
U.S. DEPARTMENT OF ENERGY | Office of Science

# Report from Office of High Energy Physics

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DOE HEP

*December 7, 2022*

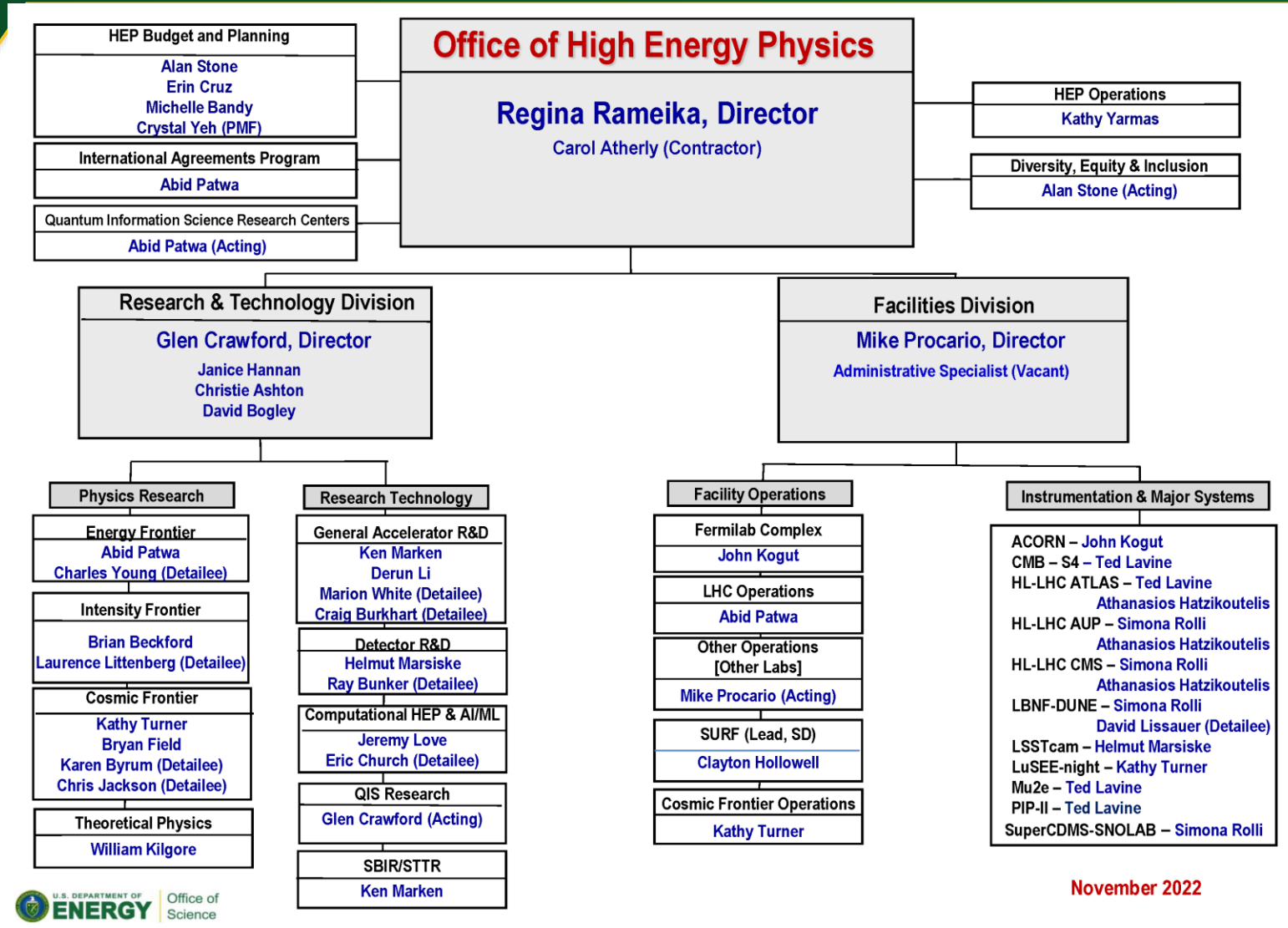
# Outline

- Introduction
- Current OHEP Organization
  - Staffing and Opportunities
- Roadmap panels – past, present and future
- Status of Projects
- Update on international activities
- Budget Update
- Summary and Outlook

# By way of Introduction

- As noted, I am new to this role in the Department of Energy, Office of Science (SC), Office of High Energy Physics (OHEP); started on November 7
- Until now, I have been 40 years as a research scientist at Fermilab
  - Early work on hyperons
  - Since 1993 my work has been on neutrinos, most recently, DUNE
- Since April 2022, OHEP has been led by Dr. Harriet Kung, assisted by the entire team, in particular Glen Crawford and Mike Procario, – my thanks to all of them for keeping the office progressing and welcoming me
  - I have received very special help from the office staff helping me to come up to speed
  - I have also received very kind briefings from the Laboratories, namely ANL, BNL, LBNL, LANL and several more scheduled in the near future
- Any errors or misunderstandings in my remarks today, are entirely mine…

# Current OHEP Organization Chart



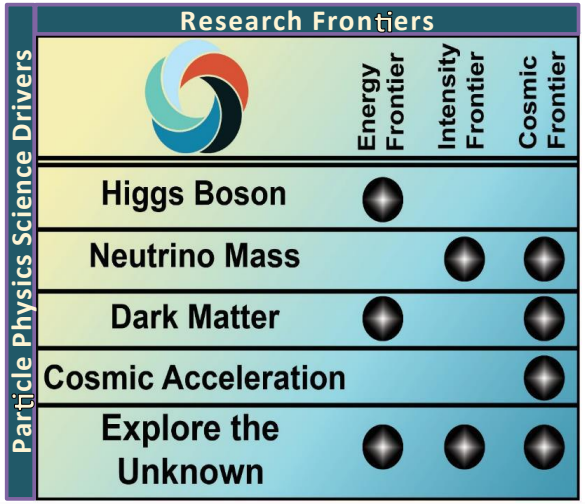

As in any organization,
it is a good idea to periodically review the structure and see if function can be improved;

We will be doing that in the new year, with particular emphasis on making sure that we have the right person power addressing our most demanding programs

# Staff Opportunities in the Office

- We are planning for four new program managers :
  - 2 in Facilities Division, 2 in Research Division
  - Program manager for scientific facilities
    - Includes detectors, accelerator and computing facilities
  - Program manager for projects
    - Experience with 413 projects is desirable
    - Experience serving on project reviews counts
  - Program manager in Cosmic Frontier
    - Growing portfolio of  experiments in Dark Matter and Dark Energy
  - Program manager for HEP-QIS
    - Includes the directed R&D ongoing at the Fermilab SQMS center as well as proposal driven research in the core HEP-QIS program at universities and national labs
  - For more information contact Mike Procario (Michael.Procario@science.doe.gov) about the Facility and Project positions and Glen Crawford (Glen.Crawford@science.doe.gov)  about the Cosmic and QIS positions

# 2014 P5 Roadmap


# Where are we now?


- A lot has happened since 2014 P5
- We (you) can evaluate how much has ben accomplished, and how much is left to do
  - We need to update this timeline
- Importantly, we can ask, what have we learned, what questions have we answered, what questions remain – be honest!
- Have we answered any of our BIG questions?
- Have new questions emerged?

# Progress on the plan

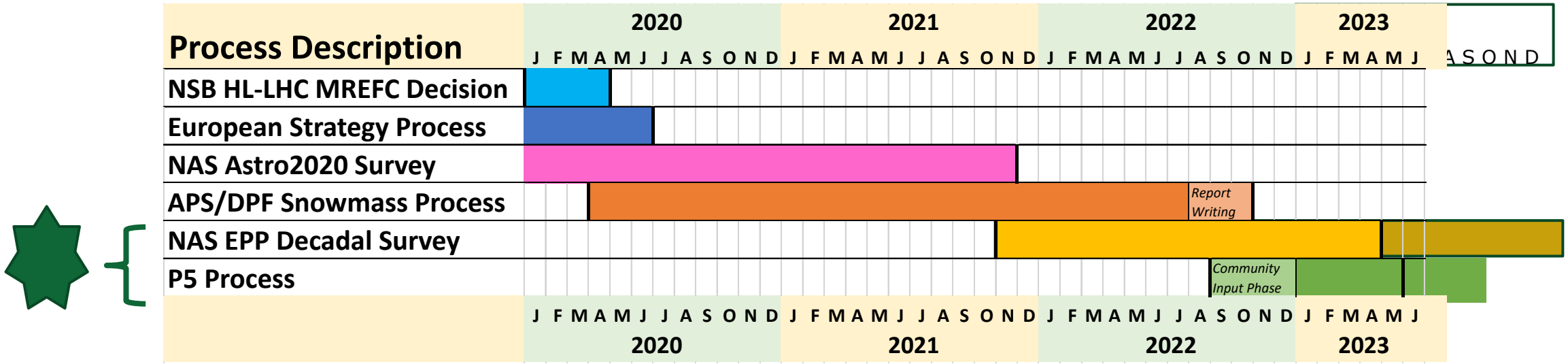
- 2019 Evaluation of progress on the plan was very positive
- March 2020 was a game changer
  - Covid impact was huge ….
- We (across the board) are slowly adjusting to a new normal
- A number of important events are influencing the way we move forward
- More about the budget later, for now, we note that the Inflation Recovery Act (IRA) has benefitted our ability to get back on track with projects on the 2014 roadmap

# Roadmaps for and from the community

HEP community-wide "Snowmass" study process organized by the American Physical Society (APS) Division of Particles and Fields (DPF) & Division of Particles and Beams held July 2022. https://snowmass21.org/start

- Identify science questions & directions & options to address these for the coming decade.

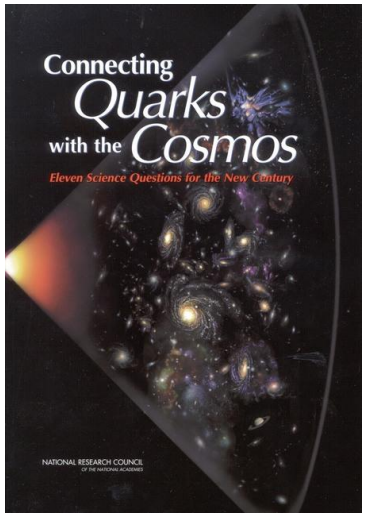
National Academy of Sciences (NAS) Elementary Particle Physics (EPP) Decadal Survey will complement the P5 process.

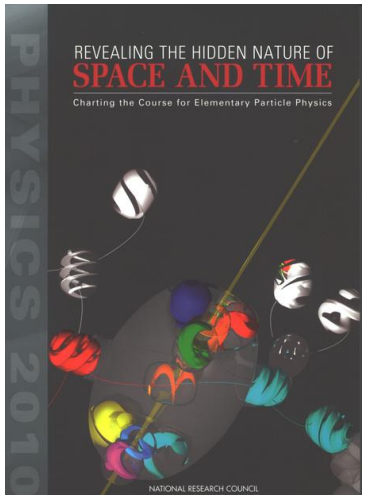


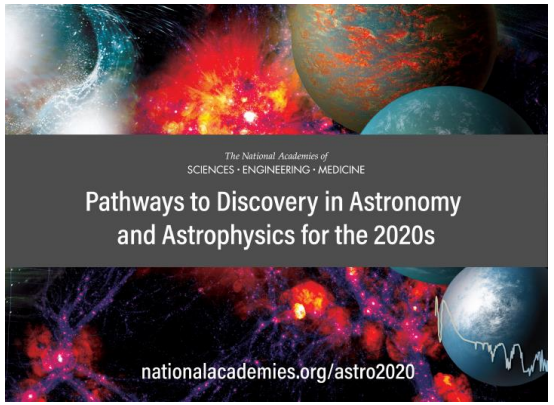
# Roadmaps for and from the community

- Overall goal is a community-led and externally vetted **strategic plan for HEP science for next 2-3 decades**
- Snowmass is largely HEP community view, and provides updated input to P5
  - P5 will look at specific projects within specific budget guidance, and related topics
- We look to NAS to bring in other viewpoints, other fields of science, "outside the box" thinking

  Past successful examples of these type studies would include *Quantum Universe* and *Quarks to Cosmos* studies




# Overview of the EPP2024 Charge Elements

1. 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.

2. 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.

3. Suggest technical research areas that could provide particle physics with new tools needed to enable new techniques and approaches.

4. 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.

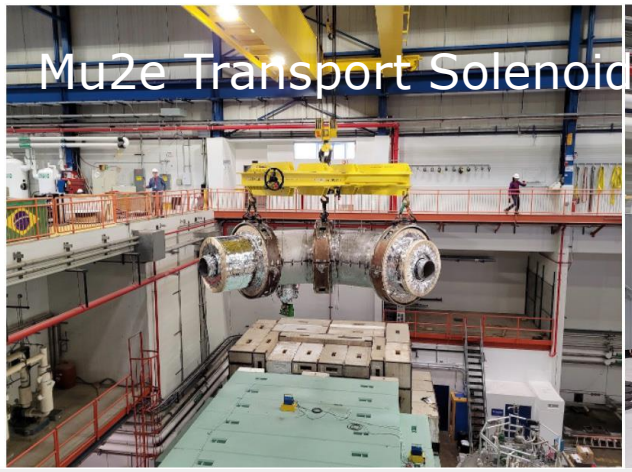
# HEP Projects Status

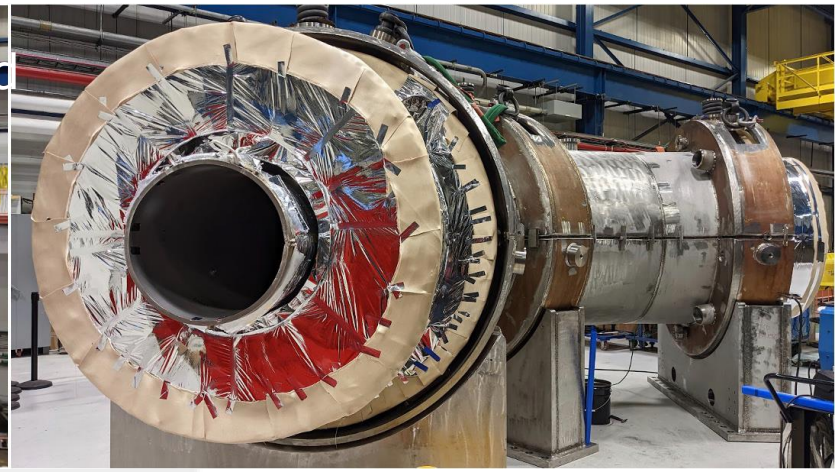
- LBNF/DUNE had a CD-1RR review in July 2022.
  - There will be an ESAAB with the Undersecretary of Energy to approve this in January 2023.
  - The first LBNF/DUNE subproject (Excavation) received CD-2/3 in August 2022.
  - The next subproject was reviewed for CD-2/3 in November 2022.
  - There are also small CD-3a (<$20 million) reviews for Far Detector and Cryogenics, and Near Site Conventional Facilities.
  - LBNF/DUNE received **$125 M** of funding from the Inflation Reduction Act.
    - This prevented the schedule from stretching due to the high inflation.

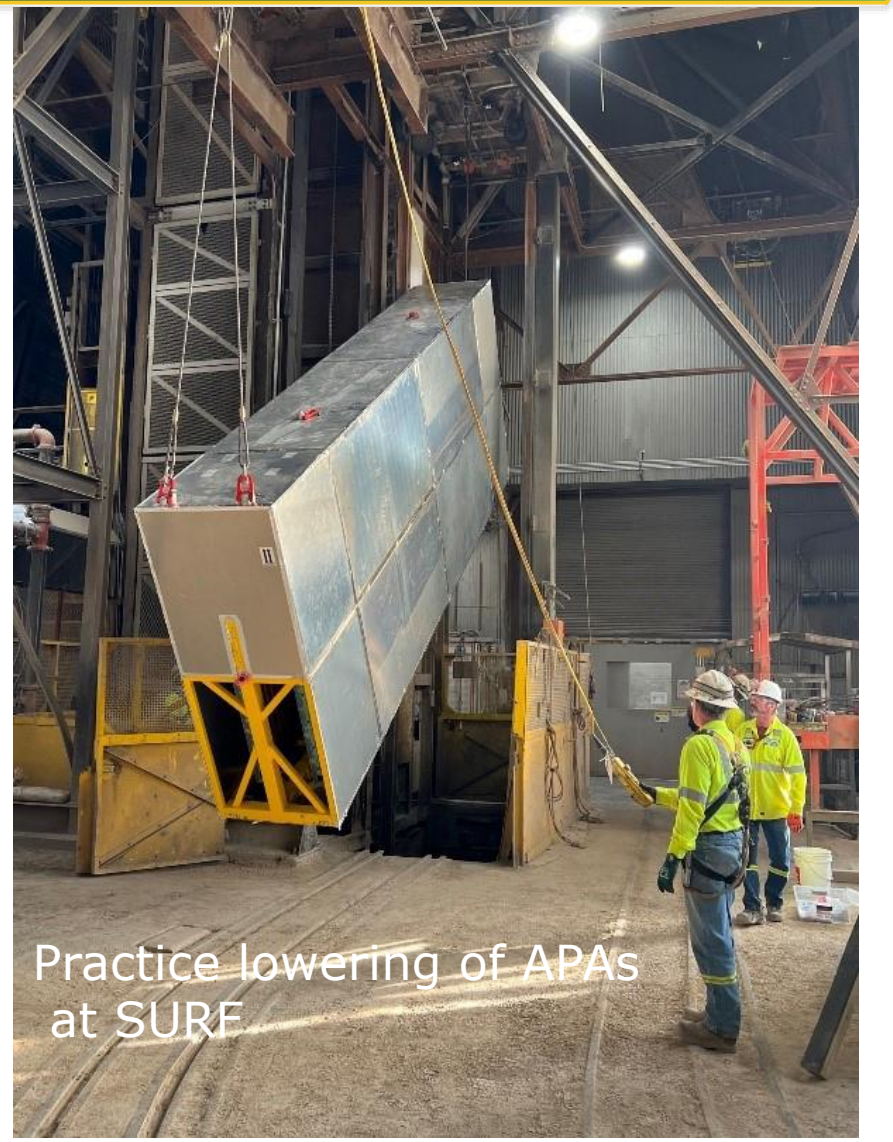
# HEP Project Status…

- Mu2e passed its Rebaseline review in September 2022.
  - The ESAAB is being planned for December 2022 with Dr. Berhe.
  - IRA funding of **$36 million** will allow the project to complete on a technically limited schedule.
- HL-LHC projects are all getting baselined and receiving IRA funding.
  - HL-LHC ATLAS had its CD-2/3 review in October and is getting **$32.8 million** from the IRA.
  - HL-LHC CMS will have its CD-2/3 review in January 2023 and is getting **$36.6 million** of IRA funding.
  - HL-LHC AUP is having its Rebaseline review in December 2022 and is getting **$38.4 million** of IRA funding.
- ACORN, PIP II, and CMB-S4 are also getting IRA funding.

# Progress on projects



# HEP International: DOE-CERN Cooperation

- Cooperative partnership between DOE and CERN in the global HEP program continues to be strong
- In 2017, DOE and CERN signed a Neutrino Addendum agreement that established the framework of CERN's contribution of the first large cryostat for the LBNF infrastructure
- An agreement amending the 2017 Addendum to include CERN's additional contribution of the second LBNF cryostat was signed by DOE (SC Director Berhe) and CERN (DG Gianotti) in September 2022


Signatures by Dr. Fabiola Gianotti (CERN DG) and Dr. Asmeret Berhe (DOE Director, Office of Science)

# HEP International: Other Cooperative Activities

Other cooperative arrangements that have been prepared or are being discussed with partners:


- CERN: additionally in 2017, DOE and CERN signed LHC Addenda agreements for DOE's contributions to the HL-LHC accelerator and HL-LHC ATLAS and CMS detector upgrades
  - DOE coordinating with CERN, U.S. ATLAS and U.S. CMS, and the international experiments to amend the total project costs specified in those agreements following CD-2 baseline (ATLAS, CMS) or re-baseline (accelerator) agency reviews and approvals; Amendments anticipated to be signed in 2023

- Italy: two draft agreements in advanced discussions with MUR/INFN, one to cooperate in advanced computing for HEP and the other on Italy's contributions to DUNE; anticipated to be signed in 2023

- France CEA: draft DOE-CEA agreement for France's contributions to the PIP-II accelerator project actively being discussed with CEA; in anticipation of signing in 2023

# HEP International: Other Cooperative Activities

Other cooperative arrangements that have been prepared or are being discussed with partners:

- France CNRS/IN2P3: draft DOE-CNRS agreement for France's contributions to DUNE in its final stage of review by the U.S. State Department in anticipation of discussing provisions in 2023 with CNRS/IN2P3

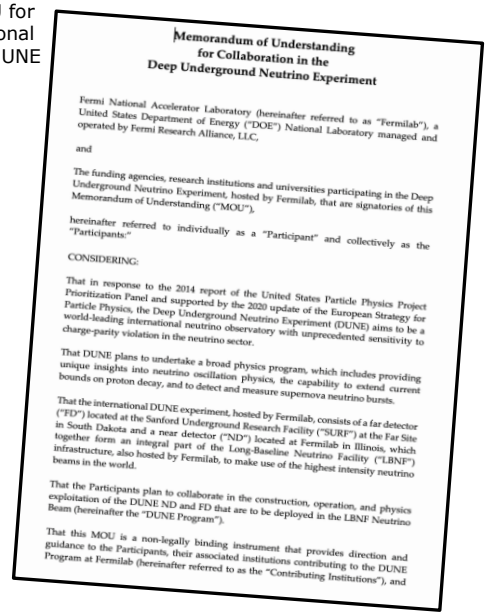
- Spain: draft agreement for Spain's contribution to DUNE Far Detectors in final stage of review by the U.S. State Department in anticipation of discussing provisions in 2023 with Spain's science ministry

- India: in discussions with India's DAE to advance India's PIP-II cooperation from the R&D to its construction phase by April 2023

# HEP International: Other Cooperative Activities

- Processing approvals at DOE that will authorize signature by Fermilab to the multi-institutional DUNE MOU between Fermilab and the collaborating international partners to DUNE's Far Detector #1
  - Once approved, Fermilab to sign MOU with CERN, Italy, the UK, Brazil, Spain, Czech Republic, and Canada

Proposed multi-institutional MOU for Collaboration by International Partners in DUNE



**Memorandum of Understanding for Collaboration in the Deep Underground Neutrino Experiment**

Fermi National Accelerator Laboratory (hereinafter referred to as "Fermilab"), a United States Department of Energy ("DOE") National Laboratory managed and operated by Fermi Research Alliance, LLC,

and

The funding agencies, research institutions and universities participating in the Deep Underground Neutrino Experiment, hosted by Fermilab, that are signatories of this Memorandum of Understanding ("MOU"),

hereinafter referred to individually as a "Participant" and collectively as the "Participants:"

CONSIDERING:

That in response to the 2014 report of the United States Particle Physics Project Prioritization Panel and supported by the 2020 update of the European Strategy for Particle Physics, the Deep Underground Neutrino Experiment (DUNE) aims to be a world-leading international neutrino observatory with unprecedented sensitivity to charge-parity violation in the neutrino sector.

That DUNE plans to undertake a broad physics program, which includes providing unique insights into neutrino oscillation physics, the capability to extend current bounds on proton decay, and to detect and measure supernova neutrino bursts.

That the international DUNE experiment, hosted by Fermilab, consists of a far detector ("FD") located at the Sanford Underground Research Facility ("SURF") at the Far Site in South Dakota and a near detector ("ND") located at Fermilab in Illinois, which together form an integral part of the Long-Baseline Neutrino Facility ("LBNF") infrastructure, also hosted by Fermilab, to make use of the highest intensity neutrino beams in the world.

That the Participants plan to collaborate in the construction, operation, and physics exploitation of the DUNE ND and FD that are to be deployed in the LBNF Neutrino Beam (hereinafter the "DUNE Program"),

That this MOU is a non-legally binding instrument that provides direction and guidance to the Participants, their associated institutions contributing to the DUNE Program at Fermilab (hereinafter referred to as the "Contributing Institutions"), and

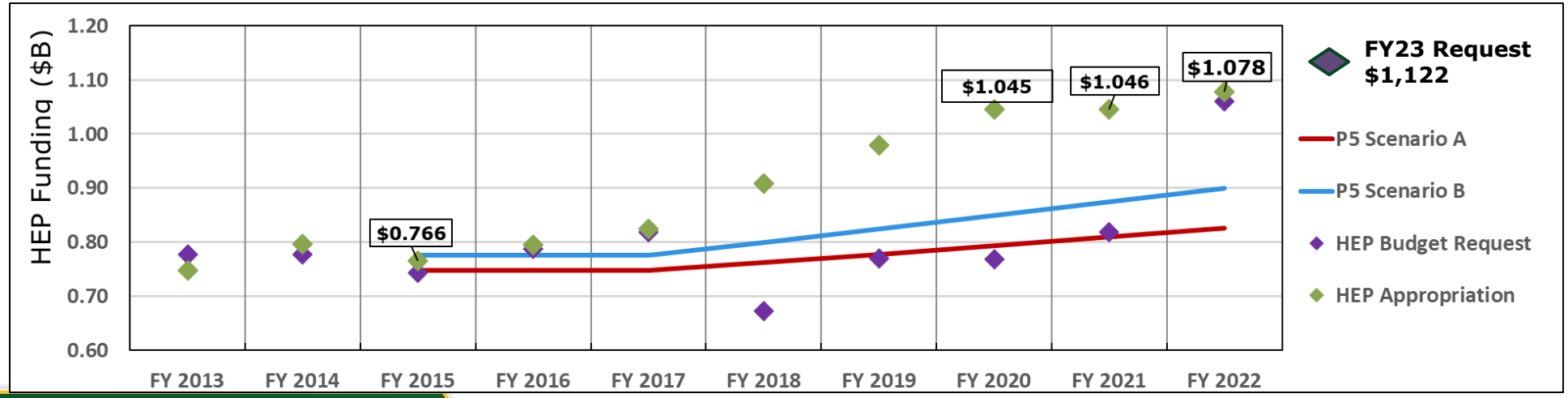
- DOE/HEP continues coordinating with Fermilab the preparation of Project Planning Documents (i.e., "MOUs") for LBNF and PIP-II facilities that detail project-specific activities and deliverables by the international partners and the respective project's planned milestones and schedules

- DOE/HEP and CERN coordinating the preparation of a Fermilab-CERN MOU for Future Circular Collider (FCC) design studies under the FCC feasibility study now progressing with CERN and global partners

- DOE/HEP coordinating with NSF Div. of Astronomical Sciences, SLAC, and the Association of Universities for Research in Astronomy (AURA) to prepare data access agreements for Vera Rubin Observatory/LSST
  - DOE agreements with UKRI-STFC, France-CNRS/IN2P3, and other potential partners are in the pipeline

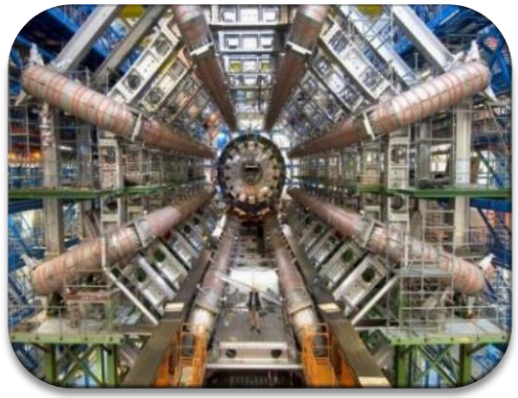
# Perspective on budgets

- HEP is continuing to carry out the 2014 P5 Strategic Plan
- The Projects selected for this P5 strategic plan offer significant leaps in addressing the HEP science goals identified by P5 and other strategic planning studies
- This plan was well received by Congress and the budget in the years 2015 onward reflects this support



# Office of High Energy Physics at a Glance

## FY 2022 Enacted: $1.078B



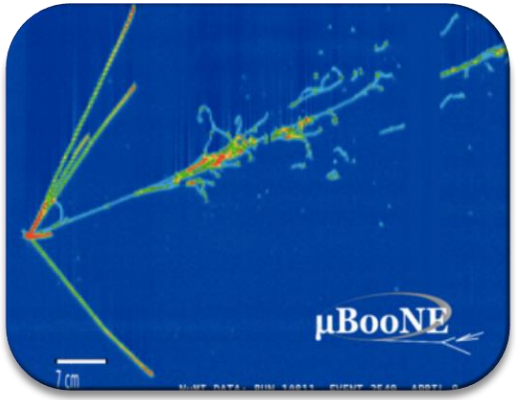
Largest Supporter (**~85%**) of Particle Physics in the U.S.

Funding at **>160** Institutions, including **12** DOE Labs

Over **1,100** Ph.D. Scientists and **600** Grad Students Supported

Over **2,475** Users at **2** SC Scientific Facilities

**~30%** of Research to Universities




Research:

**38.2%, $412.3M**

Facility Operations:

**27.8%, $299.7M**

Projects:

**34%, $366M**

# Timeline of Budget Headlines

**15 Mar 2022**

Pres. Biden signed the $1.5T FY 2022 Consolidated Appropriations Act H.R. 2471

No longer subject to spending caps of the Budget Control Act of 2011

**1.078B HEP**


**29 Mar 2022**

President's 2023 $1.6T discretionary budget request submitted to Congress

Would increase non-defense appropriations by about $97B (13%) over the 2022 enacted level

**1.112B HEP**


**20 Jun 2022**

House Appropriations Subcommittee for Energy and Water Development, and Related Agencies released a summary for the FY 2023 House Mark

**1.158B HEP**


**28 Jul 2022**

Senate Appropriations Subcommittee for Energy and Water Development, and Related Agencies released a summary for the FY 2023 Senate Mark

**1.168B HEP**


**9 Aug 2022**

Bipartisan CHIPS and Science Act of 2022 signed into law

Appropriates $39B for U.S. semiconductor, manufacturing, and workforce

Authorizes Science R&D for FY 2023-27


**16 Aug 2022**

Inflation Reduction Act of 2022 signed into law

Provides 1.55B to Office of Science to accelerate ongoing facility upgrades and national laboratory infrastructure projects

**304M HEP**

**30 Sep 2022**

Continuing Appropriations and Ukraine Supplemental Appropriations Act, 2023, signed into law

Continuing resolution temporarily extends fiscal year 2022 spending levels until Dec. 16


**16 Dec 2022**

Deadline for Congress to avoid a government shutdown.

***Today:*** Agencies await The Hill's decision to 1) pass another CR or 2) pass FY 2023 Omnibus Approp. Bill


**Feb 2023**

Release of FY 2024 President's Request

***Today:*** Agencies await OMB to pass back initial budget decisions on their budget requests

Science Act Authorization for High Energy Physics
$1.160B in FY 2023, $1.290B in FY 2024, $1.428B in FY 2025, $1.500B in FY 2026, $1.555B in FY 2027

# Budget Highlights: FY 2022 Enacted, IRA & FY 2023 CR

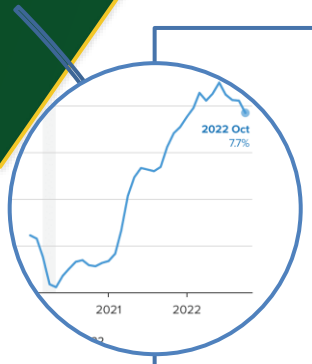
| HEP Budget | FY 2022 Final | FY 2022 IRA | FY 2023 Con. Resolution |
|---|---|---|---|
| Research | 412,272 | | 425,173 |
| Facilities/Operations | 299,728 | | 328,827 |
| Projects | 366,000 | 303,656 | 324,000 |
| **HEP Total** | **1,078,000** | **303,656** | **1,078,000** |

- FY 2022 Discretionary Budget Highlights *(excludes Line-Items Construction)*
  - Funding for Research, Facilities/Operations, MIE Projects, and SBIR/STTR increased by 16M from FY 2021 Enacted
  - To maintain progress on 3 HL-LHC projects and synchronization with international schedule, HEP redirected funds in FY 2022 enacted (+$25M above the PB Request)
  - Accelerator Stewardship (now supported by ARADP). Funded by HEP at ~17M in FY 2021. No adjustment to HEP FY 2022 topline
  - Lunar Surface Electromagnetics Experiment (LuSEE-Night): Pathfinder mission to understand radio environment on the moon & potentially make the first measurement of the Dark Ages signal. Not included within FY 2022 PB Request. TPC of $15M Joint Partnership with NASA. Fully funded in FY 2022

| Projects | FY 2022 Enacted | FY 2022 IRA | FY 2023 CR |
|---|---|---|---|
| **Mu2e** | 2,000 | 34,879 | 2,000 |
| **Reserve** | | 3,037 | |
| **HL-LHC AUP** | 12,000 | 38,355 | 30,000 |
| **HL-LHC ATLAS** | 20,000 | 32,785 | 10,000 |
| **HL-LHC CMS** | 20,000 | 34,600 | 10,000 |
| **ACORN** | 2,000 | 15,000 | 1,000 |
| **CMB S4** | 8,000 | 10,000 | 1,000 |
| **LuSEE-Night** | 15,000 | | |
| **LBNF/DUNE** | 184,000 | 125,000 | 180,000 |
| **PIP-II** | 90,000 | 10,000 | 90,000 |
| **Total** | **366,000** | **303,656** | **324,000** |

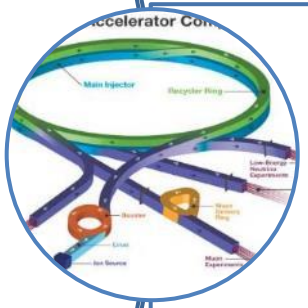
- FY 2022 IRA Supplemental funding enables flexibility in FY 2023 CR without adversely effecting projects
  - HL-LHC CMS/ATLAS yet to be baselined. Each project will have >40M for FY 2023
  - CMB-S4 needs 10M in FY 2023 & 11M in FY 2024
  - Mu2e funding at HQ until re-baseline approval
  - CFO holding 1% reserve

# Budget Challenges for FY 2023



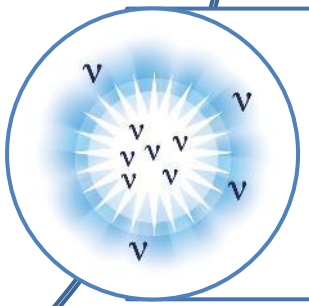

## Inflation

The **~$304M** of FY 2022 IRA funding to HEP projects has enabled the flexibility to mitigate inflationary impacts to core research, access to facilities, and infrastructure investments. HEP increased lab research and facilities/operations funding by ~8% over FY 2022. Following an FY 2023 omnibus appropriations, a similar increase to research funding is anticipated to be available for University awards



## Supply Chain

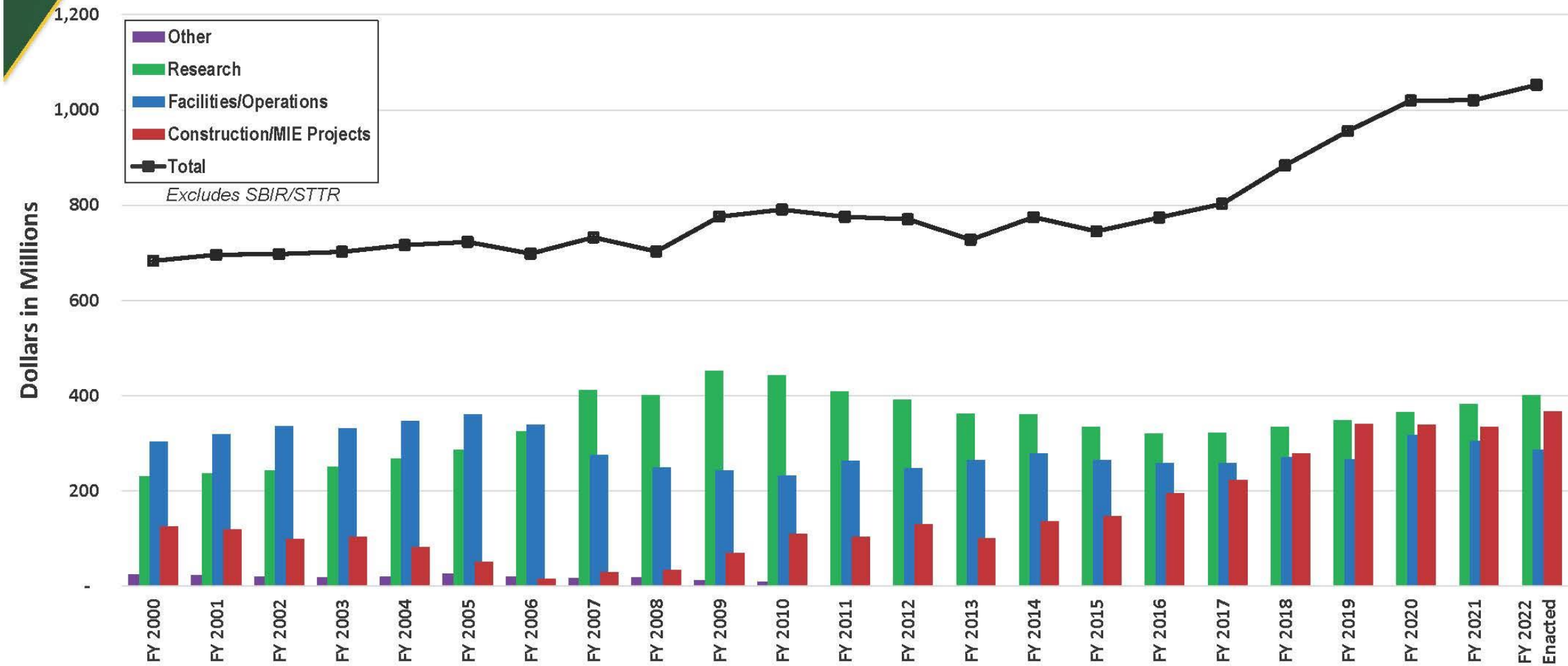
Reliable supply of highly specialized components, materials, and techniques. How to mitigate risk from sole source vendors (cost and schedule), early industry obsolescence (techniques and components), and supply chain economics



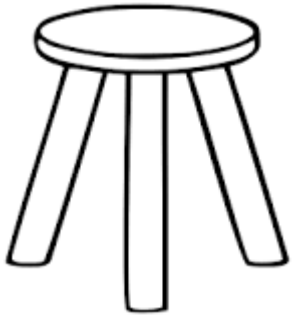
## Projects

Several HEP projects will be re-baselined over the next several months to account for the accumulative impacts due to global pandemic.


# HEP Budget by Component FY 2000-2022



# • Maintaining balance is essential



- University Community :
  - Curiosity driven
  - Empowered to teach and train
  - Offers opportunity and has broad reach
- Research Funding Agencies :
  - Proposal driven or Mission driven
  - Accountable to Congress and taxpayers
  - Major support from international partners


- Laboratories
  - Proposal, mission and curiosity driven
  - Synergistic environments where the all can come together and partner to deliver more than each alone could do

# Summary and Outlook

- Broad support from the White House, Congress, the Agencies and the science community is enabling us to implement the P5 strategic plan and achieve its vision!
  - Many thanks to the DOE Management, the Administration, and Congress for their support
  - SC activities in Accelerators, Advanced Computing, QIS, AI/ML, Microelectronics, WDTS, and Science Laboratories Infrastructure (SLI) provide additional support to enable P5 goals
- Particle physics community is successfully implementing the P5 strategy by delivering on projects and producing excellent science, even while facing recent challenges
- We will continue to work with the community and our international partners as we proceed with the next phase of long-term community planning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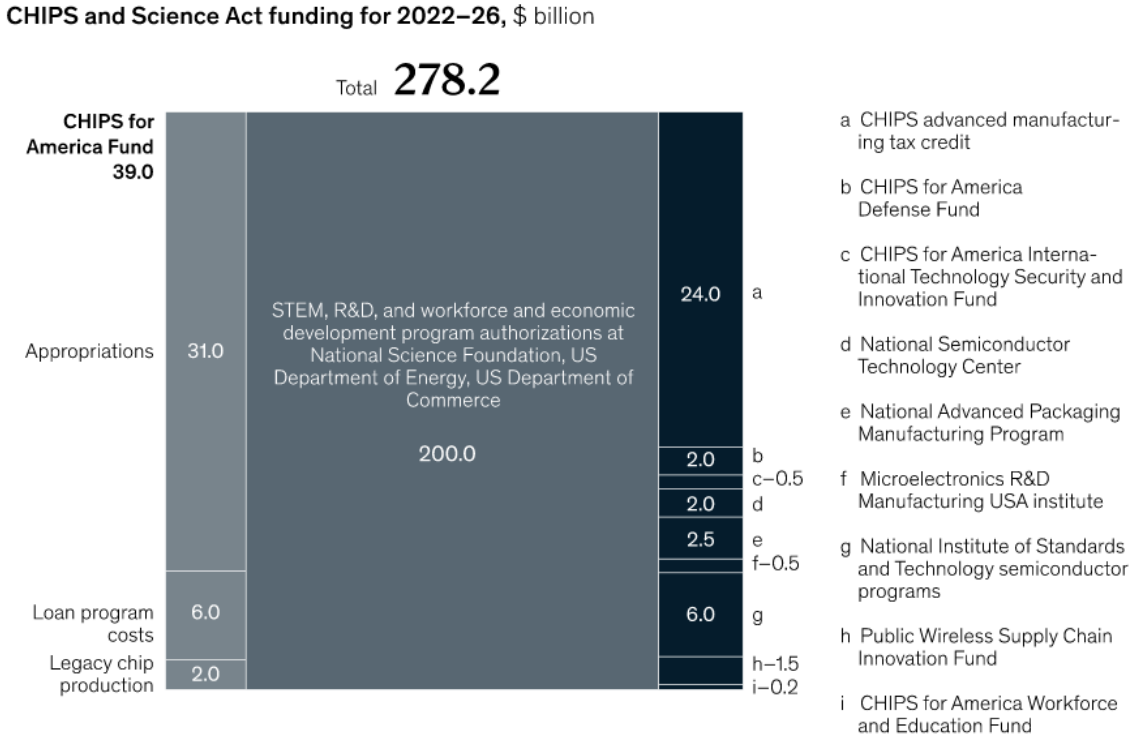
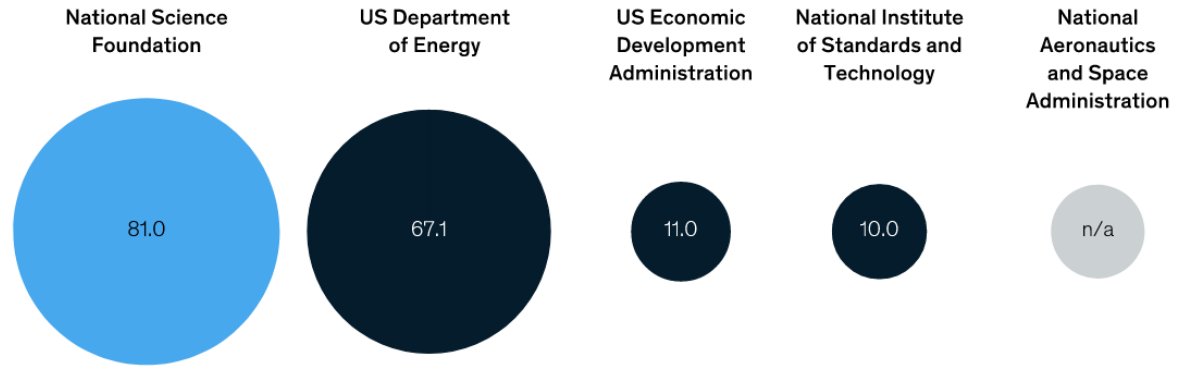
# Backup Slide: CHIPS and Science Act




Source: Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022, H.R. 4346, 117th Cong. (2022)

**The CHIPS and Science Act authorizes $174 billion for investment in science, technology, engineering, and math programs, workforce development, and R&D.**




[1]Final funding levels subject to future budget appropriations by US Congress.
Source: Congress.gov; Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022, H.R. 4346, 117th Cong. (2022)

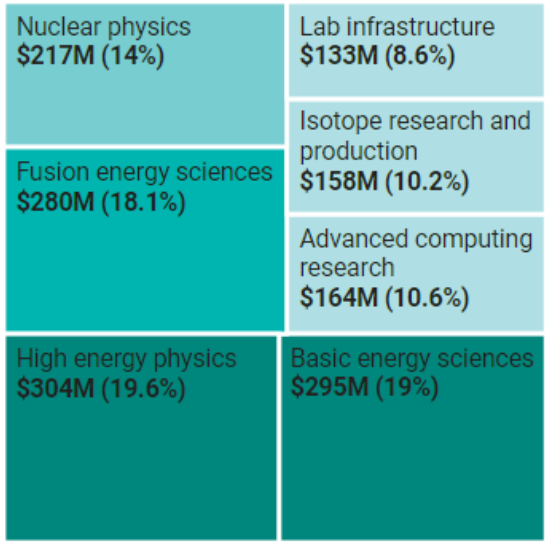
| FY 2023 | FY 2024 | FY 2025 | FY 2026 | FY 2027 |
|---|---|---|---|---|
| $1.160B | $1.290B | $1.428B | $1.500B | $1.555B |

# Backup Slide: Inflation Reduction Act

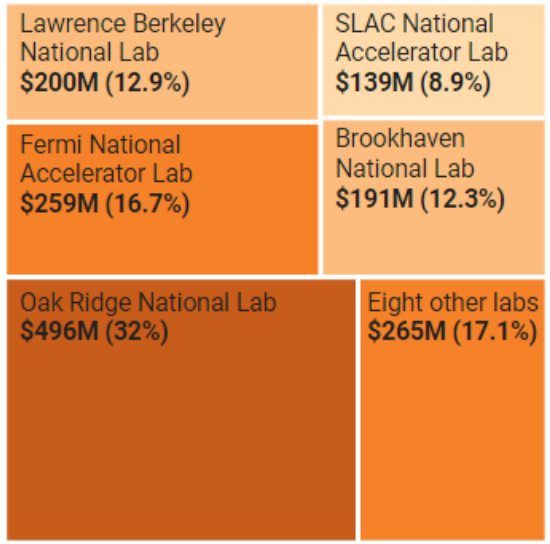
### Slicing the pie—albeit unevenly

In the distribution of an additional $1.55 billion from the Inflation Reduction Act, some of the research programs in the Department of Energy's Office of Science and some of the department's national laboratories benefit much more than others.

**Disbursement by program**




**Disbursement by laboratory**




(GRAPHIC) K. FRANKLIN/*SCIENCE*; (DATA) DOE OFFICE OF SCIENCE