

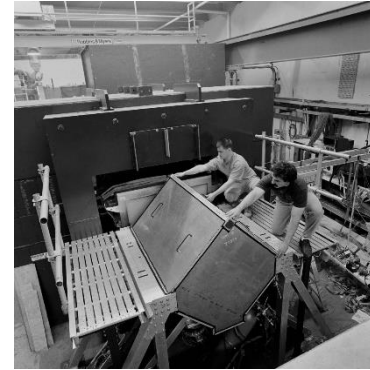
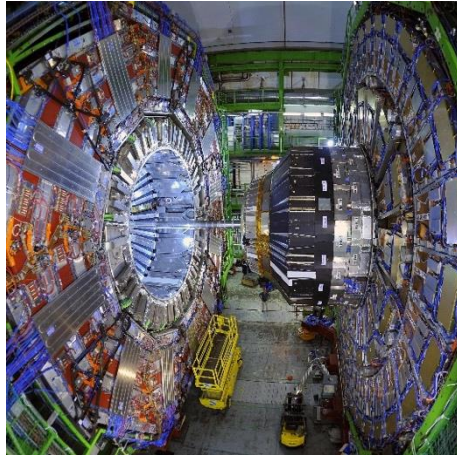
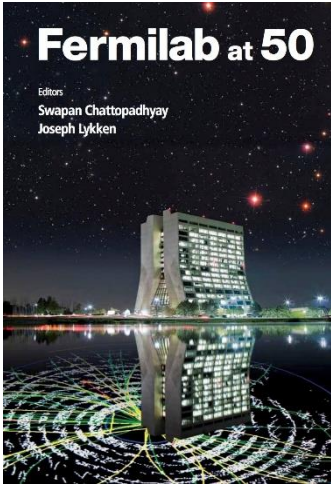


EDIT: Welcome to Fermilab

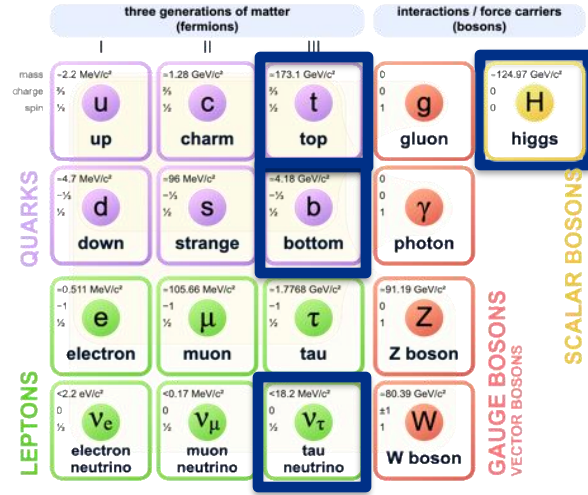
Bonnie Fleming

11 November 2024

50+ Years of Discovery



Standard Model of Elementary Particles



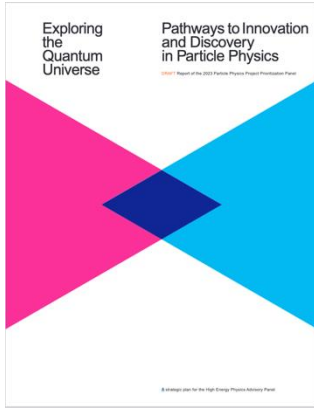
Fermilab at a Glance

- America's particle physics and accelerator laboratory
- Operates the largest US particle accelerator complex
- ~2,100 staff and ~\$750M/year budget
- 6,800 acres of federal land
- Facilities used by >4,000 scientists from >50 countries

As we move into the next 50 years, our vision remains to solve the mysteries of matter, energy, space, and time for the benefit of all.



Fermilab Science Mission – 2014 P5 science drivers, now 2023 P5 report



2023 P5 Report!



Decipher the Quantum Realm

Elucidate the Mysteries of Neutrinos

Reveal the Secrets of the Higgs Boson



Explore New Paradigms in Physics

Search for Direct Evidence of New Particles

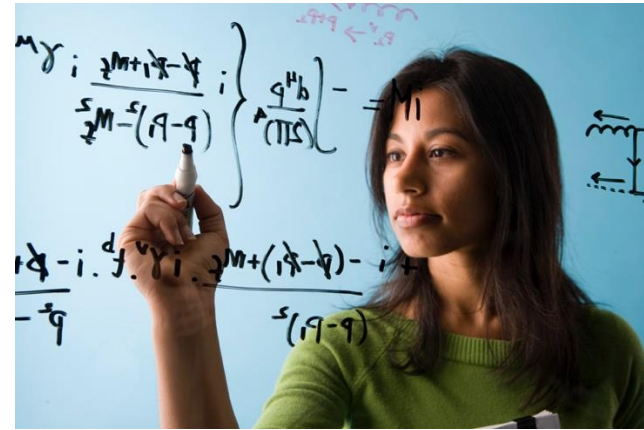
Pursue Quantum Imprints of New Phenomena



Illuminate the Hidden Universe

Determine the Nature of Dark Matter

Understand What Drives Cosmic Evolution

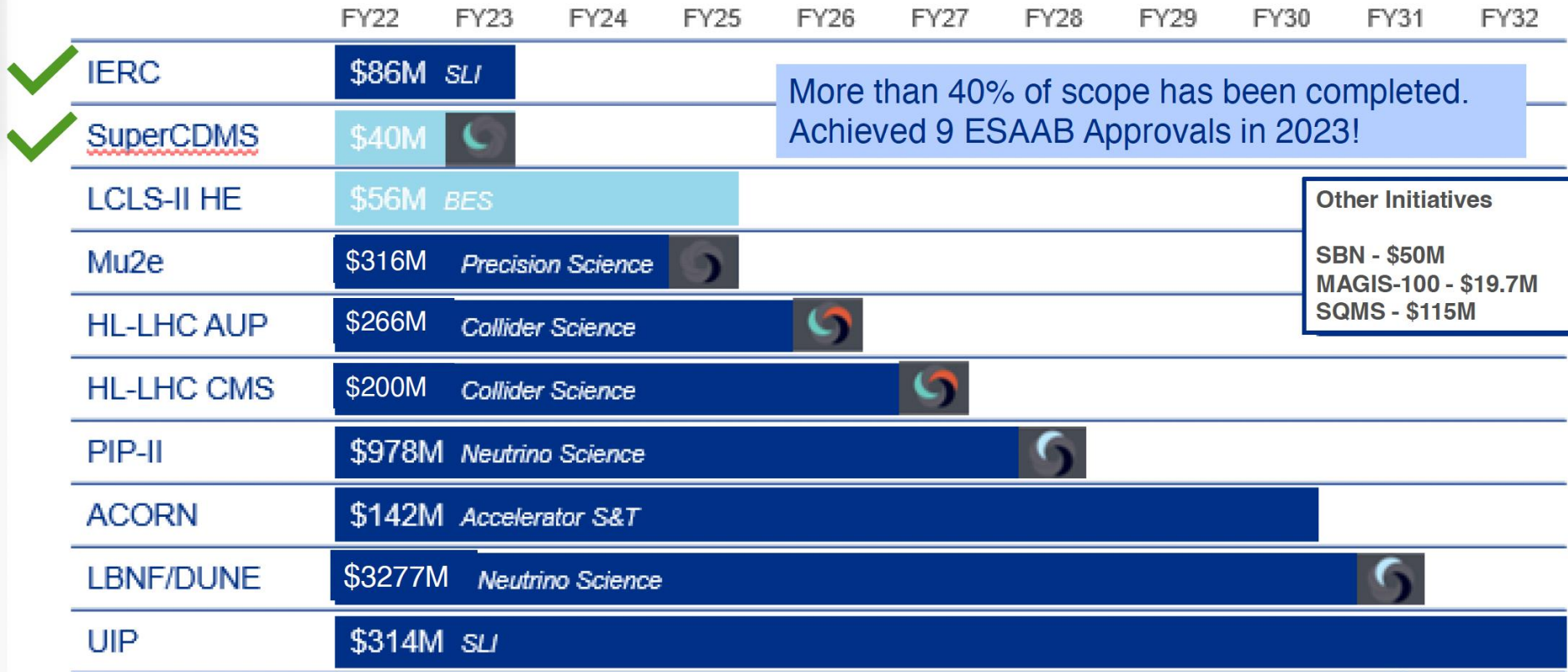


Fermilab is delivering on the DOE/SC discovery science mission: Major particle physics breakthroughs from Fermilab experiments, major technology breakthroughs from Fermilab research

Current program: Project portfolio



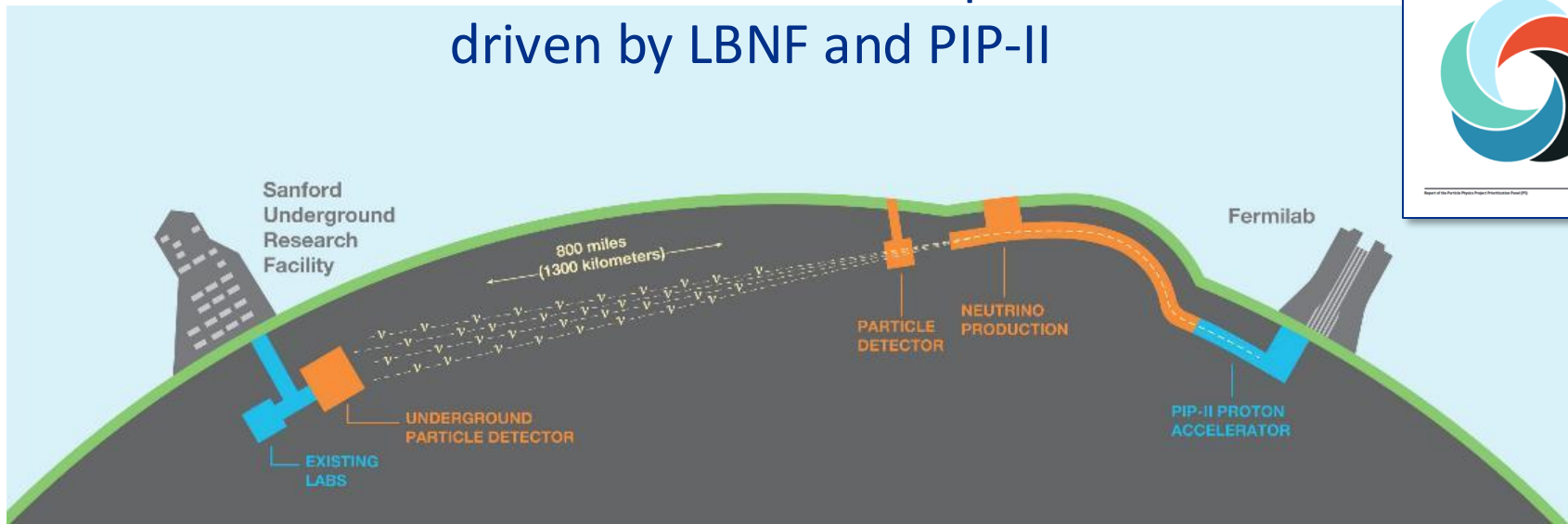
Investment
\$5.6B DOE,
\$1.1B International



More than 40% of scope has been completed.
Achieved 9 ESAAB Approvals in 2023!

Other Initiatives
SBN - \$50M
MAGIS-100 - \$19.7M
SQMS - \$115M

“Best in Class” neutrino experiment driven by LBNF and PIP-II



Origin of matter. Investigate leptonic CP violation. Are neutrinos the reason the universe is made of matter?



Neutron star and black hole formation. Ability to observe neutrinos from supernovae events and perhaps watch formation of black holes in real time.



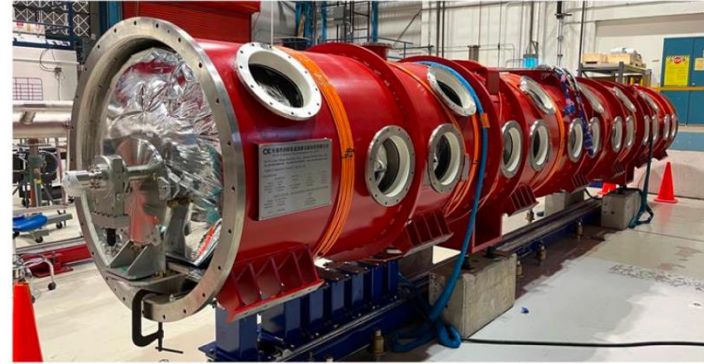
Unification of forces. Investigate nucleon decay, advance unified theory of energy and matter.

The LBNF/DUNE project will be the first internationally conceived, constructed, and operated mega-science project hosted by the Department of Energy in the United States” – DOE

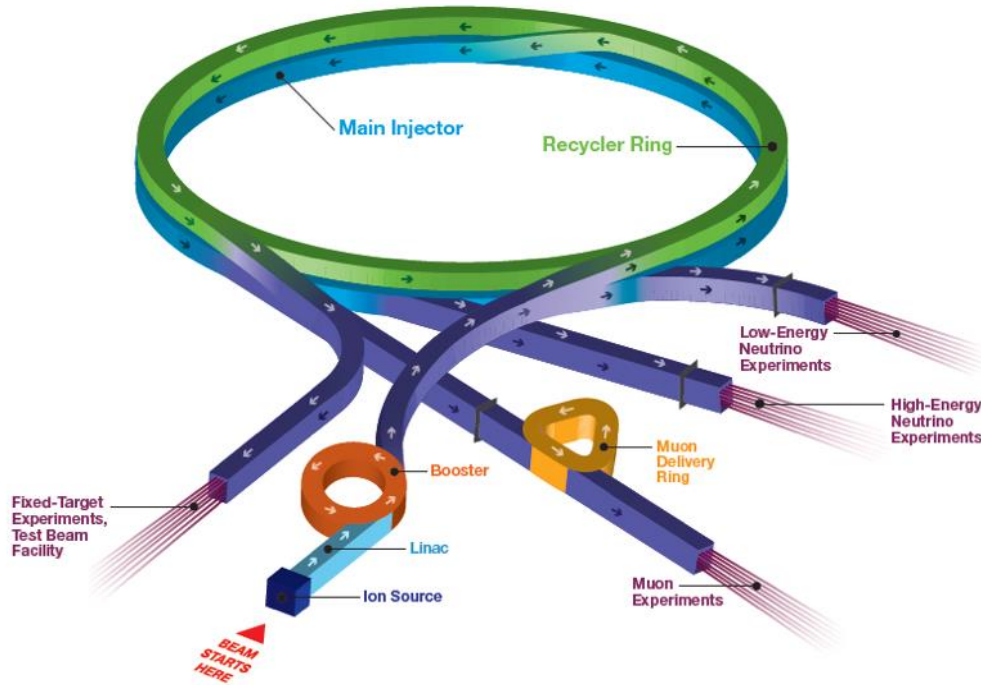
PIP-II particle accelerator complex is under construction



- Cryogenics Plant Building is complete
- Superconducting accelerator components have been successfully tested



AD: Fermilab Accelerator Complex – world-leading proton beam facility



Beams to Booster Neutrino beam, NuMI, muon campus, Test beams (MTA and 120 GeV), fixed target (spinqest)

120 GeV beam power – 1.0 MW record last year

Over 5 years power increased by 30% while beam loss reduced by factor 2
Operation with uptime of ~80%

Continue to ramp up MI power through cycle time reduction

Looking ahead to 20 year plan for modernization of the complex (P5 report)

Neutrinos at Fermilab

- Booster Neutrino Beam: Short Baseline Neutrino Program
- NuMI beam: NO ν A
- Future beam for DUNE

Booster ν beam
MicroBooNE, SBN program



NuMI ν beam
NO ν A, MINER ν A



DUNE ν beam
(planned)



Booster
proton energy: 8 GeV

Main Injector
proton energy: 120 GeV

Precision Science

Muon Campus hosts Muon g-2 and Mu2e



Collider Science and the US CMS Collaboration





Fermilab facilities are key to Particle Physics Program



Fermilab facilities are key to Particle Physics Program



Led by FNAL, \$115M
Awarded August 2020

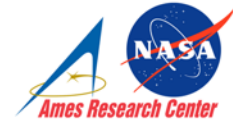
Superconducting Quantum Materials and Systems Center

A DOE National Quantum Information Science Research Center

24 Institutions
> 400 Researchers
> 100 students/postdocs



Northwestern
University



NIST

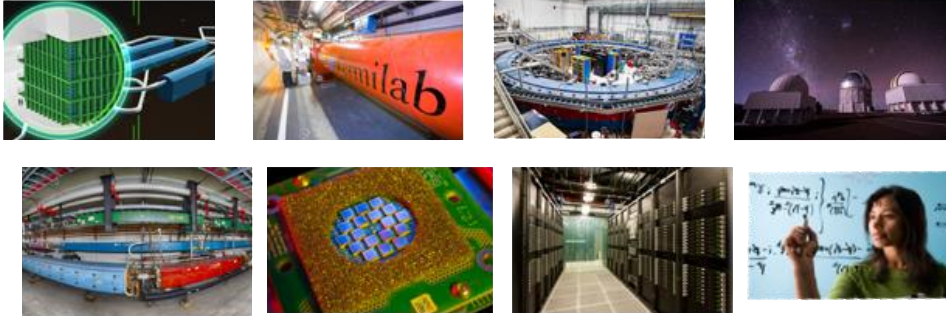


University of Colorado
Boulder



Fermilab and Emerging Technologies

HEP science with neutrinos, the LHC, muons, and the cosmos



Underpinned by strong competencies in accelerator and detector science and technology, computing, and theory

Many fundamental **HEP** research areas can **benefit** from emerging technology **applications** and many **HEP competencies** can help **advance new technologies**



NEW DIRECTORATE!

Our **science goals** demand ever increasing precision instruments, driving the need for **innovative techniques and technologies**

Establishing new and rapidly advancing programs in **QIS** and **microelectronics**, leveraging national programs and initiatives. Continue to pursue **partnerships** to apply Fermilab **accelerator** and other technologies to new applications.

Thank you!



Wilson Hall and IERC at dawn. The sloped roof on IERC is intended to mimic the curve of Wilson Hall rotated 90 degrees; this is especially evident when the image of IERC is doubled in the reflecting pond. Photo credit: Brian Rubik