

Fermilab and the Future Program

Pier Oddone
October 11, 2012



U.S. DEPARTMENT OF
ENERGY



Today's agenda

- The Fermilab physics program within the national strategy
- Fermilab as a partner of national and international institutions



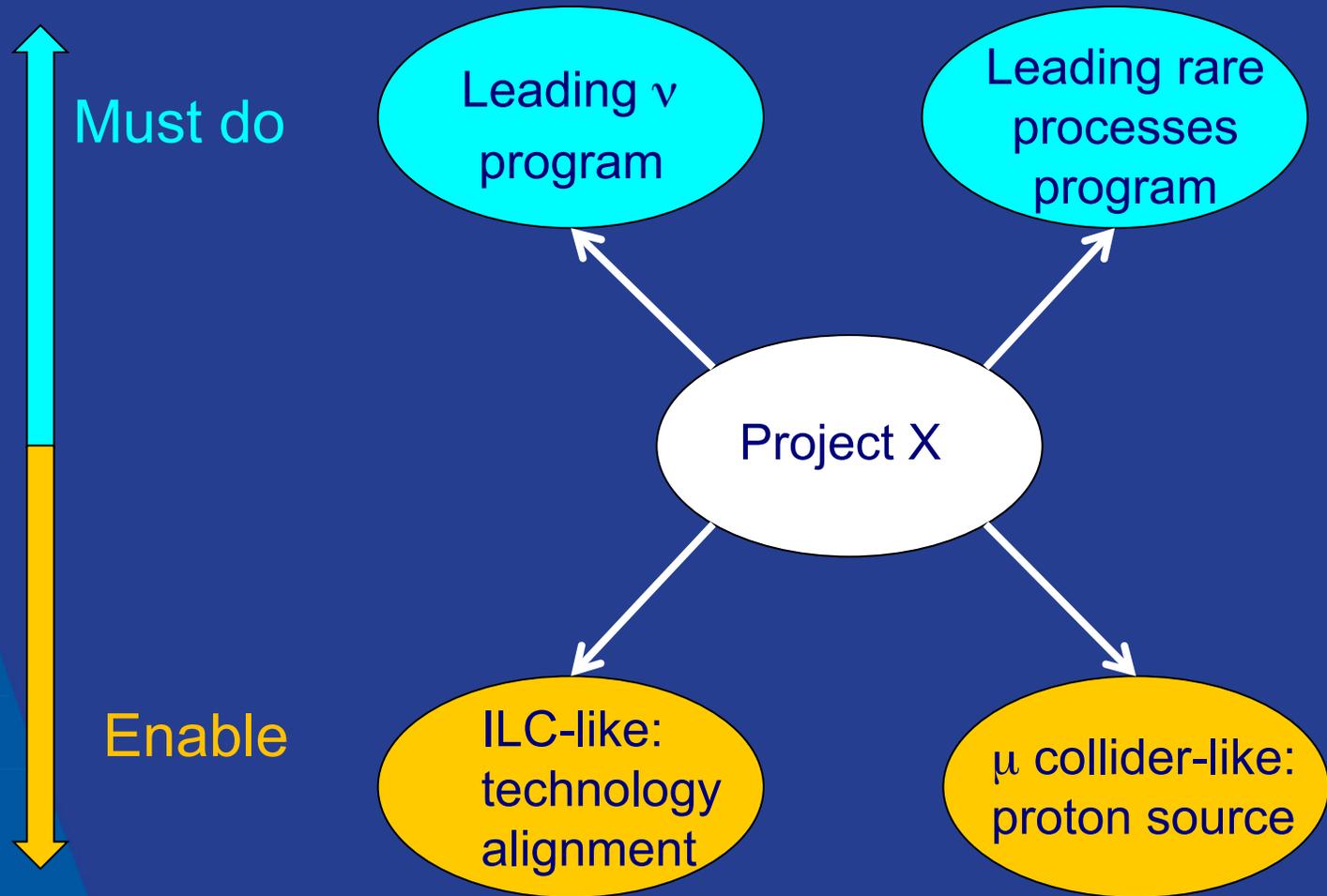
A successful HEP strategy

- Drives world-leading physics
- Is supported by the HEP community
- Continually produces scientific results
- Attracts international participation
- Is resilient relative to instability in the US system
- Is resilient relative to new discoveries
- Has the full support of the Office of Science
- Is affordable (the definition of affordability varies with time, up and down)

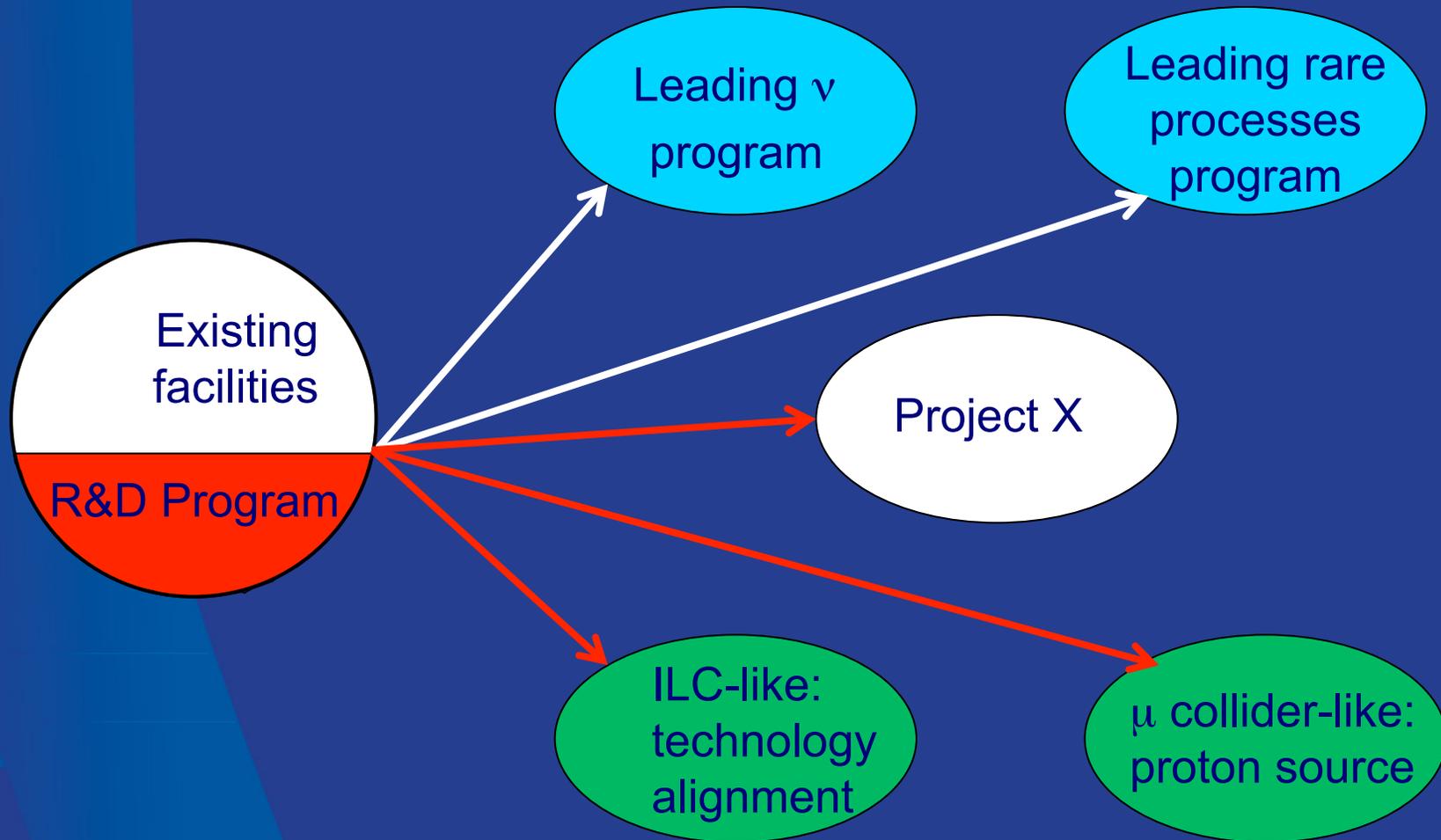
Strategy: long term vision

- The leading facilities in the world at the Intensity Frontier for neutrinos and rare processes – an essential complement to the LHC
- A path towards major contributions to future facilities at the Energy Frontier
- Major contributions to resolving the mysteries of dark matter and dark energy

Long term vision



Getting there

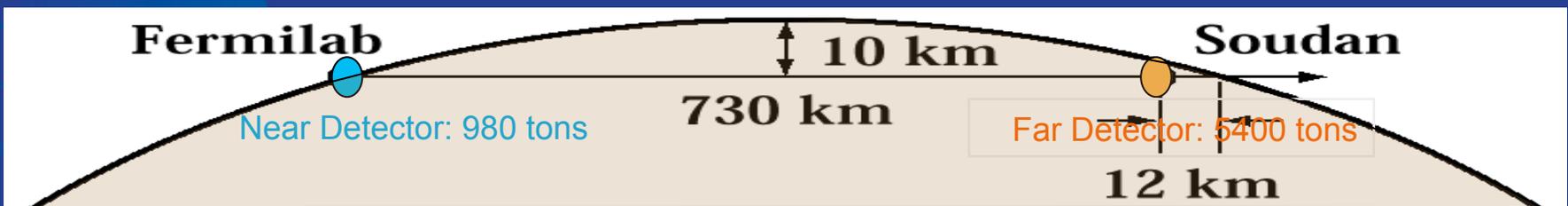
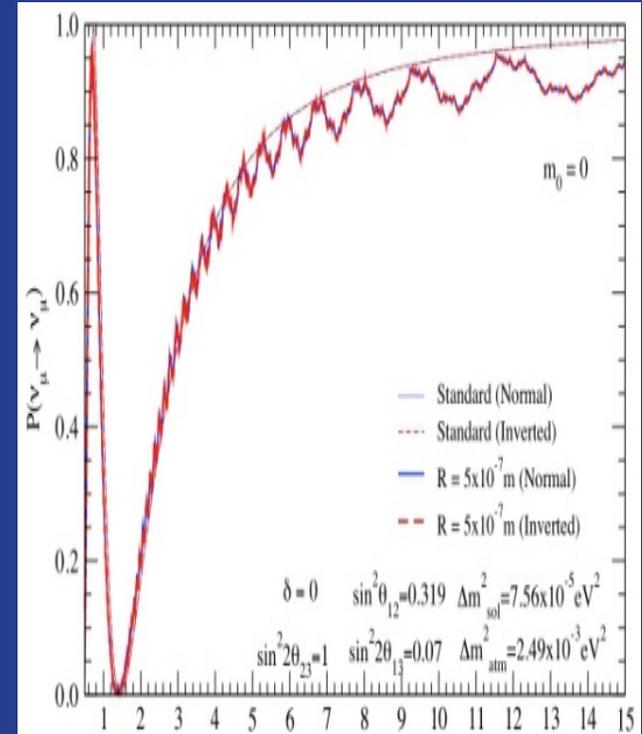


Neutrino Program

- Reveal the pattern of neutrino masses and mixings:
 - MINOS → NOvA → LBNE
- Discover if the situation is more complex than 3 neutrinos with Standard Model Interactions:
 - MINOS → NOvA → LBNE
 - MiniBooNE → MicroBooNE → vSTORM?
- Neutrinos as probes of nuclear structure and neutrino engineering measurements that make the above points possible:
 - MiniBooNE → MINERvA → MicroBooNE → vSTORM?

<https://indico.fnal.gov/getFile.py/access?contribId=17&sessionId=24&resId=0&materialId=slides&confId=5724>

Existing: Minos and Minos +

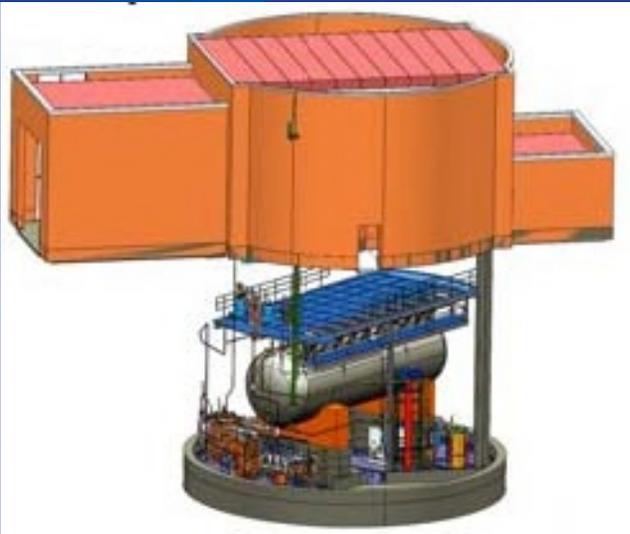


Construction: NOvA Far Detector



Block construction: 2 done, 26 to go!

Construction: MicroBooNE



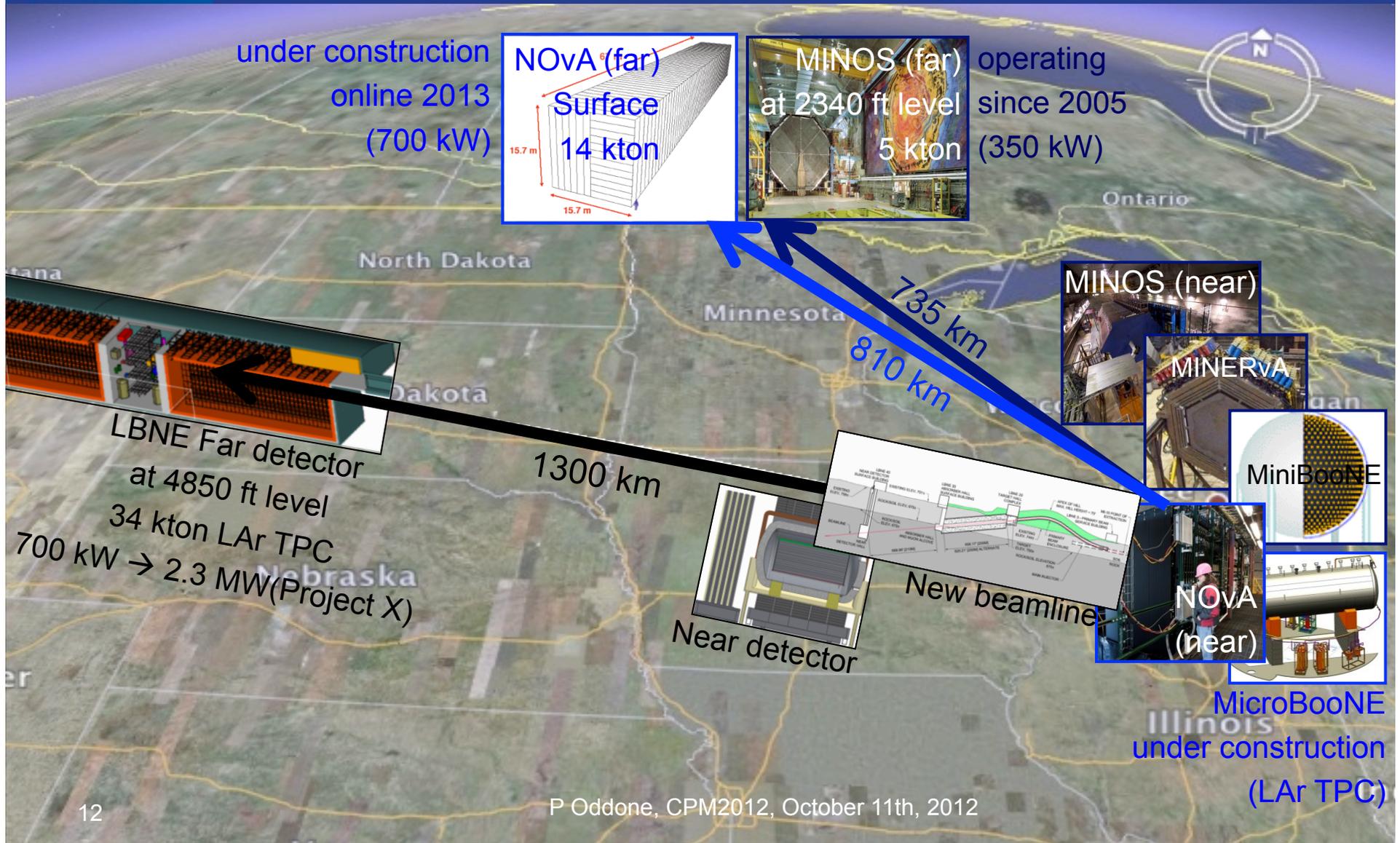
September, 2012



Dzero assembly building



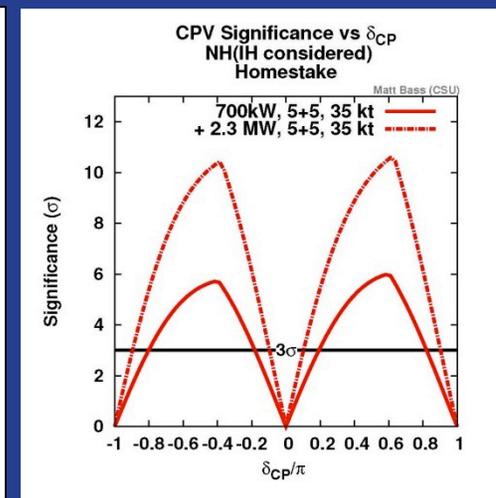
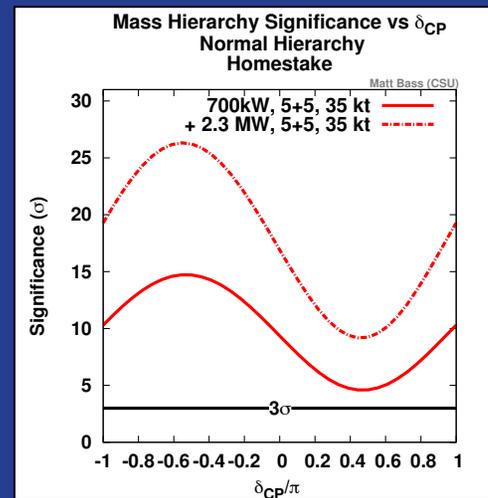
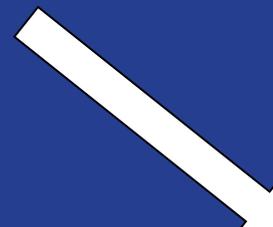
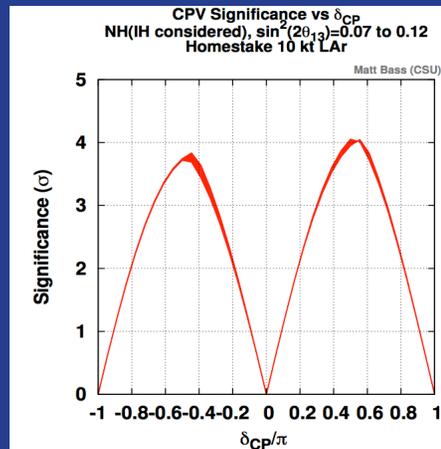
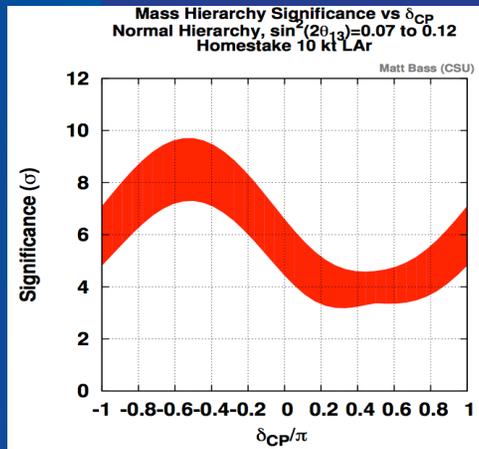
Evolution of U.S. Neutrino Experiments



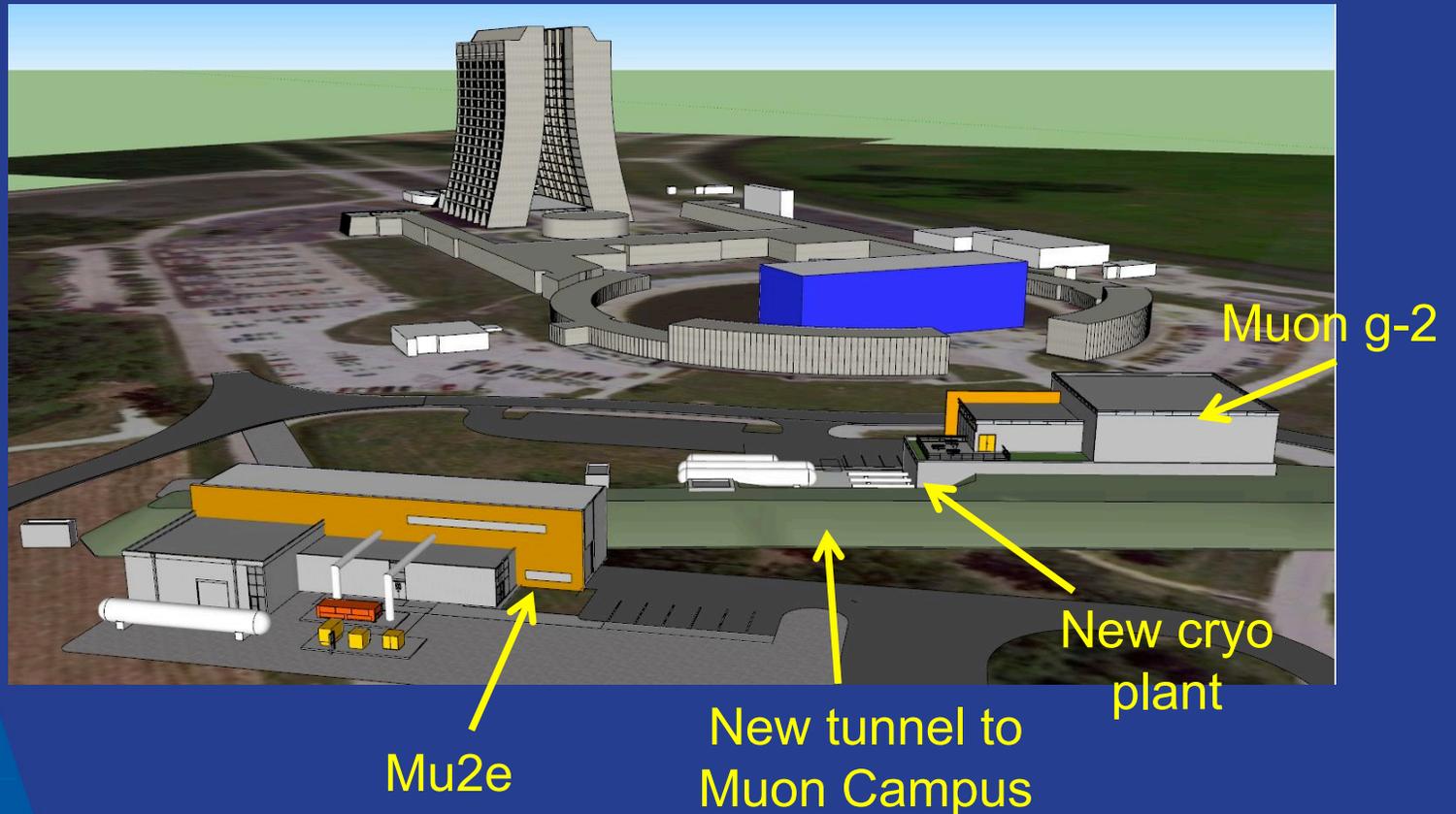
LBNE

- Reconfiguration
 - Steering Committee report (August 2012):
http://www.fnal.gov/directorate/lbne_reconfiguration/
Two phase approach
- Phase 1:
 - beamline + 10kton detector on surface, Homestake
 - Goal: placing it underground with NSF and international collaboration
 - CD-1 Review
 - Director's review: September 2012
 - DOE review: Oct. 30 – Nov. 1, 2012

Evolution of LBNE



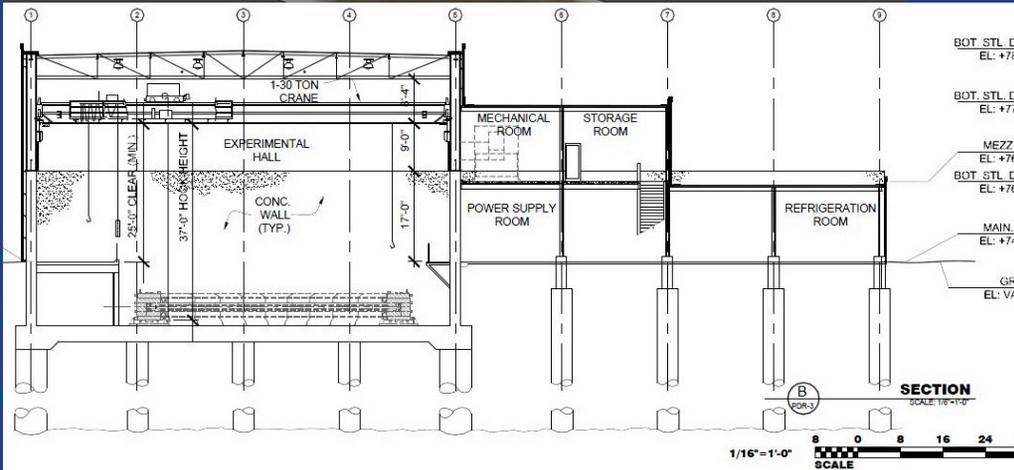
Muon Campus



Mu2e: CD-1 approval in June 2012

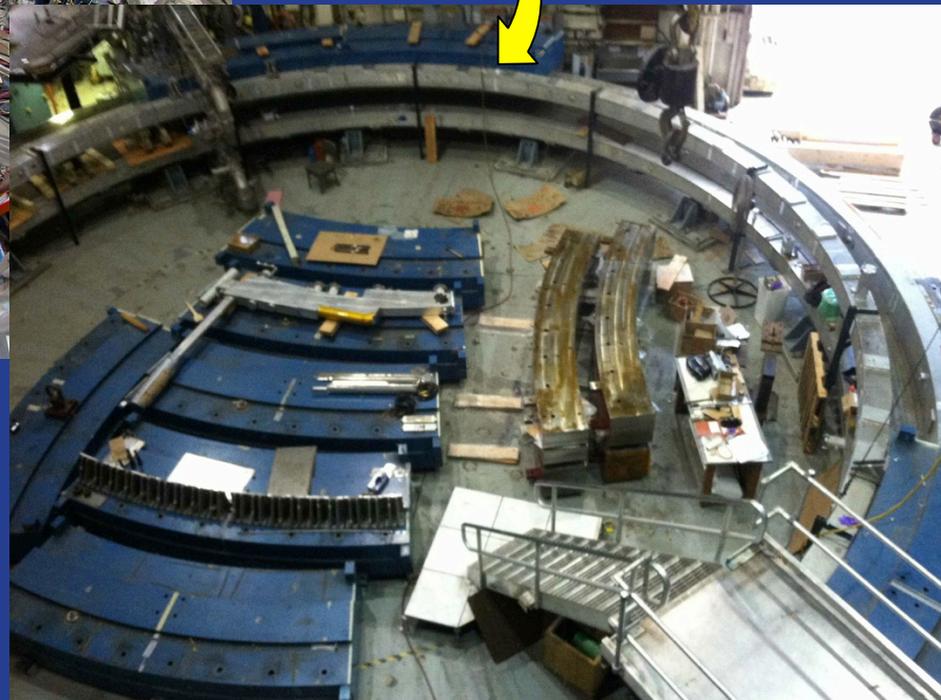
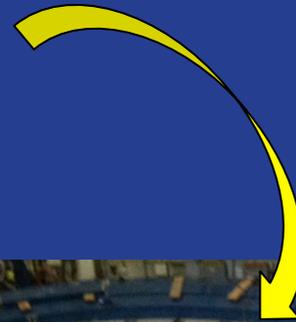
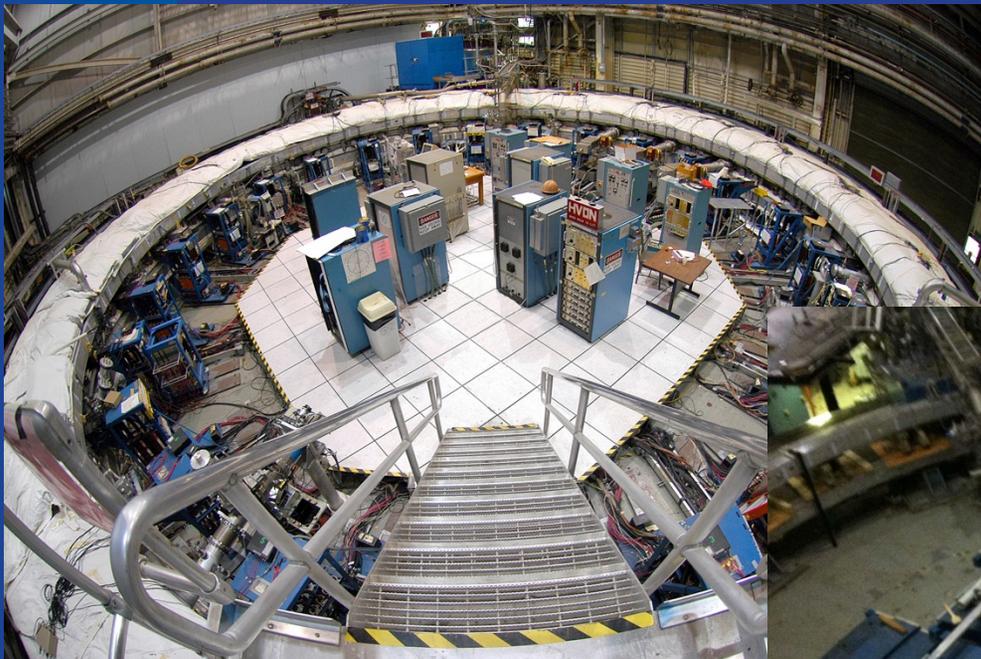
Muon g-2: CD-0 approval in September 2012

Muon g-2 building on schedule



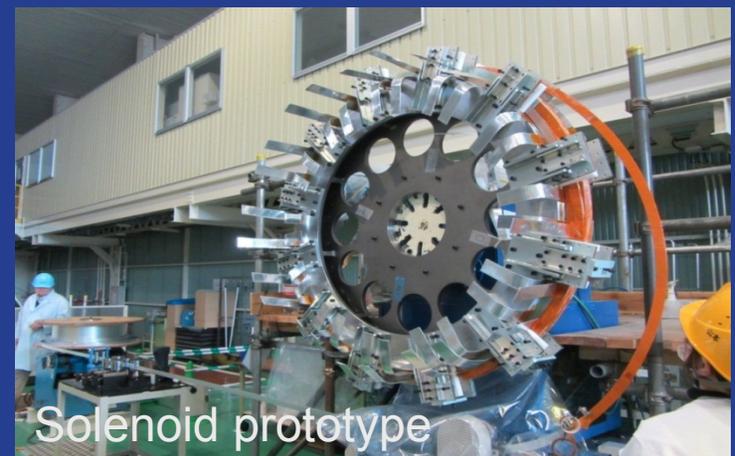
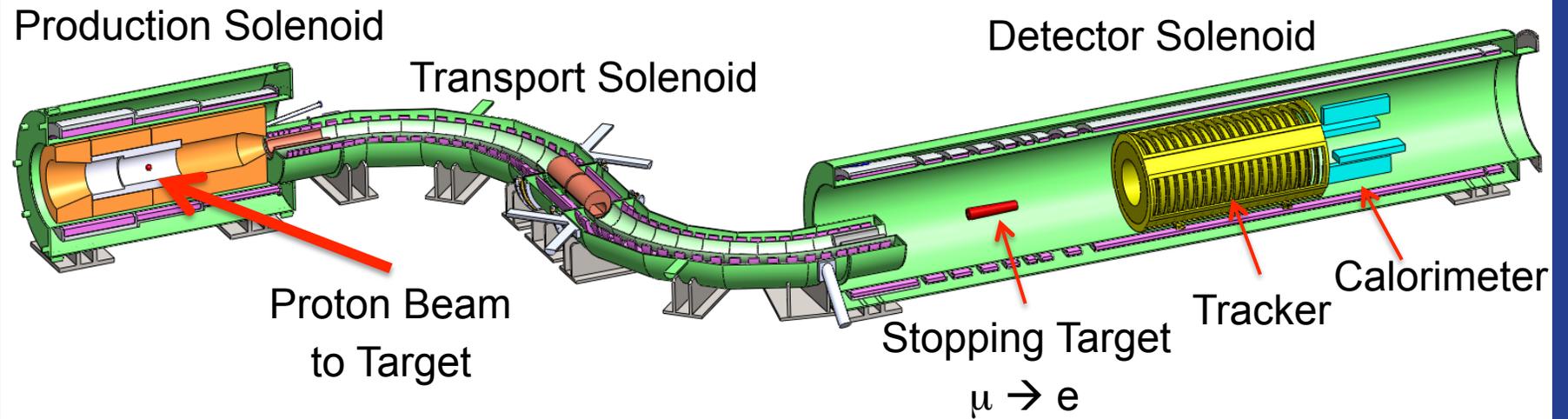
Core drilling 3 weeks ago to verify composition

Muon g-2: disassembly and transport



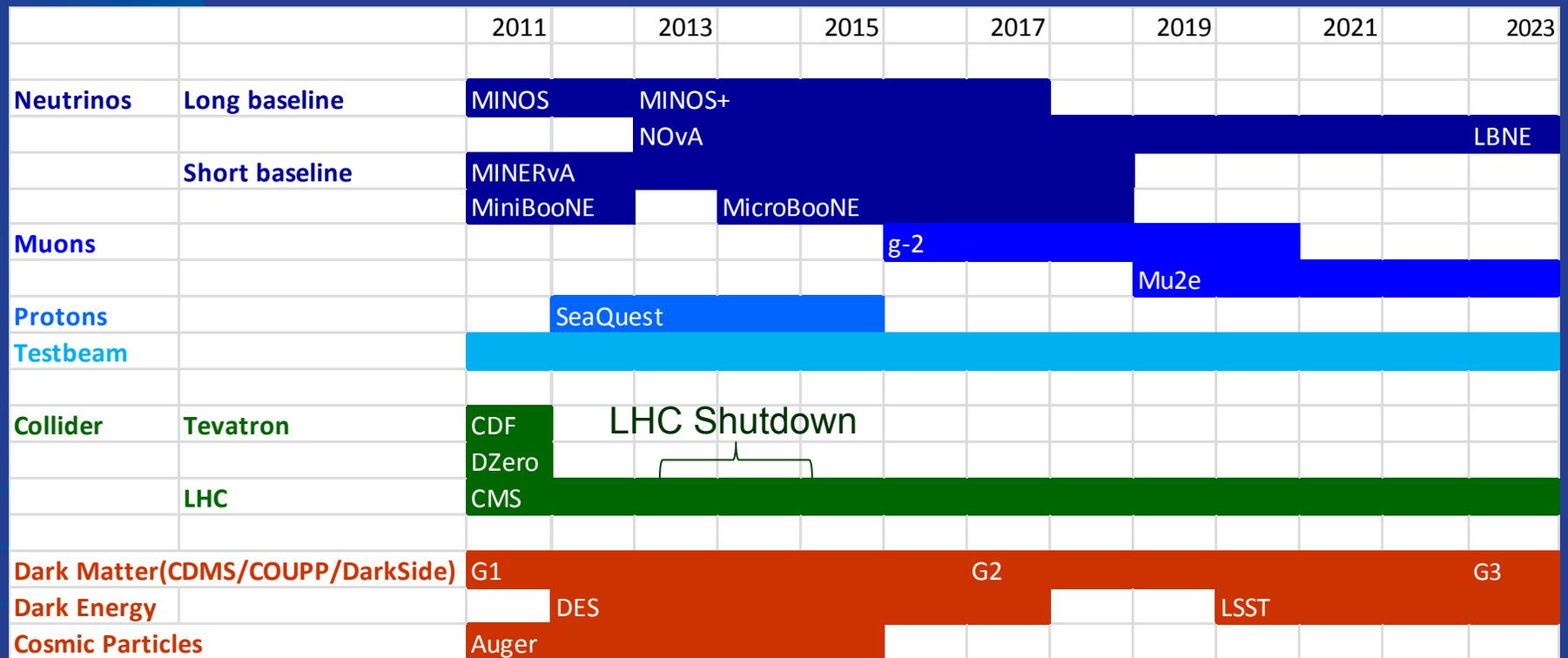
By next month, 6 tractor-trailer loads of equipment will have arrived at Fermilab

Mu2e



Experiments: Operation Schedule

Accelerator Shutdown

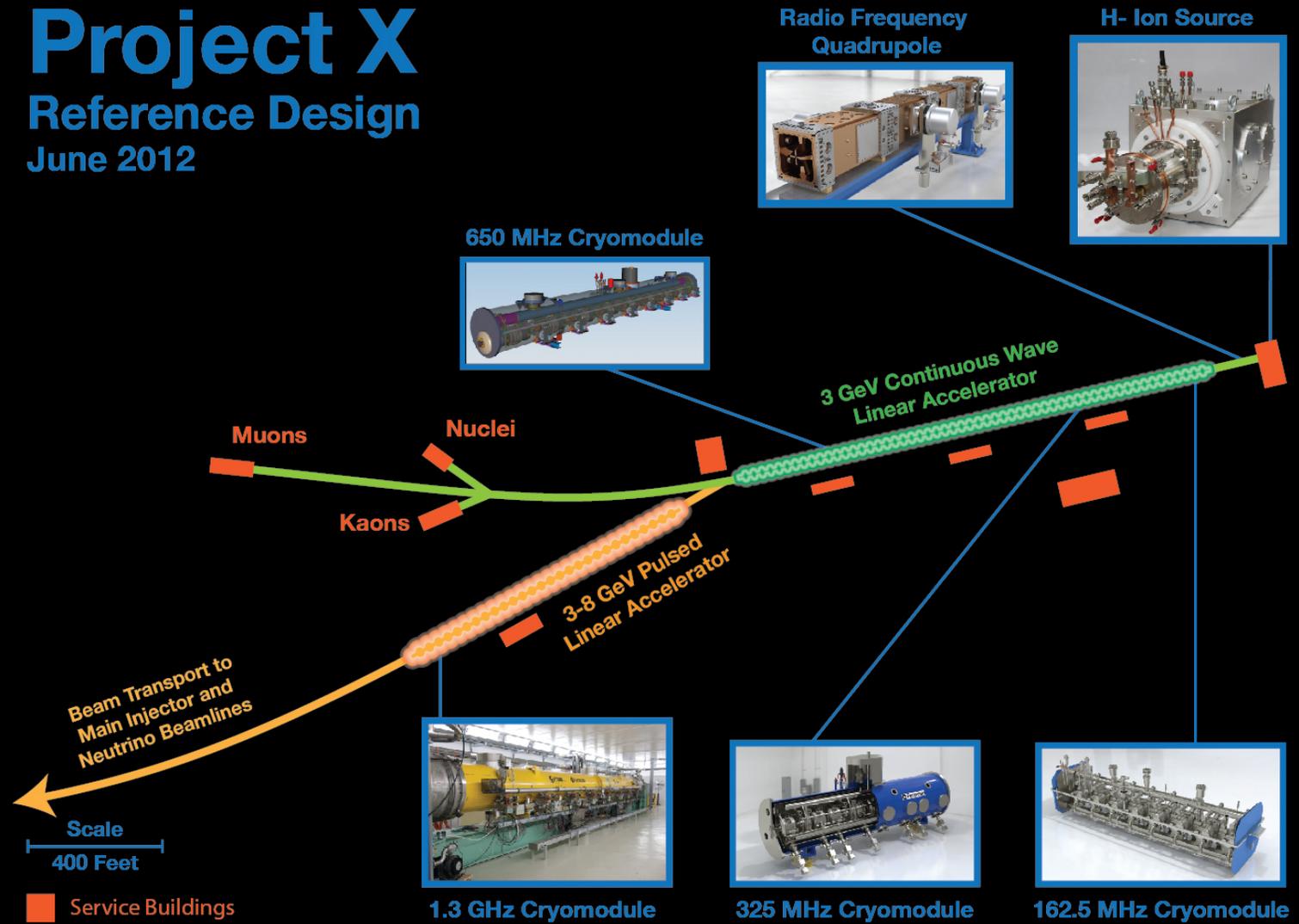


Continuous Physics Results

Project X

Reference Design

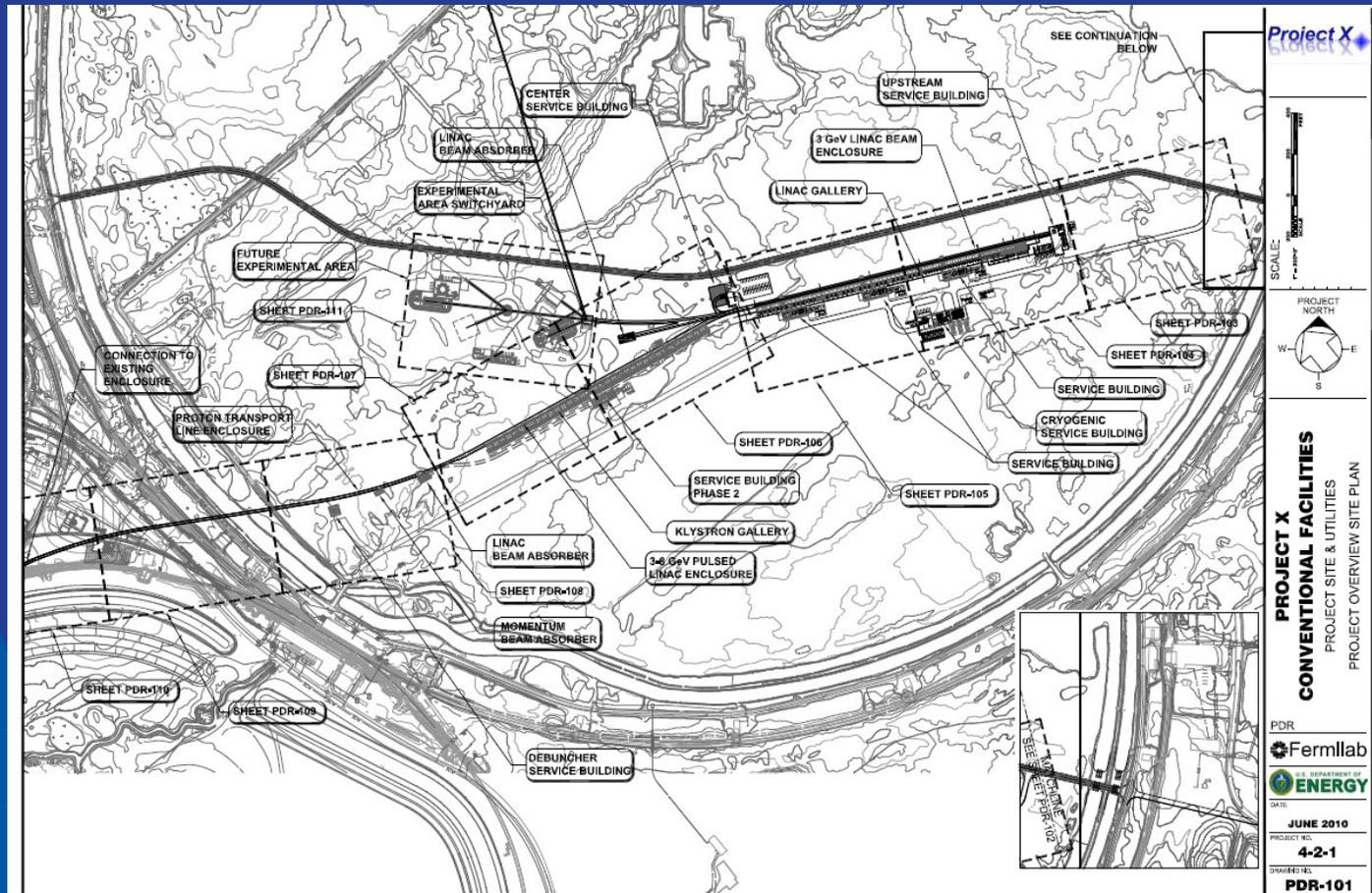
June 2012



Argonne National Laboratory • Brookhaven National Laboratory • Fermi National Accelerator Laboratory • Lawrence Berkeley National Laboratory
 Pacific Northwest National Laboratory • Oak Ridge National Laboratory / SNS • SLAC National Accelerator Laboratory • Thomas Jefferson National Accelerator Facility
 Bhabha Atomic Research Center • Raja Ramanna Center of Advanced Technology • Variable Energy Cyclotron Center • Inter University Accelerator Center

P Oddone, CPM2012, October 11th, 2012

Project X Siting



Phased approach to Project X

- Project X can be broken into three phases, each for about a third of the cost
 - **Phase 1:** Up to 1 GeV. Retires old linac, increases flux of neutrinos x1.7, enhances existing Mu2e by x10, starts EDM, nuclear-physics and nuclear-material studies
 - **Phase 2:** Up to 3 GeV. Starts powerful Intensity Frontier experiments with kaons and short baseline neutrino programs
 - **Phase 3:** Up to 8 GeV; Multiplies power to LBNE by factor of 3; power at 8 GeV by several fold for short-baseline neutrino experiments
- Decision on when these phases should start can wait to much later in the decade

Evolution of facilities

Fermilab Accelerator Complex 2012



Fermilab Accelerator Complex 2015



Fermilab Accelerator Complex 2020



Construction:

- NOvA Accelerator Upgrade
- Proton Improvement Plan
- Muon Campus
- Illinois Accelerator Research Center
- Superconducting Accelerator Facilities for Project X, ...

Construction:

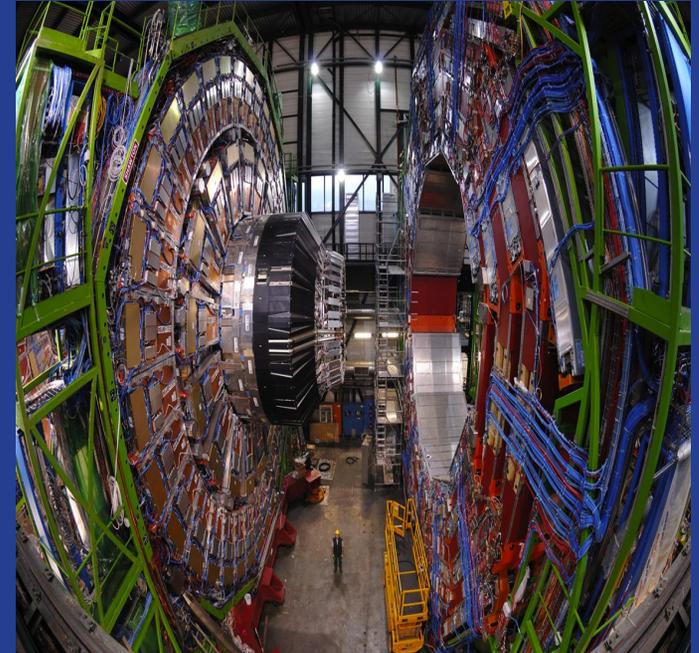
- Proton Improvement Plan
- Muon Campus
- Superconducting Accelerator Facilities for Project X, ...

Construction:

- Project X: CW, multi-MW at 3 GeV, 8 GeV and 120 GeV.
- Muon program
- Kaon program
- Neutrino program
- EDMs
- Nuclear material

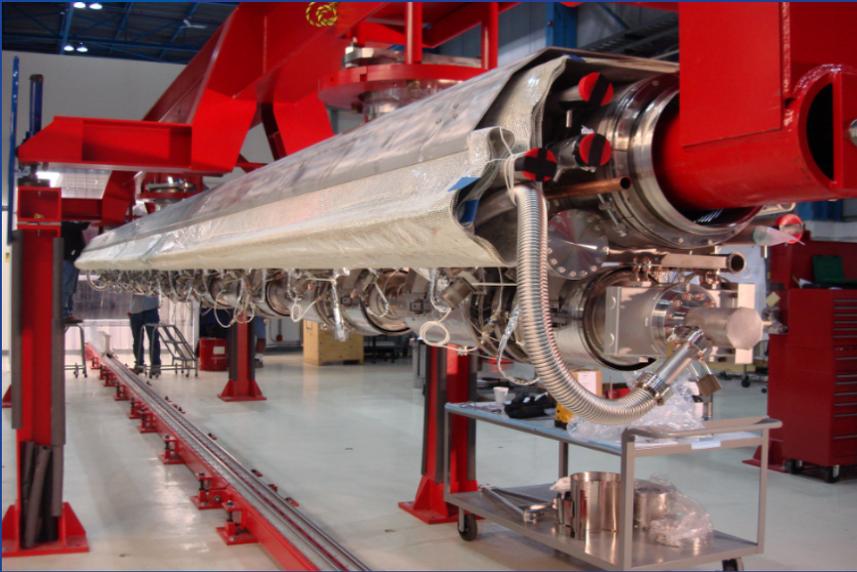
Energy Frontier

- The principal activity for the foreseeable future is exploitation of the LHC
 - Operations, physics analysis
 - Support U.S. LHC community
 - High luminosity upgrades for both accelerator and CMS detector
- The biggest unknown is what follows the LHC?: ILC ? CLIC ? Muon Collider ? Energy doubler ?

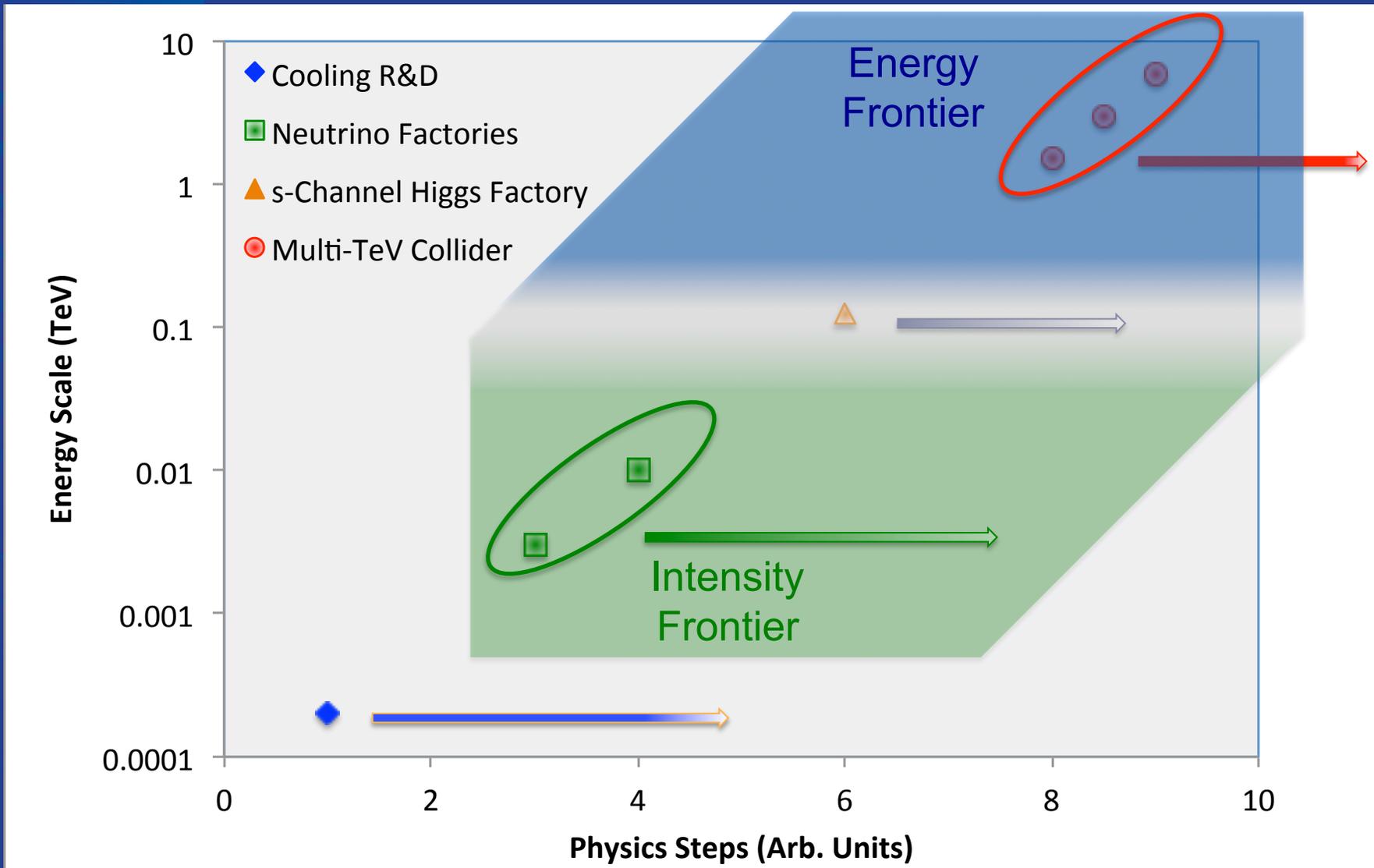


Muon Accelerator Program
New Director Mark Palmer

R&D this decade: SCRF and Project X



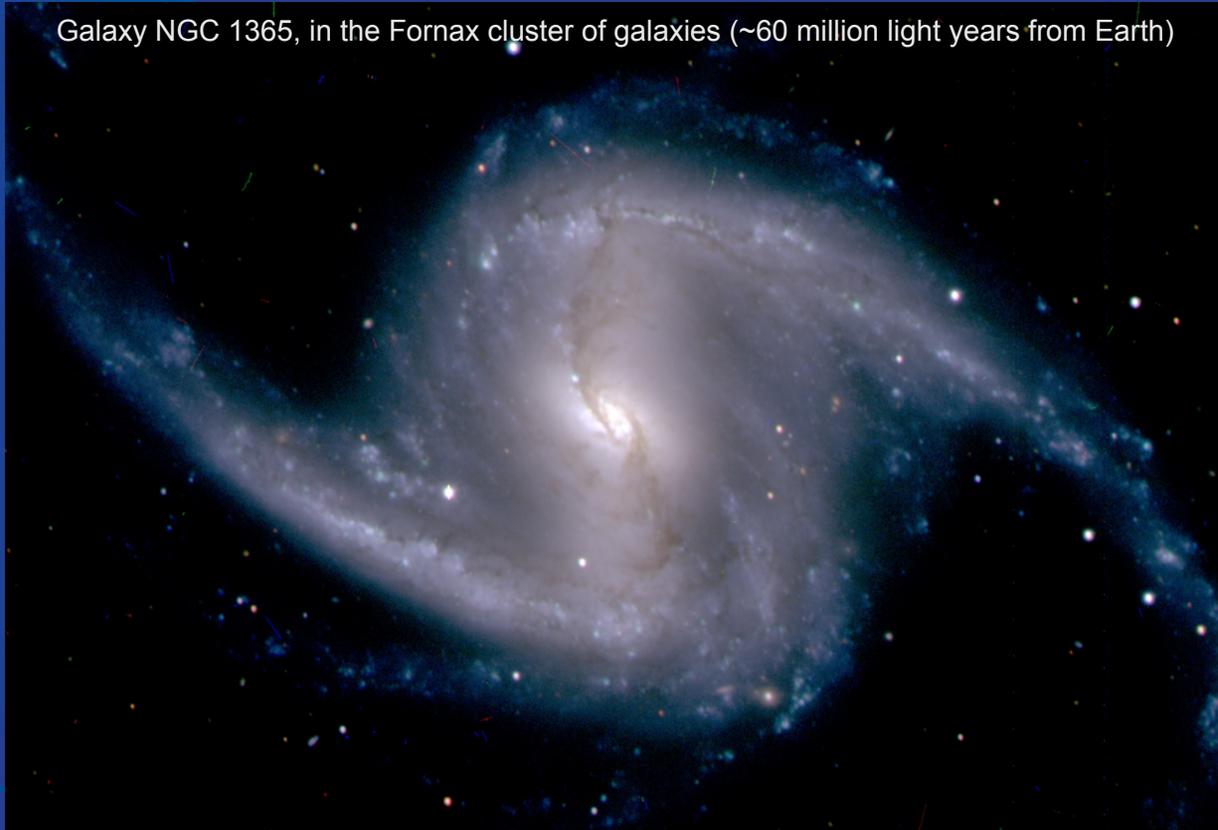
Muon Accelerator Program (MAP)



Cosmic Frontier: dark energy camera

Mounted on the Blanco telescope in Chile

Galaxy NGC 1365, in the Fornax cluster of galaxies (~60 million light years from Earth)



Progression: SDSS → DES → LSST
(+spectroscopic survey?)

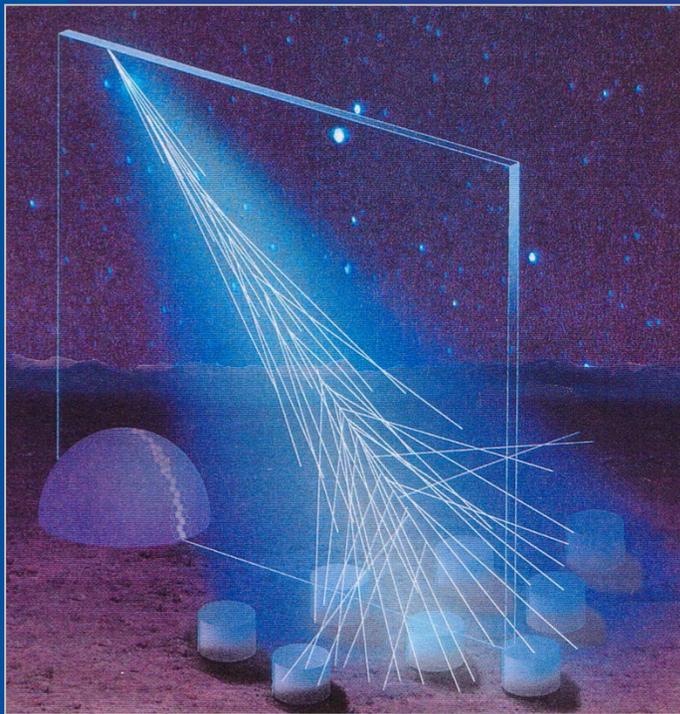
Cosmic Frontier: dark matter

Dark Matter Particle

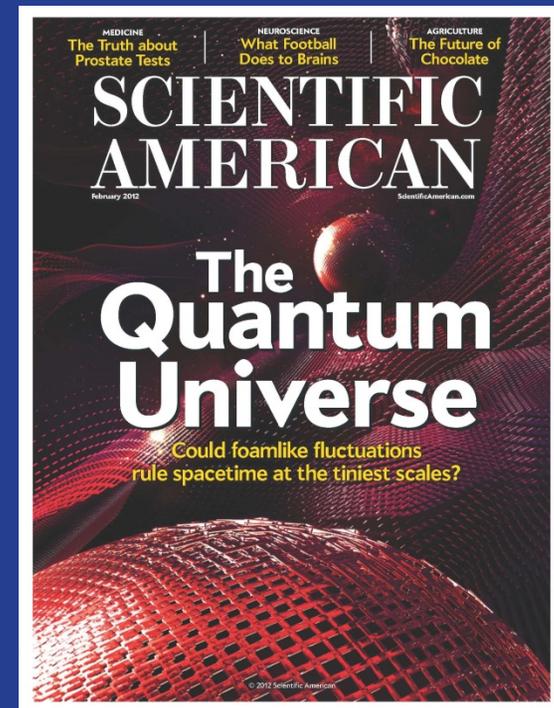


Cosmic Frontier continued

Exploring
Highest-Energy Cosmic-Ray Particles
(Auger)

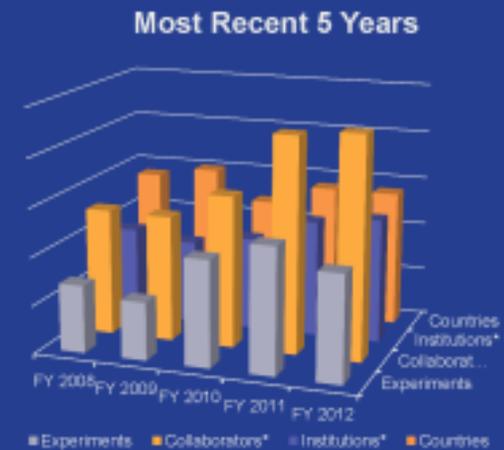


Exploring
Quantum Space-time
(Fermilab Holometer)



Test beam program

- Only US high energy hadron Test Beam
- In FY 2012 served:
 - 11 Experiments
 - 229 Collaborators
 - 64 Institutions
 - 14 Countries



<https://indico.fnal.gov/getFile.py/access?sessionId=6&resId=0&materialId=0&confId=5724>

Illinois Accelerator Research Center



Aim to have major impact on advance accelerators for society's needs

Collaborate, collaborate collaborate..

- We plan and carry out the program with full participation of the community
 - FRA Board with half the members regional representatives named by URA
 - PAC broadly representative of the community
 - Steering Group Effort in 2007 – 2008, defined the three frontiers, input to P5
 - Reconfiguration of LBNE in 2012
 - Innumerable workshops at the three frontiers
 - We bring in the expertise where it exists
 - Investment in the next generation: Hadron Collider, Neutrino and Detector Schools

Not just Fermilab but your program!



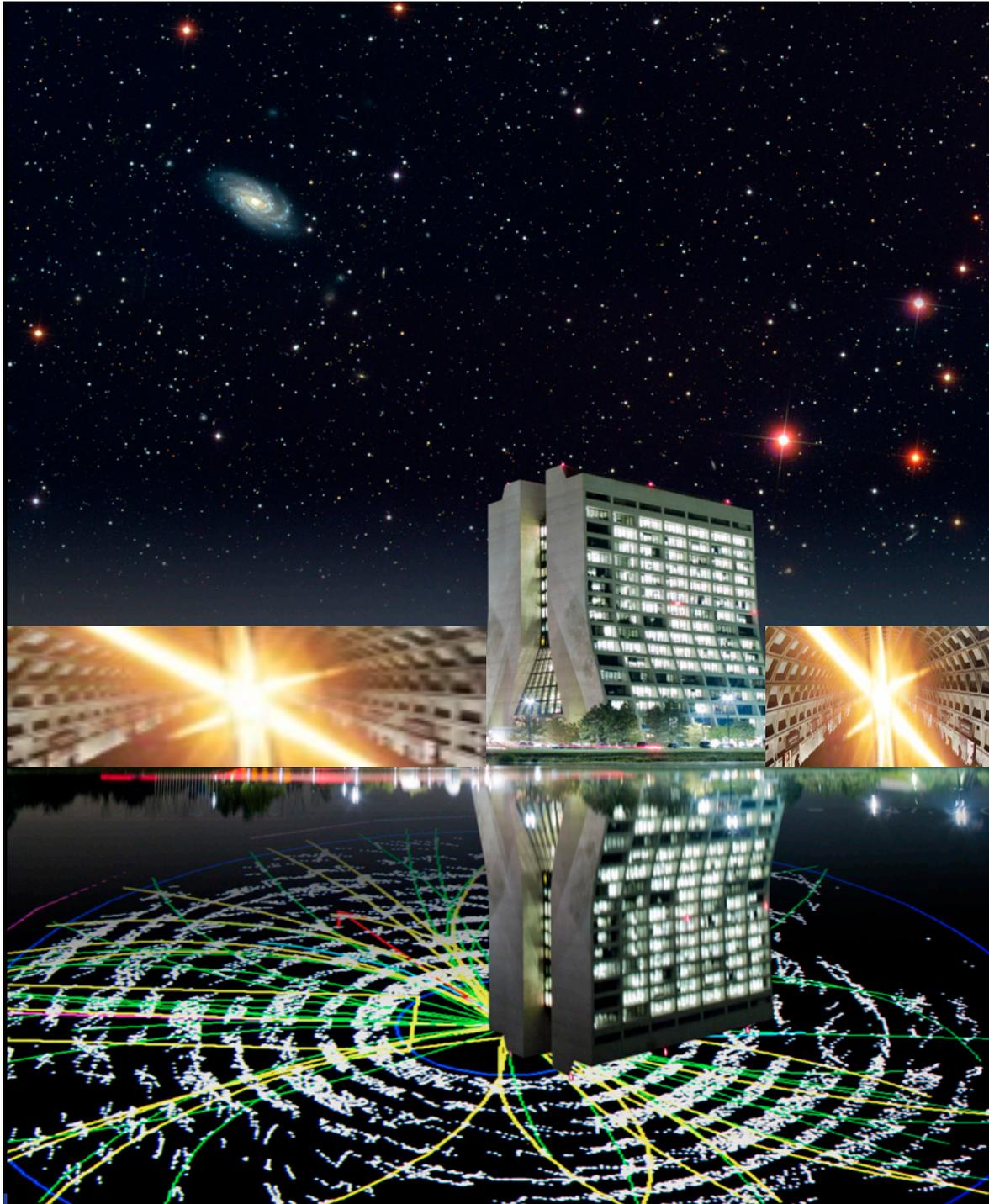
17 countries



27 countries



24 countries



Fermilab:

Your lab!