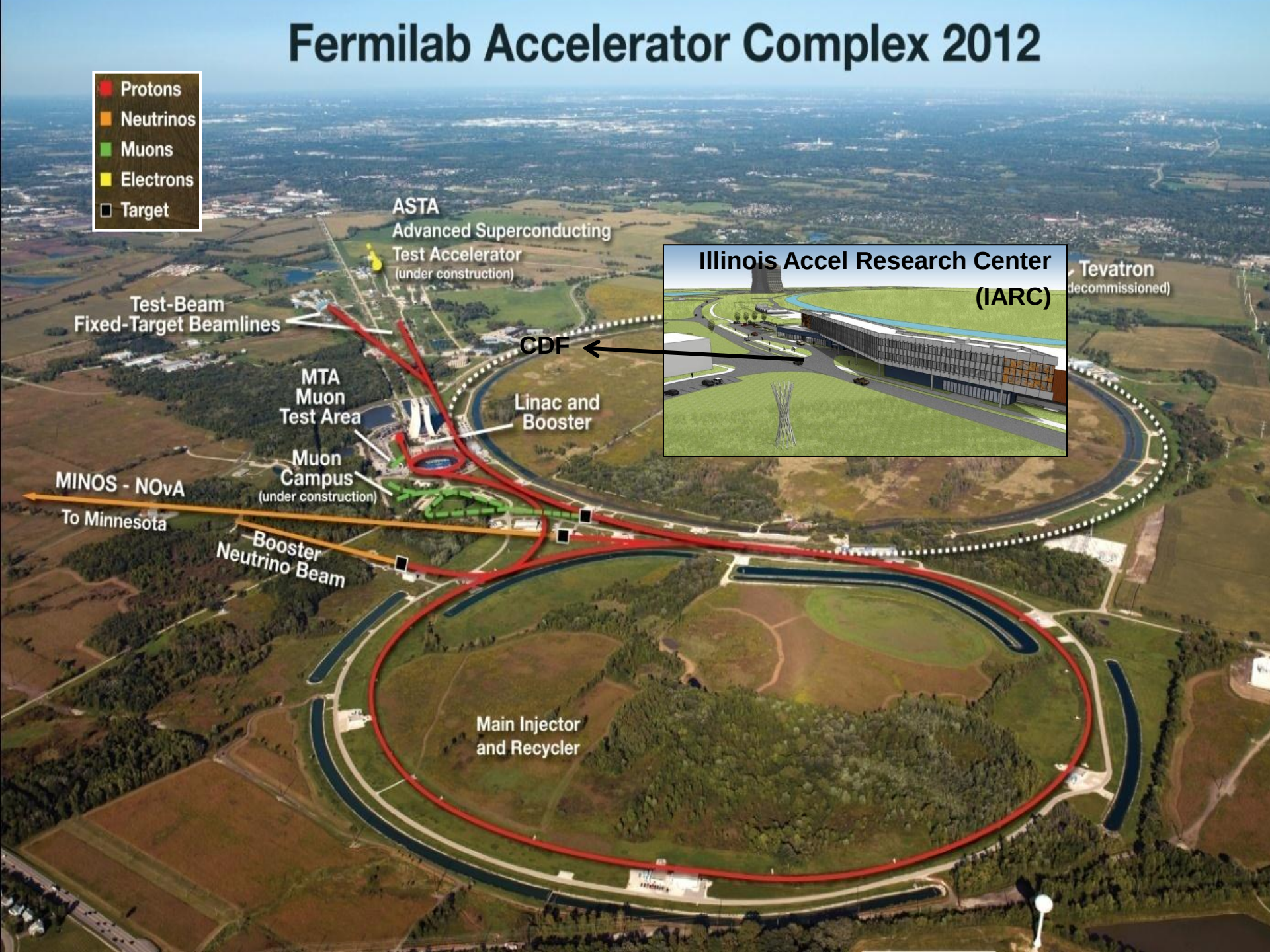
Introduction

Young-Kee Kim

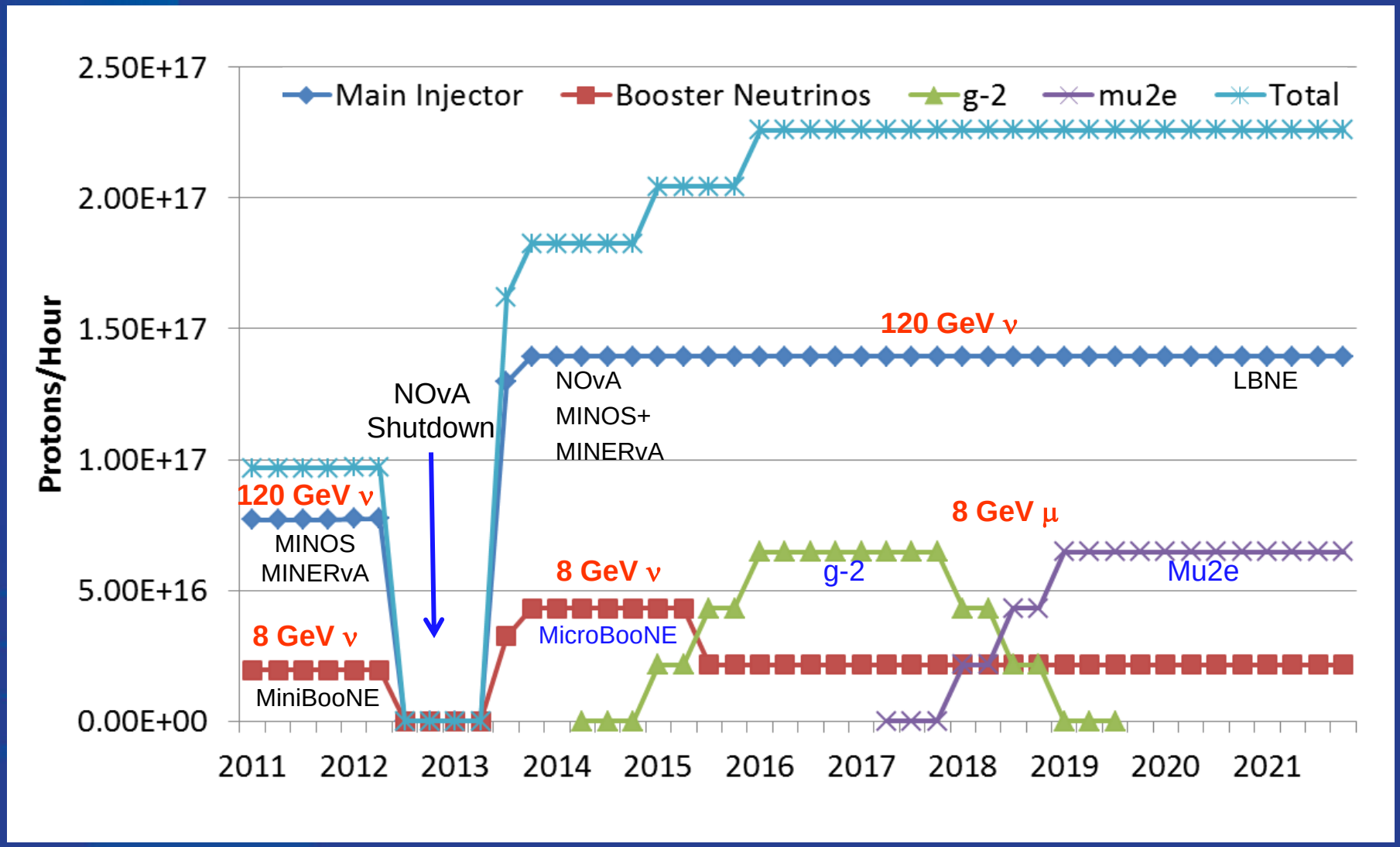
LBNE Reconfiguration Workshop
Fermilab
April 25, 2012

U.S. DEPARTMENT OF ENERGY

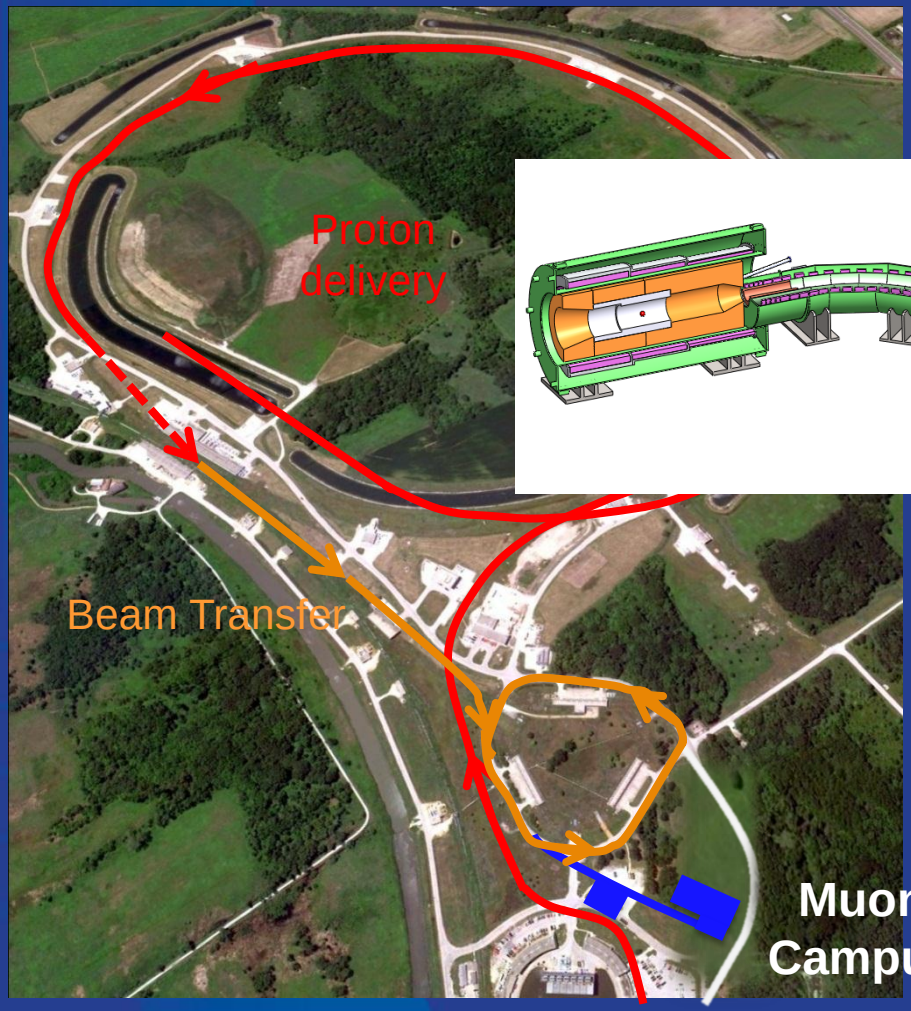
Fermilab


Fermilab Accelerator Complex 2012
Protons
Neutrinos
Muons
Electrons
Target
ASTA
Advanced Superconducting
Test Accelerator
(under construction)
Test-Beam
Fixed-Target Beamlines
MTA
Muon
Test Area
Muon
Campus
(under construction)
MINOS - NOvA
To Minnesota
Booster
Neutrino Beam
CDF
Linac and
Booster
Main Injector
and Recycler
Tevatron
(decommissioned)
Illinois Accel Research Center
(IARC)

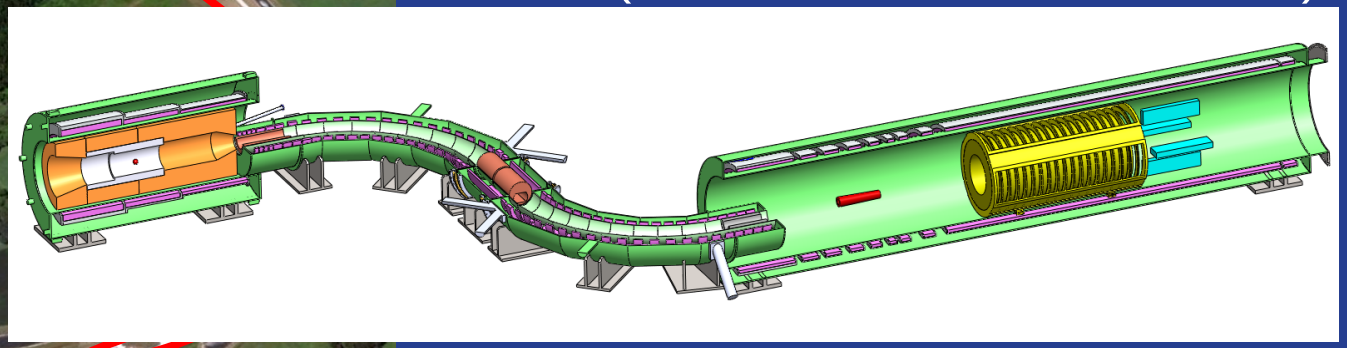
“Proton Improvement Plan” (reliable operation through 2025)

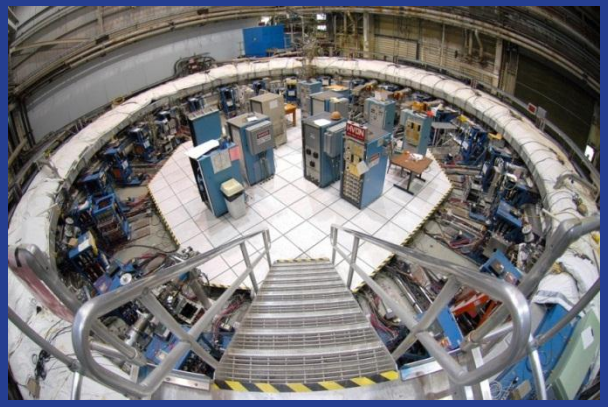


Muon Complex with Muon Experiments



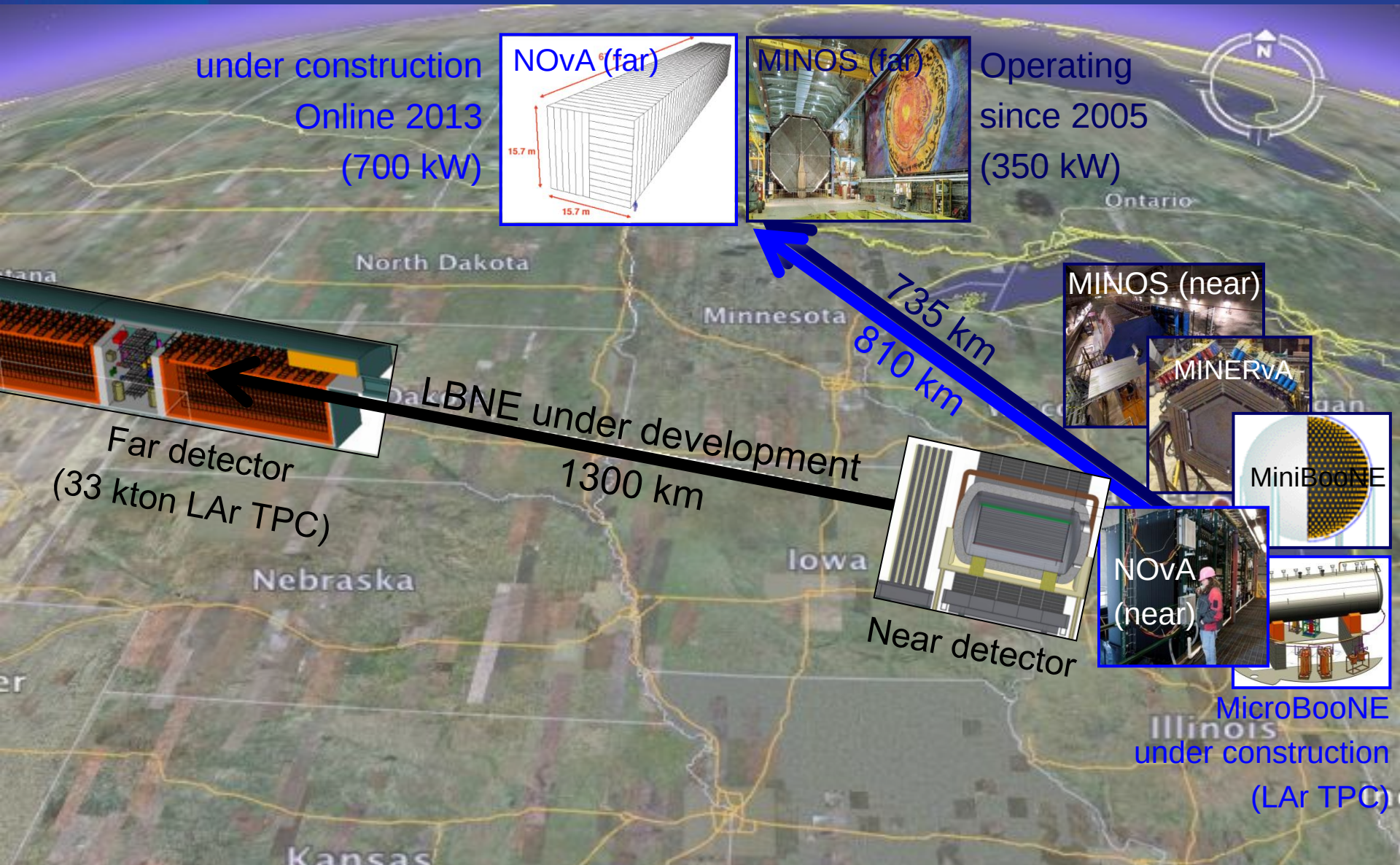
Mu2e (muon to electron conversion)





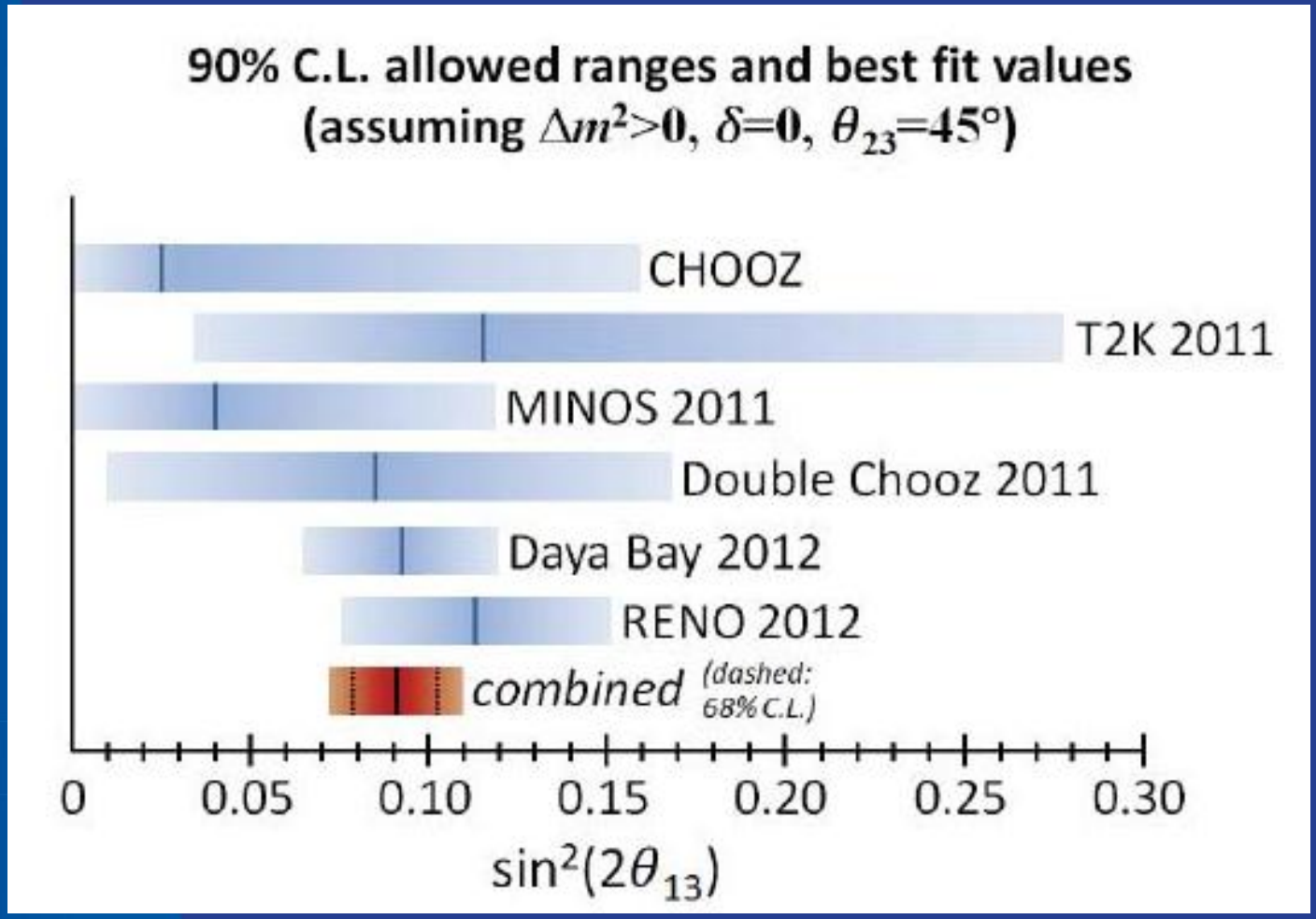
Muon g-2

Neutrino Program



$\sin^2 2\theta_{13}$ measured (March 2012)

Ryan Patterson



LBNE Science

1. Long Baseline Neutrino Oscillation Physics
   - CP violation
   - Mass hierarchy
   - Precision measurements: θ_{13}, θ_{23}, Δm^2_{32}
2. Proton Decay
3. Supernovae burst neutrinos
4. Atmospheric neutrino physics

Long-Baseline Neutrino Experiment Collaboration

Alabama: J.Goon, I Stancu

Argonne: M.D' Agostino, G.Drake.Z.Djurcic, M.Goodman, V.Guarino, S.Magill, J.Paley, H.Sahoo, R.Talaga, M.Wetstein

Boston: E.Hazen, E.Kearns, S.Linden

Brookhaven: M.Bishai, R.Brown, H.Chen, M.Diwan, J.Dolph, G.Geronimo, R.Gill, R.Hackenberg, R.Hahn, S.Hans, Z.Isvan, D.Jaffe, S.Junnarkar, S.H.Kettell, F.Lanni, Y.Li, L.Littenberg, J.Ling, D.Makowiecki, W.Marciano, W.Morse, Z.Parsa, V.Radeka, S.Rescia, N.Samios,R.Sharma, N.Simos, J.Sondericker, J.Stewart, H.Tanaka, H.Themann, C.Thorn, B.Viren, S.White, E.Worcester, M.Yeh, B.Yu, C.Zhang

Caltech: R.McKeown, X.Qian

Cambridge: A.Blake, M.Thomson

Catania/INFN: V.Bellini, G.Garilli, R.Potenza, M.Trovato

Chicago: E.Blucher, M.Strait

Colorado: S.Coleman, R.Johnson, S.Johnson, A.Marino, E.Zimmerman

Colorado State: M.Bass, B.E.Berger, J.Brack, N.Buchanan, D.Cherdack, J.Harton, W.Johnston, F.Khanam, W.Toki, T.Wachala, D.Warner, R.J.Wilson

Columbia: R.Carr, L.Camillieri, C.Y.Chi, G.Karagiorgi, C.Mariani, M.Shaevitz, W.Sippach, W.Willis

Crookston: D.Demuth

Dakota State: B.Szcerbinska

Davis: M.Bergevin, R.Breedon, D.Danielson, J.Felde, P.Gupta, M.Tripanthi, R.Svoboda

Drexel: C.Lane, J.Maricic, R.Milincic, S.Perasso

Duke: T.Akiri, J.Fowler, A.Himmel, Z.Li, K.Scholberg, C.Walter, R.Wendell

Duluth: R.Gran, A.Habig

Fermilab: D.Allspach, M.Andrews, B.Baller, E.Berman, D.Boehnlein, M.Campbell, A.Chen, S.Childress, A.Drozhdin, T.Dykhuis, C.Escobar, A.Hahn, S.Hays, A.Heavey, J.Howell, P.Huhr, J.Hylen, C.James, M.Johnson, J.Johnstone, H.Jostlein, T.Junk, B.Kayser, G.Koizumi, T.Lackowski, P.Lucas, B.Lundberg, T.Lundin, P.Mantsch, E.McCluskey, S.Moed Sher, N.Mokhov, C.Moore, J.Morfin, B.Norris, V.Papadimitriou, R.Plunkett, C.Polly, S.Pordes, O.Prokofiev, J.L.Raaf, G.Rameika, B.Rebel, D.Reitzner, K.Riesselmann, R.Rucinski, R.Schmidt, D.Schmitz, P.Shanahan, M.Stancari, J.Strait, S.Striganov, K.Vaziri, G.Velev, T.Wyman, G.Zeller, R.Zwaska

Hawai'i: S.Dye, J.Kumar, J.Learned, S.Matsuno, S.Pakvasa, M.Rosen, G.Varner

Houston: L.Whitehead

Indian Universities: V.Singh (BHU); B.Choudhary, S.Mandal (DU); B.Bhuyan [IIT(G)]; V.Bhatnagar, A.Kumar, S.Sahijpal(PU)

Indiana: W.Fox, C.Johnson, M.Messier, S.Mufson, J.Musser, R.Tayloe, J.Urheim

Iowa State: I.Anghel, G.S.Davies, M.Sanchez, T.Xin

IPMU/Tokyo: M.Vagins

Irvine: G.Carminati, W.Kropp, M.Smy, H.Sobel

Kansas State: T.Bolton, G.Horton-Smith

LBL: B.Fujikawa, V.M.Gehman, R.Kadel, D.Taylor

Livermore: A.Bernstein, R.Bionta, S.Dazeley, S.Ouedraogo

London: J.Thomas

Los Alamos: S.Elliott, A.Friedland, G.Garvey, E.Guardincerri, T.Haines, D.Lee, W.Louis, C.Mauger, G.Mills, Z.Pavlovic, J.Ramsey, G.Sinnis, W.Sondheim, R.Van de Water, H.White, K.Yarritu

Louisiana: J.Insler, T.Kutter, W.Metcalf, M.Tzanov

Maryland: E.Blaufuss, S.Eno, R.Hellauer, T.Straszheim, G.Sullivan

Michigan State: E.Arrieta-Diaz, C.Bromberg, D.Edmunds, J.Huston, B.Page

Minnesota: M.Marshak, W.Miller

MIT: W.Barletta, J.Conrad, B.Jones, T.Katori, R.Lanza, A.Prakash, L.Winslow

NGA: S.Malys, S.Usman

New Mexico: J.Mathews

Notre Dame: J.Losecco

Oxford: G.Barr, J.DeJong, A.Weber

Pennsylvania: S.Grullon, J.Klein, K.Lande, T.Latorre, A.Mann, M.Newcomer, S.Seibert, R.vanBerg

Pittsburgh: D.Naples, V.Paolone

Princeton: Q.He, K.McDonald

Rensselaer: D.Kaminski, J.Napolitano, S.Salon, P.Stoler

Rochester: L.Loiacono, K.McFarland, G.Perdue

Sheffield: V.Kudryavtsev, M.Richardson, M.Robinson, N.Spooner, L.Thompson

SDMST: X.Bai, C.Christofferson, R.Corey, D.Tiedt

SMU.: T.Coan, T.Liu, J.Ye

South Carolina: H.Duyang, B.Mercurio, S.Mishra, R.Petti, C.Rosenfeld, X Tian

South Dakota State: B.Bleakley, K.McTaggert

Syracuse: M.Artuso, S.Blusk, T.Skwarnicki, M.Soderberg, S.Stone

Tennessee: W.Bugg, T.Handler, Y.Kamyshkov

Texas: S.Kopp, K.Lang, R.Mehdiyev

Tufts: H.Gallagher, T.Kafka, W.Mann, J.Schnepps

UCLA: K.Arisaka, D.Cline, K.Lee, Y.Meng, F.Sergiampietri, H.Wang

Virginia Tech.: E.Guarnaccia, J.Link, D.Mohapatra

Washington: H.Berns, S.Enomoto, J.Kaspar, N.Tolich, H.K.Tseung

Wisconsin: B.Balantekin, F.Feyzi, K.Heeger, A.Karle, R.Maruyama, B.Paulos, D.Webber, C.Wendt

Yale: E.Church, B.Fleming, R.Guenette, K.Partyka, J.Spitz, A.Szelc

335 Members
61 Institutions
25 US States
5 Countries

9 March 2012 (335)

Department of Energy
Office of Science
Washington, DC 20585

Office of the Director

March 19, 2012

Dr. Pier Oddone
Director
Fermilab
Wilson and Kirks Road
Batavia, IL 60510-5011

Dear Pier,

Thank you for your recent presentation on the status and plans for the Long Baseline Neutrino Experiment (LBNE). The project team and the scientific collaboration have done an excellent job responding to our requests to assess the technology choices and refine the cost estimates for LBNE. We believe that the conceptual design is well advanced and the remaining technical issues are understood.

The scientific community and the National Academy of Sciences repeatedly have examined and endorsed the case for underground science. We concur with this conclusion, and this has been the motivator for us to determine a path forward as quickly as possible following the decision of the National Science Board to terminate development of the Homestake Mine as a site for underground science.

We have considered both the science opportunities and the cost and schedule estimates for LBNE that you have presented to us. We have done so in the context of planning for the overall Office of Science program as well as current budget projections.

Based on our considerations, we cannot support the LBNE project as it is currently configured. This decision is not a negative judgment about the importance of the science, but rather it is a recognition that the peak cost of the project cannot be accommodated in the current budget climate or that projected for the next decade.

In order to advance this activity on a sustainable path, I would like Fermilab to lead the development of an affordable and phased approach that will enable important science results at each phase. Alternative configurations to LBNE should also be considered. Options that allow us to independently develop the Homestake Mine as a future facility for dark matter experiments should be included in your considerations.

A report outlining options and alternatives is needed as soon as practical to provide input to our strategic plan for the Intensity Frontier program. OHEP will provide additional details on realistic cost and schedule profiles and on the due date for the report.

Thank you,

W. F. Brinkman
Director, Office of Science

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The alternatives include options that do not require further development of the Homestake site.

Director's Corner

Long-Baseline Neutrino Experiment

We have started a vigorous effort to answer Office of Science Director Bill Brinkman's charge to Fermilab to find a path forward to reach the goals of the Long-Baseline Neutrino Experiment in a phased approach.

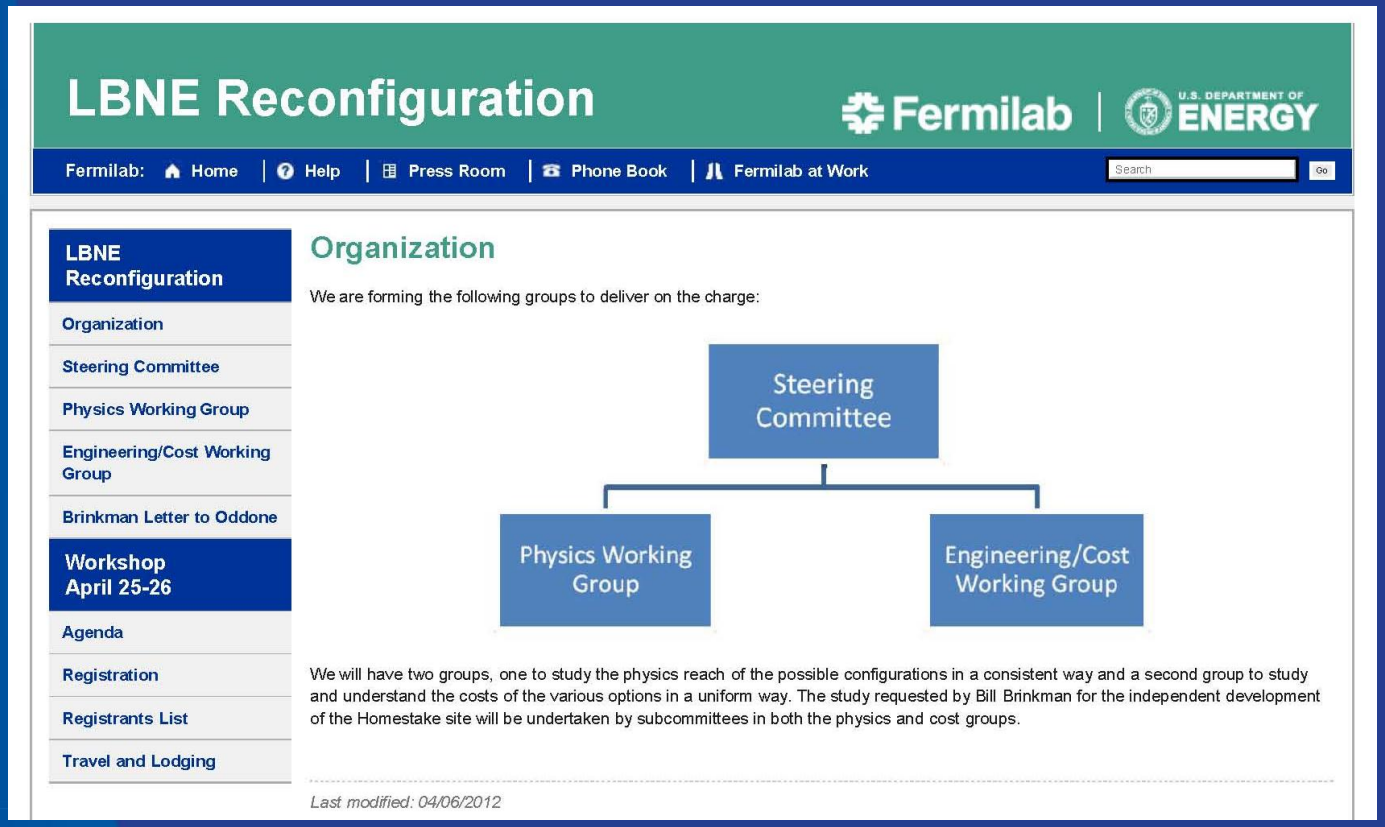
Fermilab Director Pier Oddone

A steering committee led by Deputy Director Young-Kee Kim, with many of the LBNE stakeholders as members, will guide the study. The steering committee will have two working groups: the physics working group, led by Mel Shochet of the University of Chicago, and the engineering/cost working group, led by Mark Reichanadter of SLAC. The steering committee will provide guidance to the working groups and will ultimately write the report for DOE. The physics working group will analyze the physics reach of the various phases and alternatives on a common basis. Similarly, the engineering/cost working group will provide cost estimates and analyze the feasibility of the proposed approaches with the same methodology. These two groups will provide to the steering committee factual input that covers as many aspects of the various options as possible.

To inform the community, discuss the status of the work in progress and seek input, we will hold a workshop on April 25 and 26 that is open to all interested parties.

The time scale for concluding these studies is very short because the results will influence the Congressional budget process for FY13 and the Office of Science planning process for FY14. We plan to have a preliminary report by June 1, which will be vetted by our Physics Advisory Committee and the FRA Board of Directors. A final report will be available on July 1.

Organization



http://www.fnal.gov/directorate/lbne_reconfiguration/index.shtml

Jeff Appel: Scientific Secretary for the Steering Committee and Working Groups

The Steering Committee

Many are LBNE stakeholders

Membership	
Young-Kee Kim, FNAL (Chair)	LBNE LOG (Lab Oversight Group) member
James Symons, LBNL	LBNE LOG (Lab Oversight Group) member
Steve Vigdor, BNL	LBNE LOG (Lab Oversight Group) member
Bob Svoboda, UC Davis	LBNE co-spokesperson
Kevin Lesko, LBNL	SURF (Sanford Underground Research Facility) head
Gary Feldman, Harvard	NOvA co-spokesperson
Mel Shochet, U.Chicago	Physics working group chair, Former HEPAP chair
Mark Reichanadter, SLAC	Engineering/Cost working group chair DOE DUSEL review committee co-chair
Charlie Baltay, Yale	P5 chair
Jon Bagger, JHU	Former HEPAP deputy chair
Ann Nelson, UW, Seattle	HEPAP member

Ex-officio group

Membership	
Andy Lankford, UC Irvine	HEPAP chair, DUSEL NRC study chair
Steve Ritz, UC Santa Cruz	PASAG (Particle Astrophysics Scientific Assessment Group) chair, Fermilab PAC member (chair from Fall 2012)
Jay Marx, Caltech	DOE DUSEL review committee co-chair
Pierre Ramond, U. Florida	DPF chair
Harry Weerts, ANL	DOE Intensity Frontier Workshop co-chair
JoAnne Hewett, SLAC	DOE Intensity Frontier Workshop co-chair
Jim Strait, FNAL	LBNE Project Manager Engineering/Cost working group deputy chair
Pier Oddone, FNAL	Director, Fermilab
Susan Seestrom, LANL	LBNE LOG (Lab Oversight Group) member

Working Groups

Physics Working Group	Engineering / Cost Working Group
Mel Shochet, U.Chicago (chair) Mary Bishai, BNL Ed Blucher, UChicago Steve Brice, FNAL Milind Diwan, BNL Bonnie Fleming, Yale Gil Gilchriese, LBNL Bill Marciano, BNL Mark Messier, Indiana Stephen Parke, FNAL Gina Rameika, FNAL Kate Scholberg, Duke Jenny Thomas, UCL Charlie Young, SLAC Sam Zeller, FNAL	Mark Reichanadter, SLAC (chair) Jim Strait, FNAL (deputy chair) Bruce Baller, FNAL Mike Headley, SURF Marvin Marshak, U. Minnesota Chris Mauger, LANL Elaine McCluskey, FNAL Vaia Papadimitriou, FNAL Bob O'Sullivan, FNAL Jeff Sims, ANL Additional invitation to Tracy Lundin (FNAL) Jeff Dolph (BNL) Jim Stewart (BNL) Joel Sefcovic (FNAL)

Efforts so far

- Clarify Brinkman's letter
- Determine an initial set of Phase-1 options
- Determine assumptions
  - θ_{13}, beam power, far detector technology (LAr TPC), detector mass, near detector, etc
- Working groups:
  - Set up a machinery to provide a common basis and the same methodology for physics reach cost estimates for all optioins
  - Analyze physics reach and cost estimates for the initial options

Initial options for consideration

- Fermilab → Homestake (surface, depth – 4850 foot)
  - Options A
    - Phase 1: new beam line + small far detector
    - Phase 2: large far detector
  - Options B
    - Phase 1: large far detector ← No neutrino oscillation at Phase 1
    - Phase 2: new beam line + near detector
  - Science (Phase 1 + Phase 2) – LBNE
- Fermilab → NuMI (surface, depth – 2340 foot)
  - Fermilab → Soudan (on axis, low energy beam)
  - Fermilab → Ash River (off axis, medium energy beam)

- Budget guidance (Phase 1) ~$600M
- Phase 2 will differ for different options

Assumptions on beam power (protons-on-target)

- NOvA and T2K running assumption
  - NOvA runs through 2020 at 700kW (6E20 / year), and continue to run for “NuMI” options
  - T2K runs through 2020 at 300kW on average

Period	Integ. No. of Proton on Target	Beam Power (kW)	
-Jun.2012	3.1E+20	170	
-Jun.2013	7.8E+20	200	
-Jun.2014	1.2E+21	250	*2
-Jun.2015	1.8E+21	250	
-Jun.2016	2.5E+21	300	
-Jun.2017	3.2E+21	300	
-Jun.2018	3.9E+21	300	
-Jun.2019	5.5E+21	700	*1
-Jun.2020	7.1E+21	700	
-Jun.2021	8.8E+21	700	

*1 Completion time of MR upgrade (assumed to be 2018) is suject to change, depending on economical situation, readiness and so on.

*2 LINAC upgrade completed

* Beam Energy 30GeV

Official information received on April 23, 2012

- LBNE phase-1 (homestake or NuMI)
  - 60E20 in total (10 years with 700kW, 5 years with 1.4MW)

Initial set of options

1. Option 1 (new beamline + small far detector at Homestake)
   - LBNE Phase-1: surface (not 800L)
2. Option 2 (new beamline + small far detector at Homestake)
   - LBNE Phase-1: depth (4850L)
3. Option 3: NuMI On-Axis
   - Detector in the Soudan Underground Mine (2300L)
   - Low Energy Beam = current MINOS beam energy spectrum
4. Option 4: NuMI On-Axis
   - Detector on the Soudan surface
   - Low Energy Beam = current MINOS beam energy spectrum (At the Soudan site, the spectra between surface and underground are very similar)
5. Option 4: NuMI Off-Axis
   - Detector at Ash River (surface)
   - Medium Energy Beam = NOvA beam energy spectrum
6. Option 5: NuMI On-Axis and Off-Axis combination
   - Combination of a detector in the Soudan Mine and a detector at Ash River
   - Low Energy Beam = current MINOS beam energy spectrum

LBNE Reconfiguration Workshop

25-26 April 2012 *Fermi National Accelerator Laboratory*
US/Central timezone

Overview
Scientific Programme
Timetable
Contribution List
Author index
My conference
My contributions
Registration
List of Registrants
Travel and Lodging
LBNE Reconfiguration Effort Home Page

Support

We have started a vigorous effort to answer Office of Science Director Bill Brinkman's charge to Fermilab to find a path forward to reach the goals of the Long-Baseline Neutrino Experiment in a phased approach. A steering committee led by Deputy Director Young-Kee Kim, with many of the LBNE stakeholders as members, will guide the study. The steering committee will have two working groups: the physics working group, led by Mel Shochet of the University of Chicago, and the engineering/cost working group, led by Mark Reichanadter of SLAC. The Committee is asked to deliver a preliminary report by June 1 and a final report by July 1. Detailed information can be found at http://www.fnal.gov/directorate/lbne_reconfiguration/

To inform the community, discuss the status of the work in progress and seek input, we will hold a workshop on April 25 and 26 that is open to all interested parties. ReadyTalk will be available for remote participation. Agenda includes:

* Initial studies done by working groups
* Community voice from LBNE collaboration (April 26)
* Community voice on NuMI options (April 25)
* Community voice: open mics (60' on April 25 and 60' on April 26)
* Discussion forum towards building concensus

If you would like to sign up for a time slot for the open mike sessions (up to 2 slides / 5' each), please send an email to Jon Bagger, Steve Vigdor and Mary-Ellyn McCollum (bagger@jhu.edu, vigdor@bnl.gov, mccollum@fnal.gov).

"Community voice from LBNE collaboration" and "Community voice on NuMI options" are organized by LBNE co-spokespersons and MINOS/NOvA co-spokespersons, respectively.

Dates:	from 25 April 2012 03:05 to 26 April 2012 13:00
Timezone:	US/Central
Location:	*Fermi National Accelerator Laboratory* Batavia, Illinois Room: One West, Wilson Hall
Chairs:	Kim, Young-Kee

Workshop (1/2)

April 25 (day 1)

- Plenary session (chair: Bob Wilson)
  - 10:30 am Welcome – Pier Oddone (5')
  - 10:35 am Introduction – Young-Kee Kim (30' + 5')
  - 11:10 am Physics Working Group: Introduction + Summary of Initial Studies – Mel Shochet / Gina Rameika (40'+10')
  - 12:00 pm Lunch (60')
- Plenary session (chair: Brajesh Choudhary)
  - 1:00 pm Engineering / Cost Working Group: Introduction – Mark Reichanadter or Jim Strait (10' + 5')
  - 1:15 pm Beamline including Conventional Facilities: assumptions and cost estimates - Vaia Papadimitriou (30' + 15')
  - 2:00 pm Near Detector including Conventional Facilities: assumptions and cost estimates - Christopher Mauger (15' + 5')
  - 2:20 pm Conventional Faclities for the Far Detector: assumptions and cost estimates - Tracy Lundin (30' + 15')
  - 3:05 pm Far Detector: assumptions and cost estimates – Bruce Baller (25' + 10')
  - 3:40 pm Coffee Break (30')
- Plenary session (chair: Kevin Lesko)
  - 4:10 pm Community voice: moderated discussion focusing on NuMI options (60')
    - This session is organized by MINOS + NOvA co-spokespersons
  - 5:10 pm Community voice: open mikes – up to 2 slides / 5' each (60')
    - If you want to sign up for a time slot, please send an email to Jon Bagger, Steve Vigdor and Mary-Ellyn McCollum (bagger@jhu.edu, vigdor@bnl.gov, mccollum@fnal.gov).
- Reception (6:30 – 8:30 pm) – Wilson Hall 2nd floor South Crossover

Workshop (2/2)

April 26 (day 2)

- Plenary session (chair: Jon Rosner)
  - 8:00 am Neutrino reach – Mary Bishai (30' + 10')
  - 8:40 am Proton decay and cosmic neutrino reach – Kate Scholberg (30' + 10')
  - 9:20 am Community voice: LBNE collaboration (60')
    - This session is organized by LBNE co-spokespersons
  - 10:20 am Coffee Break (30')

- Plenary session (chair: Shekhar Mishra)
  - 10:50 am Community voice: open mikes – up to 2 slides / 5' each (60')
    - If you want to sign up for a time slot, please send an email to Jon Bagger, Steve Vigdor and Mary-Ellyn McCollum (bagger@jhu.edu, vigdor@bnl.gov, mccollum@fnal.gov).
  - 11:50 am Community voice: moderated discussion – moderator: Charlie Baltay (40')
  - 12:30 pm Wrap-up (15') – Young-Kee Kim

1 pm – 3 pm

Steering Committee face-to-face meeting

Steps to follow after this workshop

- Include the community's input in the process.
- Choose acceptable Phase-1 options
- For each Phase-1 option,
  - Study potential Phase-2 options in terms of the overall U.S. strategy / leadership role
  - Study pros and cons
- Dialog with DOE OHEP
- The Steering Committee's face-to-face meetings
  - 1st meeting: April 26 at Fermilab (tomorrow)
  - 2nd meeting: May 22-23 at Fermilab
- Preliminary Report (deadline June 1)