Fermilab Status
Plans for the Future

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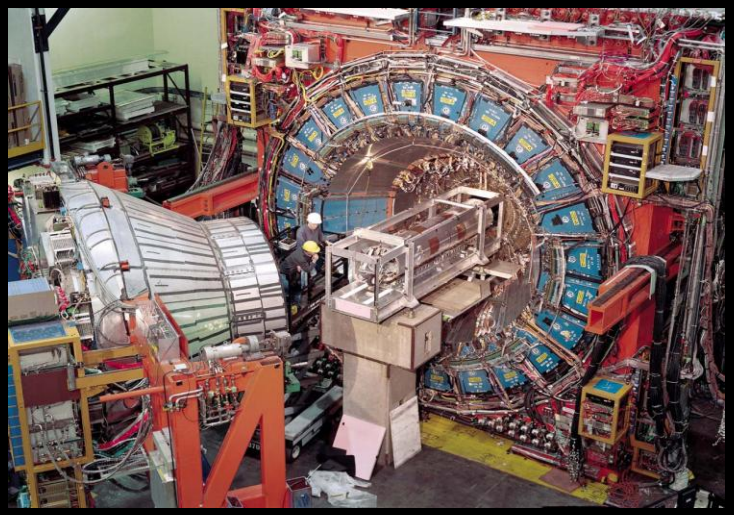
April 25, 2008

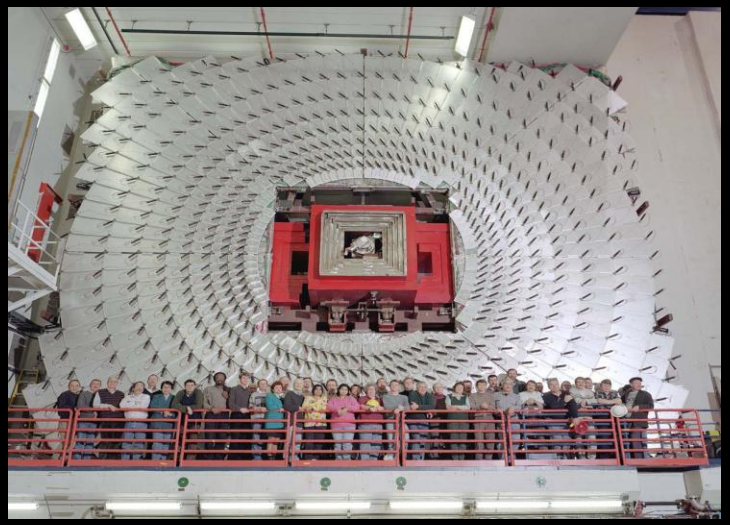
Outline

- Current Program Highlights
- FY2008 Crisis
- Recovery and Strategic Plan

Ongoing program: Tevatron

- Greatest discovery opportunities before LHC
- Strong collaborations; 80 PhDs last year
- Great operations at high luminosity
- Dominates world physics results





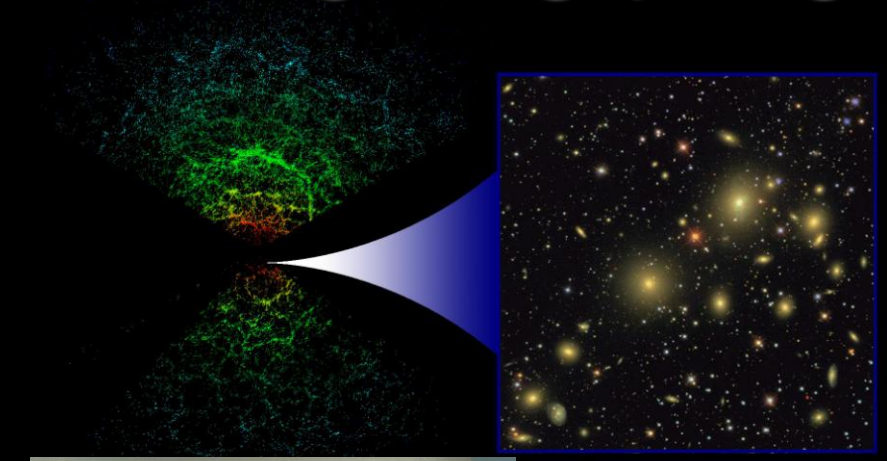
Ongoing program: neutrinos

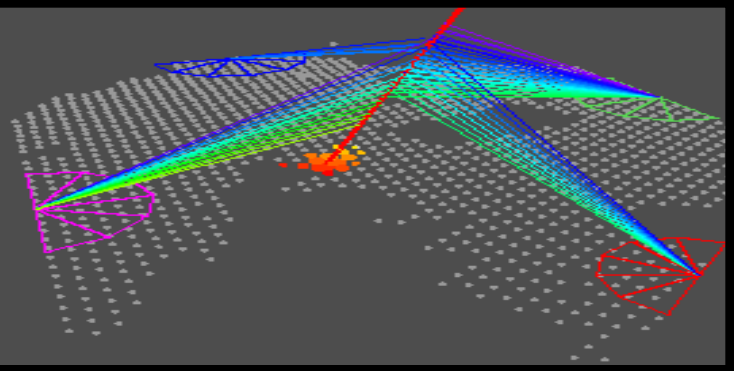
Minos Far detector

MiniBooNE detector

- **MINOS: neutrino oscillations in the atmospheric region; coming electron appearance at CHOOZ limit or below**
- **MiniBooNE: neutrino oscillations in the LSND region; exploration of low energy anomaly in neutrino interactions**
- **SciBooNE: neutrino cross sections**

Ongoing program: astrophysics





- CDMS II – last month best dark matter limits
- SDSS – huge impact survey, baryon acoustic oscillation
- Pierre Auger – GZK, association with active galactic nuclei
- COUPP – competitive results for spin-dependent WIMPS, scalable

In the last three years…..

- Tight budgets but great productivity
  - FY 2006 $324M
  - FY 2007 $342M
  - FY 2008 $372M (President's Request)
- Increases reflected the ramp up of ILC R&D and also the start of new projects, principally NOvA

Particle physics cuts

- HEP budget is cut
  - President's Request FY08 $782M
  - Operational plan FY2007 $752M
  - Omnibus bill for HEP $688M
- About $90M taken out of the expected program for FY08

Effect on Fermilab

- From the expected budget of $372M received only $320M for FY08.

- Therefore we need to reduce expenditures by $52M from PBR in the remaining of FY08 and adjust to a smaller base for FY09.

Effect on Fermilab

- Prescriptive language: no funding for NOvA
- ILC R&D and SCRF cut by 75% one quarter of the fiscal year through
- Effectively negligible funding for the rest of the year on these projects

Effect on Fermilab

- Immediate stop of ILC, SCRF, and NOvA. Staff will move to other projects.
- Implement a “rolling furlough” approx. 2 days/month.
- For the future, re-size the laboratory to absorb the reduction in the program. The size of the RIF is about 200 FTEs.

Effect on Fermilab

- Rolling furloughs are the only fast acting remedy to get within budget in FY08. They take 10% of the labor out of the lab

- Layoffs are necessary to adapt to a smaller base. Scary prospect in the last five months of this year: between furloughs and layoffs 20% of the labor will be out.

Impact on the community

- ILC is a broad national and international collaboration; our US HEP partners will suffer as much (60% of ILC R&D done at SLAC, ANL, BNL, LBNL and JLAB)

- Coupled with cut of ITER construction funds, termination of the B factory at SLAC, there could be long lasting impact on US credibility as international partner

Recovery Plan

- A critical goal to maintain the planned 2008 run for the Tevatron and the neutrino programs. Ray Orbach: DOE's plan to run through 2010
- We will fully support our commitment and participation in the LHC; first triplet at full current (7TeV) yesterday
- We also will try to maintain the smaller projects that add vitality to our program: DES, Minerva, CDMS-25kg

Planning issues: present state

- No investment in renewal of national facilities since decision to build NUMI/MINOS in 1998
- For vitality of the field must invest capital: else the business plan is to go out of business !!
- The plan we were on: shut present facilities, don’t start new ones, start the ILC early

Planning issues: present state

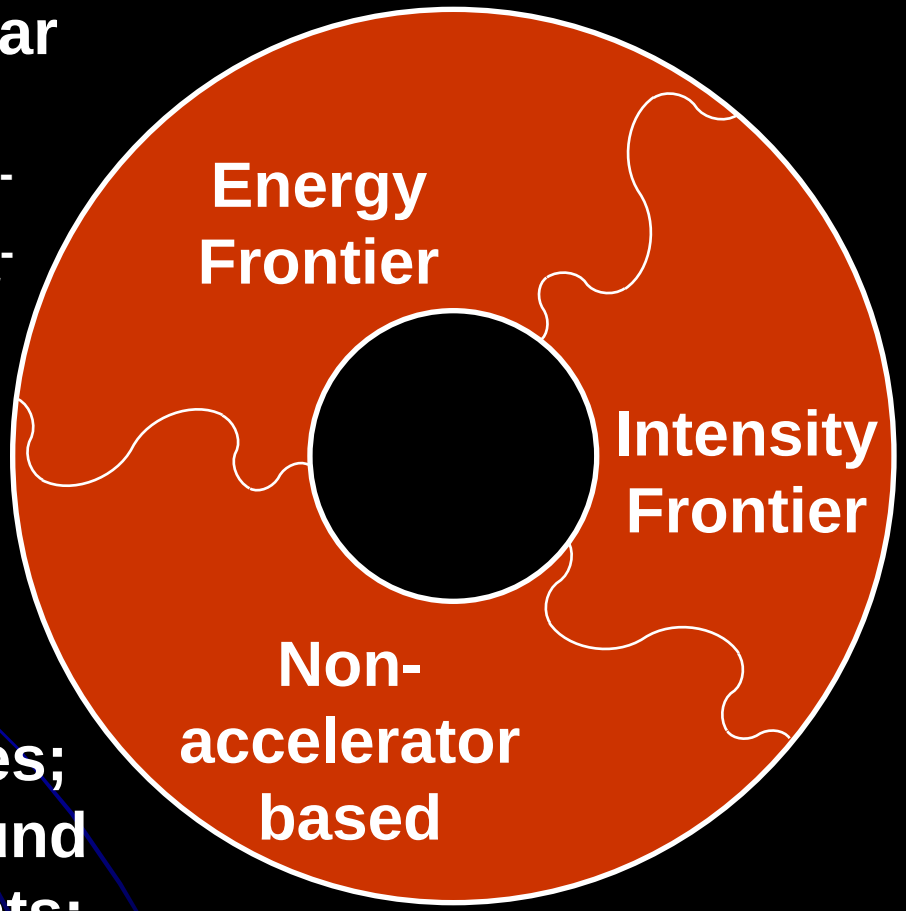
- ILC cost, LHC delays, international picture led DOE to more realistic timeline
- As a consequence we are shutting down $4B worth of facilities with no follow on
- We need a realistic plan within a plausible DOE office of Science budget profile. ILC decision is beyond DOE (it is not immediate).

Getting to a plan

- The physics case must be compelling
- It should be realistic
- It should be world-class in its domain
- It should be adaptable to new discoveries
- It should be the community and laboratory plan

Fermilab and the future

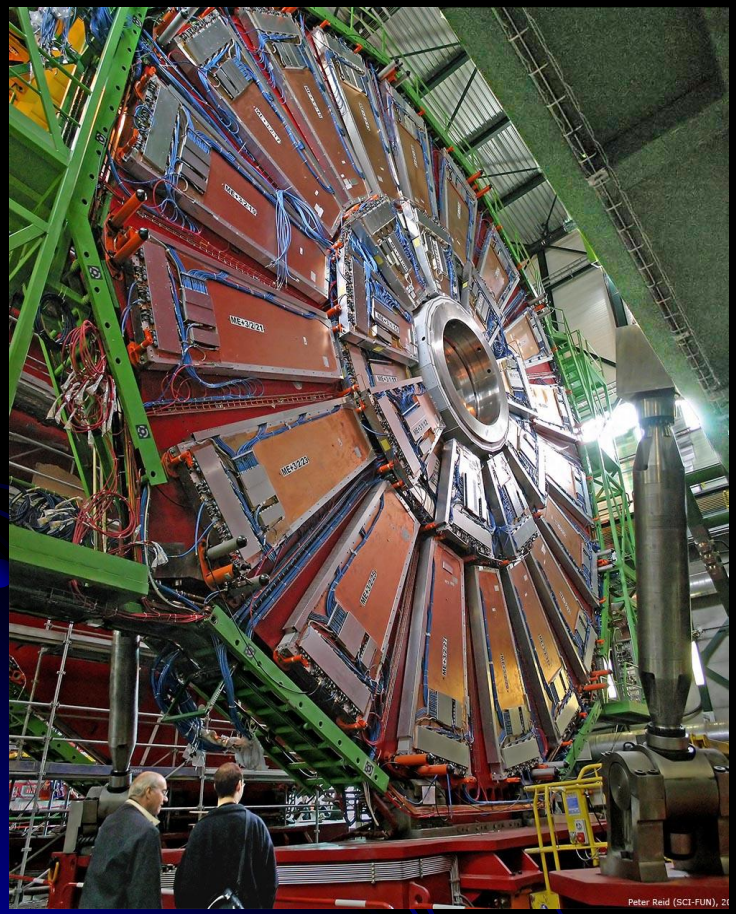
pp-bar
pp
e^+e^-
$\mu^+\mu^-$



Intense ν, μ, K, . beams; and B, C factories;

Telescopes; Underground experiments;

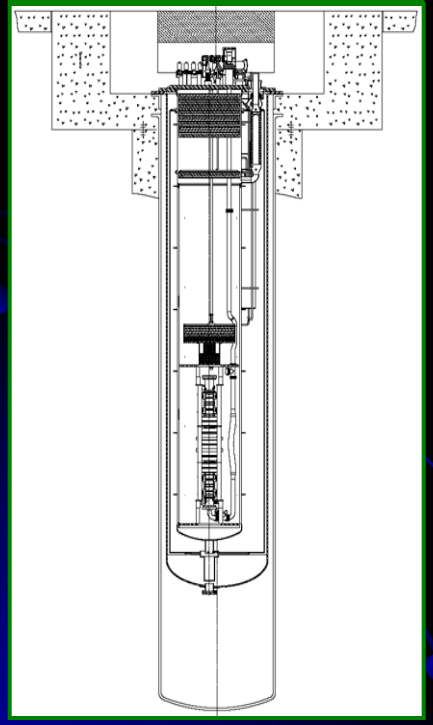
Energy frontier : LHC and Fermilab



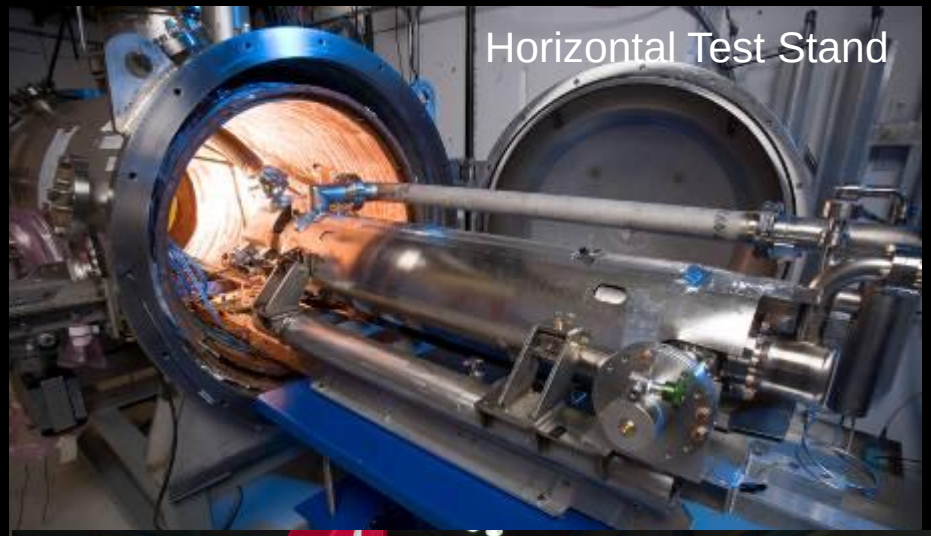
Compact Muon Spectrometer CMS

Remote Operations Center at Fermilab

Energy Frontier : ILC technology



Vertical Test Stand



Horizontal Test Stand

First cryomodule

The Energy Frontier

- We should run the Tevatron until the LHC has clearly overtaken it
- The LHC is the mainstay of the US program: we will collaborate in physics and upgrades
- Need for a lepton collider:
  - ILC by far the easiest if the energy is right
  - CLIC could reach higher energies later
  - Muon collider could reach several TeV later

The particle astrophysics frontier

- The US program has been a key contributor: COBE, WMAP, discovery of Dark Energy, limits on dark matter, origin of cosmic rays, gravity (LIGO)……

- Clearly a part of any future program: reactor neutrino experiments, JDEM, dark matter searches, neutrinoless double beta decay, LSST, gravity (LISA)……

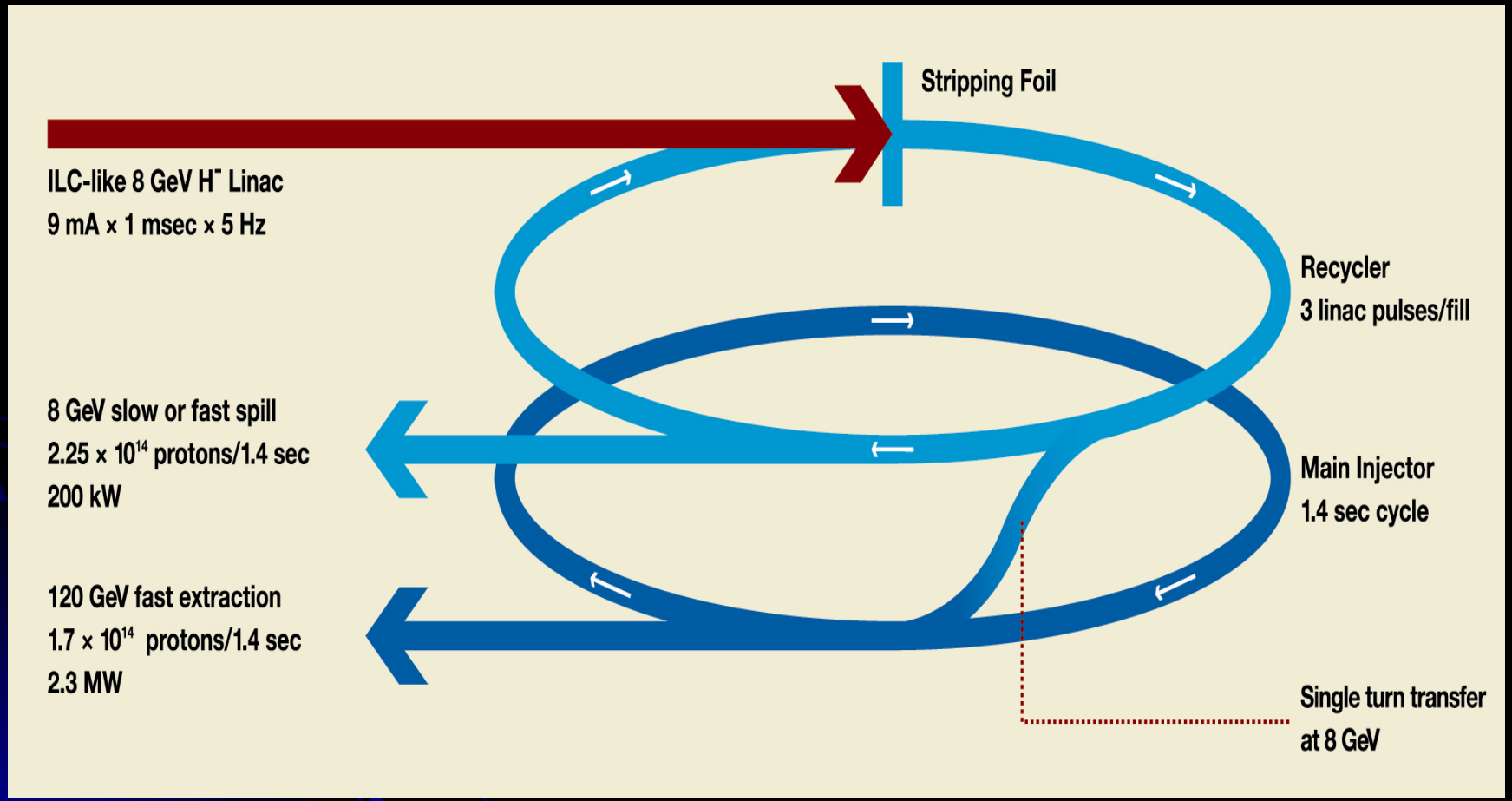
Fermilab and astrophysics

- Dark Energy Survey: CD-2 review went well
- CDMS – 25kg is supported by the agencies
- COUPP scaling from 2 → 60 kg
- Collaborators in the Joint Dark energy Mission JDEM/SNAP

Fermilab and the intensity frontier

- Successful CD-2 for NOvA, a major neutrino detector and upgrades to present complex
- Steering Group strategic planning: facility for neutrinos and rare processes at the intensity frontier – aligned with ILC development

Project X and the intensity frontier



US and the intensity frontier

- A program with a new injector for Fermilab:
  - Can exploits the large infrastructure of accelerators: Main Injector (120 GeV), Recycler (8GeV), Debuncher (8 GeV), Accumulator (8 GeV)
  - Provides the best program in neutrinos, and rare decays in the world (great with DUSEL)
  - Positions the US program for an evolutionary path leading to neutrino factories and muon colliders

Project X: expandability

- Initial configuration exploits alignment with ILC
- But it is expandable (we will make sure the hooks are there):
  - Three times the rep rate
  - Three times the pulse length
  - Three times the number of klystrons
- Would position the program for a multi-megawatt source for intense muon beams at low <8 GeV energies – very difficult with a synchrotron.

Project X: it is the best source

- Neutrino program at 120 GeV (2.3 MW); 55% recycler available at 8 GeV (200kW)
- We can develop existing 8 GeV rings to deliver and tailor beams, allowing full duty cycle for experiments with the correct time structure: *K* decays, $\mu \rightarrow e$ conversion, *g-2.*
- High rate experiments do not decrease protons-on target for the neutrino program at 120 GeV.

Project X and the Universities

- Plan was developed with the community through the Steering Group
- It will enable students, faculty and university technical resources to be applied to a challenging range of experiments from design to physics
- It will push technological detector development: such as LAr TPC, very high rate technology

Example: neutrino strategy

- Build NOvA. With T2K and reactor: best shot at neutrinos, first glimpse of mass hierarchy depending on $\sin^2 2\theta_{13}$
- Develop beamline, caverns/detectors for DUSEL – with new beam-line from Project X it is the ultimate super-beam experiment (water or LAr)
- If neutrino factory is needed – large endowment with source and beamline done

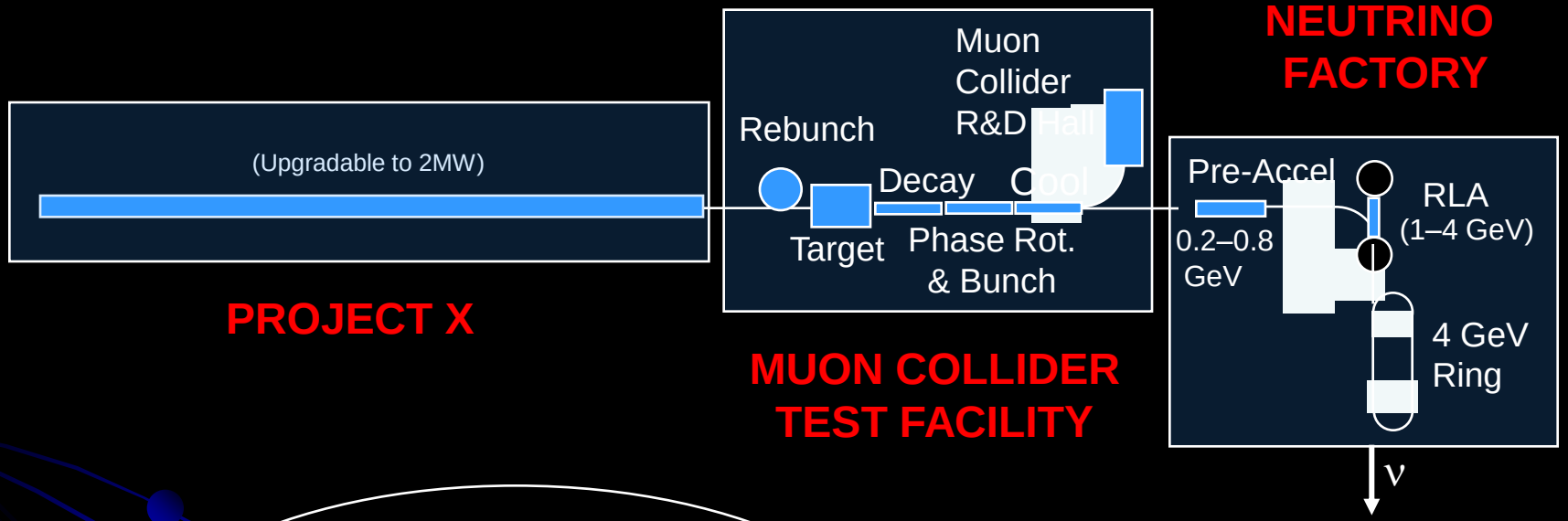
Example: μ to e conversion

- Could start with Booster beam: already better than MECO experiment; together with NOvA a great program for the early part of the decade
- If signal found at 10^{-16} level: study A dependence, with full Project X
- If signal not found, extend search with higher beam levels – full Project X

Example: evolutionary path to ILC

- Project X linac develops US capabilities towards an ILC
- Positions Fermilab as potential host
- Positions US to contribute on major part of the ILC
- Allows concrete collaboration with potential partners

Example: evolutionary path muons



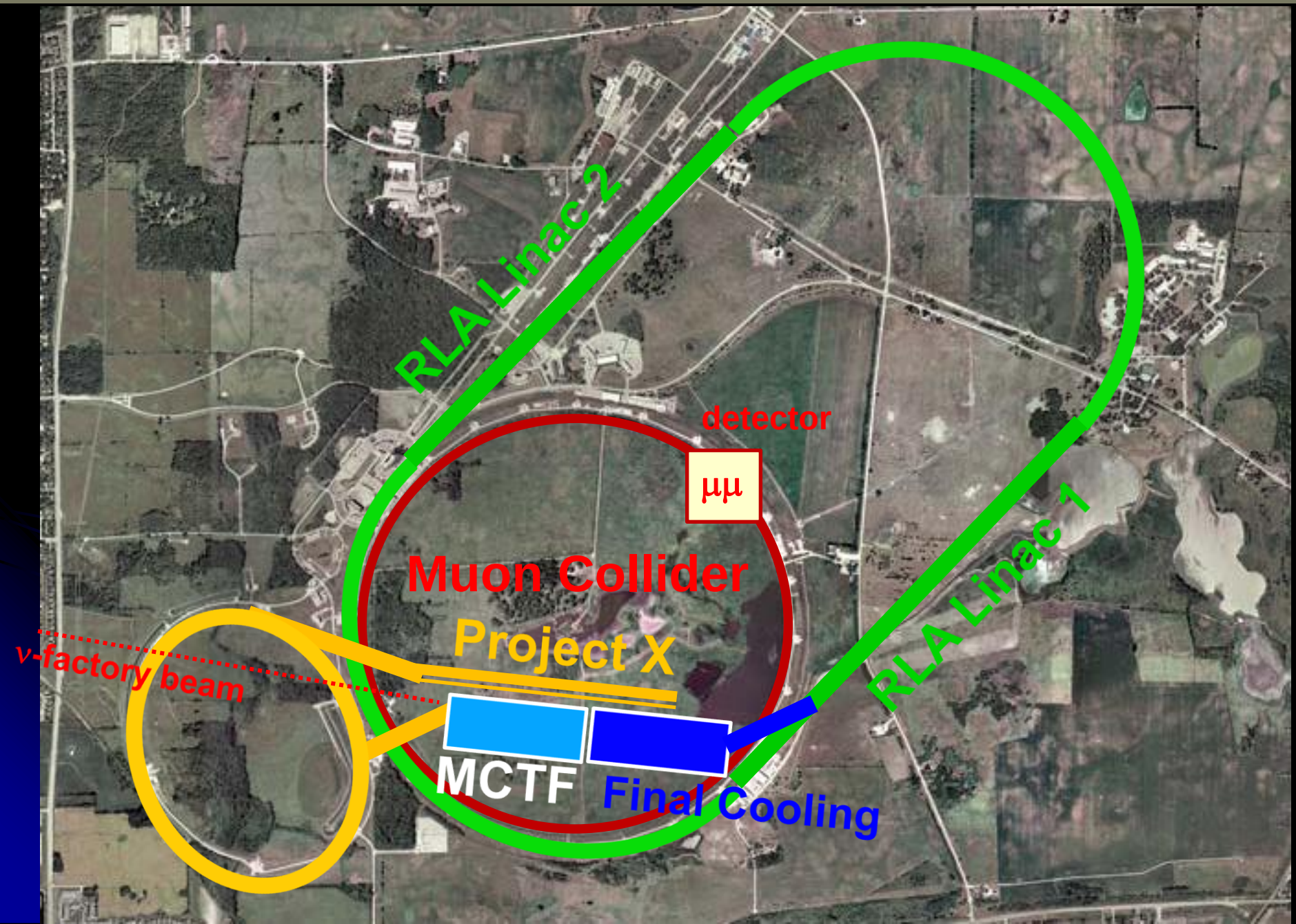
Illustrative Vision

Three projects of comparable scope:

- Project X (upgraded to 2MW)
- Muon Collider Test Facility
- 4 GeV Neutrino Factory

Far Detector
at Homestake

1.5-4 TeV Muon Collider at Fermilab



Conclusion

- It is possible to design a base program that satisfies the criteria listed earlier in this talk: we expect the advisory committee's and DOE's support
  - Runs the Tevatron until overtaken by LHC
  - Supports particle astrophysics and LHC upgrades
  - Builds NOvA as first step in world class neutrino program
  - Builds additional experiments for present complex
  - Builds Project X as the best high intensity platform in the world
  - Develops the technology for the ILC in the US through Project X and positions the US well for an ILC anywhere
  - Has a "long throw" in terms of future possibilities at the intensity frontier (neutrino factory) and energy frontier (muon collider)