

# Fermilab and the FY 2003 Budget

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HEPAP meeting

April 26, 2002

# Strategic Steps Toward our Scientific Goals

## *A Multi- Prong Approach*

### ? Elements of a Roadmap by Topic

- The Existing and Near- Term Program
- Theoretical Physics, Phenomenology and Data Analysis Theory
- The Energy Frontier      Tevatron/CDF/D0    LHC/CMS
- Lepton Flavor Physics      MiniBooNE      NuMI/MINOS
- Quark Flavor Physics      CDF/D0      BTeV    CKM
- Unification Scale Physics
- Cosmology and Particle Physics      SDSS    CDMS
- High- Energy Particle- Astrophysics      Auger

from Bagger and Barish talk at HEPAP

# The Tevatron Collider Program

## Run II

- ? Much of the accelerator complex is new or rebuilt.
- ? CDF and D0 were upgraded to operate at the higher luminosity.

## Physics of the Weak Energy Scale

- ? Precise  $t$ ,  $W$  mass measurements –
- ? Supersymmetry searches
- ? Search for new physics: hidden dimensions, strong dynamics, ...
- ? Low-mass Higgs search, in time

## CP Violation and Quark Flavors

- ?  $B_s$  mixing to determine  $V_{ts}$
- ? CP-violating asymmetries



# Run IIa Luminosity Goals

- ? **Run IIa** refers to operations supported by the collider configuration envisioned during the Main Injector construction.
  - Luminosity:
    - $5 \times 10^{31}$  (Main Injector Project baseline)
    - $8 \times 10^{31}$  (renormalized when we exceeded our Run I goal by 60%)
    - $2 \times 10^{32}$  (Recycler Ring incorporated into the Main Injector Project)
  - Integrated luminosity:  $2 \text{ fb}^{-1}$  over a 2-3 year period

**The Collider Run II is the most important activity at Fermilab.**



# Run II Luminosity

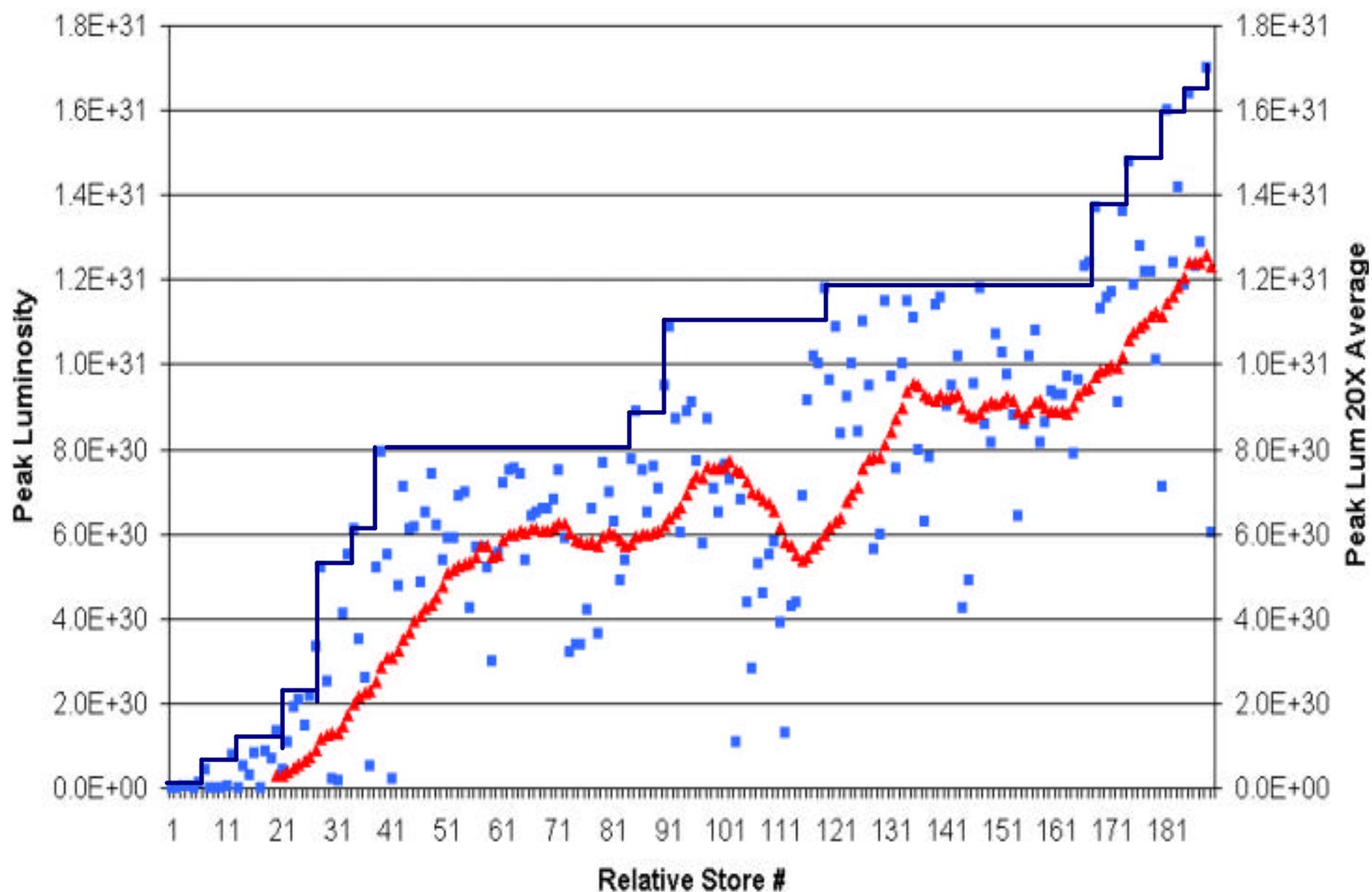
- ? The Tevatron physics program is the best opportunity we have in the world of particle physics for some time.
  - It is critically important that we deliver as much integrated luminosity as possible over the next several years.
  - We must do this while keeping NuMI, LHC, CMS, MiniBooNE on schedule.

## Unfortunately

- ? The collider performance in Run II is off to a disappointing start.
  - The initial luminosity is typically  $1.3 \text{ E}31$ , should be  $3\text{-}4 \text{ E}31$  at this point.
  - Many problems identified; some solutions found; many more to go.
- ? We are finding ways to bring additional effort to bear on the problems.



# Collider Run IIA Peak Luminosity



# Accelerator Effort

## ? Some of the steps taken to date

- Beams Division has had the ability to hire new accelerator scientists for two years, despite tight limits elsewhere in lab.
- M. Church took on new role as Deputy Beams Division Head with responsibility for directing the effort to improve collider performance. He
  - established a plan for addressing performance issues and is now implementing it.
  - made lists of tasks useful for talking to the outside world about helping.
  - meets weekly with S. Holmes and others to plan the campaign.
- Help from rest of laboratory and other laboratories
  - next slide

## ? We are in the middle of this process. There will be more later.



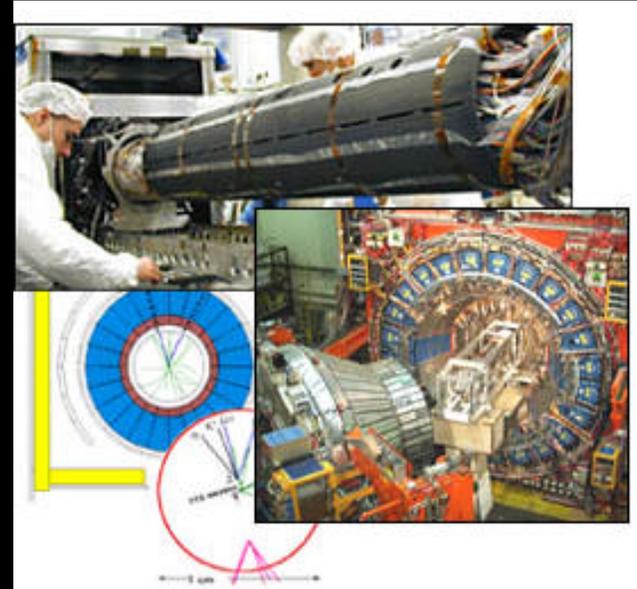
## Help (from S. Holmes talk)

- ? We are starting to achieve success with integration of laboratory resources outside the Beams Division
  - PPD and CD staff: Shot Data Analysis and instrumentation projects.
  - Stephen Pordes transfer from PPD (Deputy) to Beams Division with responsibility for coordination of instrumentation
  - Initiation of “wise-person” advisory group incorporating senior people with previous experience (Peoples, Edwards, Limon, Tollestrup, Finley, Harrison[BNL])
- ? And we are starting to establish assignments with the outside
  - Calculational assignments made in the SLAC accelerator theory group
  - Visit from LBNL senior staff week of May 6
  - Invitations to senior accelerator scientists to “spend your summer vacation at Fermilab”
  - A few more things in the works that can’t yet be publicized

# CDF and D0 Status

## ☞ CDF

- ☞ Detector performance as designed
- ☞ Starting physics studies
- ☞ Full detector taking physics-quality data, but with some glitches
- ☞ Studying how to shield and protect power supplies, silicon, and muon chambers from backgrounds



## ☞ D0

- ☞ Commissioning all systems and starting physics studies
- ☞ Fiber tracker electronics completely installed, being tuned
- ☞ Trigger performance good enough for now; moving smoothly to ethernet-based system for full rate capability



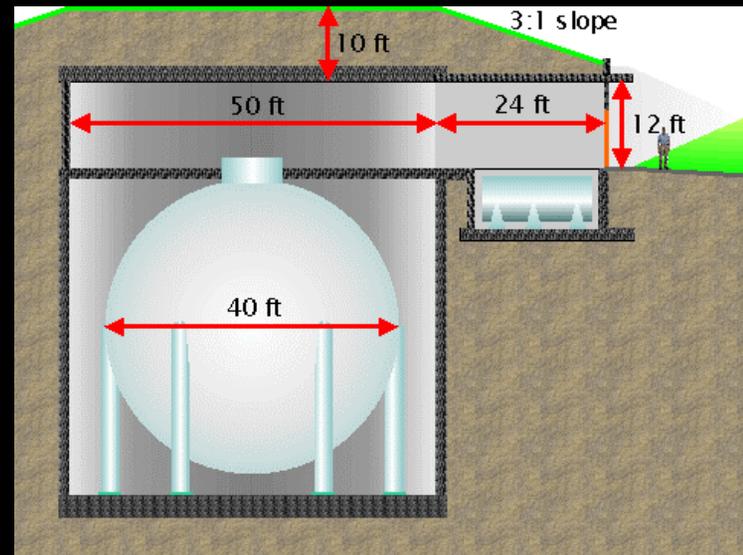
# The Neutrino Program

## ? MiniBooNE

- will make possible a decisive check of the LSND anomaly;
- uses 1 GeV  $\nu$  @ 500 m.
- Construction will soon be complete and the experiment will start operating this summer!

## ? NuMI/MINOS

- will measure the atmospheric neutrino oscillation with high statistics and a controlled source;
- uses 3-20 GeV  $\nu$  @ 740 km.
- The project is making good progress on its new baseline.
- Construction and installation of the MINOS experiment is going very well.



# The LHC Program

## ? US-LHC Accelerator Project

- 73% complete; schedule performance good
- Very positive reviews
- Preparing a US effort to work toward higher luminosity

## ? US-CMS

- 65% complete; schedule performance good
- Much of contingency for increased scope, including Silicon
- Very positive reviews
- We are working to integrate the CMS research program into the laboratory.
  - We will make it possible for US-CMS members to work productively on CMS research.



# Physicists need forefront facilities if they are to address the big problems.

Program	Physicists	Facilities
Tevatron	600 CDF, 600 D0	collider complex, detectors, computing farms
Neutrino	200 MINOS, 60 BooNE	neutrino beams, large detectors
US-CMS	300	detector, computing, research home
US-LHC	600 US, 3000 other	accelerator systems
Astro	250 Auger, 45 CDMS 150 SDSS	large detectors telescope, data handling system
Quark Flavor	150 BTeV, 60 CKM	accelerator complex, detectors
Lattice Gauge	60	commodity cluster facility
FNPL		photoinjector laboratory



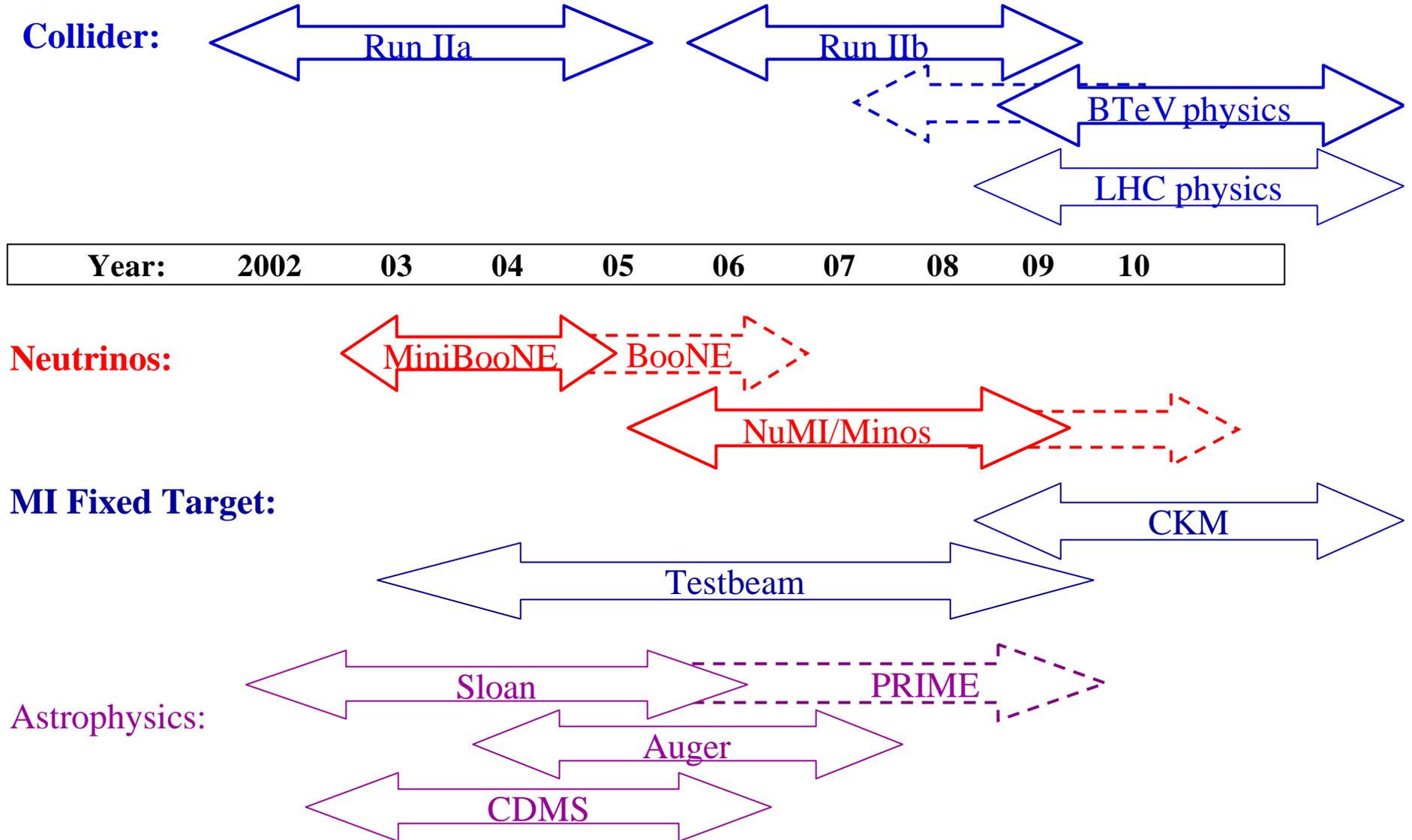
# Ongoing Construction Projects

- ? Run 2b Upgrades (2005)
  - Accelerator luminosity
  - Detectors
- ? Neutrino Projects
  - NuMI/MINOS (2005)
  - MiniBooNE (2002)
- ? LHC (2005)
  - US LHC Accelerator project
  - US CMS
- ? Astrophysics
  - Auger Cosmic Ray Experiment
  - Cryogenic Dark Matter Search

There are a number of projects ending around 2005.  
Some of these are ramping down somewhat in 2004.



# Fermilab Research Program



# Linear Collider Activities

- ? US Leadership
  - Linear Collider Steering Committee is being formed.
- ? International Leadership
  - ICFA appointed Working Group chaired by M. Tigner (US members Dorfan, Gilman, Tigner, Witherell) to select membership and charge for International LCSC.
- ? Accelerator R&D
  - The US needs to increase linear collider R&D support **immediately** if it is to take a leading role.
  - Bob Kephart will discuss Fermilab role.
- ? Physics and Detector Studies
  - New leadership for a broader US physics and detector group
  - Octet of 4 Fermilab, 4 university physicists to coordinate Fermilab-related effort

Workshop on “Research and Development Opportunities for the Linear Collider” here April 5 with >100 attendees. (Accelerator & Detector)



# The Distribution of Effort

- ? The rough fraction of the laboratory personnel costs (SWF) that supports the various research programs:

Program	SWF FY02 Funds (\$M)	% of total research
Tevatron Collider	64.7	60
Neutrino Program	8.0	8
LHC	8.5	8
Accelerator R&D	7.6	7
Exp. Astrophysics*	2.0+1.7	2+2
BTeV	3.0	3
CKM	1.4	1
Fixed Target	3.2	3
Theory	4.2	4

\*First number is Fermilab funding, second is from outside sources.



# Impact of FY 2002 Budget

- ? The program we described at HEPAP last year required \$300 M for FY2002.
- ? The President's Budget Request would have allocated \$291 M.
- ? The actual FY2002 budget is \$286 M.
  - The 3.6% increase is better than HEP as a whole, but constant level of effort.
  - Support for Tevatron operations and upgrades is up ~\$10 M (15%). Room for that effort must be done by cuts elsewhere.
- ? To fit within that budget
  - Tevatron program receives amount needed.
  - NuMI, MiniBooNE receive amount built into plan.
  - Divisions' base budgets and all other programs were cut.
  - M&S spending on successful low-field magnet, neutrino factory R&D programs were zeroed.



# FY 2003 President's Budget Request

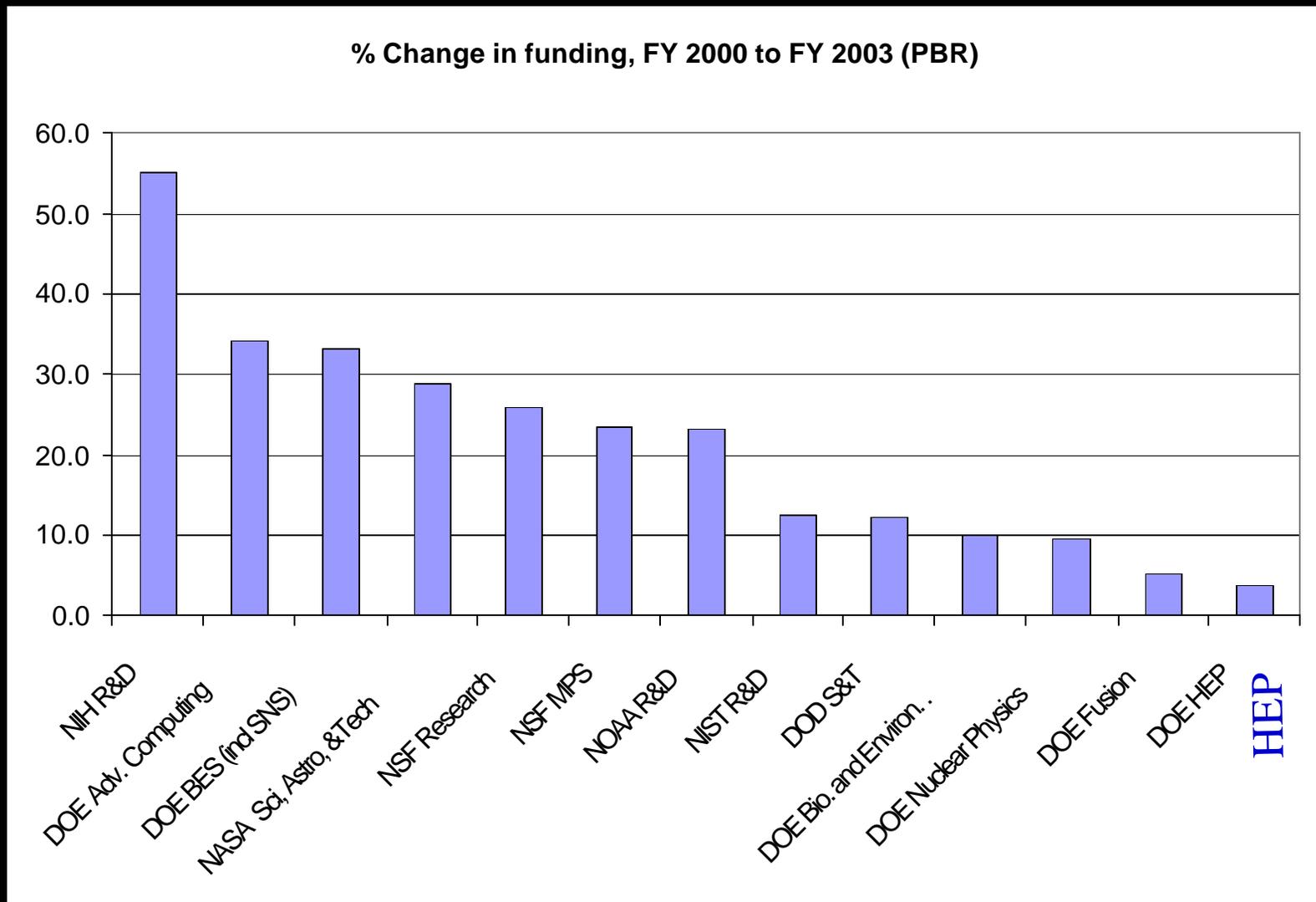
	FY2002 Actual (\$M)	FY2003 PBR	02-03 Change (%)
Fermilab	286.3	288.7	+0.9
HEP	713.1	725.0	+1.7
DOE- Science	3,280.7	3,285.1	0

- ? I will discuss the impact of this budget on the important parts of the US HEP program at Fermilab.
- ? The problem at Fermilab cannot be solved without more for HEP as a whole.

The scientific future for HEP could be great, but we will not get there with a budget for US High Energy Physics below inflation every year.



# The Large Funding Picture, 2000-2003



# What we need to do in FY 2003

## ? **Run II**

- **Keep improving luminosity.**
- Operate the collider and the experiments efficiently.
- Keep offline computing capable of handling data production.
- Make great progress on upgrades.

## ? **Neutrino program**

- Keep NuMI/MINOS construction on the new schedule.
- Operate MiniBooNE efficiently.

## ? **LHC**

- Keep US-LHC and US-CMS projects on schedule.
- Get ready for the physics program.

## ? **Accelerator R&D**

- Make good progress, despite budget, on Linear Collider R&D.
- Keep other programs lean and productive.

## ? **BTeV & CKM**

- Do R&D and engineering needed to be ready to start construction, with minimal impact on other programs.



<b>Incremental Analysis FY2002 to FY2003</b>				
		<b>FY2002 Guidance</b>	<b>FY2003 WPAS</b>	<b>Increase</b>
<b>Total Salary, Wage and Fringe</b>		<b>174.3</b>	<b>181.0</b>	<b>6.8</b>
<b>Items Below are M&amp;S</b>				
	<b>Accelerator Ops and Maintenance</b>	<b>28.4</b>	<b>29.2</b>	<b>0.9</b>
	<b>Run II Accelerator Improvements</b>	<b>2.6</b>	<b>4.8</b>	<b>2.3</b>
	<b>CDF/D0 Ops and Computing</b>	<b>10.0</b>	<b>11.1</b>	<b>1.1</b>
	<b>Run II b Detector Upgrades</b>	<b>4.7</b>	<b>7.3</b>	<b>2.6</b>
	<b>NuMI / MINOS</b>	<b>25.8</b>	<b>23.3</b>	<b>(2.5)</b>
	<b>MiniBooNE</b>	<b>4.8</b>	<b>0.1</b>	<b>(4.7)</b>
	<b>LHC</b>	<b>6.1</b>	<b>5.2</b>	<b>(0.9)</b>
	<b>Future Accelerator R&amp;D</b>	<b>3.9</b>	<b>8.2</b>	<b>4.4</b>
	<b>Experimental Initiatives</b>	<b>1.9</b>	<b>1.8</b>	<b>(0.0)</b>
	<b>Project Management Software</b>	<b>0.7</b>	<b>0.0</b>	<b>(0.7)</b>
	<b>Electrical Power</b>	<b>16.0</b>	<b>17.0</b>	<b>1.0</b>
	<b>GPP + UIP</b>	<b>8.1</b>	<b>8.2</b>	<b>0.1</b>
	<b>Other M&amp;S</b>	<b>23.5</b>	<b>20.6</b>	<b>(2.9)</b>
<b>M&amp;S Total</b>		<b>136.3</b>	<b>136.9</b>	<b>0.6</b>
<b>Total Budget</b>		<b>310.6</b>	<b>318.0</b>	<b>7.4</b>
	<b>Funding from Other Sources</b>	<b>24.3</b>	<b>21.2</b>	<b>(3.1)</b>
<b>Base Budget</b>		<b>286.3</b>	<b>296.8</b>	<b>10.4</b>

We need to cut **\$8.1 M** from this to fit the guidance of \$288.7 M, which corresponds to about \$9M **below** constant effort.

# FY 2003 Budget Needs

? We need \$296.8 M in FY 2003.

**This budget is based on the need to take advantage of the discovery potential of the upgraded collider complex, keep approved projects on schedule, and start to prepare for the future.**

□ This is less than the FY 2002 request we discussed a year ago.

? The main increments that lead to the \$296.8 M need in FY2003:

□ Inflation on wages alone	7 M
□ Electrical power	1 M
□ Tevatron operation and upgrades	7 M
□ Accelerator R&D (mostly LC)	4 M
□ Neutrino program	-7 M
□ Other M&S	-3 M

? The corresponding amount in the President's budget request is \$288.7

? Including Fermilab activity supported by outside funds, mostly LHC, the budget will go down from \$310.6 M in FY02 to \$309.9 M in FY03.



# Summary

## ? **We have great opportunities for discoveries ahead.**

- Exploring a new mass region in Run II
  - An excellent program in the fast-moving area of neutrinos
  - Unique experiments in particle astrophysics
  - First look at the TeV scale with LHC
  - Best of class flavor physics with BTeV and CKM
- and
- Prospects for hosting an international linear collider

## ? **But we have to increase Tevatron luminosity first.**

