



# Report & News from the Office of High Energy Physics

## HEPAP Meeting

October 23-24, 2009  
Washington, D.C.

**Dennis Kovar**  
Associate Director of the Office of Science  
for High Energy Physics

# Overview

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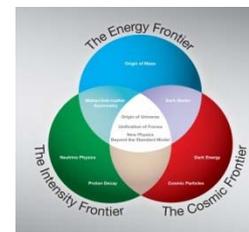
The HEP program, with input from the scientific community, has developed a long-range plan that maintains a leadership role for the U.S. at the three scientific frontiers that define the field

The main elements of this plan are to:

- Maintain a strong, productive university and laboratory research community
- Enable U.S. leadership roles in the Tevatron and LHC programs at the [Energy Frontier](#)
- Achieve the vision of a world-leading U.S. neutrino and rare decay program at the [Intensity Frontier](#), building on the existing accelerator infrastructure at Fermilab
- Deploy selected, high-impact experiments at the [Cosmic Frontier](#)
- Support accelerator R&D to position the U.S. to be at the forefront of [Advanced Technologies](#) for next-generation facilities.

Need to design and construct new research capabilities,

- while maintaining a world-leading scientific program and
- supporting targeted long-range R&D for the future.





# 21<sup>st</sup> Century Tools for Science

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## ▪ Projects under construction

- Dark Energy Survey (**Cosmic**)
- Daya Bay (**Intensity**)
- NOvA (**Intensity**)
- MINERvA (**Intensity**)
- SuperCDMS-Soudan (**Cosmic**)

## ▪ Projects in design

- BELLA (Accelerator R&D)
- FACET (Accelerator R&D)
- Accelerator Project for the Upgrade of the LHC (**Energy**)

## ▪ Projects seeking Mission Need

- Long Baseline Neutrino Experiment (**Intensity**)
- Muon to Electron Conversion Experiment (**Intensity**)
- MicroBoone (**Intensity**)

## ▪ Large Projects considered for the future

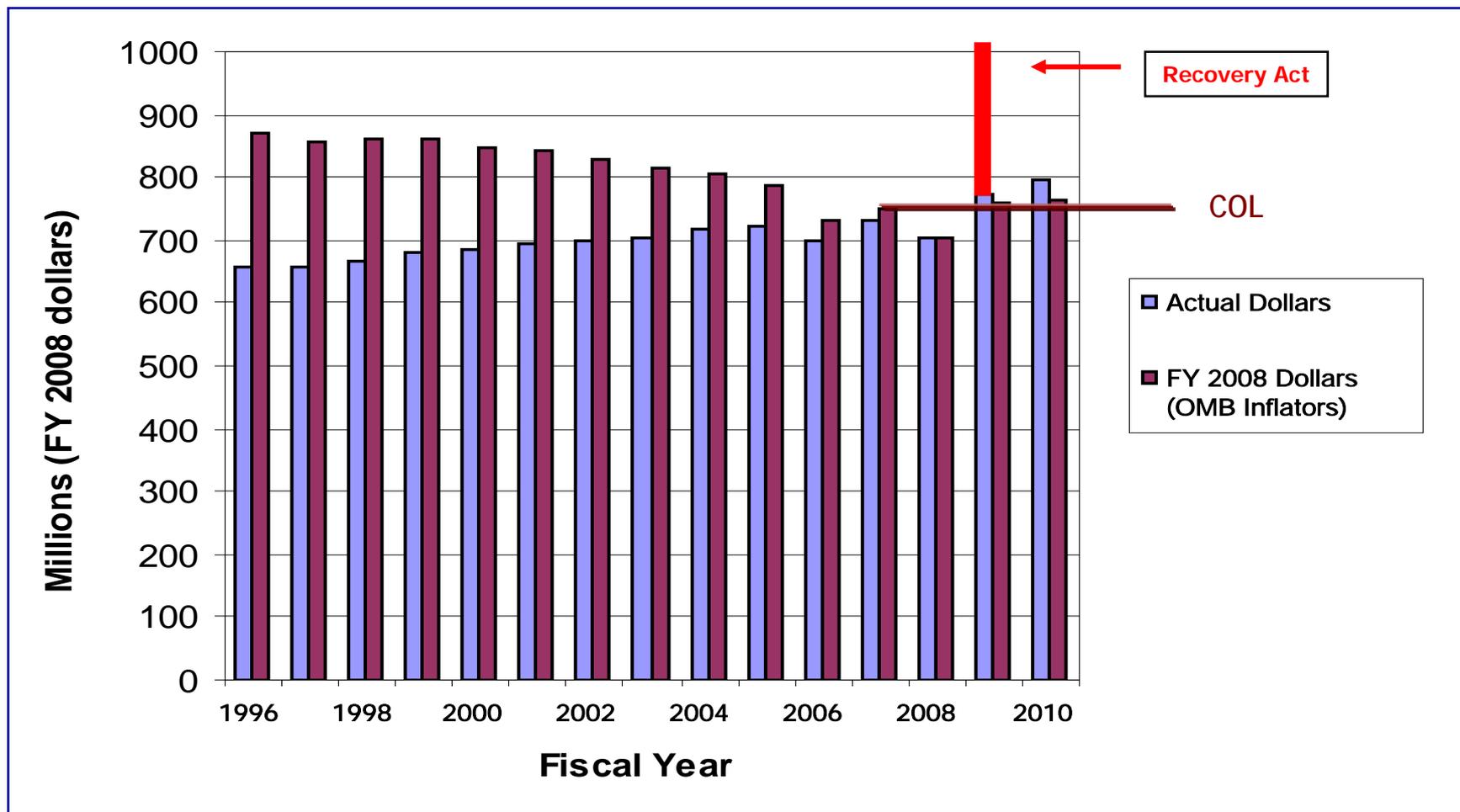
- Joint Dark Energy Experiment (**Cosmic**)
- LHC detector upgrades (**Energy**)
- Large Synoptic Survey Telescope (**Cosmic**)
- Project X (**Intensity**)



# Budgets

## Change the Prevailing Funding Trends

- HEP FY 2009 funding is + 10% compared to FY 2008 and above OMB Cost-of-Living (COL) from FY 2007
- **HEP received \$236.5 million in Recovery Act funding**
- HEP FY 2010 Appropriations is about OMB COL compared to FY 2009



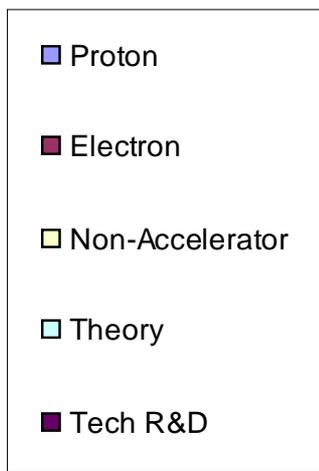
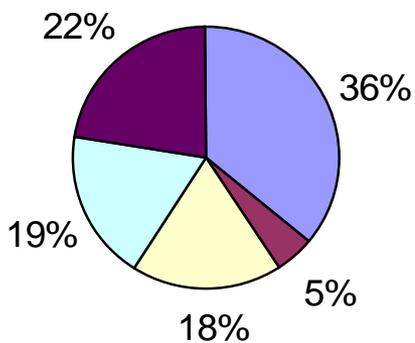
# FY 2009 Budget Overview

HEP Functional Categories	FY 2007	FY 2008	Diff vs FY08	FY 2009	Diff vs FY08	Diff vs FY07
Fermilab Accelerator Complex Operations	145.1	151.0	11.8	162.8	7.8%	12.2%
LHC Detector Support/Operations	56.8	65.6	3.8	69.4	5.8%	22.1%
SLAC Accelerator Complex Operations	79.0	36.5	-21.2	15.3	-58.0%	-80.6%
<b>Facility Operations</b>	<b>280.9</b>	<b>253.1</b>	-5.6	<b>247.5</b>	-2.2%	-11.9%
EPP Research	249.1	264.5	20.2	284.7	7.6%	14.3%
Advanced Technology R&D	167.7	138.1	29.0	167.2	21.0%	-0.3%
<b>Core Research</b>	<b>416.8</b>	<b>402.6</b>	49.2	<b>451.9</b>	12.2%	8.4%
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	7.1	14.0		
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	4.2	9.7		
Super CDMS	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		
<b>Projects</b>	<b>22.6</b>	<b>34.1</b>	34.7	<b>68.9</b>	101.8%	204.4%
<b>Other (GPP/GPE/SBIR/STTR)</b>	<b>31.5</b>	<b>31.5</b>	-4.0	<b>27.5</b>	-12.8%	-12.7%
<b>High Energy Physics</b>	<b>751.8</b>	<b>721.3</b>	74.4	<b>795.7</b>	10.3%	5.8%

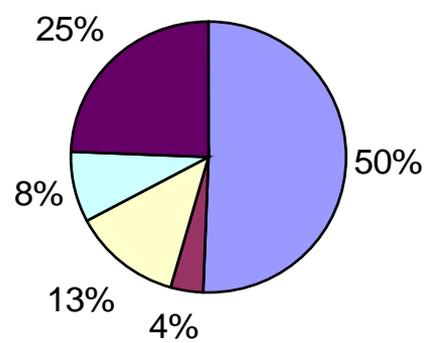
# HEP Funding by Budget Categories

<u>Budget Categories</u>	(millions) FY 2009	
	HEP Research	HEP Research, Projects and Operations
Proton Accelerator-Based Physics	125.7	401.4
Electron Accelerator-Based Physics	16.5	32.0
Non-Accelerator Physics	62.4	101.1
Theoretical Physics	64.8	66.1
Advanced Technology R&D	77.7	195.1
<b>High Energy Physics</b>	<b>347.1</b>	<b>795.7</b>

**Research Funding**



**Total Funding**



# FY 2009 American Recovery and Reinvestment Act (ARRA)

	FY 2009 ARRA
Fermilab Accelerator Complex Operations	15.0
<b>Facility Operations</b>	<b>15.0</b>
Proton Research	6.6
Electron Based Research	0.3
Non-Accelerator	1.4
Theory	2.9
<b>EPP Research</b>	<b>11.2</b>
Accel Science	0.4
General Accel Development	6.0
Superconducting RF	52.7
Advanced Tech SRF R&D	9.0
Detector Development	8.4
<b>Advanced Technology R&amp;D</b>	<b>76.5</b>
<b>Core Research</b>	<b>87.7</b>
Project - NOvA	55.0
FACET	13.0
BELLA	20.7
<b>Projects</b>	<b>88.7</b>
<b>Other (GPP/GPE/SBIR/STTR)</b>	<b>28.6</b>
<b>High Energy Physics</b>	<b>220.0</b>

<u>HEP ARRA Projects</u>	
15.0	University Enhancement & Infrastructure
52.7	SRF Infrastructure (Fermilab & Industry)
20.0	Advanced Technologies (Universities & Labs)
15.0	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
3.6	SBIR/STTR
<b>220.0</b>	

# FY 2010 HEP Budget

**FY 2010 Funding Status**  
(budget authority in thousands of dollars)

	FY 2009			FY 2010				
	Base Approp.	Recovery	Enacted Approp. <sup>a/</sup>	Request	Req. vs. 09 Base Approp.	Conf.	Conf. vs. Request	
Basic Energy Sciences	1,571,972	+555,406	2,127,378	1,685,500	+113,528	1,636,500	-49,000	4.1%
Advanced Scientific Computing	368,820	+161,795	530,615	409,000	+40,180	394,000	-15,000	6.8%
Biological and Environmental Research	601,540	+165,653	767,193	604,182	+2,642	604,182	—	0.4%
High Energy Physics	795,726	+232,390	1,028,116	819,000	+23,274	810,483	-8,517	1.9%
Nuclear Physics	512,080	+154,800	666,880	552,000	+39,920	535,000	-17,000	4.5%
Fusion Energy Sciences	402,550	+91,023	493,573	421,000	+18,450	426,000	+5,000	5.8%
Science Lab Infrastructure	145,380	+198,114	343,494	133,600	-11,780	127,600	-6,000	-12.2%
Science Program Direction	186,695	+5,600	192,295	213,722	+27,027	189,377	-24,345	1.4%
Workforce Development	13,583	+12,500	26,083	20,678	+7,095	20,678	—	52.2%
Safeguards and Security	80,603	—	80,603	83,000	+2,397	83,000	—	3.0%
Subtotal, Science	4,678,949	+1,577,281	6,256,230	4,941,682	+262,733	4,826,820	-114,862	3.2%
ARPA-E	15,000	—	15,000	—	-15,000	—	—	
Safeguards and Security (reimbursable)	—	—	—	—	—	—	—	
Congressionally-directed projects	93,687	—	93,687	—	-93,687	76,890	+76,890	
SBIR/STTR	—	+18,719	18,719	—	—	—	—	
Use of prior year balances	-15,000	—	-15,000	—	+15,000	—	—	
Unallocated	—	+4,000	4,000	—	—	—	—	
<b>Total, Science</b>	<b>4,772,636</b>	<b>+1,600,000</b>	<b>6,372,636</b>	<b>4,941,682</b>	<b>+169,046</b>	<b>4,903,710</b>	<b>-37,972</b>	<b>2.7%</b>

<sup>a/</sup> FY 2009 Enacted Appropriation is prior to the Small Business Innovation Research/Technology Transfer reprogramming and appropriations

<sup>b/</sup> \$15,000,000 appropriated under for Science prior appropriation Acts for the Advanced Research Projects Agency--Energy is to be transferred to

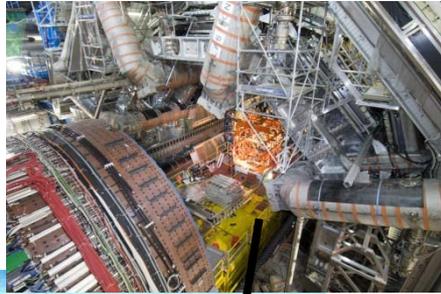
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EPP Research	249.1	264.5	284.7	2.4	287.0	0.8%
Advanced Technology R&D	167.7	138.1	167.2	-4.7	162.5	-2.8%
<b>Core Research</b>	<b>416.8</b>	<b>402.6</b>	<b>451.9</b>	-2.3	<b>449.6</b>	-0.5%
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Project - T2K	0.6	2.5	1.0	-1.0	0.0	
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# **Subprograms Activities: Science for Discovery**

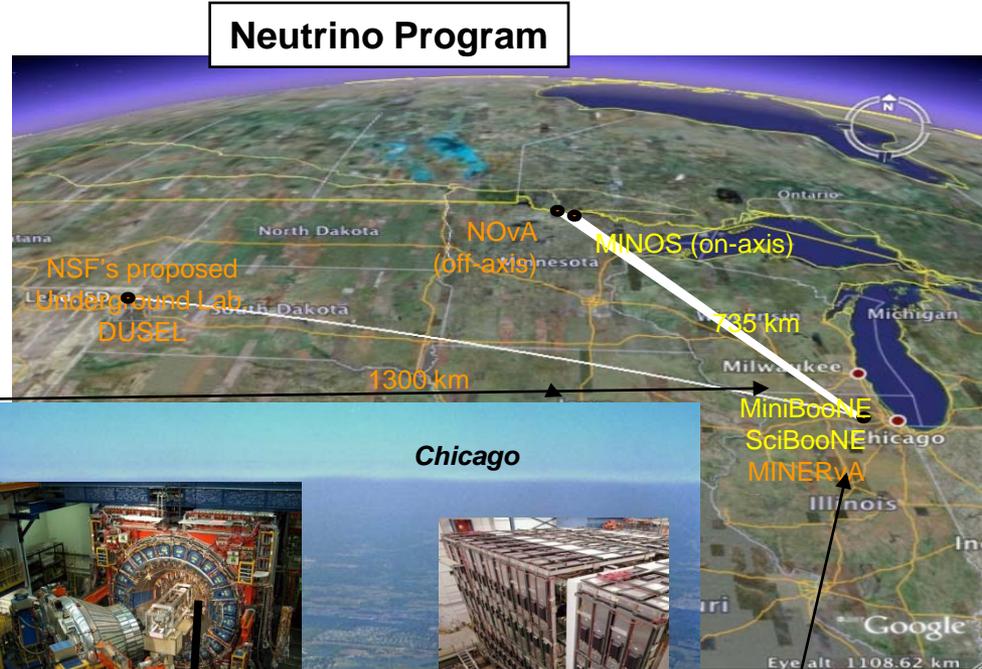
# Energy Frontier Facilities



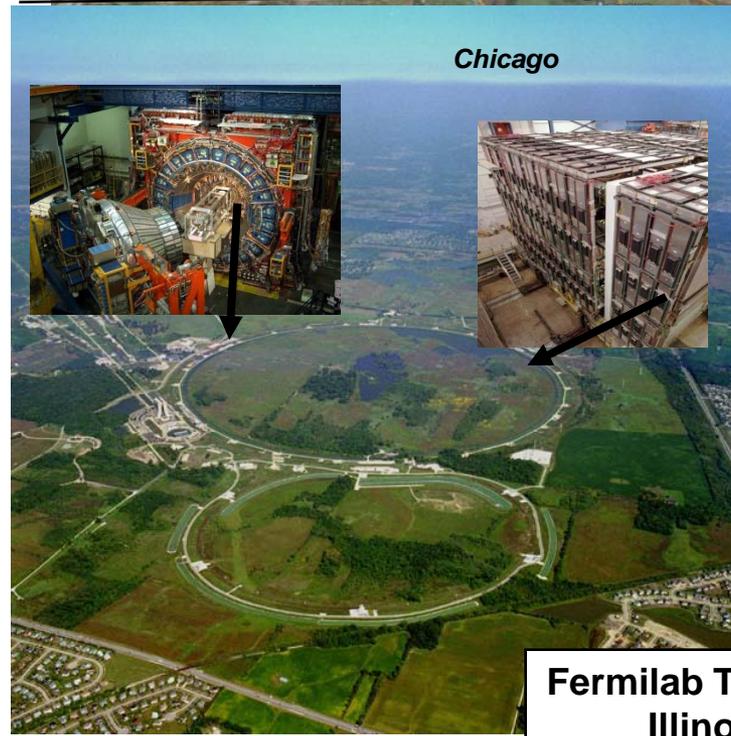
MontBlanc



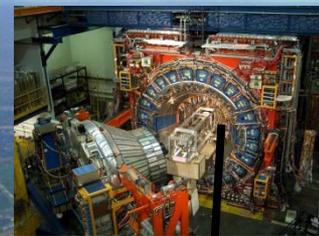
Large Hadron Collider  
Geneva



Neutrino Program



Fermilab Tevatron  
Illinois



# Energy Frontier Recent Activities

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## Tevatron Program

- With the delay in the LHC there is an increasingly strong case for running the Tevatron in FY 2011. OHEP now plans to request funding in FY 2011 to run the Tevatron

## LHC Program

- CERN has a Working Group on possible geographic and scientific enlargement of CERN
- U.S (DOE and NSF) provided input the CERN WG deliberations on September 3, 2009
- U.S. proposes that its relations with CERN remain basically the same as now
  - **Project stakeholder/CERN-Observer (not CERN Member State)**
  - **Will participate in the LHC program until end of US-CERN MOU (2017)**
    - Includes detector/accelerator “replacement”/“modest upgrades” (Phase I LHC upgrades)
  - **Will decide what its role might be for LHC major upgrade (sLHC or Phase II)**
    - CERN has not yet made a decision on Phase II proposed x10 upgrade
    - U.S. position is that we will not pay LHC facility operating costs

## Next generation TeV Facility

- An international “ILC decision” awaits results from LHC and commitments of interested participants
- This had been envisioned to happen ~ FY 2012, but most now believe it will happen later
- OHEP plans to support ILC R&D thru FY 2012 and has asked U.S. ILC Team to articulate the options and needed funding for beyond FY 2012.





# Proton Accelerator Based Intensity Frontier

## Recent Activities

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### HEPAP envisioned "world-class" intensity frontier program entails evolution of Fermilab program

- MINOS/Minerva → NOvA (700kW) → LBNE (700kW) → SLBNE (2000 kW) --> Energy Frontier ?
- The accelerator infrastructure allow: SLBNE → neutrino factory → muon collider
- Option for the Energy Frontier

### Envisioned "world-class" intensity frontier program entails development of an underground detector

- LBNE needs a large underground detector (~100-300 ktons)
- A large detector (~300 kton) at the right depth (~5000 ft) detector can also do proton decay
- Physics goals: searches for CP violation and proton decay at factors of 10-100 greater sensitivity

### Goals are ambitious and will take significant combined (DOE, NSF, other countries) resources

- NSF is proposing a Deep Underground Science and Engineering Laboratory (DUSEL) with a suite of experiments that includes a large detector (for neutrino oscillations and proton decay)
- Europeans have a large underground detector in their strategic planning
- Japanese are also interested in the science

### DOE and NSF have had discussion with OMB and OSTP on how to coordinate planning

- NSF is supporting the conceptual design of the DUSEL facility and a suite of experiments
- DOE HEP is seeking Mission Need (CD-0) approval for the Long Baseline Neutrino Experiment (LBNE) that includes the neutrino beam and a large underground detector
- DOE and NSF are working to coordinate their efforts, avoid duplication, and optimize their investments
- Joint DOE/NSF Statement submitted by DOE (Koonin) and NSF (Bement)



# Electron Accelerator Based Physics Intensity Frontier

## Recent Activities

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### B-Factory / BaBAR

- BaBAR data need to be analyzed and archived
- D&D activities confronted with DOE orders preventing disposal of waste with metals
- Disposal of PEP II components await Italian decision on proposed SuperB

### Proposed SuperB Facility (Italy)

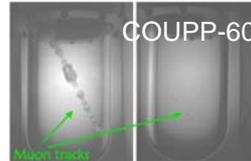
- Italians (INFN) proposing a next generation ~ 10 GeV electron-positron collider facility
  - Decision by Italian government is expected by the end of calendar 2009.
  - CERN Council recognized that this project is in agreement with the European Strategy for Particle Physics
- INFN has requested that all the PEP II components be provided for this facility
  - No significant U.S. need for components foreseen
  - U.S. scientists are interested in participating
  - The estimated value is 130 million Euros
- OHEP will need to make a decision in FY 2010
  - OHEP is requesting that SLAC do an assessment of options (costs, benefits, etc.) for U.S. involvement before the end of the calendar year.

# Cosmic Frontier Projects

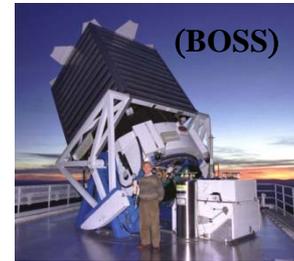
## Gamma-ray Astrophysics



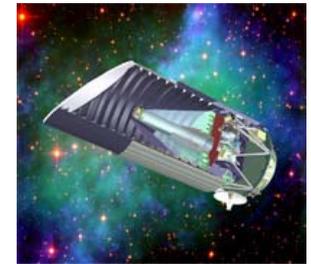
## Dark Matter (WIMPs)



## Dark Energy (ground-based)

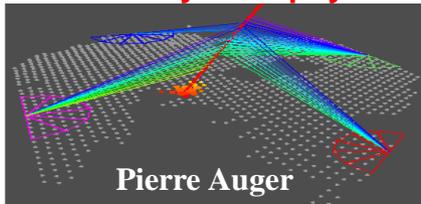


## Dark Energy (space-based)

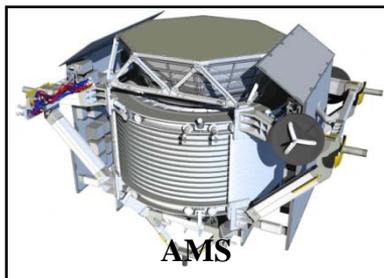


JDEM - proposed

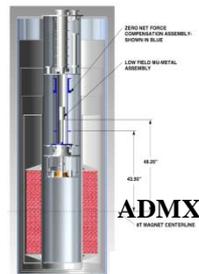
## Cosmic Ray Astrophysics



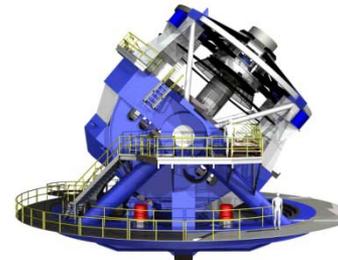
## Anti-matter, Dark Matter



## Dark Matter (axions)



## LSST - proposed



# Non-Accelerator Physics

## Recent Activities

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### DOE and NASA have been working on identifying the path forward on a JDEM

- Two concepts (IDECS and OMEGA) have been presented to Astro2010.
  - The cost of both of these missions is large and current budget projections show that large-class missions may not be possible.
- NASA and DOE have agreed to examine a “probe class” \$650-capped mission concept
  - We are asking the Project Offices at GSFC and LBNL to develop these concepts
  - Directors of GSFC and LBNL have committed to facilitating these efforts

### We are looking for guidance from HEPAP (PASAG)

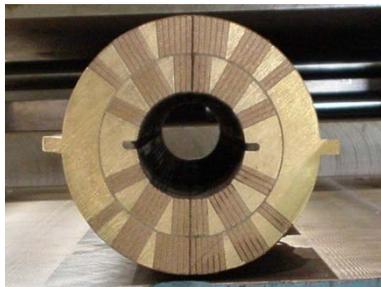
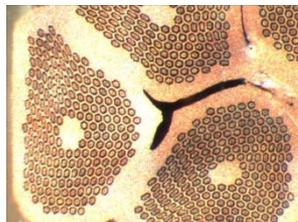
- The findings and recommendations are important:
  - they will help define the HEP “particle astrophysics” program
  - they will be used in setting priorities and articulating the scientific deliverables

### We are looking for guidance from Astro2010.

- The findings and recommendations are important:
  - they will influence the opportunities for HEP participation
  - they will inform OHEP on scientific/technical aspects of particle astrophysics (e.g.; optimum dark energy strategy with available resources)

# Advanced Technology

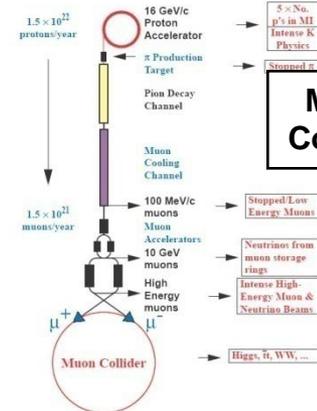
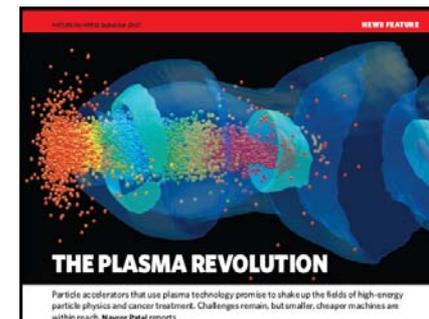
## Superconducting Cable & High Field Magnets



## Superconducting Cavity Technology

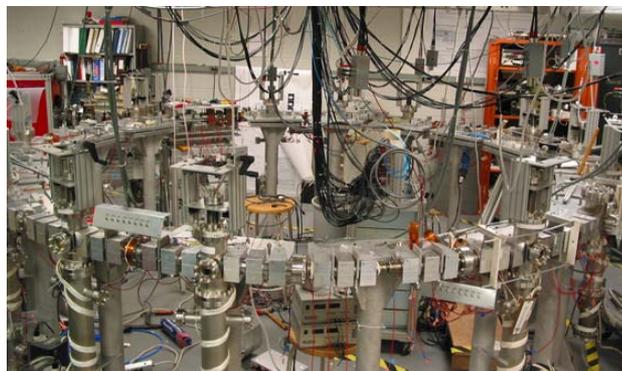
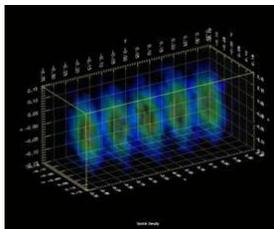


## Accelerators

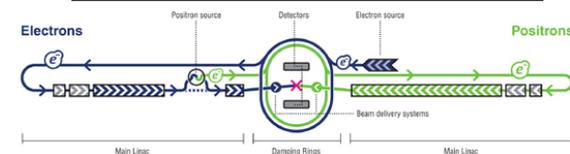


## Muon Collider

## Accelerator Science



## International Linear Collider



# Advanced Technology Recent Activities

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Historically the U.S. has been a leader in the development of advanced accelerators. The developments have been largely driven by the HEP program, and supported by the DOE OHEP, in the quest for higher energies and intensities and more demanding beam properties.

- **U.S. leadership in this area is being challenged by other regions/countries**
  - Investments have been made and are being made in new forefront HEP accelerator facilities
  - There appears to be recognition by governments of the importance of accelerator competency and infrastructure
  - Industrial capabilities have been nurtured in Europe/Japan and are now preferred vendors for specialized accelerator components
  
- **OHEP has begun to address this technology gap**
  - Started in FY 2007 to nurture the development critical accelerator capabilities (e.g.; SRF cavities) in the U.S.
  - Participating in the international ILC R&D effort
  - Significant Recovery Act funding is being directed towards accelerator R&D and in particular industrialization” BELLA, FACET, and SRF infrastructure and industrialization
  
- **OHEP sponsoring a Symposim/Workshop in Accelerator R&D**
  - To make a more direct connection between fundamental accelerator technology and applications
  - To obtain guidance on the needs of federal programs and the private sector

# Accelerators for America's Future

## Symposium, October 26, 2009

- Examine the challenges for developing and deploying accelerators to meet the nation's needs in
  - Discovery Science
  - Medicine and Biology
  - Energy and Environment
  - National Security
  - Industrial Applications and Production
- Poster session and white papers will solicit views from a broad range of stakeholders

## Workshop, October 27-28, 2009

- Invited experts in the above areas will meet to draft a report to the Office of Science and the Office of High Energy Physics
- Report to be used as planning document for possible future OHEP activities

**For more information**

[www.acceleratorsamerica.org](http://www.acceleratorsamerica.org)

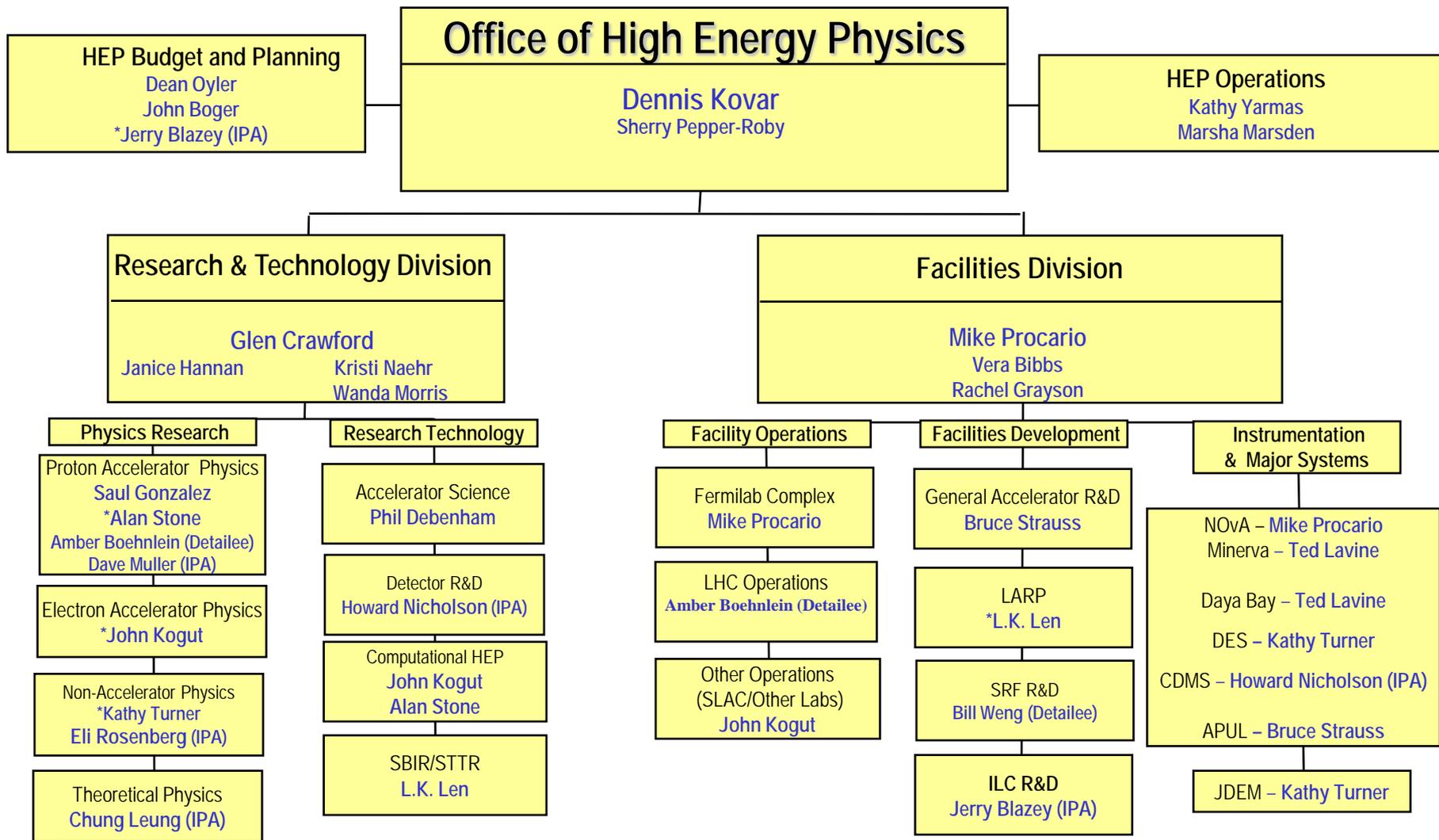


# DOE Early Career Research Program

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- **A new funding opportunity for early career researchers in universities and DOE national laboratories.**
  - **Five-year awards : approx. \$500k/yr for lab researchers, \$150k/yr for universities**
  - **Competitive peer-reviewed proposals, replaces Outstanding Junior Investigator (OJI) program in HEP starting in FY 2010.**
  - **Expect ~12 awards in HEP in 1<sup>st</sup> year from ~150 proposals (about 3X typical OJI pool)**
  - **Supported by Recovery Act funds in the first year, will be adopted by SC programs over the following 4 years.**
  
- **Proposals were due September 1.**
  - **Proposals are no longer being accepted. All proposals are currently under review within our program offices. We need peer reviewers!**
  - **Current plan is to make awards in Spring 2010. Due to overwhelming response to this program, it will be challenging to meet this goal.**
  - **Please be advised that our program managers cannot discuss specific pending proposals.**
  
- **Questions? See : [http://www.science.doe.gov/SC-2/early\\_career.htm](http://www.science.doe.gov/SC-2/early_career.htm)**

# HEP Organization Chart



\*Denotes base position

# Positions Available

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Currently have 13 Federal employees who are physicists, six visiting physicists, and eight administrative employees.

➤ **Research and Technology Division**

- **Positions advertised (close 10/30/09)**
  - Theory Program Manager
  - Non-Accelerator Program Manager
- **Near Future**
  - Interdisciplinary Computer Scientist/Physicist (Computational HEP)

➤ **Facilities Division**

- **Position advertised (closes 10/30/09)**
  - Interdisciplinary General Engineer/Physicist (Instrumentation & Major Systems)
- **Near Future**
  - FNAL Program Manager