

## Report from the Office of High Energy Physics

### **Fermilab Users Meeting**

June 3-4, 2009

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#### **New Leadership**

#### **DEPARTMENT OF ENERGY**



\* The Deputy Secretary also serves as the Chief Operating Officer

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- Following the P5 Roadmap
- The Current Budget Situation
- The Tevatron in 2011?
- Intensity Frontier
- Bulletin from the Cosmic Frontier
- Accelerator Workshop
- OHEP Positions



#### Particle Physics Today Three Scientific Frontiers

- The Energy Frontier, powerful accelerators are used to create new particles, reveal their interactions, and investigate fundamental forces;
- The Intensity Frontier, intense particle beams and highly sensitive detectors are used to pursue alternate pathways to investigate fundamental forces and particle interactions by studying events that occur rarely in nature; and
- The Cosmic Frontier, ground and spacebased experiments and telescopes are used to make measurements that will offer new insight and information about the nature of dark matter and dark energy, to understand fundamental particle properties and discover new phenomena.





Office of Science

### 2008 HEP Science Highlights Delivered at all three Frontiers



- Operation of LHC (AIP Top Ten Story)
- Tevatron (Performance/Experimental Results)
  - (AIP Top Ten Story)







#### **Intensity Frontier**

 BaBar discovery of bottomonium ground state

(AIP Top Ten Story)

Results from MiniBooNE and MINOS



#### **Cosmic Frontier**

- Pierre Auger (AIP Top Ten Story)
- FGST (GLAST)





ECE (GeV)



#### Particle Physics at an exciting period today

- Studies over the last decade and recent discoveries have revealed the Standard Model of particle physics to be highly successful, but incomplete
   the model
  - Does not predict all the properties of the known particles
  - > Fails at extremely high energies
  - Describes only a small fraction of the matter and energy filling the universe



The field is on the verge of significant discoveries and probably paradigm changes but needs critical experimental results and observations!

- The Standard Model will break at O(1 TeV)...but how?
- Measuring the small neutrino mixing angle will determine how rich this sector is: can we see CP Violation in leptons?
- Dark matter just "around the corner" of direct detection?
- The elephant in the room: Dark Energy. What is it?



- Additional results will be needed
  - > Requires results from all three scientific frontiers
  - Requires significant resources
    - International / interagency
    - Coordination / collaboration
- The U.S. needs to play a part in these discoveries!





### Energy Frontier

- > LHC accelerator upgrades
- > LHC detector upgrades

## Intensity Frontier

- > MINERvA & NOvA
- > Long Baseline Neutrino Experiment
- > Mu2e
- > Project X

## Cosmic Frontier

- > DES
- > Dark matter experiments
- > JDEM/LSST



Three fiscal years and one stimulus bill in play:

- FY 2009 American Recovery and Reinvestment Act (ARRA)
  - > Feb 17<sup>th</sup>, \$1.6B for Office of Science
- FY 2009 Appropriations
  - March 11<sup>th</sup>, \$795.7M for HEP
- FY 2010 Congressional Request
  - Rolled out May 7<sup>th</sup>, \$819M for HEP
- FY 2011
  - > In Planning stages
- I can talk about some of these!



### **American Recovery and Reinvestment Act**

- President signed the FY 2009 American Recovery and Reinvestment Act (ARRA) on February 17, 2009
- Primary goal is U.S. workforce and economy. Another is to restore science and innovation as keys to economic growth
- DOE/SC received \$1.6 B and has proposed how to allocate the funding
- OHEP: \$168.8M released so far
- Extensive "tracking" required from the all institutions that obtain ARRA funds

million	HEP ARRA Projects
15.0	University Enhancement & Infrastructure
16.0	Early Career Awards
?	SRF Infrastructure (Fermilab & Industry)
20.0	Advanced Technologies (Universities & Labs)
?	Long Baseline Neutrino Experiment (LBNE) R&D
55.0	NOvA (Univ. Minnesota and Fermilab)
33.7	Advanced Plasma Accelerator Facilities (LBNL/SLAC)
25.0	GPP Fermilab
4.1	SBIR/STTR
168.8	-



## **ARRA details**

- University Enhancement & Infrastructure
  - Proposals due June 5. Peer review in July/Aug, awards in fall
- Early Career Awards (Universities & Labs)
  - Coordinated SC program, Announcement later this summer
- SRF Infrastructure (Fermilab)
  - > Advance Fermilab facilities, promotes industrialization
- Advanced Technology R&D (Universities & Labs)
  - Includes high field magnets, SRF grants, and detector R&D
- Long Baseline Neutrino Experiment (LBNE) R&D
  - > Funds development of CD-1, work plan in development
- NOvA (Univ. Minnesota and Fermilab)
  - > Advances schedule for construction
- Advanced Plasma Accelerator Facilities (LBNL/SLAC)
  - > Funds fabrication of both FACET and BELLA proposals
- GPP (Fermilab)
  - > Addresses backlog of infrastructure improvements at FNAL
- SBIR/STTR



## **HEP FY2009 Program Overview**

	(millions)
Subprograms	FY 2009
Proton Accelerator-Based Physics	402.5
Electron Accelerator-Based Physics	31.0
Non-Accelerator Physics	100.9
Theoretical Physics	64.8
Advanced Technology R&D	196.6
High Energy Physics Total	795.7





<b>Research Statistics</b>	FY 2009 estimate
# University Grants	200
# Laboratory Groups	45
# Permanent Ph.D.'s (FTEs)	1,135
# Postdoctoral Associates (FTEs)	550
# Graduate Students (FTEs)	595
# Ph.D.'s awarded	110



### FY2009 Budget: Functional "Slice"

HEP Functional Categories	FY 2007	FY 2008	vs FY08	FY 2009	vs FY08	vs FY07
Fermilab Accelerator Complex Operations	145.1	151.0	6.6	157.7	4.4%	8.7%
LHC Detector Support/Operations	56.8	65.6	6.4	71.9	9.7%	26.6%
SLAC Accelerator Complex Operations	79.0	36.5	-22.0	14.5	-60.3%	-81.7%
Facility Operations	280.9	253.1	-9.0	244.1	-3.6%	-13.1%
EPP Research	249.1	264.5	19.7	284.2	7.5%	14.1%
Advanced Technology R&D	167.7	138.1	30.1	168.2	21.8%	0.3%
Core Research	416.8	402.6	49.8	452.4	12.4%	8.5%
Project - NOvA	12.5	12.0	15.7	27.8		
Project - Minerva	4.0	7.2	-2.3	4.9		
Project - T2K	0.6	2.5	-1.5	1.0		
Daya Bay	1.0	6.9	6.1	13.0		
LHC Detectors	3.2	0.0	0.0	0.0		
LHC Accelerator Upgrade Phase I	0.0	0.0	2.5	2.5		
DES	1.4	5.5	3.2	8.7		
CDMS 25 MIE	0.0	0.0	1.0	1.0		
FACET	0.0	0.0	0.0	0.0		
BELLA	0.0	0.0	8.0	8.0		
Projects	22.6	34.1	32.7	66.9	96.0%	195.5%
Other (GPP/GPE/SBIR/STTR)	31.5	31.5	0.9	32.4	2.7%	2.9%
High Energy Physics	751.8	721.3	74.4	795.7	10.3%	5.8%



## FY2009 Program Status

- The program was under some stress due to the continuing resolution but managed to maintain momentum due to
  - > FY 2008 supplemental funding
  - > Termination of B-Factory operations
  - Change in responsibilities for GPP
- Funding of the President's FY09 Request restores momentum and maintains projects:
  - Full Tevatron operations
  - > LHC detector support issues addressed
  - Research programs to provide +2-3% over FY 2008 level
    - FY 2009 supplemental requests being acted on now
  - > ILC and SRF R&D support restored to manageable levels
  - Projects restored to baseline funding levels
  - NOvA had enough funds to stay on re-baselined schedule



### FY2010 Request: Functional "Slice"

Office of Science

	FY 2007	FY 2008	FY 2009	ו <u>ד</u>	FY 2010 Request	vs FY09	vs FY07
Fermilab Accelerator Complex Operations	145.1	151.0	157.7	0.9	158.5	0.5%	9.3%
LHC Support (Detectors / Accelerators)	56.8	65.6	71.9	-1.4	70.5	-2.0%	24.1%
Electron Based Facilities	79.0	36.5	14.5	-2.4	12.1	-16.7%	-84.7%
Facility Operations	280.9	253.1	244.1	-3.0	241.1	-1.2%	-14.2%
EPP Research	249.1	264.5	284.2	2.8	287.0	1.0%	15.2%
Advanced Technology R&D	167.7	138.1	168.2	-5.7	162.5	-3.4%	-3.1%
Core Research	416.8	402.6	452.4	-2.9	449.6	-0.6%	<b>7.9</b> %
Project - NOvA	12.5	12.0	27.8	31.2	59.0		
Project - Minerva	4.0	7.2	4.9	-4.1	0.8		
Project - T2K	0.6	2.5	1.0	-1.0			
Daya Bay	1.0	6.9	13.0	-2.0	11.0		
LHC Accelerator Upgrade Phase I			2.5	13.5	16.0		
DES	1.4	5.5	8.7	-0.1	8.6		
CDMS 25 MIE			1.0	0.5	1.5		
FACET							
BELLA			8.0	-8.0	0.0		
Projects	22.6	34.1	66.9	30.0	96.9	44.9%	328.3%
Other (GPP/GPE/SBIR/STTR)	31.5	31.5	32.4	-0.9	31.4	-2.9%	-0.1%
High Energy Physics	751.8	721.3	795.7	23.3	819.0	2.9%	<b>8.9</b> %



- Full Tevatron Collider and NuMI Operations
- Support for LHC Ops and Accelerator Upgrade
  > Detector Upgrades TBD, review this summer
- BaBar in "intensive analysis" mode
- Maintain current projects on baseline schedule
- BELLA, FACET in construction
- To maintain Facility Ops and Projects, overall Research is held approximately flat
  - ARRA Early Career, University Infrastructure awards will ameliorate impacts



### **Budget Trend Turning Up?**

- > HEP funding has been eroded by inflation: FY 2008 / FY 1996 ~ 20 % (OMB COL)
- > HEP FY 2009 funding is +10 % compared to FY 2008 and above OMB Cost-of-Living (COL) from FY 2007
- > HEP has received \$168.8 million in RA funding so far. Additional proposals under consideration.
- > HEP FY 2010 Request is above OMB COL (+2.9 %) compared to FY 2009





## FY 2011 Budget Process

#### FY 2008/FY 2009 Reviews and Briefings

- > Fermilab and SLAC Reviews
- > Theory and Accelerator Science Laboratory Groups Reviews
- > Particle Data Group Review, BELLA/FACET Review
- > Detector R&D and General Accelerator Development Briefings
- > LARP, LHC, LQCD. SciDAC, etc.
- Laboratory Management Budget Briefings Scheduled
  - > Feb 23: LBNL / Feb 26: FNAL / Feb 27: ANL
  - > March 3: SLAC / March 4: BNL
- OHEP Retreat March 18-20
- FY 2011 HEP Budget submissions
  - Going to SC now
  - > To DOE probably around July
- OMB Passback in November
- FY 2011 HEP Congressional Budget in December

#### Sausage with a cast of thousands !





## **Tevatron Run in FY 2011?**



# LHC Run plans for CY 2009 – CY 2011:

- Circulate beam at 450 GeV (1/2 of Tevatron energy) by the end of September 2009, verifying that the new protection systems are working properly
- First collisions with 5 TeV beams (5x Tevatron energy) by November
- Integrate 200 pb<sup>-1</sup> before first run ends in September 2010
- Restart in mid-2011 at 7 TeV beam energy (design energy)





#### Standard Model Higgs exclusion in 2011:

- Tevatron will be able to exclude Standard Model Higgs at 95% CL in the allowed 114-185 GeV mass range
- LHC will be able to start excluding Higgs in the mass region <u>already excluded</u> by Tevatron
- Tevatron is more sensitive to Standard Model Higgs than LHC in favored low mass region below 150 GeV

#### Possible observation of Standard Model Higgs in 2011:

- If there is a Standard Model Higgs with a mass of 115 GeV, Tevatron has a 50% chance of observing it with 3σ significance
- The LHC needs about 10 fb<sup>-1</sup> to start to reach Tevatron sensitivity in the low-mass region -- well beyond 2011





#### **Tevatron Collider:**

- Running extremely well, delivering record luminosities
- A one-year run extension would have minimal impact on other Fermilab programs

#### **CDF and D-Zero experiments:**

- Running very well, with detectors typically recording ~80% of delivered luminosity
- Collaborations holding up well they  $\frac{2}{2}$  have requested DOE to commit to a run extension
- run extension
  A run extension through FY 2011 would double the dataset that the experiments will have this summer





## **The Intensity Frontier**



- MiniBoone and MINOS are running.
- MINERvA and NOvA are under construction.

• OHEP is pursuing CD-0s for MicroBoone, LBNE, and Mu2e.

- The larger the project the higher up in DOE
- it goes for approval.
- More preparation required.
- LBNE requires coordination with NSF.
- Project X is still in the R&D phase.



#### Long Baseline Neutrino Experiment (LBNE)

- OHEP is seeking approval from the Department for approval of Mission Need (CD-0) for the LBNE project. The project includes both a neutrino beam and a large detector.
- OHEP has identified FNAL, working with BNL as lead on the detector, to take responsibility for performing the work needed for approval of CD-1 (Exploration of Alternatives). This includes conceptual design, alternatives analysis, etc.
- FNAL has been working with the other laboratories to develop a CD-1 "work plan". We have seen a draft. Expect final version this week.
- With the approval of CD-0, DOE R&D funds will be made available to support this work, which is expected to involve participants from laboratories and universities. We hope to receive ARRA funds will enable us to advance this work.
- As recommended by P5 we are working with NSF to coordinate LBNE and DUSEL efforts.



- PEP-II
  - Planning for Decommissioning & Decontamination (D&D) underway, review has been held
  - > A number of alternatives for disposition of equipment
- Proposed SuperB Facility (Italy)
  - Italians (INFN) proposing a next generation ~10 GeV electron-positron collider facility Decision by Italian government is expected in calendar 2009.
  - INFN has requested that all the PEP II components be provided for this facility The estimated value is \$130 million Euros (no significant U.S. need for additional components foreseen).
  - > OHEP will need to make a decision in FY 2010, some considerations:
    - Level of interest by U.S. community
    - In context of constrained funding impact on other parts of the program
    - International impact



## **Cosmic Frontier**

- National Academy of Science's Astronomy and Astrophysics Decadal Survey (Astro2010)
  - > Major planning activity for NASA and NSF astronomy.
    - Doe is participating.
  - > Town Hall meeting at APS in Denver
  - Over 200 proposals for projects were submitted to the Program Prioritization Panels – some will be asked to present at their meeting in early June.
  - http://sites.nationalacademies.org/bpa/BPA\_049810
- Particle Astrophysics Scientific Assessment Committee (PASAG) also underway.
  - > An effort to prioritize which astrophysics is most important to HEP.
  - > Steve Ritz (chair) reported on the PASAG at the APS meeting.
  - > Four subgroups have been formed and are holding regular phone calls.
  - > Draft report by early August.
- Alpha Magnetic Spectrometer (AMS)
  - > AMS transport to the ISS is planned for space shuttle mission #STS-134 scheduled for 2010.



## JDEM

#### JDEM

- > Town Hall meeting at APS in Denver with DOE and NASA sitting on the panel.
- The European Space Agency (ESA) is continuing to review the Euclid space-based dark energy mission as part of their Cosmic Visions program planning process. They may join with JDEM at a later time.
- DOE has identified JDEM to be scientifically compelling and an excellent opportunity for an inter-agency (and perhaps global) partnership that can achieve transformational discoveries.
- DOE is committed to pursuing this opportunity with NASA and implementing a successful mission. In this partnership, input will be solicited from the scientific community and utilized to ensure that the mission concept, plan for the science investigations, and our contributions are optimized to deliver the best science within available resources.



## **Accelerator R&D Workshop**

- OHEP historically has been the steward of advanced accelerator R&D for DOE (particle physics and SC programs)
- OHEP and SC believes that this stewardship should be informed and responsive to national needs. To do so we will be holding a national workshop on accelerator R&D
- Workshop goals are to identify, understand, and report on:
  - Role of accelerators in society
  - > Current status with regard to capabilities, costs, and deployment
  - Stakeholder requirements (intensity, resolution, timing, and energy)
  - > Organization of current accelerator R&D efforts
  - Path forward to meet society's needs
- The following individuals have agreed to be workshop co-chairs:
  - > Walter Henning, Argonne
  - > Charles Shank, Berkeley
- Weekly planning meetings
  - > Dates are October 26-28, 2009
  - > Working now to define scope and membership of subpanels
  - > Open Plenary Session, Sub-panel participation by invitation
- Please contact John Boger (OHEP Lead) with questions and suggestions.



## **OHEP Positions**

- Research and Technology Division (to be advertised shortly)
  - > Theory Program Manager
  - > Non-Accelerator Program Manager
  - > Interdisciplinary Computer Scientist/Physicist (Computational HEP)
  - Administrative Support Specialist (Position open to internal DOE candidates)
  - > Program Analyst (Position open to internal SC candidates)
- Facilities Division
  - > Interdisciplinary General Engineer/Physicist
    - (Instrumentation and Major Systems)
  - > FNAL Program Manager