

An aerial photograph of the Fermilab particle accelerator complex. The image shows several large, circular and semi-circular concrete structures, which are the particle rings, set against a backdrop of green fields and some buildings. The sky is clear and blue.

Fermilab Steering Group

**develop roadmap
for accelerator-based HEP program at Fermilab**

Young-Kee Kim
Fermilab / University of Chicago

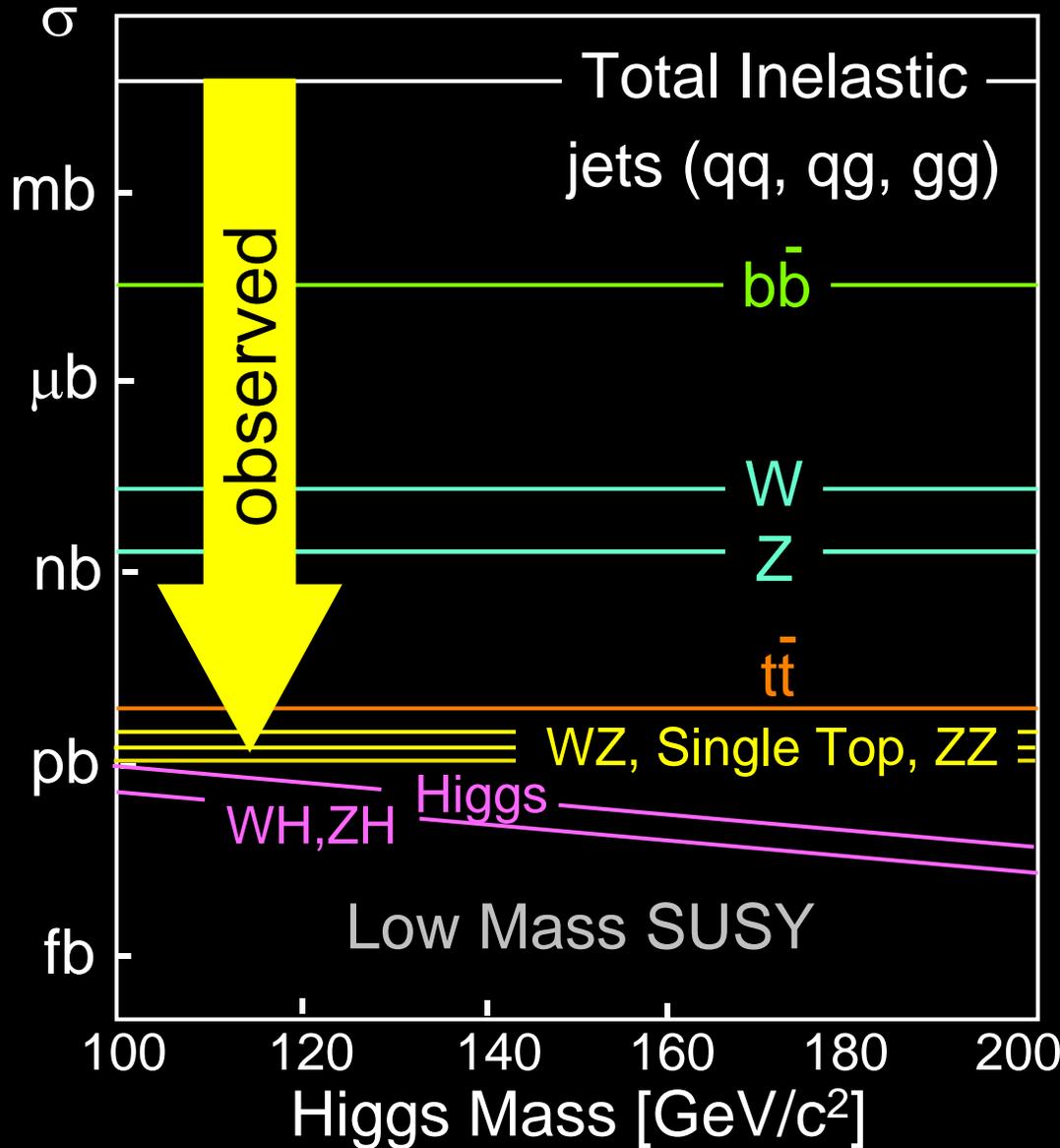
Energy Frontier Physics at FNAL: Tevatron

Large Hadron Collider
International Linear Collider R&D



Tevatron: close to 2 publications / week

Road to the Higgs!



Reach 10^{-19} m

$B_s - \bar{B}_s$ Oscillation
Discovery +
Precision Meas.

$M_W \sim 0.05\%$

$M_{top} \sim 1\%$

$M_{Higgs} < 144$ GeV
at 95% CL

Energy Frontier Physics at FNAL: Tevatron Large Hadron Collider (CERN) International Linear Collider R&D

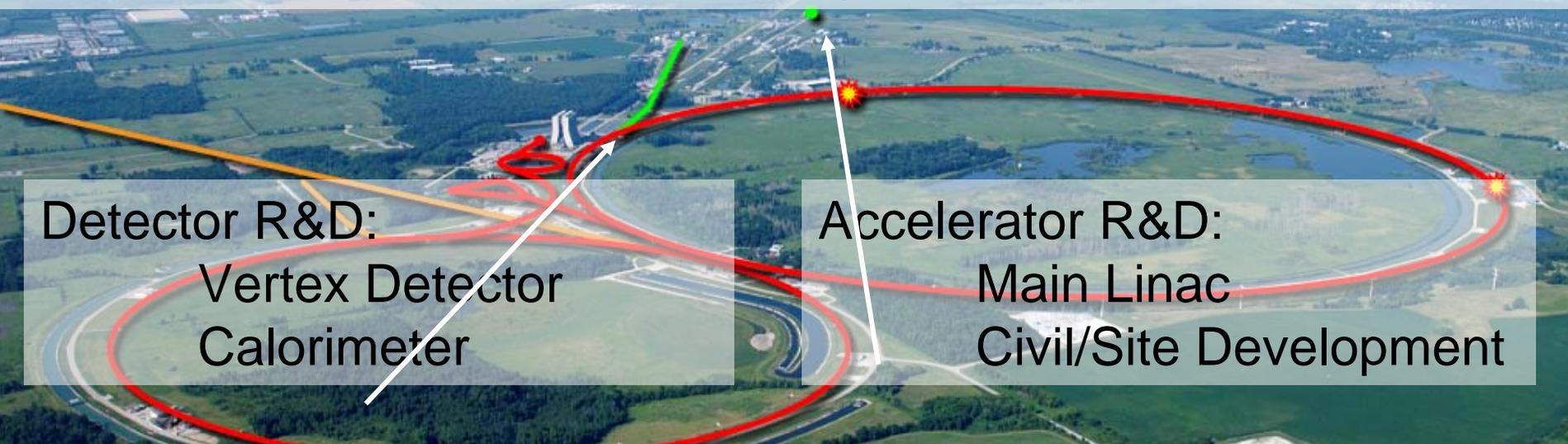
LHC Accelerator: a leading US institution
CMS Experiment: the US CMS Host Institution



Remote Operations Center
Tier-1 Computing Center
LHC Physics Center

Energy Frontier Physics at FNAL: Tevatron Large Hadron Collider International Linear Collider R&D

Consensus of HEP Community: ILC is next accelerator.



Detector R&D:
Vertex Detector
Calorimeter

Accelerator R&D:
Main Linac
Civil/Site Development



Detector Test Facility
for General Use



Accelerator Test Facility

together with
ILC institutions

Neutrino Physics at FNAL:

MiniBooNE, SciBooNE with 8 GeV Booster protons

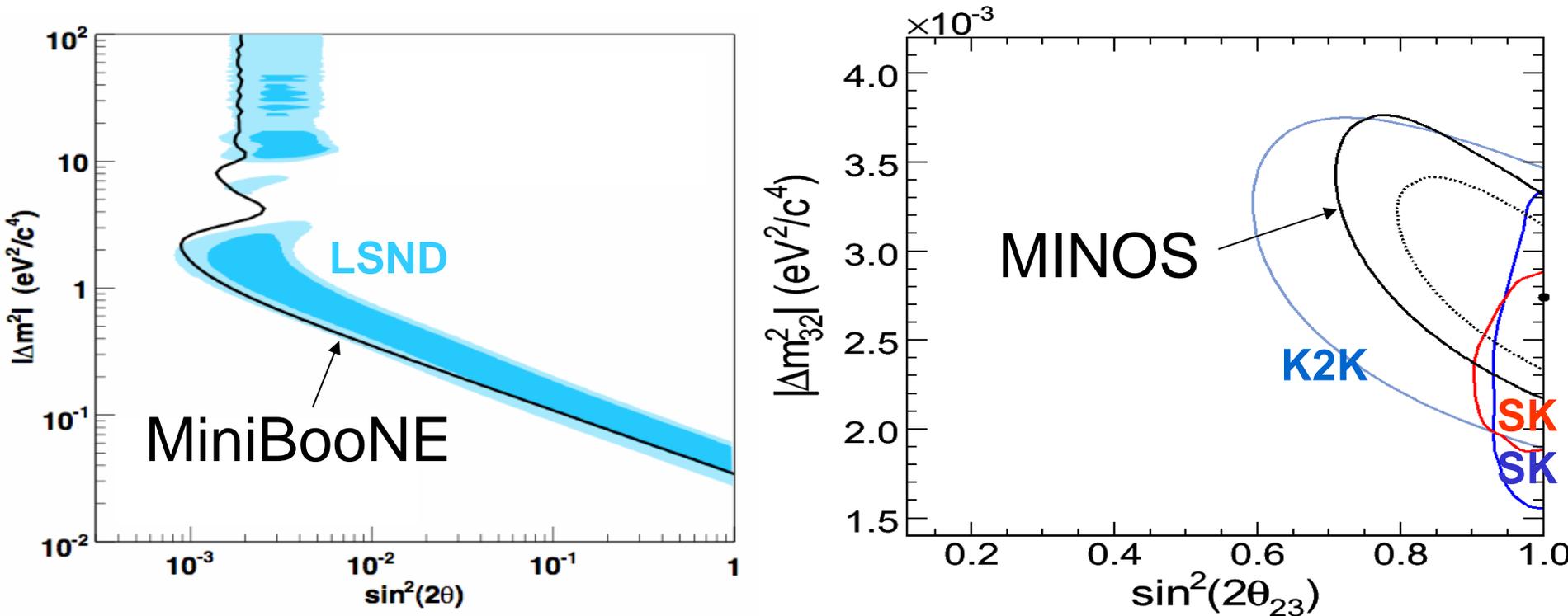
MINOS, MINERvA, NOvA with 120 GeV Main Injector protons



Neutrino Physics at FNAL:

MiniBooNE, SciBooNE with 8 GeV Booster protons
MINOS, MINERvA, NOvA with 120 GeV Main Injector protons

Neutrino Oscillation: MiniBooNE, MINOS, NOvA



Neutrino Cross Sections and Flux: SciBooNE, MINERvA
Important, yet not very well understood

Accelerator Physics Center

- R&D aimed at future generations of accelerators
- Educate and train next generation of accelerator scientists and engineers
 - So far, Fermilab has been supporting ~10 Ph.D. students at a given time
 - Enhance this effort
 - more Ph.D. students, undergraduate programs
- Engage university community in accelerator research

Particle Astrophysics at FNAL

Center for Particle Astrophysics

Theory

Computational cosmology

Sloan Digital Sky Survey

Pierre Auger Observatory

Cold Dark Matter Search CDMS

Cold Dark Matter Search COUPP

Dark Energy Survey

Supernova Acceleration Project (SNAP) R&D

- World class limits of direct dark matter detection
- SDSS, in combination with WMAP, achieves most precise measurement of cosmological parameters.

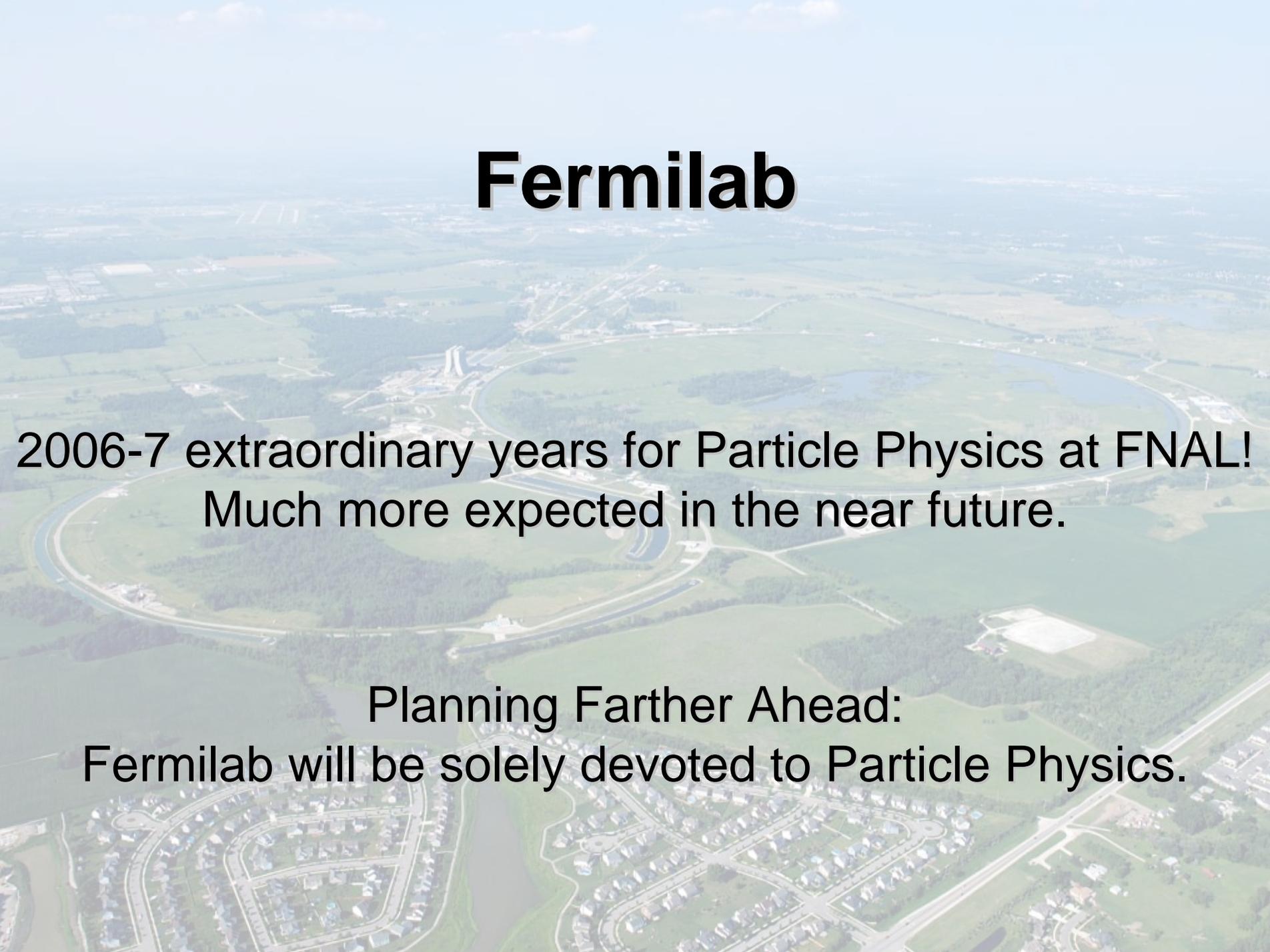
Fermilab's Scientific Program addresses:

1. Are there undiscovered principles of nature.
New symmetries, new physical laws?
2. Are there extra dimensions of space?
3. Do all the forces become one?
4. Why are there so many kinds of particles?
5. What happened to the antimatter?
6. What is dark matter?
How can we make it in the laboratory?
7. How can we solve the mystery of dark energy?
8. How did the universe come to be?
9. What are neutrinos telling us?

From "Quantum Universe" and
"Discovering Quantum Universe"



Fermilab

An aerial photograph of the Fermilab particle accelerator complex. The image shows a large circular structure, likely the Tevatron, surrounded by green fields and some buildings. The sky is blue with light clouds.

2006-7 extraordinary years for Particle Physics at FNAL!
Much more expected in the near future.

Planning Farther Ahead:
Fermilab will be solely devoted to Particle Physics.

EPP 2010 Recommendations

1. LHC
2. ILC Global
ILC Hosting
3. Particle Astrophysics
4. Global Neutrino Program
5. Quark Flavour Physics

P5 Recommendations

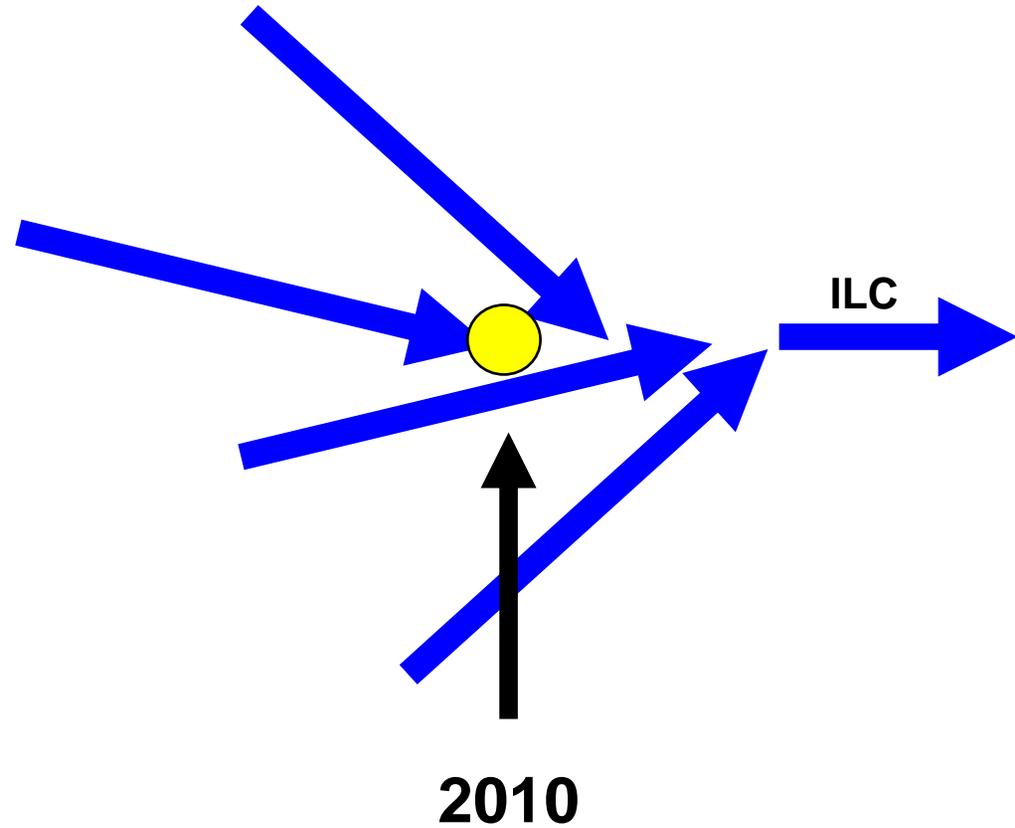
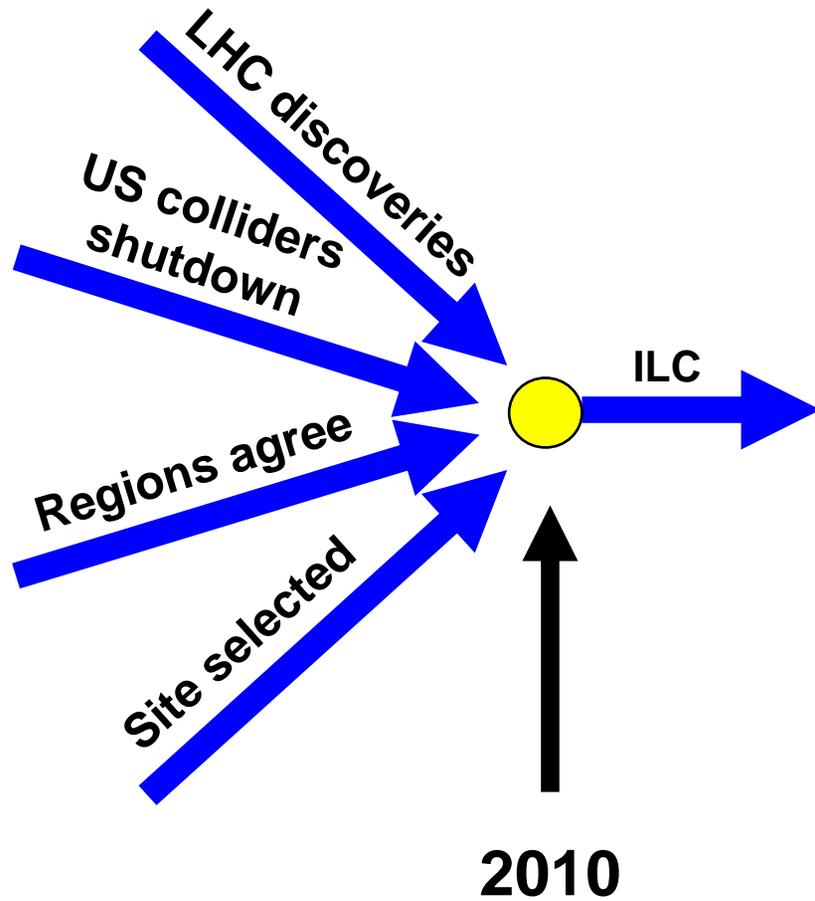
- LHC and ILC are highest priorities.
- FY08 - run Tevatron and PEP II and start:
 - Dark Energy Survey (DES)
 - Cold Dark Matter Search Super CDMS-25kg
 - NOvA long baseline neutrino program
 - Daya Bay reactor neutrino experiment
- Longer term - prepare SNAP and LSST

P5 Recommendations (Fermilab)

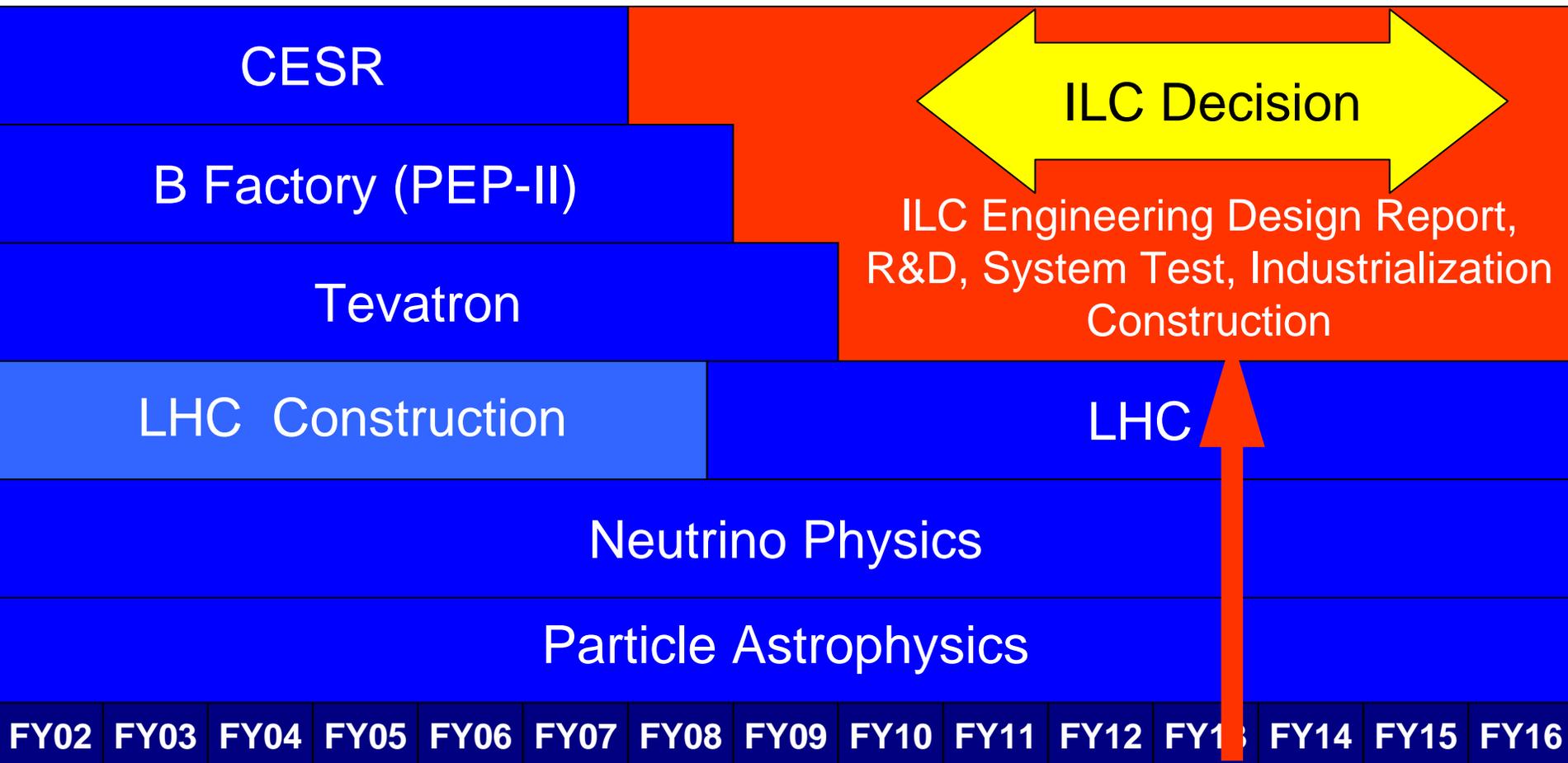
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P5's ILC assumption - early start

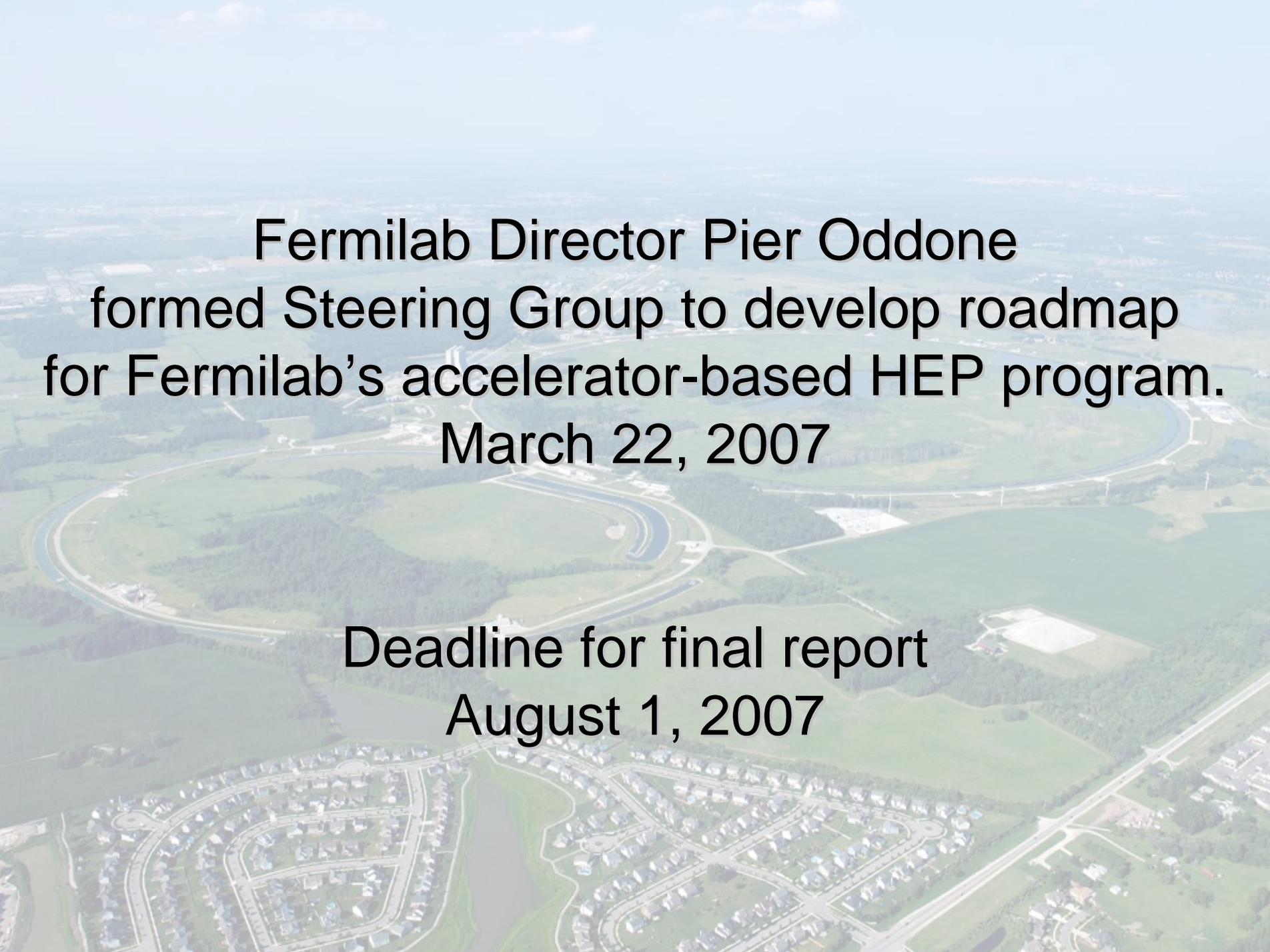
ILC Decision



Uncertainty in ILC Decision Time



Sustain rigorous ILC activities over a possibly longer period.
Alternative discovery opportunities that might be needed.
Prepare colliders beyond the ILC / LHC.

An aerial photograph of the Fermilab particle accelerator complex, showing the large circular structure and surrounding green fields. The image is semi-transparent, allowing text to be overlaid.

Fermilab Director Pier Oddone
formed Steering Group to develop roadmap
for Fermilab's accelerator-based HEP program.
March 22, 2007

Deadline for final report
August 1, 2007

Steering Group: Charge

The Steering Group will build the roadmap based on the recommendations of the EPP2010 National Academy report and the recommendations of the P5 subpanel of HEPAP. The Steering Group should consider the Fermilab based facilities in the context of the global particle physics program. Specifically the group should develop a strategic roadmap that:

1. supports the international R&D and engineering design for as early a start of the ILC as possible and supports the development of Fermilab as a potential host site for the ILC;
2. develops options for an accelerator-based high energy physics program in the event the start of the ILC construction is slower than the technically-limited schedule; and
3. includes the steps necessary to explore higher energy colliders that might follow the ILC or be needed should the results from LHC point toward a higher energy than that planned for the ILC.

Steering Group Membership

Eugene Beier	U. Penn
Joel Butler	Fermilab
Sally Dawson	BNL
Helen Edwards	Fermilab
Thomas Himel	SLAC
Steve Holmes	Fermilab
Young-Kee Kim (chair)	Fermilab / U.Chicago
Andrew Lankford	UC Irvine
David McGinnis	Fermilab
Sergei Nagaitsev	Fermilab
Tor Raubenheimer	SLAC
Vladimir Shiltsev	Fermilab
Maury Tigner	Cornell
Hendrick Weerts	ANL

Physics Groups

Neutrino Physics

NuSAG (up to ~1 MW, ν oscillation)
+ multi MW proton sources,
 ν cross section measurements, ...

Eugine Beier	U Penn
Deborah Harris	Fermilab
Ed Kearns	Boston Univ.
Boris Kayser	Fermilab
Sacha Kopp	UT Austin
Andrew Lankford	UC Irvine
Bill Louis	Los Alamos
(Young-Kee Kim)	UChicago/FNAL

Flavor Physics

Quarks, Charged Leptons,
Physics with anti-protons, etc.

Joel Butler	Fermilab
Brendan Casey	Brown
Sally Dawson	BNL
Chris Hill	Fermilab
Dan Kaplan	IIT
Yury Kolomensky	UCBerkeley/LBNL
William Molzon	UC Irvine
Kevin Pitts	UIUC
Frank Porter	CalTech
Bob Tschirhart	Fermilab
Harry Weerts	ANL
(Young-Kee Kim)	UChicago/FNAL

Steering Group Activities

- Weekly Telephone Meeting (Kick-off meeting on April 2nd)
- Fact findings
 - EPP2010 and P5 assumptions
 - ILC R&D needs, needs as a host country / host laboratory
 - LHC Upgrades
 - Physics and Facility Opportunities: near, med, long term
 - Physics; ν , μ , K, p-bar, B, ...
 - reconfiguring existing accelerator complex, and new facilities
- Formed 5 subgroups – analysis done through subgroups
- Reach out to community for input
- For all activities, we include
 - ILC GDE leaders, HEP / ILC program managers in DOE and NSF
 - Chairs of Fermilab/SLAC Users Executive committees
 - HEPAP Chair / Deputy Chair, P5 Chair
- Steering Group Webpage: publicly accessible by anyone
 - http://www.fnal.gov/directorate/Longrange/Steering_Public/
 - Agendas, presentations, minutes, documents, etc.

Subgroups

- **Oversight (additional constituents)**
 - To make sure that roadmaps being developed are consistent with EPP2010 and P5 recommendations (Mel Shochet, Jon Bagger, Abe Seidan, Sally Dawson)
- **Neutrino Physics (additional constituents)**
 - Develop roadmap for neutrino physics based on NuSAG studies
- **Flavor Physics: quarks, charged leptons, ... (additional constituents)**
 - Develop 10-year plan with reconfiguring existing accelerator complex
- **Accelerator Facilities (based on technical and resources feasibilities)**
 - Develop options of a roadmap that supports ILC R&D for early start, supports Fermilab as a potential host site, and provides an accelerator-based high energy physics program in case of delayed start
- **High Energy Colliders beyond the ILC**
 - Develop steps necessary to explore higher energy colliders that might follow ILC or be needed should results from LHC point toward a higher energy than that planned for ILC.

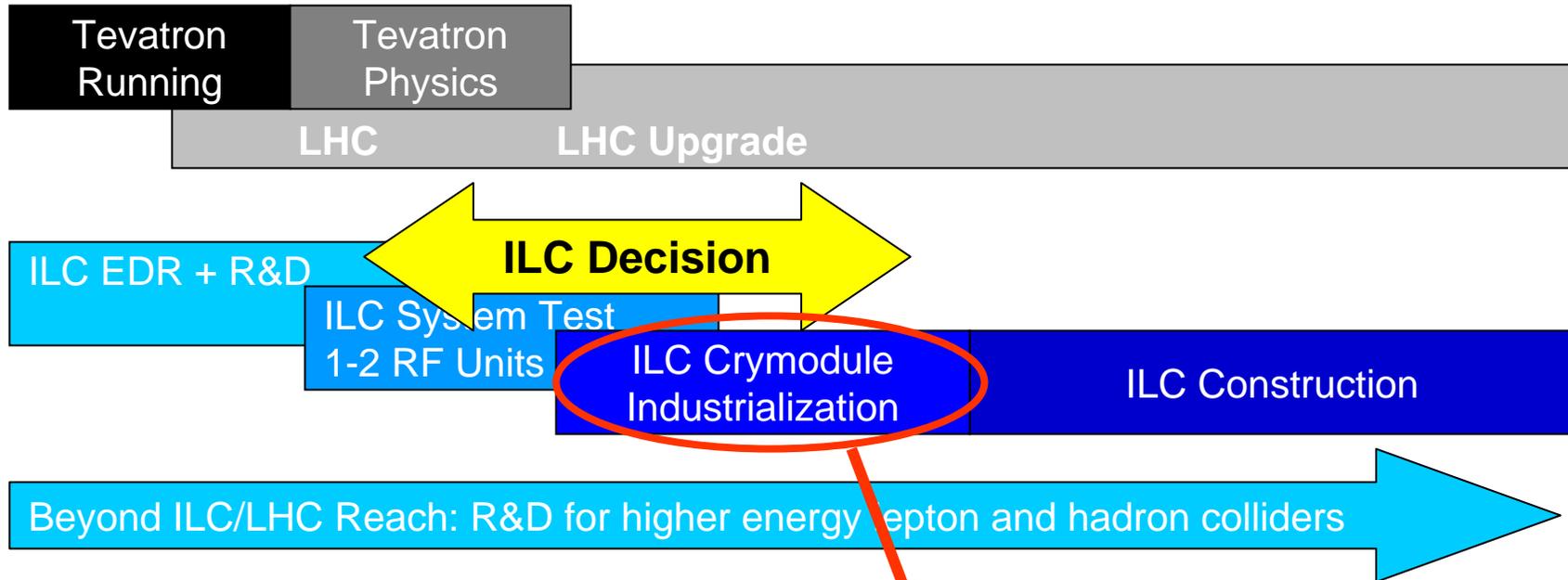
Face-to-Face Meeting at Fermilab (June 12)

Tentative Agenda

Time	Topics
8:30 – 12:00	Energy Frontier ILC: What is needed for early decision and construction? LHC accelerator upgrades R&D steps for colliders beyond ILC and LHC
1:00 – 2:30	Intensity Frontier - Protons Reconfiguration of the existing accelerator complex Toward higher intensity proton sources
2:30 – 3:30	Luminosity Frontier - Electrons Super B factory, Giga-Z
4:00 – 6:00	Sketching Possible Roadmaps
6:00 – 6:30	Discussion for Final Report Writing
7:00 – 9:00	Dinner Discussion

Example of Possible Fermilab Roadmap

Energy Frontier:



Intensity Frontier: High Intensity Protons



ILC Style 6 GeV Linac → High Intensity Proton Sources

