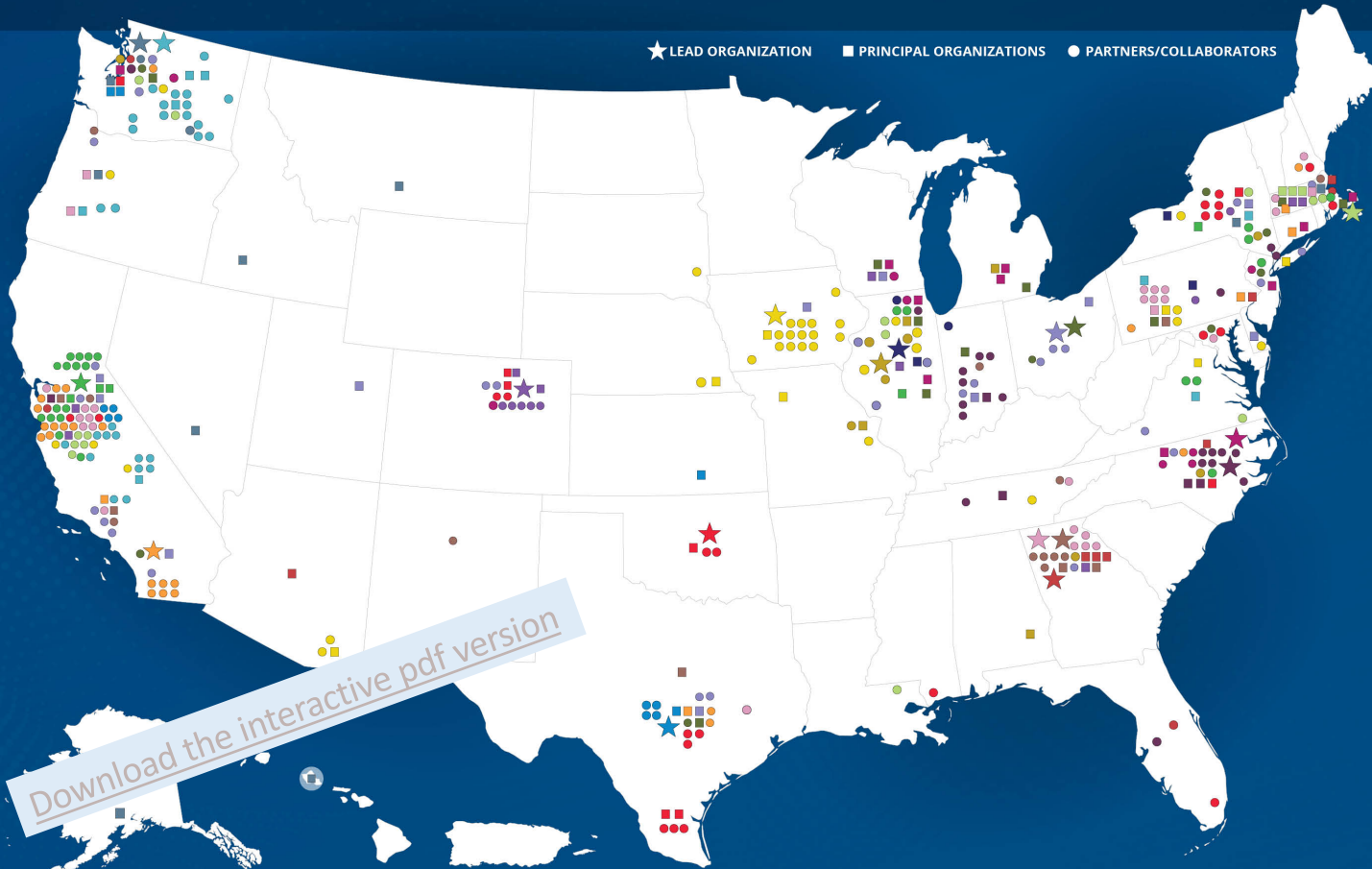


## NSF-LED NATIONAL AI RESEARCH INSTITUTES

2020 and 2021 awards

The U.S. National Science Foundation (NSF) announced a **\$220 million** investment in eleven new Artificial Intelligence (AI) Research Institutes, building on the first round of seven AI Institutes totaling **\$140 million** funded last year. (The default map view below shows all awards combined).

★ LEAD ORGANIZATION ■ PRINCIPAL ORGANIZATIONS ● PARTNERS/COLLABORATORS



- NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography
- NSF AI Institute for Foundations of Machine Learning
- USDA-NIFA AI Institute for Next Generation Food Systems
- USDA-NIFA AI Institute for Future Agricultural Resilience, Management, and Sustainability (AIFARMS)
- NSF AI Institute for Student-AI Teaming
- Molecule Maker Lab Institute (MMLI): NSF AI Institute for Molecular Discovery, Synthetic, and Manufacturing
- NSF AI Institute for Artificial Intelligence and Fundamental Interactions
- NSF AI Institute for Collaborative Assistance and Responsive Interaction for Networked Groups (AI-CARING)
- NSF AI Institute for Learning-enabled Optimization at Scale (TILOS)
- NSF AI Institute for Optimization
- NSF AI Institute for Intelligent Cyberinfrastructure with Computational Learning in the Environment (ICICLE)
- NSF AI Institute for Future Edge Networks and Distributed Intelligence (AI-EDGE)
- NSF AI Institute for Edge Computing Leveraging Next Generation Networks (Athena)
- NSF AI Institute for Dynamic Systems
- NSF AI Institute for Engaged Learning
- NSF AI Institute for Adult Learning and Online Education (ALOE)
- USDA-NIFA AI Institute: Agricultural AI for Transforming Workforce and Decision Support (AgAID)
- USDA-NIFA AI Institute: AI Institute for Resilient Agriculture (AIIRA)

The map reflects the approximate location of the Institutes' lead and principal organizations (staffing and/or activity), as well as their initial funded and unfunded partners. Note: Partners and collaborators related to an Institute may be represented with a single plot due to space limitations.



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This is an Interactive PDF and is best viewed using Adobe Acrobat. Hover cursor over dates below or circles to the right to display more information. If you have issues with these features you can download a standard PDF available [here](#).

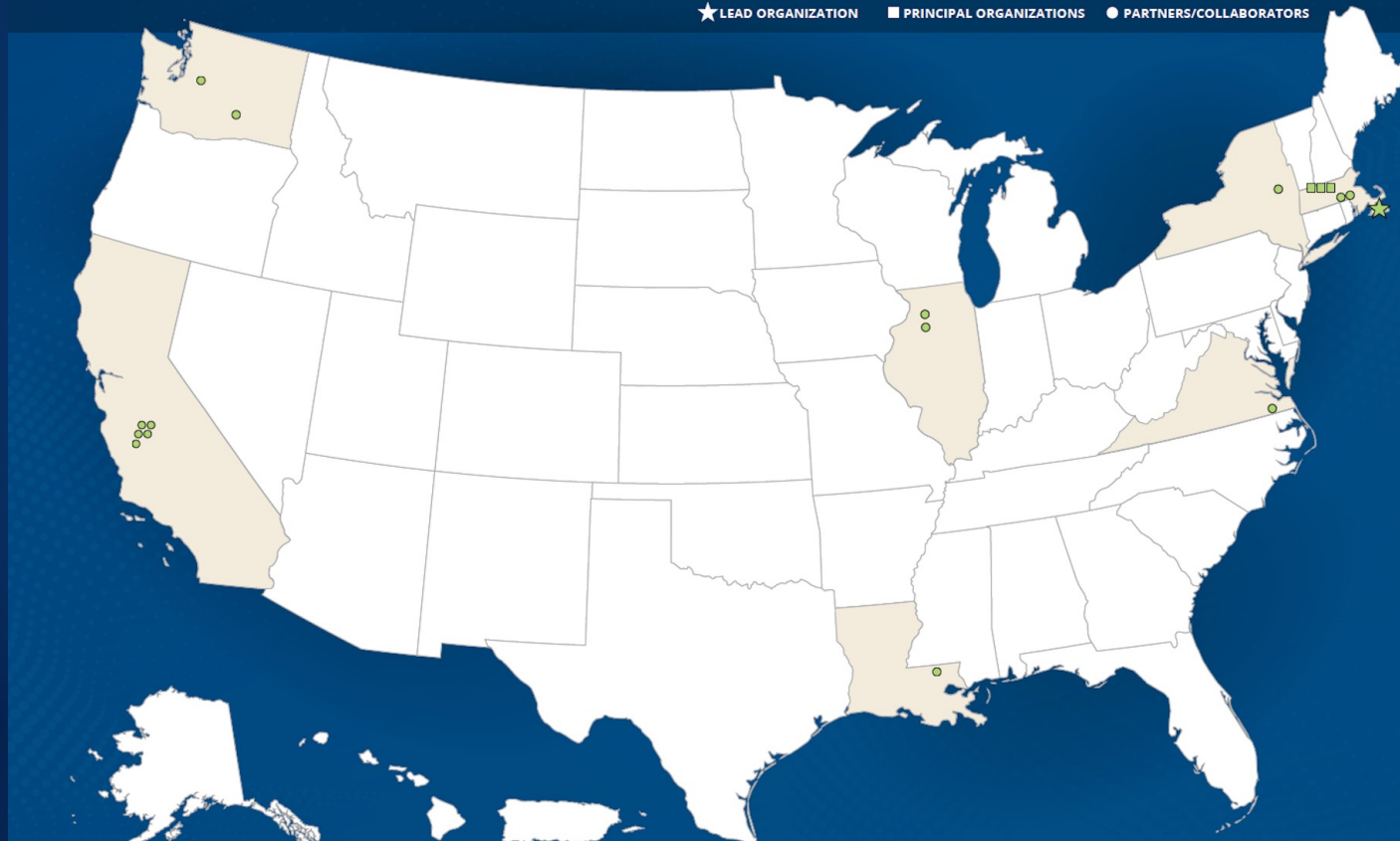
2020 Awards

2021 Awards

★ LEAD ORGANIZATION

■ PRINCIPAL ORGANIZATIONS

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### AWARDS

- NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography
- NSF AI Institute for Foundations of Machine Learning
- USDA-NIFA AI Institute for Next Generation Food Systems
- USDA-NIFA AI Institute for Future Agricultural Resilience, Management, and Sustainability (AIFARMS)
- NSF AI Institute for Student-AI Teaming
- Molecule Maker Lab Institute (MMLI): NSF AI Institute for Molecular Discovery, Synthetic, and Manufacturing
- NSF AI Institute for Artificial Intelligence and Fundamental Interactions**
  - LEAD:**
    - Massachusetts Institute of Technology
  - PRINCIPAL ORGANIZATIONS:**
    - Northeastern University – MA
    - Harvard University – MA
    - Tufts University – MA
  - PARTNERS/COLLABORATORS:**
    - MIT-Bates Computing Center – MA
    - CERN – Switzerland
    - Fermilab – IL
    - Jefferson Lab – VA
    - Argonne National Lab – IL
    - LIGO Scientific Collaboration – LA and – WA
    - Amazon – CA
    - X, the moonshot factory – CA
    - Xilinx – CA
    - IBM – NY
    - Nvidia – CA
    - DeepMind – London, UK
    - Microsoft Research – WA
    - Yandex – Moscow, Russia
    - MIT-IBM Watson AI Lab – MA
    - Sony – Tokyo, Japan
    - SalesForce – CA
- Online Education (ALOE)
- USDA-NIFA AI Institute: Agricultural AI for Transforming Workforce and Decision Support (AgAID)
- USDA-NIFA AI Institute: AI Institute for Resilient Agriculture (AIIRA)



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# AI Institutes

- Solicitation NSF 20-503 for 2020
- Solicitation NSF 20-604 for 2021 - less involvement with MPS
- And now Solicitation NSF 22-502 for 2022. Again, less relevance to MPS
  - National Artificial Intelligence (AI) Research Institutes Accelerating: Research, Transforming Society, and Growing the American Workforce
  - Theme 1: Intelligent Agents for Next-Generation Cybersecurity
  - Theme 2: Neural and Cognitive Foundations of Artificial Intelligence
  - Theme 3: AI for Climate-Smart Agriculture and Forestry
  - Theme 4: AI for Decision making
  - Theme 5: Trustworthy AI
  - Theme 6: AI-Augmented Learning to Expand Education Opportunities and Improve Outcomes
- MPS AI Dear Colleague Letter:
  - MPS ADAPT-DCL Started in 2021, resulting in 5 EAGER and 3 Supplement awards.
  - Continues in FY22, but funds now depleted for this year
- CISE/OAC HDR Institutes:
  - **Harnessing the Data Revolution : Institutes for Data-Intensive Research in Science and Engineering NSF 21-519**
  - Award to U. Washington in Sept. 2021. → A3D3
  - No new HDR Institute, but TRIPODS solicitation is ongoing:
    - **Harnessing the Data Revolution (HDR): Transdisciplinary Research in Principles of Data Science Phase II (TRIPODS)**
    - NSF 21-604. Submission Window: January 04, 2022 - January 18, 2022

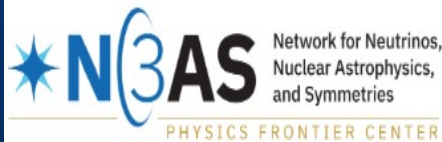


# NSF Particle Physics Centers and Institutes



Institute for Research and Innovation  
in Software for High Energy Physics

Center for Bright Beams Science  
and Technology Center

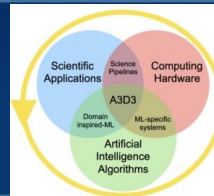


Network for Neutrinos, Nuclear  
Astrophysics, and Symmetries (N3AS)  
(Physics Frontier Center)

Institute for Artificial Intelligence and  
Fundamental Interactions



Harnessing the Data Revolution Institute:  
Accelerated AI Algorithms for Data-Driven  
Discovery (A3D3) (<https://a3d3.ai>)  
U. Washington



← Recent



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# Other NSF sessions this week @ Snowmass

12:30 PM → 1:45 PM Special US funding Agency Meetings (during Lunch time): Wednesday Meetings during Lunch

Weds.

12:30 PM

Poster and exhibit, NSF General Meeting

Genl. PHY report  
a la HEPAD

12:15 PM → 1:45 PM Special US funding Agency Meetings (during Lunch time): US Funding Agency meetings, DOE and NSF

Thurs.

12:30 PM

DOE Program Managers Meeting: Coic Frontier

EPP-exp PI's

12:30 PM

NSF Special PI Meeting

"The Future of EPP"



# Conclusions

- Thank you
- Enjoy Seattle
- Be Safe!

