Welcome

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Fermilab Workshop on Megawatt Rings &
IOTA/FAST Collaboration

8 May 2018

Why Megawatt Beams?

2014: the P5 plan for U.S. high energy particle physics

Building for Discovery

Strategic Plan for U.S. Particle Physics in the Global Context

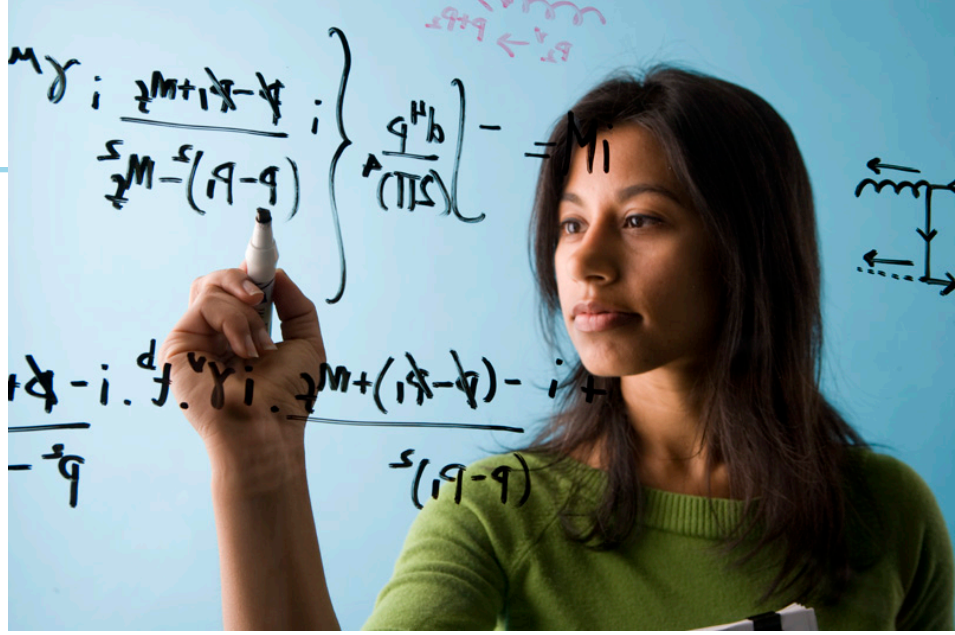
- A strategic plan for U.S. particle physics maximizing opportunities for breakthrough science
- U.S. particle physics community unified behind the plan
- Strong support for the plan from U.S. Dept. of Energy and U.S. Congress

P5 plan in a nutshell

- Continue U.S. commitment and leading roles in the LHC
- Build a neutrino program at Fermilab that will attract the world community
- Continue U.S. leading efforts in dark matter, dark energy, and cosmic microwave background
- Invest in the accelerator and detector technologies that we will need in the future

It is a feature of this plan that the major components reinforce each other

P5 science drivers



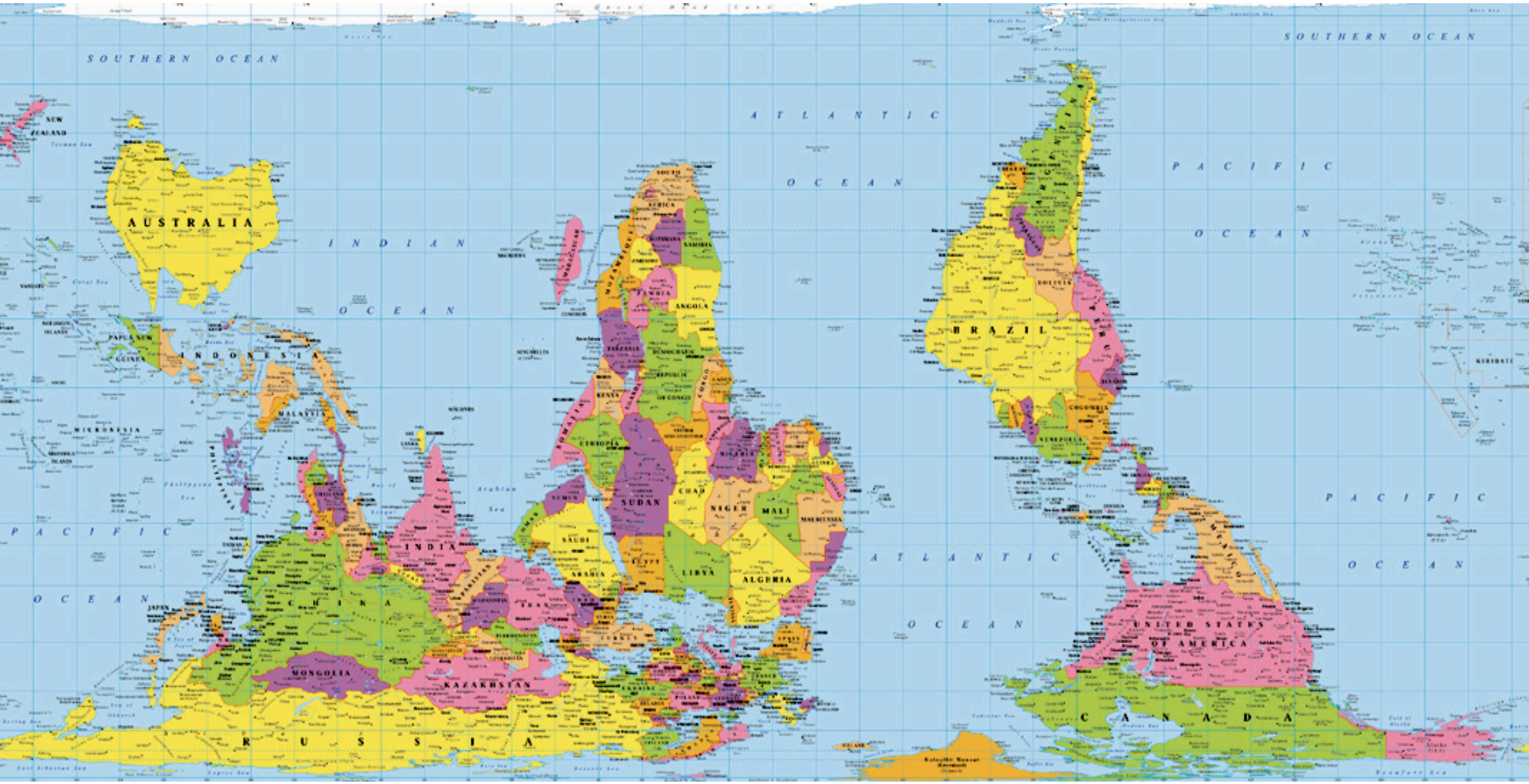
- Higgs boson
- Neutrinos
- Dark matter, dark energy

➔ What the above have in common:

- Fundamental roles in the universe
- Intertwined
- Very difficult to study -> little is known about them

- Exploring the unknown

P5 report: Particle Physics is Global



Fermilab

P5 Recommendation 12:

In collaboration with international partners, develop a coherent short and long baseline neutrino program hosted at Fermilab

Basically asks Fermilab to do for neutrinos what CERN did for the Higgs, involving the worldwide community

P5 Recommendation 13:

Form a new international collaboration to design and execute a highly capable Long-Baseline Neutrino Facility (LBNF) hosted by the U.S. To proceed, a project plan and identified resources must exist to meet the minimum requirements in the text [of the report]. LBNF is the highest-priority large project in its timeframe.

P5 requirements for LBNF/DUNE:

The minimum requirements to proceed are the identified capability to reach an exposure of at least 120 kt*MW*yr by the 2035 timeframe, the far detector situated underground with cavern space for expansion to at least 40 kt LAr fiducial volume, and 1.2 MW beam power upgradable to multi-megawatt power.

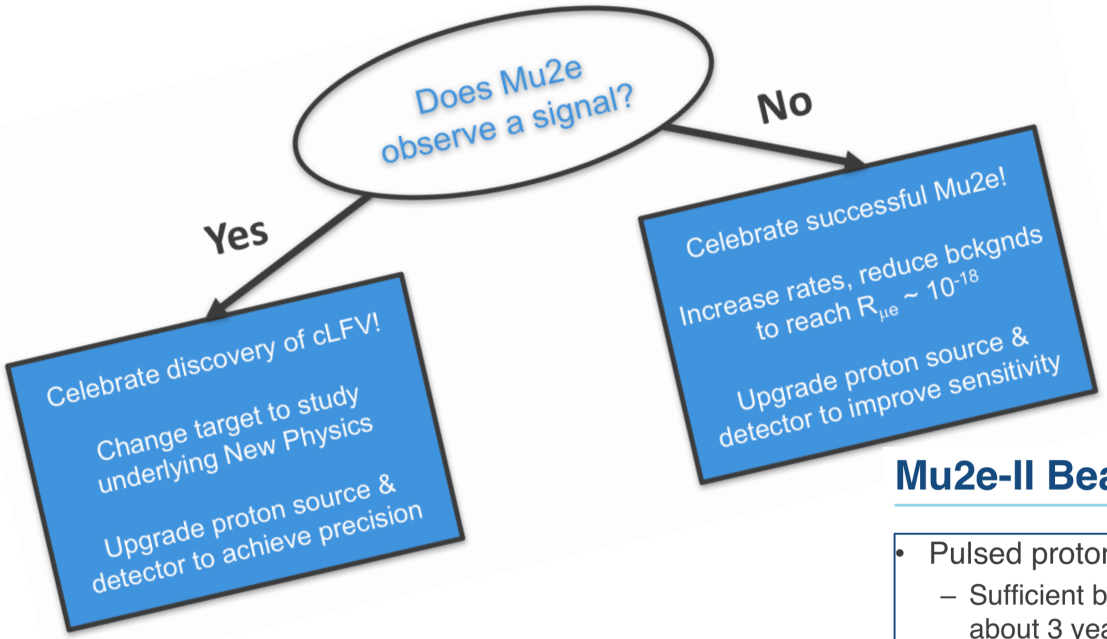
For a long-baseline oscillation experiment …we set as the goal a mean sensitivity to CP violation of better than 3σ … over more than 75% of the range of possible values of the unknown CP-violating phase δCP. By current estimates, **this goal corresponds to an exposure of 600 kt*MW*yr**

P5 Recommendation 14:

Upgrade the Fermilab proton accelerator complex to produce higher intensity beams. R&D for the Proton Improvement Plan II (PIP-II) should proceed immediately, followed by construction, to provide proton beams of > 1 MW by the time of first operation of LBNF


DUNE
NOvA
OS Neutrino Detector
Minnesota
Nebraska
800 miles
Wisconsin
Iowa
Michig
Milwaukee
Fermilab
Chicago
Missouri
Image © 2008 TerraMetrics
© 2008 Europa Technologies
Image NASA
© 2008 Tele Atlas
Google
43°14'04.36" N 92°07'15.58" W
Eye alt 678.31 km

It is not just about neutrinos:



Mu2e-II Beam Requirements

- Pulsed proton beam
  - Sufficient beam power to achieve few x 10^{18} stopped muons in about 3 years of full intensity running (>100 kW)
  - Pulsed with spacing of ~1700 ns
    (a tunable spacing in the range 800-1700 ns even better)
  - Full width ~100 ns (ie. +/- 50 ns around center)
  - Suppress out-of-time protons by 10^{-11} or better
  - Duty factor ~90% or better
  - Preferences
    - To avoid using Delivery Ring
    - Kinetic energy < 4 GeV to avoid antiprotons in beam

PIP-II capable of meeting all of these requirements

Enjoy the workshop