DOE High Energy Physics

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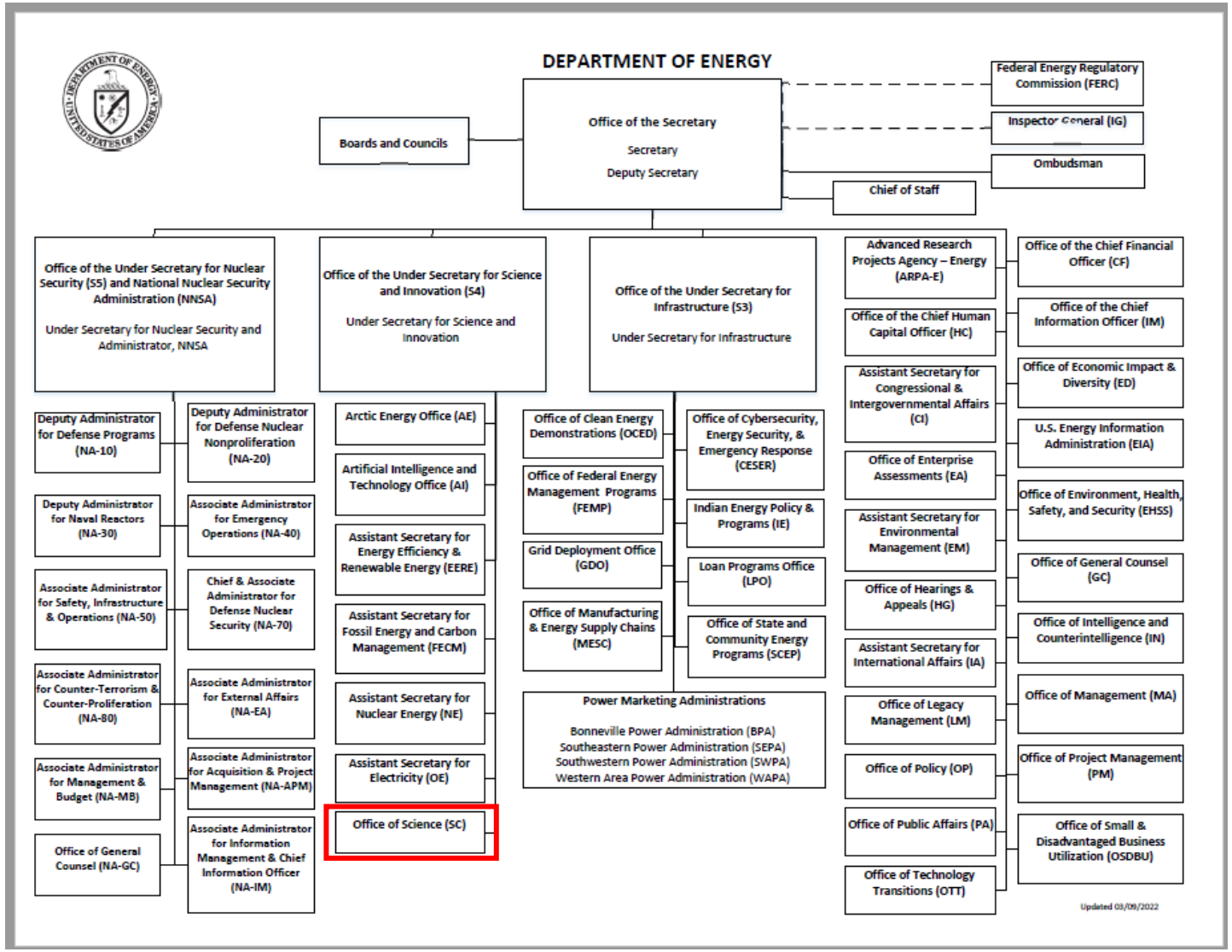
Associate Director for HEP - US DOE Office of Science

56th Annual Fermilab Users Meeting
June 29, 2023

Topics

- HEP in Office of Science
- HEP Overview
- Executing a plan
- Budget Process
- Prospects for New Projects
- Updating our plan
- Outlook

DOE ORG CHART



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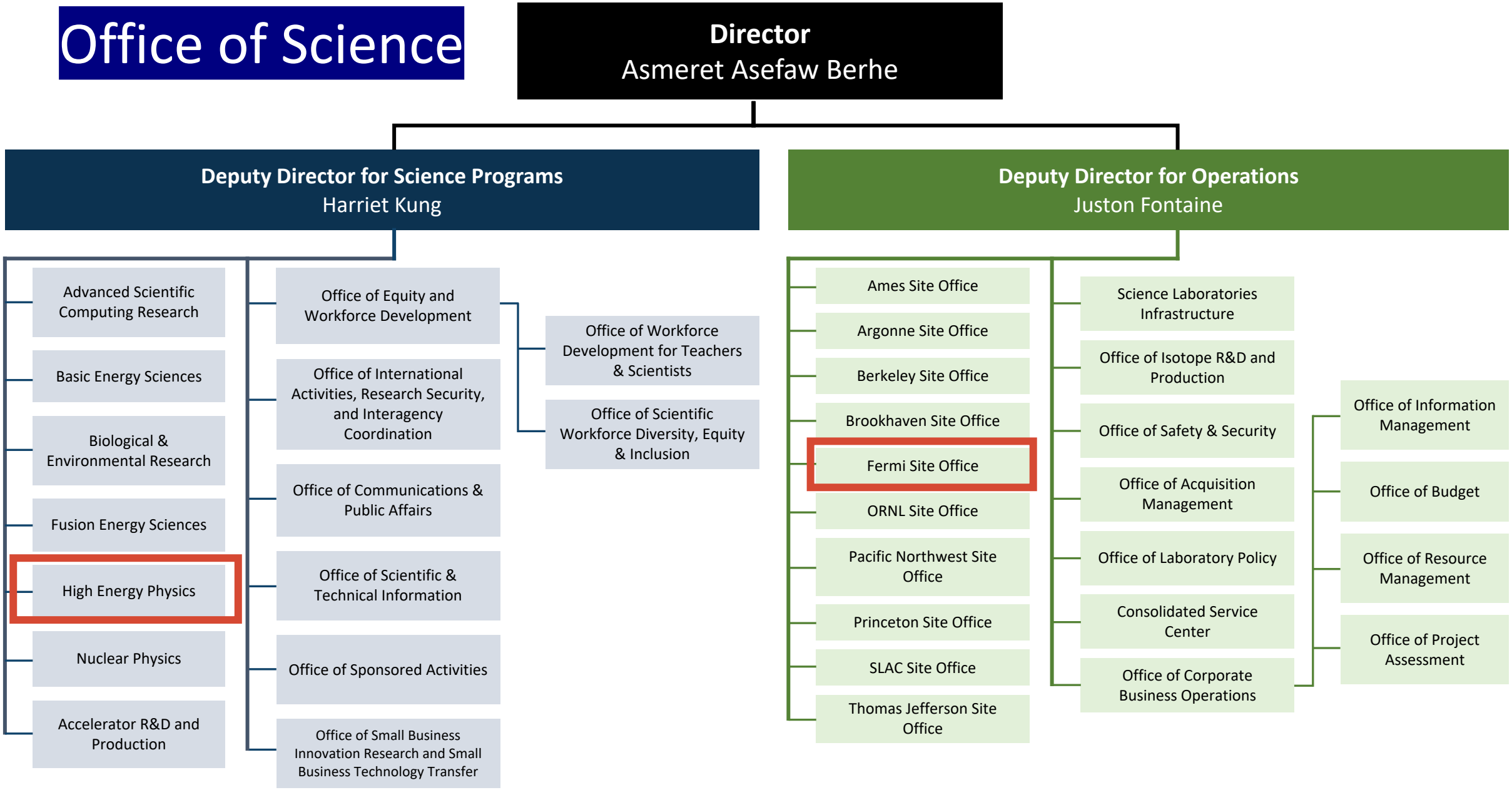

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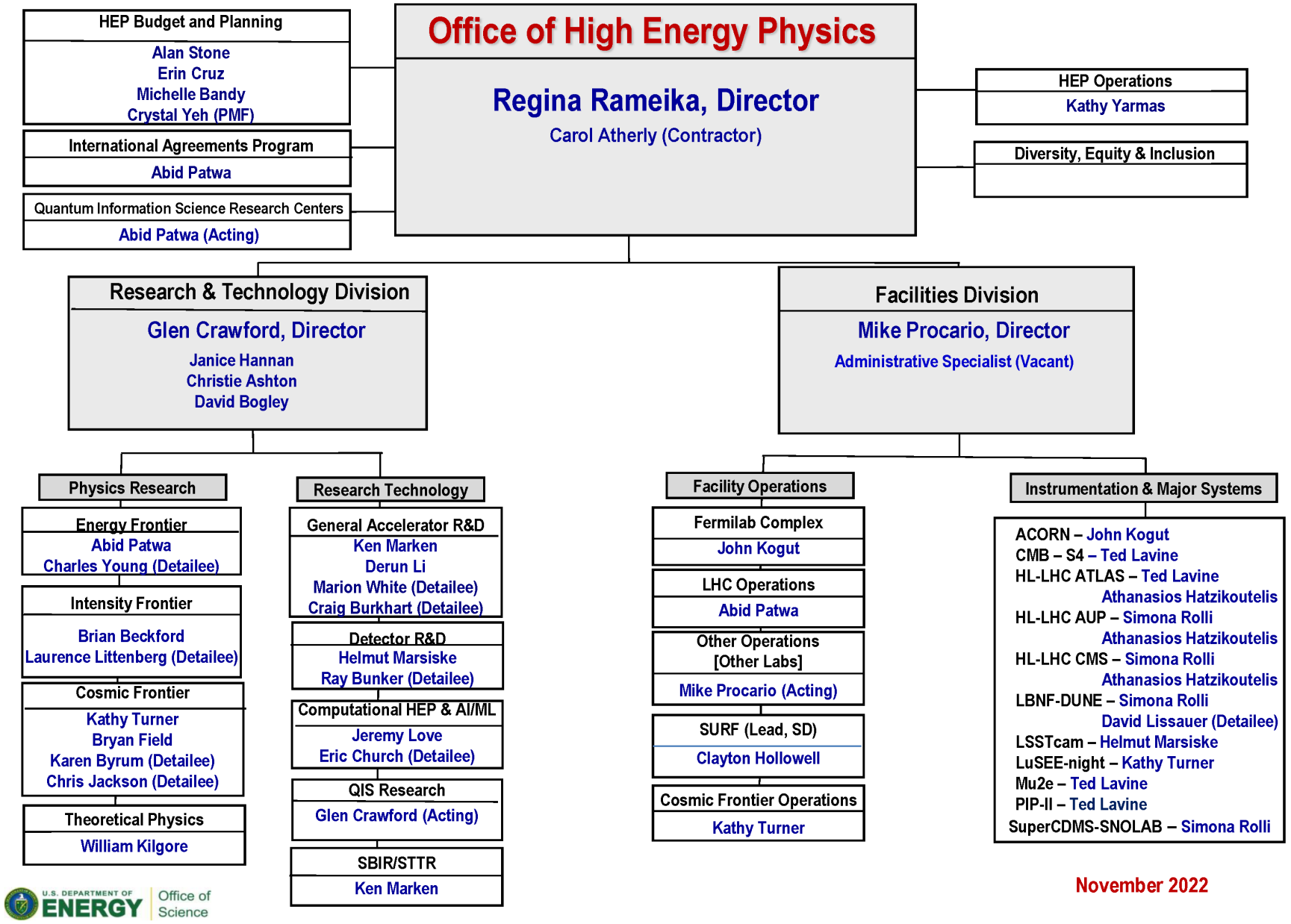
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Research & Technology Division
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Janice Hannan
Christie Ashton
David Bogley
Facilities Division
Mike Procario, Director
Administrative Specialist (Vacant)
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Abid Patwa
Charles Young (Detailee)
Intensity Frontier
Brian Beckford
Laurence Littenberg (Detailee)
Cosmic Frontier
Kathy Turner
Bryan Field
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Chris Jackson (Detailee)
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Detector R&D
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LHC Operations
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Other Operations
[Other Labs]
Mike Procario (Acting)
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Clayton Hollowell
Cosmic Frontier Operations
Kathy Turner
Instrumentation & Major Systems
ACORN – John Kogut
CMB – S4 – Ted Lavine
HL-LHC ATLAS – Ted Lavine
Athanasios Hatzikoutelis
HL-LHC AUP – Simona Rolli
Athanasios Hatzikoutelis
HL-LHC CMS – Simona Rolli
Athanasios Hatzikoutelis
LBNF-DUNE – Simona Rolli
David Lissauer (Detailee)
LSSTcam – Helmut Marsiske
LuSEE-night – Kathy Turner
Mu2e – Ted Lavine
PIP-II – Ted Lavine
SuperCDMS-SNOLAB – Simona Rolli
November 2022
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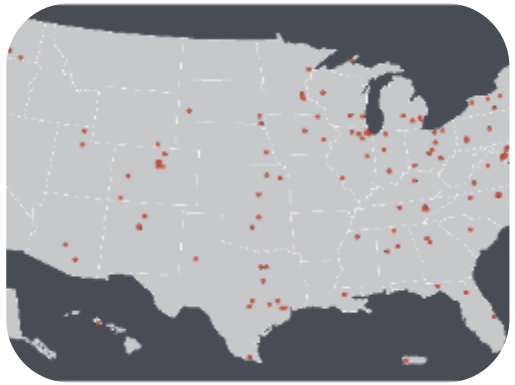
Office of High Energy Physics at a Glance

FY 2023 Enacted: $1.166B

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

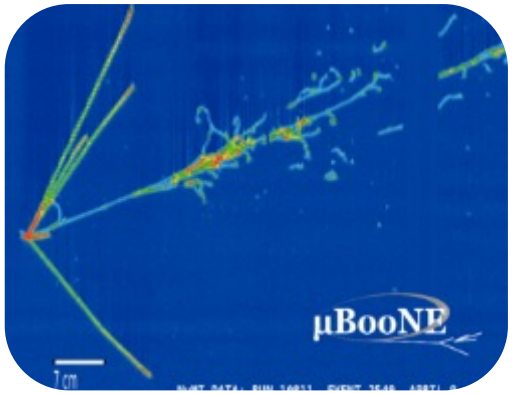


Funding at **>160** Institutions, including **12** DOE Labs

Over **1,175** Ph.D. Scientists and **525** Grad Students Supported

Over **2,325** Users at **2** SC Scientific Facilities

~30% of Research to Universities



Research:

39.8%, $464.4M

40%

Facility Operations:

29.7%, $346.6M

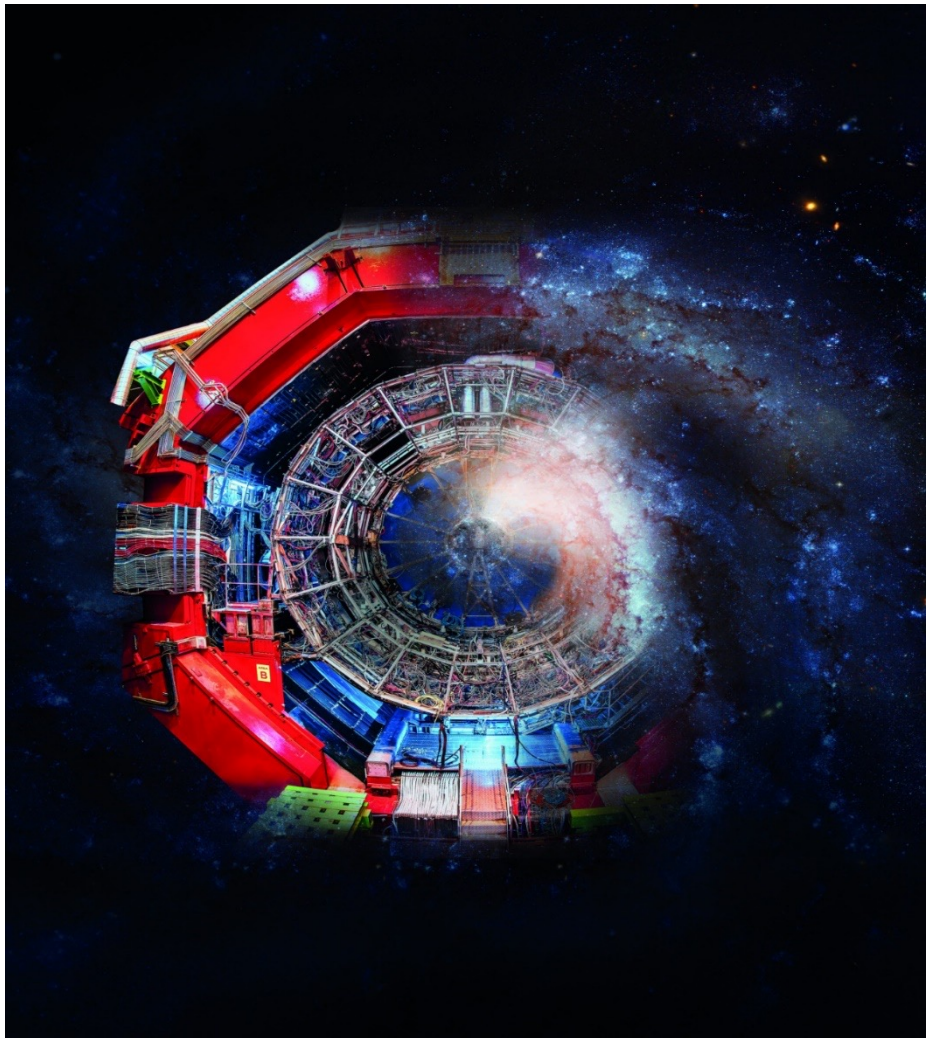
30%

Projects:

30.4%, $355M

30%

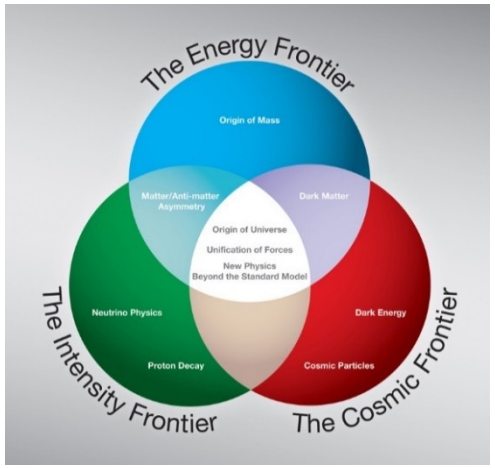
What ~~we~~ You do



Colliders to the Cosmos

Spans the breadth of three "frontiers":

- Energy Frontier
- Intensity Frontier
- Cosmic Frontier



2008 P5

Plus cross-cutting themes

- Theoretical physics
- General Accelerator and Detector R&D
- Computational HEP and AI/ML
- QIS Research

2014 Frontiers to Science Drivers

	Energy Frontier	Intensity Frontier	Cosmic Frontier
Higgs Boson	●		
Neutrino Mass		●	●
Dark Matter	●	●	●
Cosmic Acceleration			●
Explore the Unknown	●	●	●

HEP Budget ($K): Research, Facilities/Ops, Projects

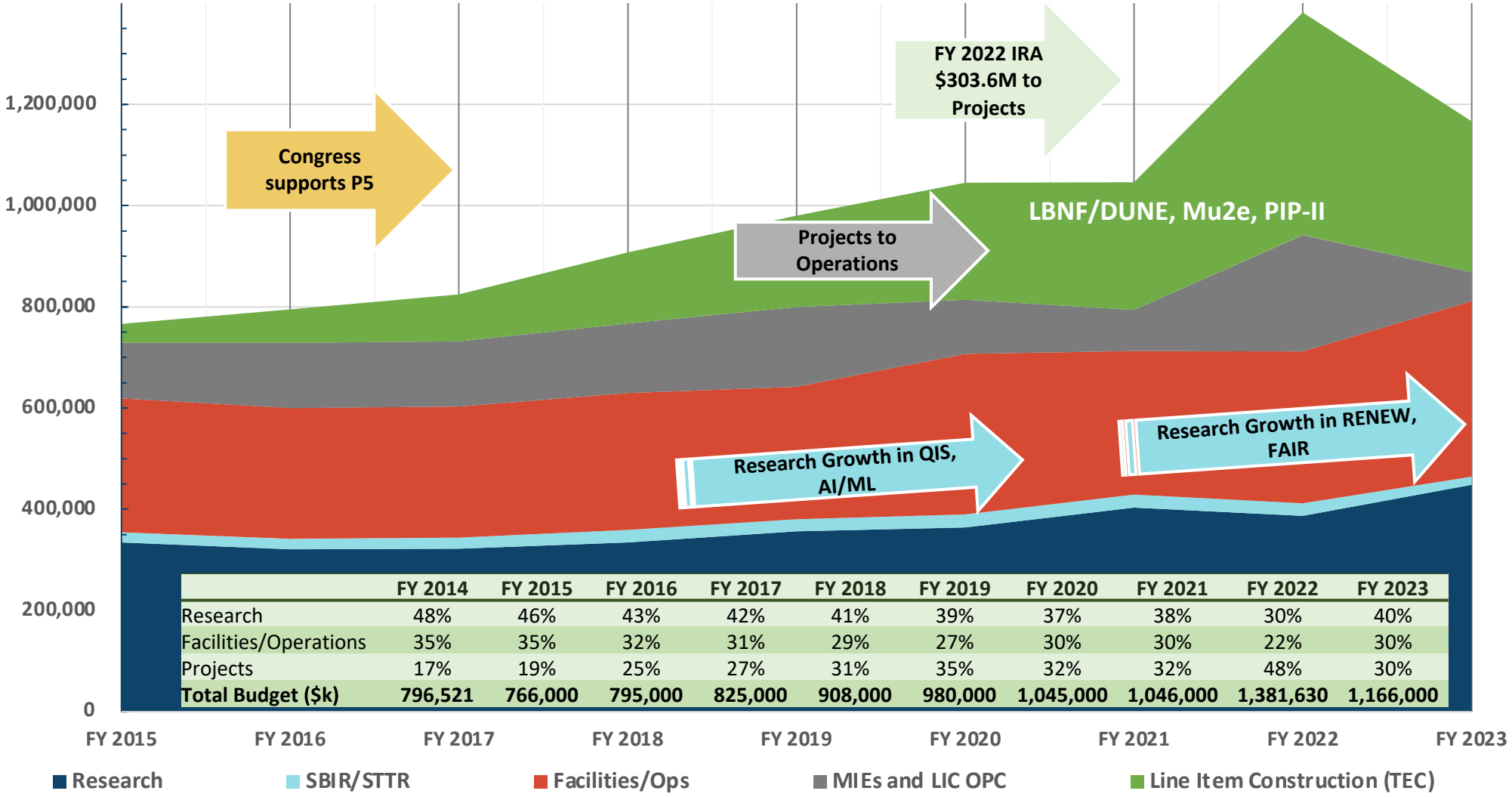
FY 2014 – FY 2023

Strategic Plan for U.S. Particle Physics next 10 years

Particle physics is global

Community made difficult choices

Increase investment in construction

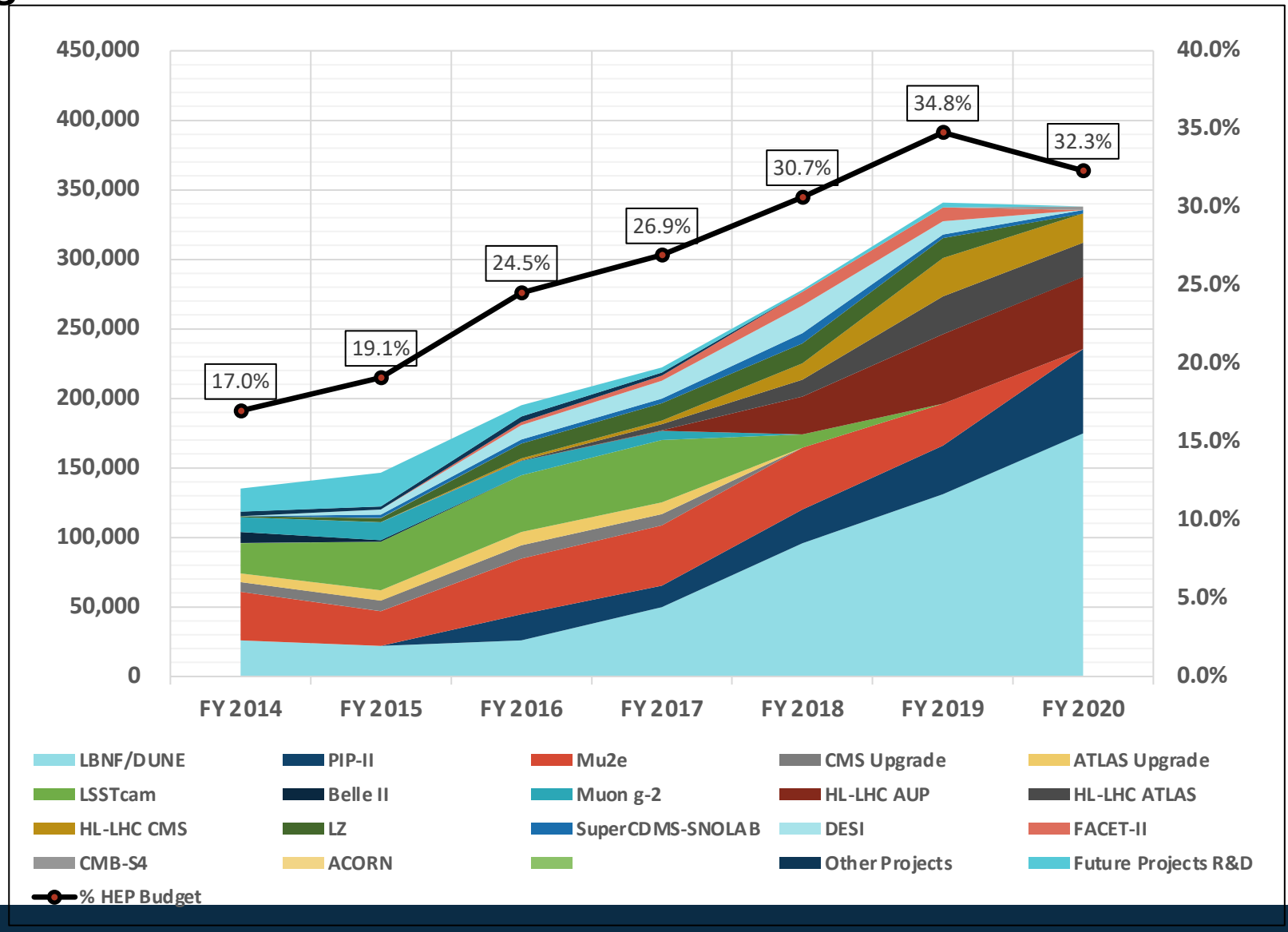


	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Research	48%	46%	43%	42%	41%	39%	37%	38%	30%	40%
Facilities/Operations	35%	35%	32%	31%	29%	27%	30%	30%	22%	30%
Projects	17%	19%	25%	27%	31%	35%	32%	32%	48%	30%
Total Budget ($k)	**796,521**	**766,000**	**795,000**	**825,000**	**908,000**	**980,000**	**1,045,000**	**1,046,000**	**1,381,630**	**1,166,000**

HEP Projects FY 2014-2020

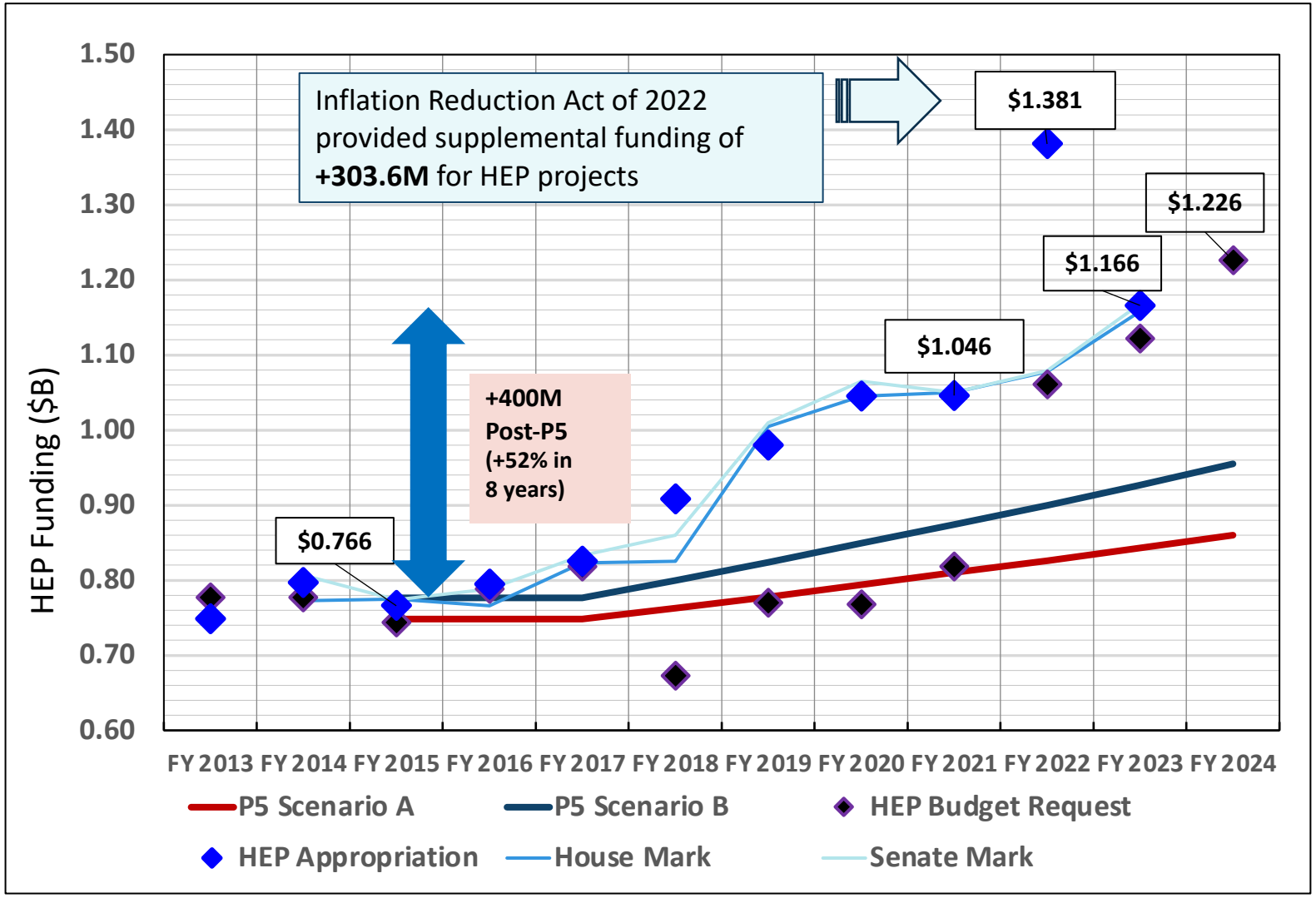
$1.65B. Avg 27.1% of total budget

- About half of P5 HEP projects obtained final funding by FY 2020
  - CMS & ATLAS Detector Upgrades
  - Muon g-2 & Belle II
  - LZ & SuperCDMS SNOLAB
  - LSSTcam & DESI
  - FACET-II
  - Future Project R&D (PIP-II, HL-LHC)
- Project fraction w.r.t. total budget doubled over the period
- Recommended fractions to maintain balanced HEP program
  - Research: 42±2%
  - Facility/Operations: 28±2%
  - Projects: 30±2%



HEP FY 2024 President's Request - Communication Strategy

- The President is required to submit a budget request to Congress early in the legislative session
- The President's budget is only a request to Congress, but it establishes the President's wishes regarding the direction of national policies and priorities and often influences the direction of congressional revenue and spending decisions
- Agencies usually invited to brief Congress on budget request
  - Opportunity to reinforce overall strategy. Highlight key elements of request
  - Informational request for additional detail
  - Respond to requests regarding impact of alternative funding decisions
- SC and HEP await Congressional Appropriation subcommittees (HEWD, SEWD) to designate funding levels for programs and projects
  - Typically, before August recess
- **Bottom line: Request ≠ Appropriations**



HEP FY 2024 President's Request Highlights

- FY 2024 President's Request of **$1,226.3M is an increase of $60.3M, or 5.2%**, above the FY 2023 Enacted level
  - No new starts or initiatives are anticipated
  - **Non-LIC funding $850.3M (-$15.7M decrease)**
- Report from next P5 strategic plan expected in early 2024
  - First budget impact likely to be guidance for FY 2025 Execution
- **Research**
  - +$5.5M increase to RENEW and FAIR
  - -$21.3M decrease to Core Research
- **Facilities Operations**
  - +$4M for Vera Rubin to prepare for FY 2025 survey start
  - -$5M for SURF infrastructure
- **Projects**
  - +$75M to $255M (TPC) to support the 5 LBNF/DUNE subprojects
  - +$8M for CMB-S4 MIE to prepare for CD-1
  - +$5M to support baseline profile of PIP-II
  - -$14.3M overall for the HL-LHC Upgrades
    - +$15.7M for the ATLAS and CMS Detector Upgrades per the planned profiles
    - -$30M as the HL-LHC Accelerator Upgrade received final funding in FY 2023

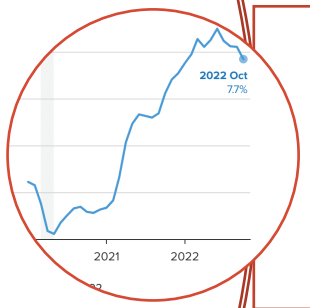
President requests

Congress appropriates

Ongoing HEP Budget Challenges & Opportunities

Core Research

Our recent Committee of Visitors report encouraged HEP to increase research effort and broaden workforce engagement to better match needs for operation of the new experiments and support ongoing construction activities



Inflation

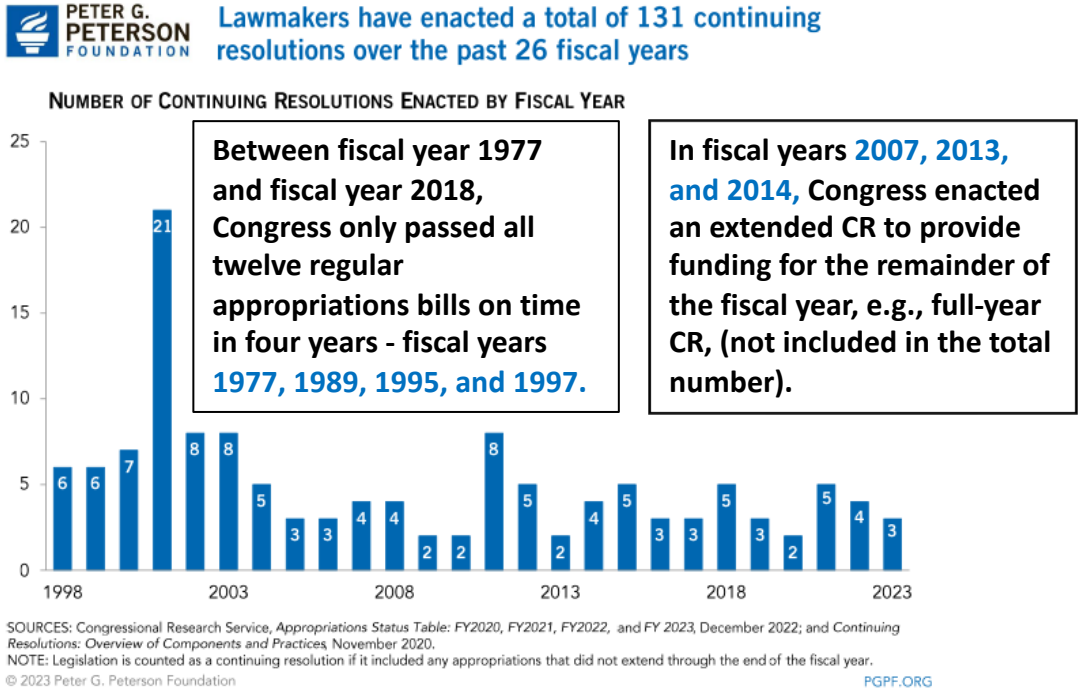
FY 2022 IRA funding to HEP projects enabled the flexibility to mitigate inflationary impacts to core research, access to facilities, and infrastructure investments. HEP increased FY 2023 research and facilities/operations funding by ~8% over FY 2022. Inflation remains a risk for the foreseeable future

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

Impacts of a Continuing Resolution (CR)

- If U.S. Congress and President have not passed and signed all appropriations bills by September 30, a CR may be passed to avoid a U.S. Government shutdown
  - Must pass some form of appropriations to have legal authority to spend money!
  - **CRs are now a routine** part of the federal budget process
  - CRs prevent us from making final funding decisions
  - **Increases workload** as we must revisit funding decisions
- Therefore, a CR may impede the start of new projects
  - Projects with total cost >$5M must be approved by Congress in an appropriations bill before funding can begin
- A CR may also impact the ramp-up of new projects
  - DOE is committed to the successful execution of projects that have reached CD-2 (aim to meet baseline funding profile)
  - **Projects that have not reached CD-2 are most likely to be impacted under a CR**
- Mitigation Strategies for University Grants
  - Moved start dates for University grants back in the Q3 or later in fiscal year
  - Grant funding decisions have a greater chance to be made **after the appropriation is passed**
  - No longer do supplemental awards to fix inadequate award funding made done during a CR
- A CR may also impact future-year planning…



2014 P5 Analysis: HEP Facilities & Operations

FY 2014-2023 ($k)

Increase demands on SC User Facilities

- **Provide higher beam intensity**
- **Manage increasing data processing and storage**
- **Support a growing user population**

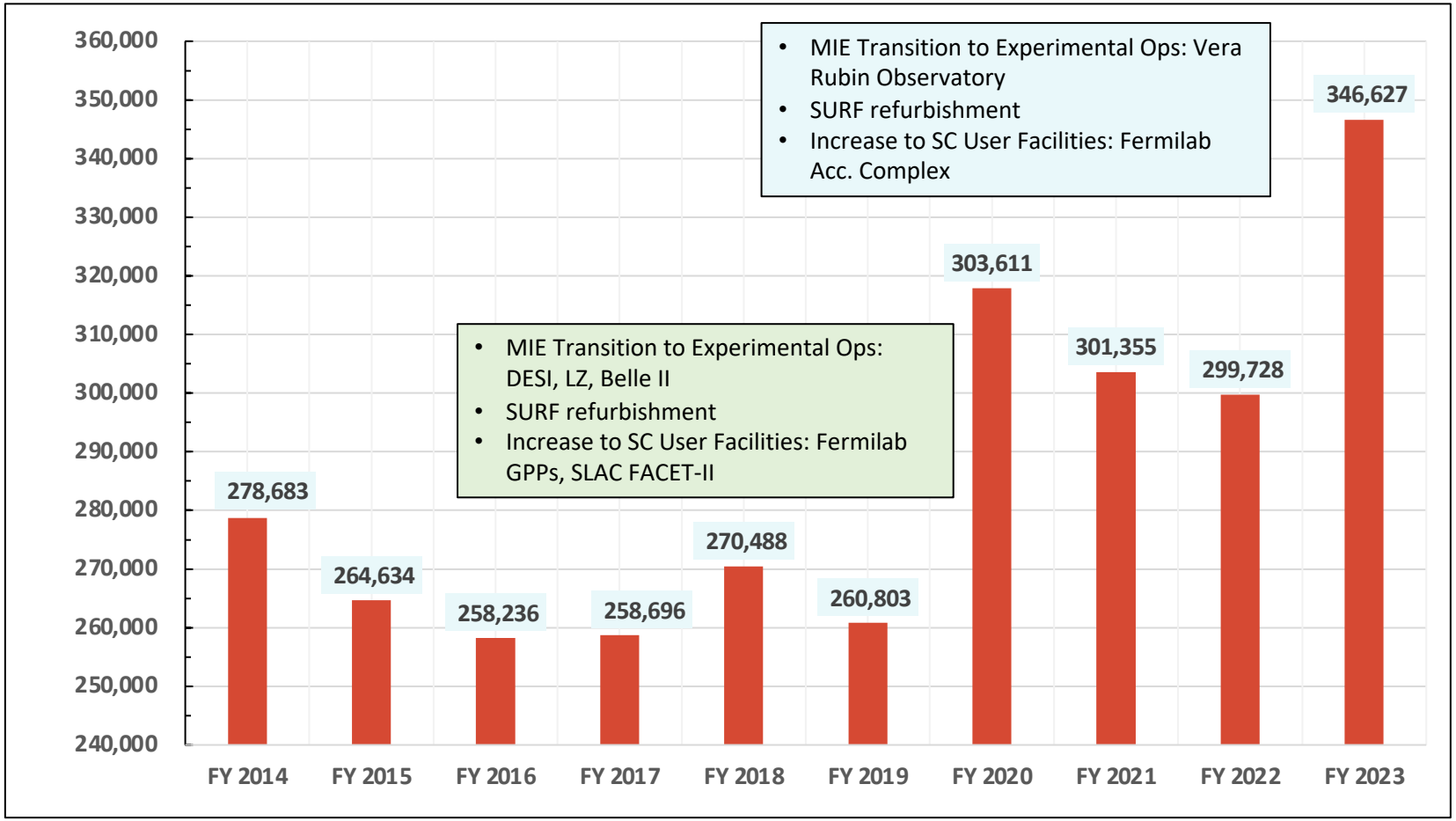
SURF refurbishment

Lab Infrastructure

Cosmic Projects Transition to Experimental Operations

Interagency coordination

International agreements

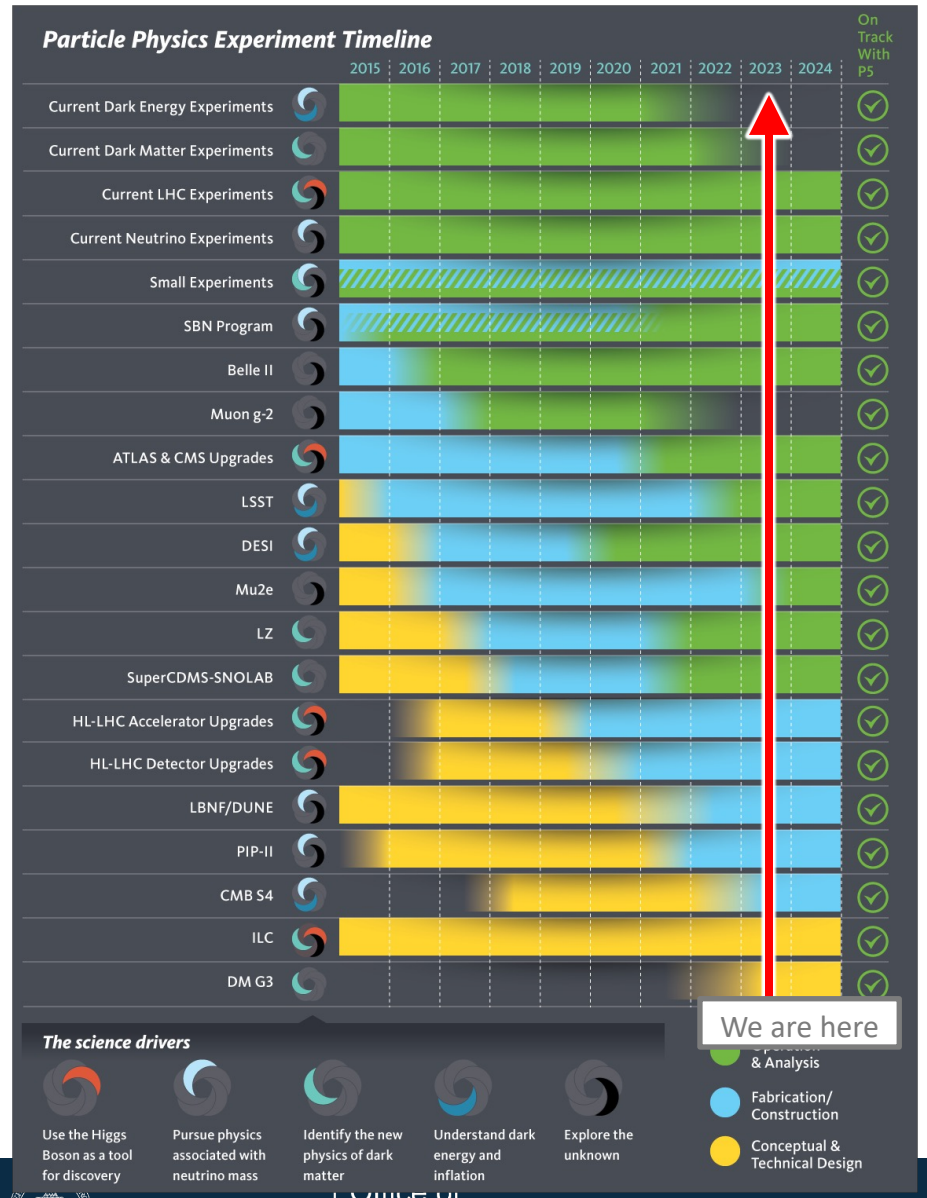


- 2014 P5 report reflected relatively flat funding profile for facilities (~$250M/year)
- P5 implementation demanded much greater resources for both MIE transition to experimental operations, and upgrades and modernization to SC User Facilities

U.S. Particle Physics Strategic Planning Process

- The May 2014 U.S. P5 report was successful because it was **well informed by the science community**, including information from:
  - 2010 New Worlds, New Horizons in Astronomy and Astrophysics
  - 2012 Report of the Subcommittee on Future Projects of High Energy Physics (Japan)
  - 2013 Update of the European Strategy for Particle Physics Report
  - 2013 U.S. Particle Physics Community-driven "Snowmass" process
- Community **engagement continued during** the P5 process:
- P5 report **rollout included targeted engagement** with HEP community, science interested public, and decision makers
- Initial and continuing **community support for P5 strategy** has been critical to successful implementation

2014 P5 Implementation Status



Implementation of the 2014 P5 strategy continues

Continuous physics analyses and output throughout the "P5 envisioned" 10-year plan

- HL-LHC accelerator and detector upgrade projects underway
- LBNF/DUNE & PIP-II schedules advanced due to strong support by the U.S. Administration & Congress
- DESI, LZ and LSSTCam (for Rubin Observatory) projects completed
- Broad portfolio of small projects running

- General assessment – good progress, in spite of Covid delays

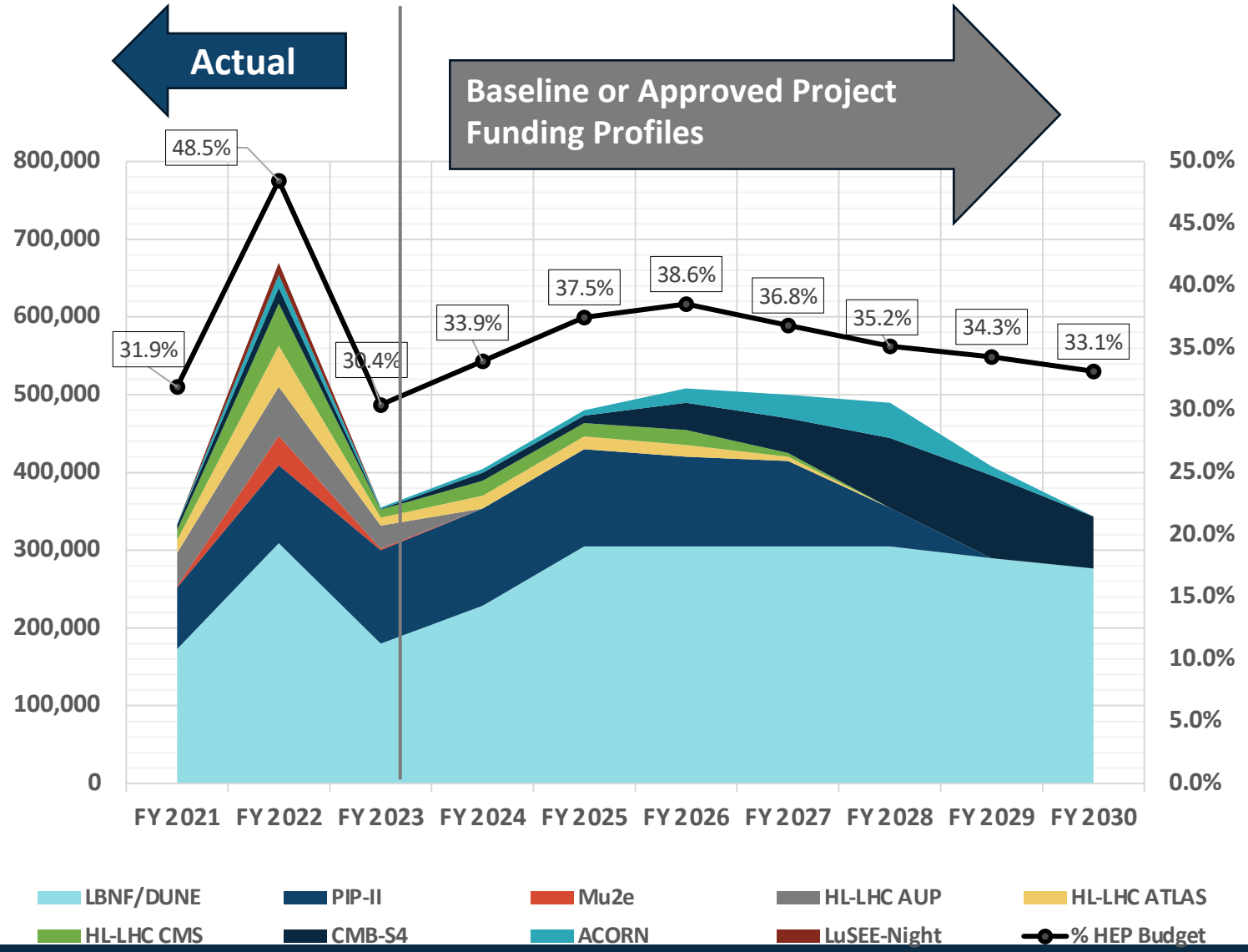
- LSST and Mu2e not yet operating
- CMB-S4 not yet in construction
- Direction for Future Colliders (beyond High Lumi-LHC) undetermined

- **Time to update and refresh the plan…**

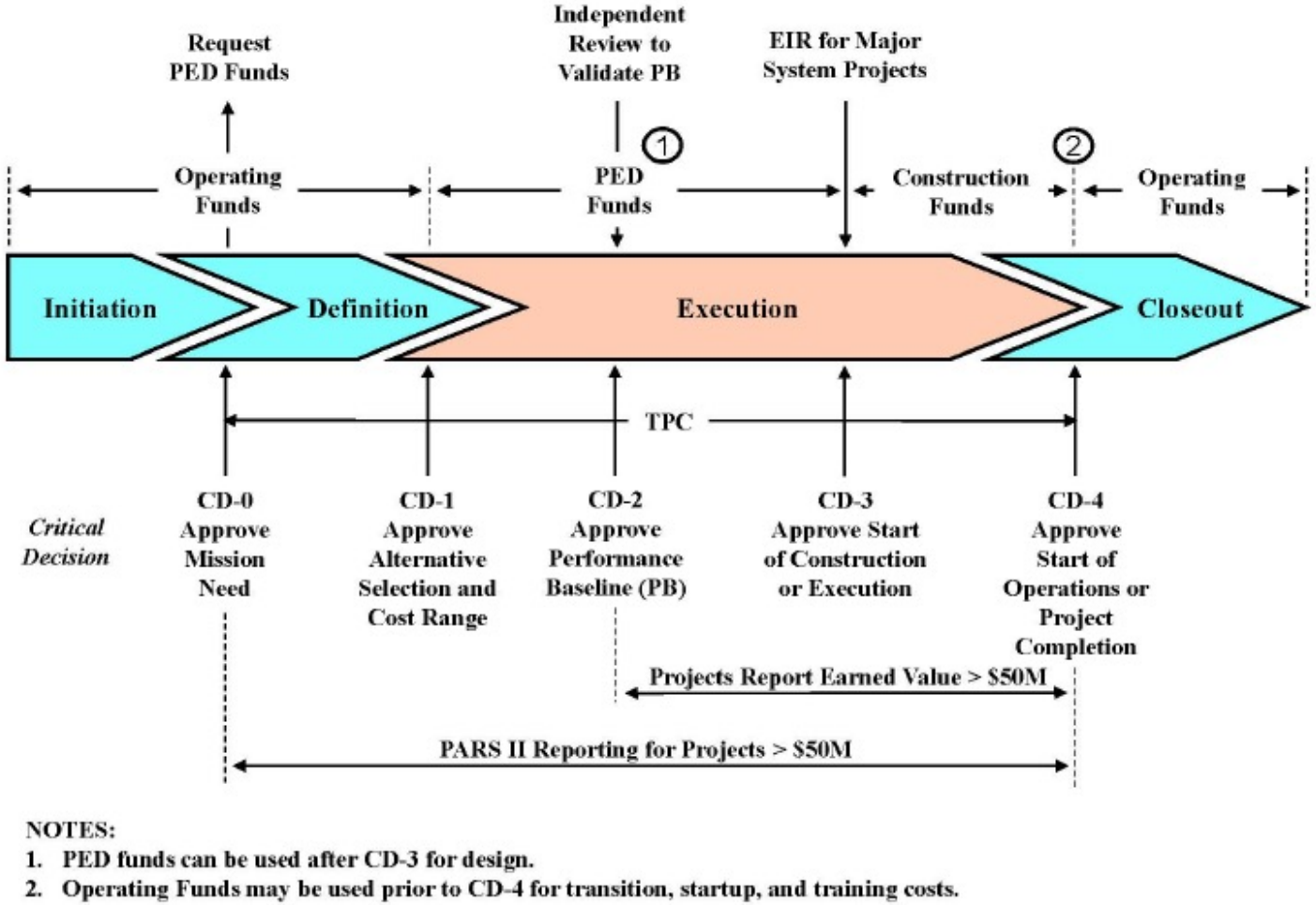
HEP Projects FY 2021-2030

$4.95B. Avg 36.1% of total budget

- Assumption #1 (shown here): Favorable HEP budget growth ~6%/year
  - $3.6B planned funding from FY 2024-2030 to complete 6 current projects, but project fractions > 35% through FY 2028
  - New project(s) ~ FY 2028 or later
- Assumption #2: Modest rate of growth 2-3%/year
  - Project funding profiles (ACORN, CMB-S4, and/or LBNF/DUNE) may be stretched out by 12-18 months
  - New project(s) ~ FY 2029 or later



What it takes to start a new *large* project



NOTES:
1. PED funds can be used after CD-3 for design.
2. Operating Funds may be used prior to CD-4 for transition, startup, and training costs.

Figure 1. Typical DOE Acquisition Management System for Line Item Capital Asset Projects

This chart is for projects with civil construction;
similar process for projects without civil construction;
just some differences in "color of money"

What makes a small project?

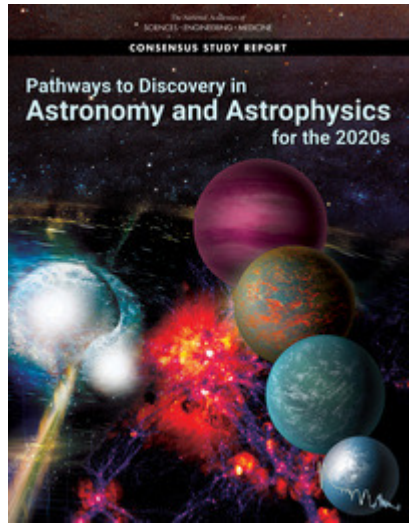
- Management of MIE Projects of <$50M *may* be delegated to management by a Laboratory;
  - This decision is taken by DOE program office
  - Laboratory is expected to provide adequate project management oversight to insure success (technical scope, cost and schedule)
- Any MIE projects at Laboratories greater than $5M must be reported in the budget (two year advance planning)
  - Some pre-project R&D can be provided
  - If installed at a University, upper limit is $2M or budget reporting is required
- Accelerator Improvement Projects (AIP) must be <$30M; same limit applies to General Plant Projects (GPP)

Important Considerations

- Timelines and Expectations
  - Navigating the CD process takes a long time
- Accuracy of cost estimates
  - We need to do better than we have in previous planning
    - Being off by factors of two to three has large consequences
- Importance and consequences of partnering
  - We need to partner on large projects
  - We need to understand the constraints and goals of partners

U.S. Particle Physics Strategic Planning Process

- Each of these processes provides important input to the next P5 strategic process
  - Updated 2020 European Strategy for Particle Physics
  - NAS Astronomy and Astrophysics Decadal Survey (2021)
  - 2021-2022 Community Snowmass Process
  - New NAS Decadal Survey in Elementary Particle Physics
  - Upcoming HEPAP Report on International Benchmarking
- The next P5 process is currently in progress
  - A P5 report by late 2023 will inform the FY 2025 U.S. budget formulation process




Report of the
2021 U.S. Community Study on the
Future of Particle Physics
(Snowmass 2021)
organized by the APS Division of Particles and Fields

Snowmass 2021

Charge to the 2023 P5 Subcommittee

Consider : HEP is a global field	Support decisions to retain US leadership as a global partner	Preserve essential roles of Universities and National Labs	EDIA throughout the field results in improved science
Balanced core research budget is paramount to producing science	Remember costs of R&D, commissioning, and operations for future projects	Address synergies with broad national initiatives	Assess science case for on-going projects

Outlook

- It is an exciting time in High Energy Physics
- We can look forward to a decade or more of exciting data at the Hi-lumi LHC
- The U.S. neutrino program is strong and growing; LBNF/DUNE construction is progressing and results from DUNE and should answer some important questions that we have been asking for a long time
- Experiments at the Cosmic frontier are unique, diverse and very exciting
- Our on-going long range planning process should inform our future directions and poise us to continue to answer the important questions about nature.
- We need to plan carefully to maintain credibility

Thank you!!!

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