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...
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 been 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?

---

<table>
<thead>
<tr>
<th>Project</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently operating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mu2e</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHC: Phase 1 upgrade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HL-LHC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBNF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ILC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium and Small Projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM G2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM G3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMB S4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We are here.

November 29, 2022
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
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.
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.
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

- PIP II Cryoplant building
- Mu2e Transport Solenoid
- Practice lowering of APAs at SURF
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.

Photos by Jacques Fichet, CERN

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

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
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

16 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 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

Feb 2023
Release of FY 2024 President’s Request
Today: Agencies await The Hill’s decision to 1) pass another CR or 2) pass FY 2023 Omnibus Appropriations Bill
Budget Highlights: FY 2022 Enacted, IRA & FY 2023 CR

- 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

- 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

### HEP Budget

<table>
<thead>
<tr>
<th></th>
<th>FY 2022 Final</th>
<th>FY 2022 IRA</th>
<th>FY 2023 Con. Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>412,272</td>
<td>425,173</td>
<td></td>
</tr>
<tr>
<td>Facilities/Operations</td>
<td>299,728</td>
<td>328,827</td>
<td></td>
</tr>
<tr>
<td>Projects</td>
<td>366,000</td>
<td>303,656</td>
<td>324,000</td>
</tr>
<tr>
<td>HEP Total</td>
<td>1,078,000</td>
<td>303,656</td>
<td>1,078,000</td>
</tr>
</tbody>
</table>

### Projects

<table>
<thead>
<tr>
<th></th>
<th>FY 2022 Enacted</th>
<th>FY 2022 IRA</th>
<th>FY 2023 CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mu2e</td>
<td>2,000</td>
<td>34,879</td>
<td>2,000</td>
</tr>
<tr>
<td>Reserve</td>
<td></td>
<td>3,037</td>
<td></td>
</tr>
<tr>
<td>HL-LHC AUP</td>
<td>12,000</td>
<td>38,355</td>
<td>30,000</td>
</tr>
<tr>
<td>HL-LHC ATLAS</td>
<td>20,000</td>
<td>32,785</td>
<td>10,000</td>
</tr>
<tr>
<td>HL-LHC CMS</td>
<td>20,000</td>
<td>34,600</td>
<td>10,000</td>
</tr>
<tr>
<td>ACORN</td>
<td>2,000</td>
<td>15,000</td>
<td>1,000</td>
</tr>
<tr>
<td>CMB S4</td>
<td>8,000</td>
<td>10,000</td>
<td>1,000</td>
</tr>
<tr>
<td>LuSEE-Night</td>
<td>15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBNF/DUNE</td>
<td>184,000</td>
<td>125,000</td>
<td>180,000</td>
</tr>
<tr>
<td>PIP-II</td>
<td>90,000</td>
<td>10,000</td>
<td>90,000</td>
</tr>
<tr>
<td>Total</td>
<td>366,000</td>
<td>303,656</td>
<td>324,000</td>
</tr>
</tbody>
</table>
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.
• 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
The CHIPS and Science Act authorizes $174 billion for investment in science, technology, engineering, and math programs, workforce development, and R&D.

FY 2023: $1.160B  
FY 2024: $1.290B  
FY 2025: $1.428B  
FY 2026: $1.500B  
FY 2027: $1.555B
**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**
- Nuclear physics: $217M (14%)
- Lab infrastructure: $133M (8.6%)
- Fusion energy sciences: $289M (18.1%)
- Isotope research and production: $158M (10.2%)
- Advanced computing research: $164M (10.6%)
- High energy physics: $304M (19.6%)
- Basic energy sciences: $295M (19%)  

**Disbursement by laboratory**
- Lawrence Berkeley National Lab: $200M (12.9%)
- Fermi National Accelerator Lab: $259M (16.7%)
- Brookhaven National Lab: $191M (12.3%)
- Oak Ridge National Lab: $496M (32%)
- Eight other labs: $265M (17.1%)

**FY23 Budget Proposals: DOE Office of Science**

<table>
<thead>
<tr>
<th>Program</th>
<th>Request</th>
<th>House</th>
<th>Senate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Science Total ($7.475 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Energy Sciences ($2.308 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Energy Physics ($1.078 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adv. Sol. Computing Research ($1.038 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Physics ($728 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusion Energy Sciences ($713 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio. &amp; Environmental Research ($815 M)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% change from FY22 enacted
$ in () are FY22 amounts

Funds from Inflation Reduction Act excluded