

Fermilab: Introduction

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*DOE KA12 (Electron Research) Review
June 22-23, 2010*

Fermilab Accelerator Complex Operating Simultaneously

MINOS

SCRF Test Facilities for
Project X, ILC, Muon Collider,
Accelerator Research

Testbeam
for Det. R&D

Muon Cooling
Test Facility

SeaQuest

MINERvA

CDF

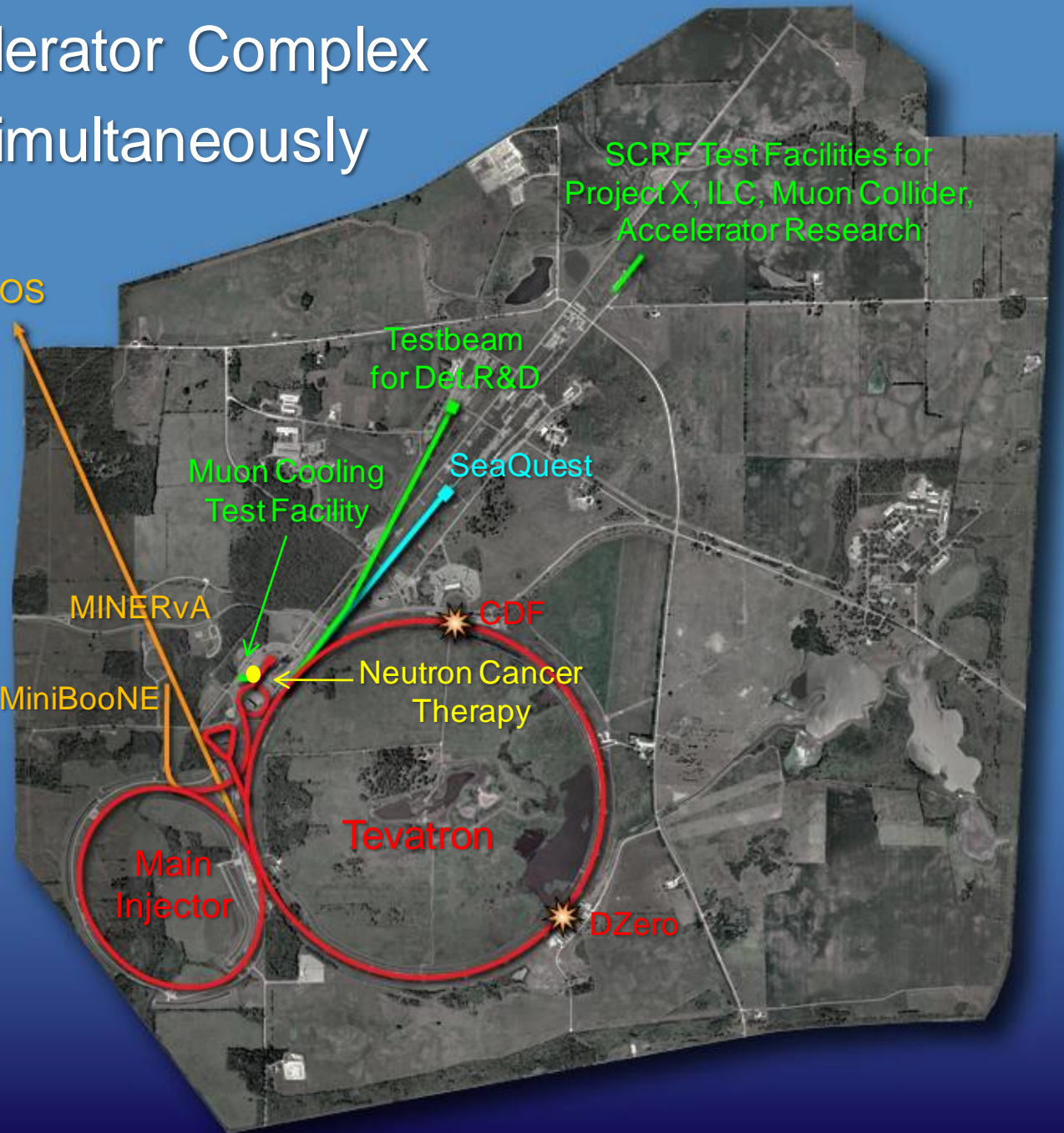
MiniBooNE

Neutron Cancer
Therapy

Main
Injector

Tevatron

DZero



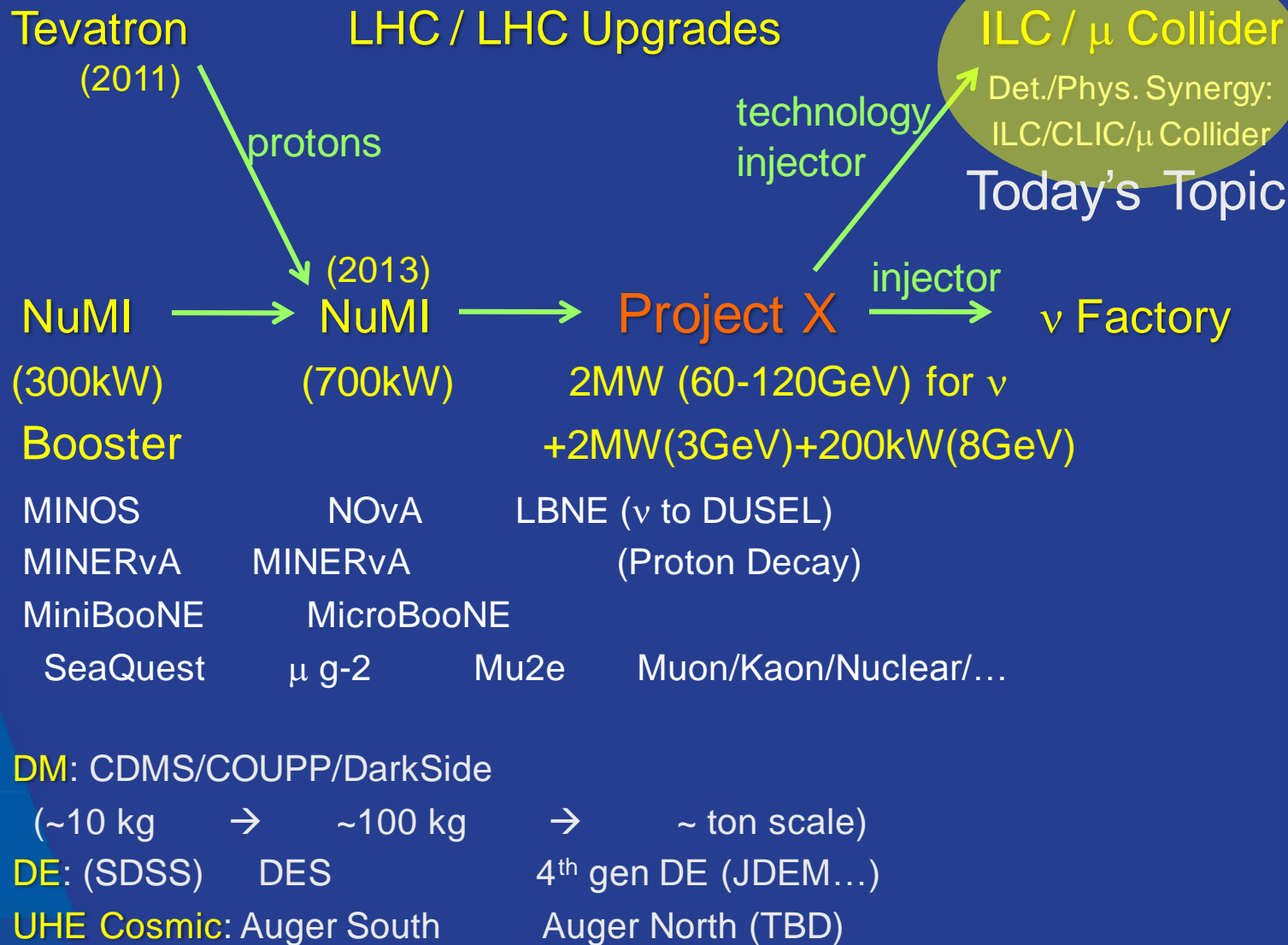
Fermilab Strategic Plan at the Three Frontiers

time →

Energy Frontier

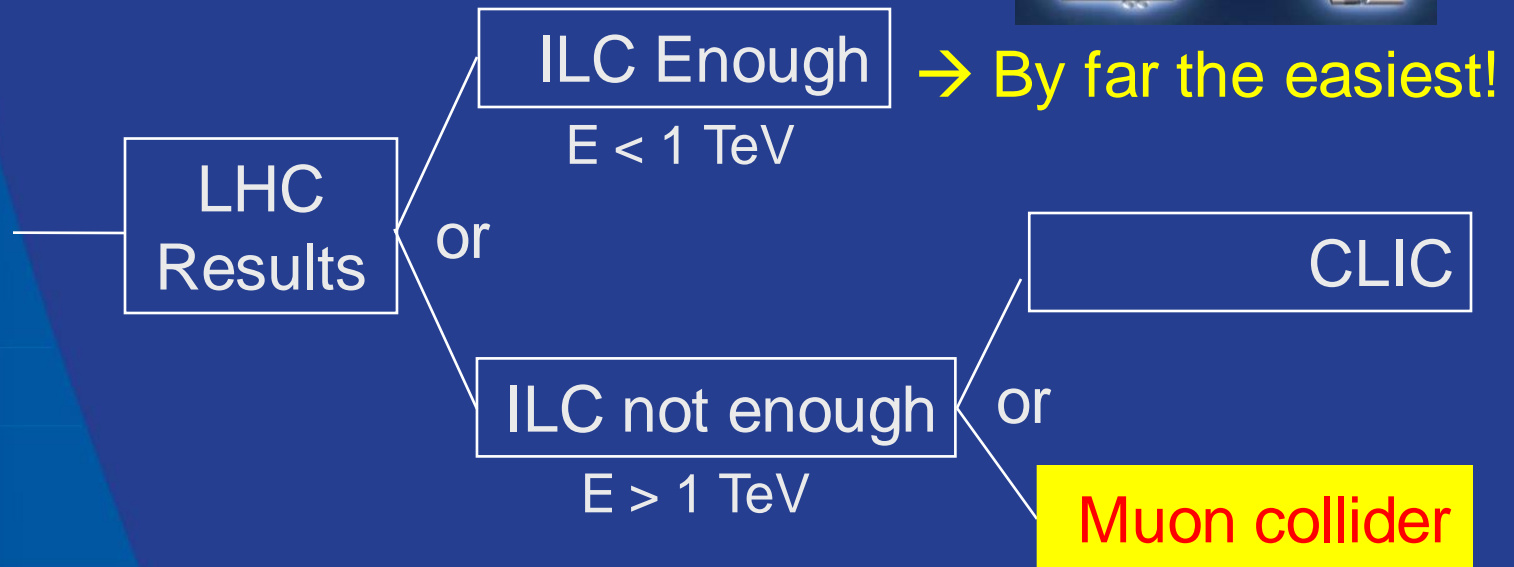
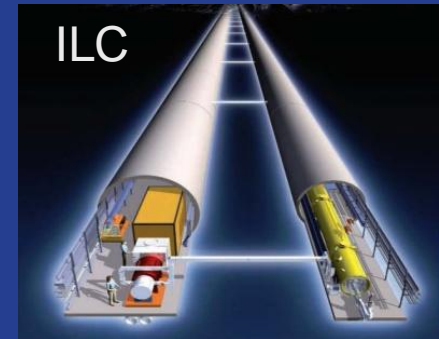
Intensity Frontier

Cosmic Frontier



Lepton Colliders beyond LHC

“Electron Research (KA12)”
Scientists: Generic det R&D
for ILC & other applications



4 TeV Muon Collider Conceptual Layout

http://www.fnal.gov/pub/muon_collider/

We very much encourage participation from all regions of the world.

Project X

Accelerate hydrogen ions to 8 GeV using SRF technology.

Compressor Ring

Reduce size of beam.

Target

Collisions lead to muons with energy of about 200 MeV.

Muon Cooling

Reduce the transverse motion of the muons and create a tight beam.

Initial Acceleration

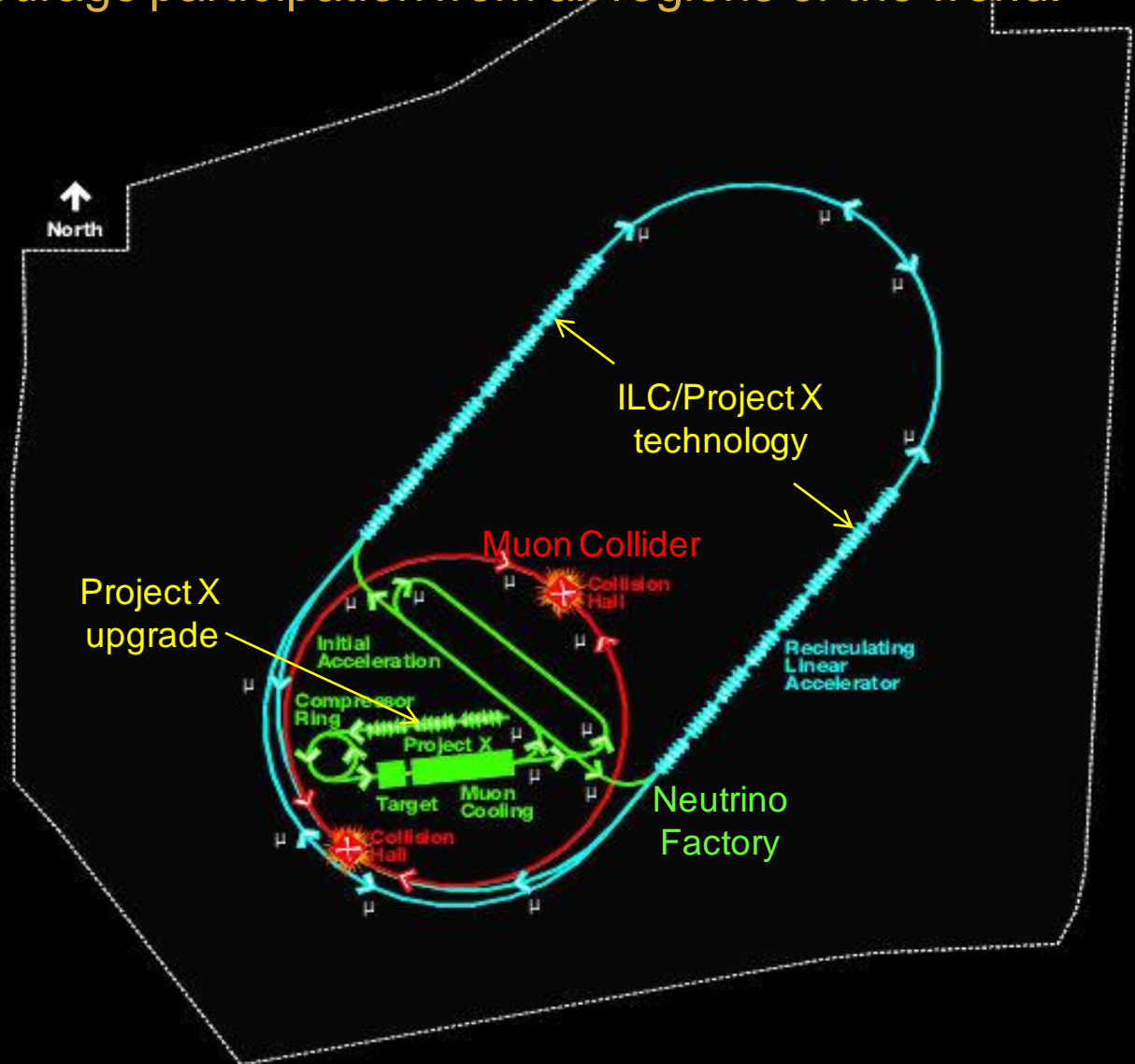
In a dozen turns, accelerate muons to 20 GeV.

Recirculating Linear Accelerator

In a number of turns, accelerate muons up to 2 TeV using SRF technology.

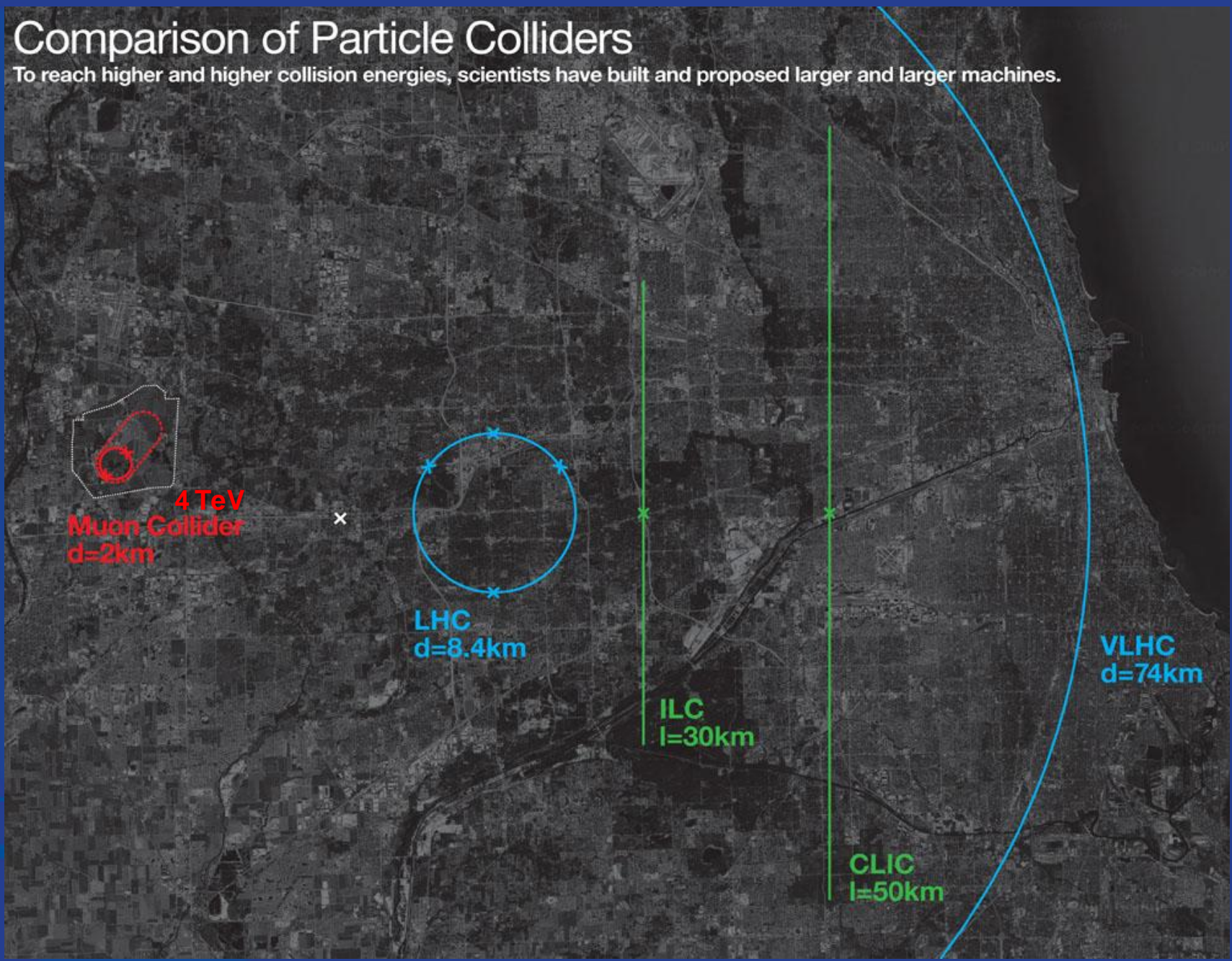
Collider Ring

Located 100 meters underground. Muons live long enough to make about 1000 turns.



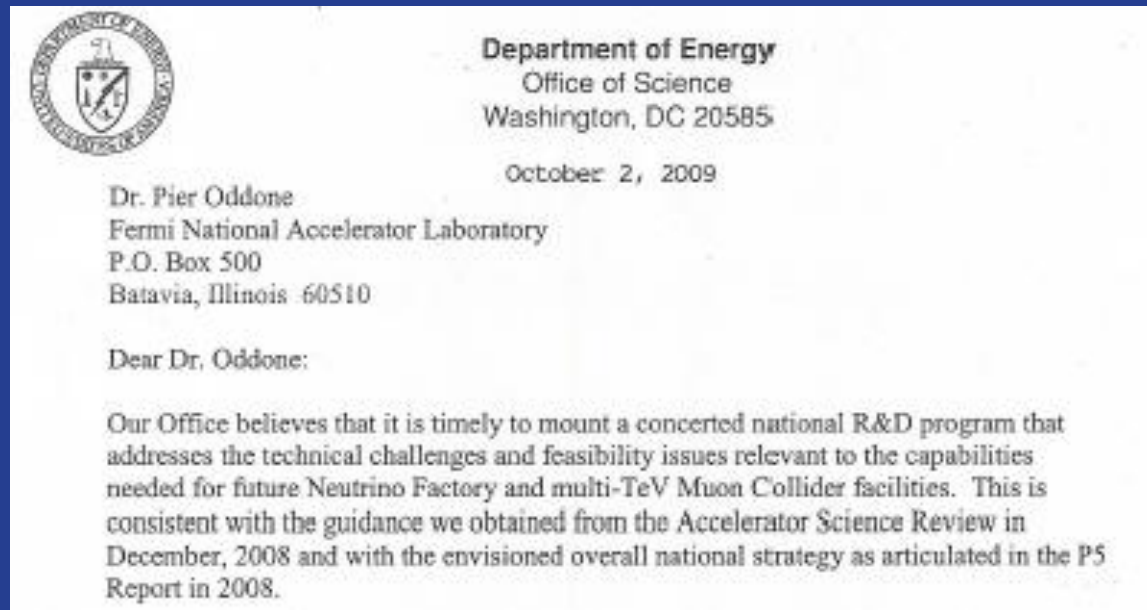
Comparison of Particle Colliders

To reach higher and higher collision energies, scientists have built and proposed larger and larger machines.



MAP (Muon Accelerator Program) Initiative

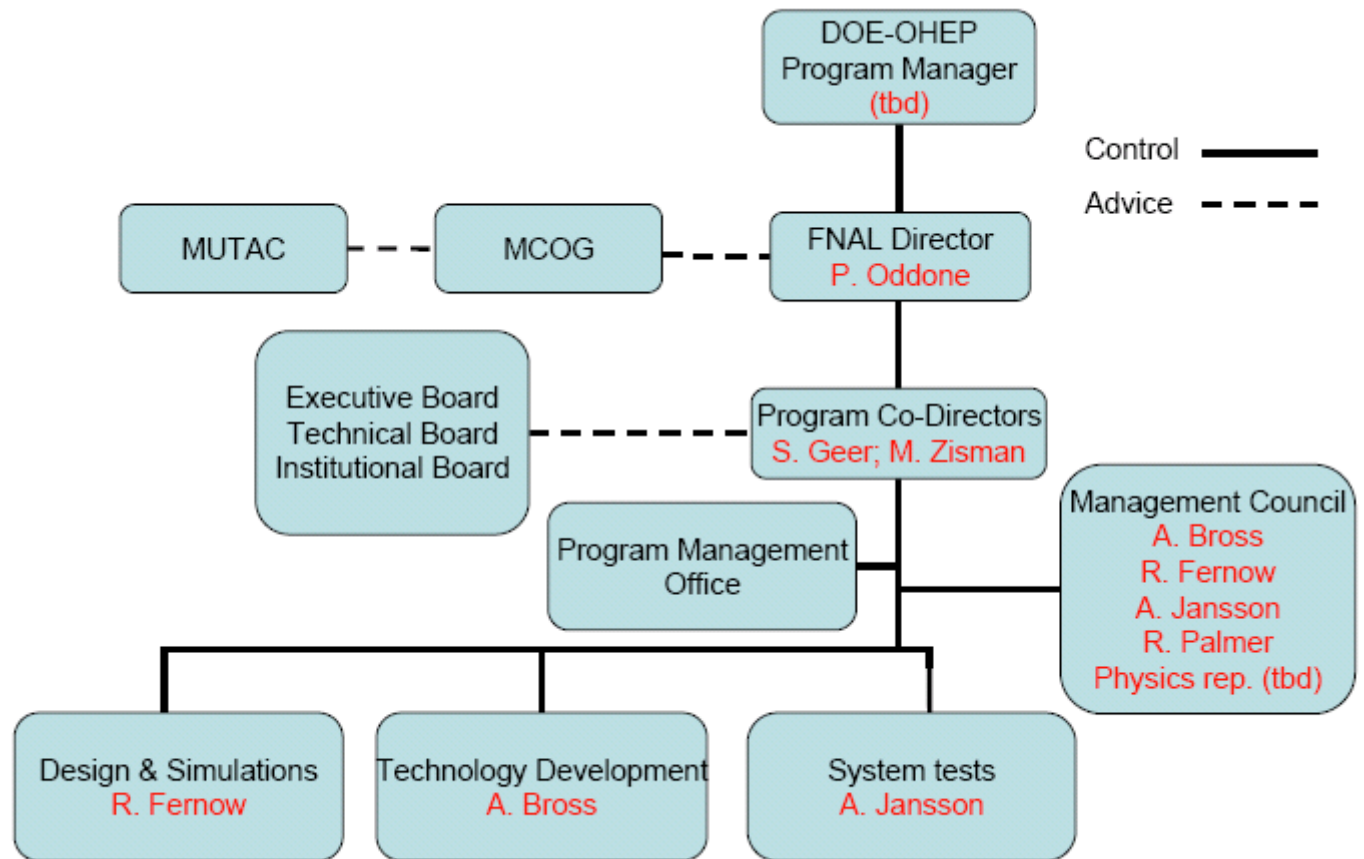
- US 5 year R&D proposal submitted to DOE
- DOE's response to this proposal



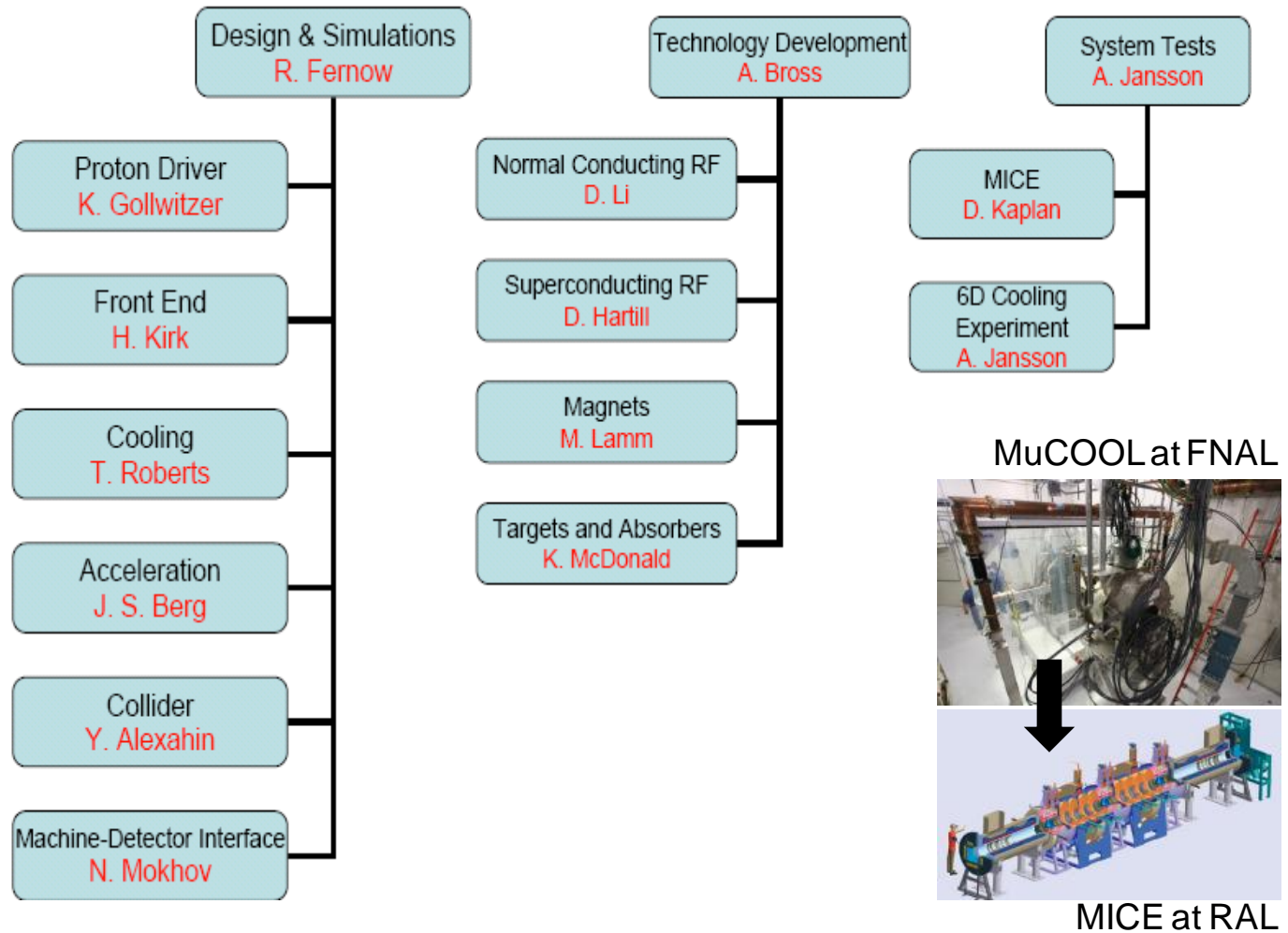
→ Creating a “DOE project management” structure
→ MAP

MAP Organization

* Interim assignments





MAP Organization



MAP Proposal

- Submitted by Oddone on behalf of the MAP collab., on March 1, 2010.
- 214 participants (at birth) from 14 institutions:
 - ANL, BNL, FNAL, JLab, LBNL, ORNL, SNAL, Cornell, IIT, Princeton, UCB, UCLA, UCR, U-Miss
- Briefing to DOE (Apr, 2010)
- DOE Review
 - August 24-26 at FNAL

FERMILAB-TM-2459-APC



**R&D PROPOSAL FOR THE NATIONAL
MUON ACCELERATOR PROGRAM**
Revision 5b; February 24, 2010

Abstract
This document contains a description of a multi-year national R&D program aimed at completing a Design Feasibility Study (DFS) for a Muon Collider and, with international participation, a Reference Design Report (RDR) for a muon-based Neutrino Factory. It also includes the supporting component development and experimental efforts that will inform the design studies and permit an initial down-selection of candidate technologies for the ionization cooling and acceleration systems. We intend to carry out this plan with participants from the host national laboratory (Fermilab), those from collaborating U.S. national laboratories (ANL, BNL, JLab, LBNL, and SNAL), and those from a number of other U.S. laboratories, universities, and SBIR companies. The R&D program that we propose will provide the HEP community with detailed information on future facilities based on intense beams of muons—the Muon Collider and the Neutrino Factory. We believe that these facilities offer the promise of extraordinary physics capabilities. The Muon Collider presents a powerful option to explore the energy frontier and the Neutrino Factory gives the opportunity to perform the most sensitive neutrino oscillation experiments possible, while also opening expanded avenues for the study of new physics in the neutrino sector. The synergy between the two facilities presents the opportunity for an extremely broad physics program and a unique pathway in accelerator facilities. Our work will give clear answers to the questions of expected capabilities and performance of these muon-based facilities, and will provide defensible ranges for their cost. This information, together with the physics insights gained from the next-generation neutrino and LHC experiments, will allow the HEP community to make well-informed decisions regarding the optimal choice of new facilities. We believe that this work is a critical part of any broad strategic program in accelerator R&D and, as the P5 panel has recently indicated, is essential for the long-term health of high-energy physics.

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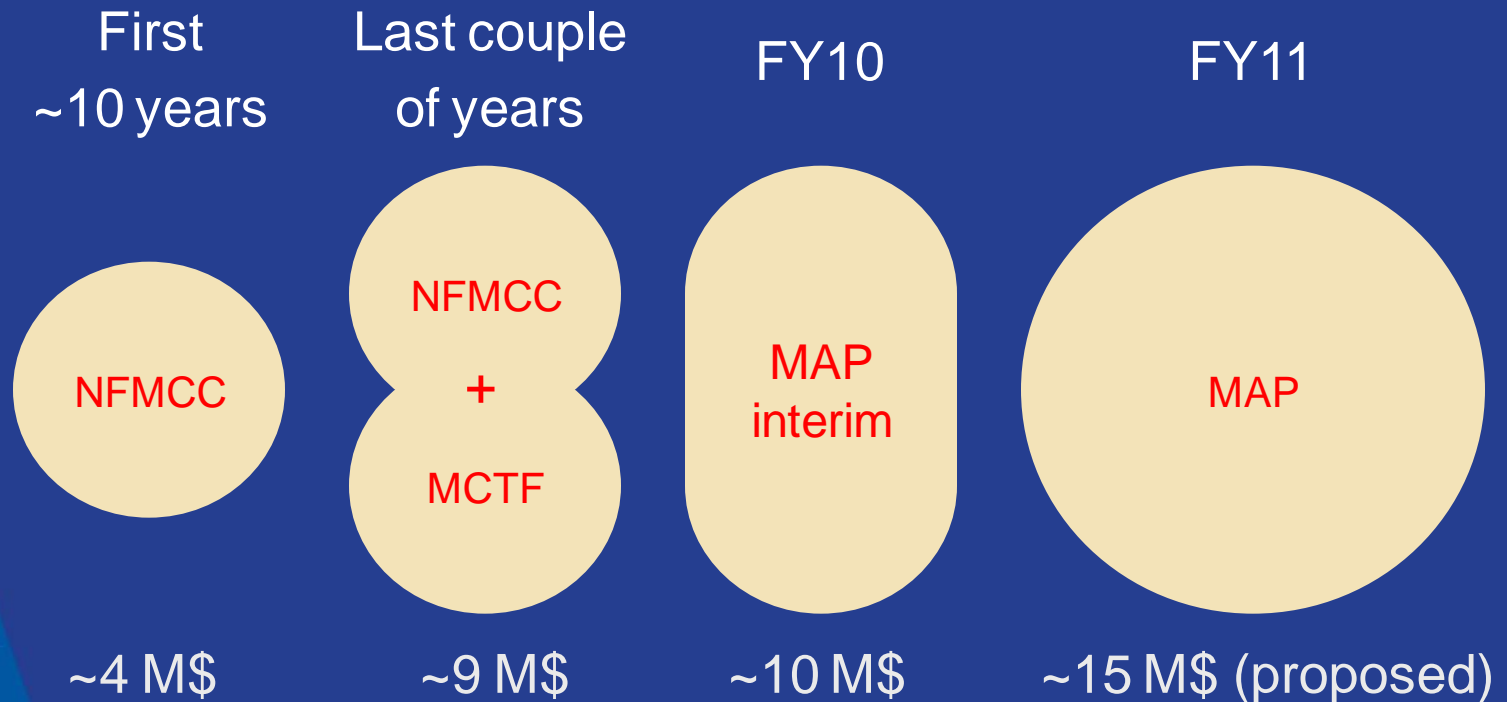
MAP Goals and Deliverables

- Deliverables in 6-7 years:
 - Muon Collider Design Feasibility Report (FY16)
 - Hardware R&D results → technology choice
 - MC Cost range (FY16)
 - Also contributions to the IDS-NF RDR (FY14)
- Will address key R&D issues, including
 - Maximum RF gradients in magnetic field
 - Magnet designs for cooling, acceleration, collider
 - 6D cooling section prototype & bench test
 - Full start-to-end simulations based on technologies in hand, or achievable with a specified R&D program

From NFMCC to MAP

NFMCC: Neutrino Factory and Muon Collider Collaboration

MCTF: Muon Collider Task Force at Fermilab



(CLIC: ~\$30M / year now, and likely will grow)

Detector and Physics

- Muon Collider (**NOT** included in MAP)
 - Synergy to ILC / CLIC
 - 1st workshop in November 2009
 - ILC/CLIC community included
 - 2nd workshop planned in late Fall 2010

- Understanding muons
 - Neutrino Factory – Synergy to LBNE
 - Current accelerator complex (Mu2e, muon g-2)
 - Project X (muon programs)

Laboratory white paper on lepton colliders

- Goal:
 - Although lepton collider options have very different levels of maturity and operational conditions, we believe that broad physics goals are similar and we need an objective physics comparison of the options in a coherent, efficient, and cost effective manner (presented by David MacFarlane)
- Meetings
 - First meeting (5 labs + DOE:Glen Crawford) on Apr 27, 2010, Sendai, Japan during the 32nd meeting of the US-Japan Committee meeting for Cooperation in HEP
 - 5-lab conference call on May 4, 2010
 - Email communication

Laboratory white paper on lepton colliders

- Communication with the ILC & university community about the white paper
 - ILCSCA chair (Maury Tigner), ILC Physics and Detectors: America's regional contact (Jim Brau), DPF chair (Chip Brock) in May, 2010
 - Also sent the white paper to them
- Developing a national strategy for lepton colliders
 - Plan to discuss in the detector R&D workshop at Fermilab on Oct 7-9, organized by 5 labs and DPF
 - Plan to discuss at the next DPF meeting, Spring 2011
 - Further communication/discussion with ILC community, and ILC US physics and detectors community

Fermilab Presentations

- Introduction (10')
 - Young-Kee Kim
- Collider Detector Development (30')
 - Marcel Demarteau
- Muon Collider Backgrounds (20')
 - Nikolai Mokhov
- Summary (10')
 - Marcel Demarteau