The Fermilab Accelerator Science Program: Overview

Vladimir Shiltsev Fermilab September 21-22, 2009

Outline



- FY2009
- FY2010 Plan
- Recent Progress/Issues/Discussion

Backup mayterials:

- General info on FNAL Accel Sci program (Shiltsev)
- Muon Accelerator R&D program (Geer)
- AARD at A0 Photoninjector and at NML (Church)

Fermilab 's Accelerator Science Program Components



- KA 15 01 02 FUTURE PHYSICS ACCELERATOR SCIENCE
 - 1.7.2 FNPL A0 Photo-injector
 - 1.7.3 Muon Storage Ring
 - 1.7.6 Advanced Accelerator Concepts Computing
 - 1.7.9 Accelerator Physics Center General R&D
 - 1.10.12 US Particle Accelerator School

FY2009 KA 15 01 02 Budget



• 91.7% thru FY2009

	FY09	YTD	Budget	%
	BUDGET	OBLIG	Balance	Obligated
KA 15 01 02 FUTURE PHYSICS -				
ACCELERATOR SCIENCE	11,833	10,617	1,216	89.7%
1.10.12 U.S. Particle School Office	872	829	42	95.1%
1.7.2 Advanced Accelerator Program	2,749	2,708	40	98.5%
1.7.3 Muon Storage Ring	6,214	5,801	413	93.4%
1.7.6 Advanced Accelerator Concepts -				
Computing	855	720	135	84.2%
1.7.9 Accelerator Physics Center General				
R&D	1,142	557	585	48.8%

FY2010 KA 15 01 02 : IFP



	SWF	M&S	ОН	TOTAL
KA 15 01 02 FUTURE PHYSICS - ACCELERATOR				
SCIENCE	5,633	1,542	4,959	12,135
1.10.12 U.S. Particle School Office	435	56	373	864
1.7.2 Advanced Accelerator Program	1,184	386	1,043	2,614
1.7.3 Muon Storage Ring	3,097	910	2,746	6,753
1.7.6 Advanced Accelerator Concepts -				
Computing	472	6	400	878
1.7.9 Accel Physics Center General R&D	444	184	395	1,023

Total funds available 11,635k\$ =

10,860k\$ of funding (IFP)

+ 775k\$ carryover to FY10

Variance to budget (526.5)k\$

DOE OHEP Visit,

Budget: 2009 vs 2010



12,161.5

657.6

11,503.8

	FY09 FUNDING	FY10 BUDGET	CHANGE 09→10
1.7.2.1 FNPL Operations	1,834.9	2,050.9	215.9
1.7.2.2 FNPL Upgrades	348.9	259.1	(89.8)
1.7.2.5 Other Advanced Accelerator R&D	480.4	305.0	(175.4)
1.7.3 Muon Storage Ring	6,064.8	6,779.5	714.7
1.7.6 Advanced Accel Concepts - Computing	829.6	878.7	49.1
1.7.9 Accelerator Physics Center General R&D	1,100.4	1,023.5	(76.8)
1.10.12 U.S. Particle School Office	844.9	864.9	20.0

 $September\ 21\text{-}22,\ 2009-V. Shiltsev$

Grand Total

Budget Analysis



- FY10 budget (upload, PBR) is 540k\$ short of the 12,702k\$ requested in Dec'08 DOE Review as part of FNAL proposal
 - incl. 240k\$ shortage for Muon R&D

				All amounts in \$K, fully burdened			
				Proposal Request Amounts			
				FY09	FY10	FY11	FY12
				Total	Total	Total	Total
Fe	Fermilab Accelerator Science Program		9,876	12,702	14,620	TBD	
	Веа	am :	Sources and Instrumentation	2,782	3,948	4,885	TBD
	Muon Collider and Neutrino Factory		5,697	7,015	7,622	8,087	
	Acc	cele	rator and Beam Physics	1,397	1,739	2,113	2,095

- Current budget plan is 527k\$ short of IFP budget
 - So, the real difference might be 540+527=1,067k\$
 - There is still chance for getting budget as in President's Budget request (is there?)

Muon Budget Issues



- Muon Accelerator R&D plan presented at the Dec'08 DOE Review had 21M\$ request for FY2010
 - With estimated FNAL share of 11M\$ (~50%)

	FY08	FY09	FY10	FY11	FY12	FY13
Effort (FTE)	37	48	79	81	79	43
SWF (\$M)	5.5	9	14	15	15	8
M&S (\$M)	1.6	4	7	7	6	4
Total (\$M)	7.1	13	21	22	21	12

- Current budget plan is 50-60% of the request
 - 6,780k\$

Possible Approaches to Address Muon Collider R&D Budget Issues



- Get National Muon R&D Program endorsed by DOE OHEP
 - That means get reviewed and approved.... that requires :
 - Build national organization
 - Revise/update the proposal
 - > Prepare the review
 - We are also organizing the Physics community
 - ➤ Briefing DOE OHEP (Jun'09)
 - ➤ Workshop on MC Physics/Detector (Nov'09)
- Reorient (limited) existing resources:
 - Additional support from high-field magnet program
 - (very limited) from A0 Photoinjector and General R&D tasks

Muon Collider Detector and Physics



Organization and coordination of the Muon Collider Physics and Detector effort is very important for getting HEP community on board.

Recent developments:

- **Briefing DOE OHEP** 06/24/2009
 - > H.Nicholson, et al
 - > E.Eichten, A.Bross, M.Demarteau, S.Geer
- MC Physics Workshop Nov 10-12 2009 (following Pr-X Physics workshop)
 - ➤ Chaired by E.Eichten, K.Peach, J.Konigsberg



Muon Collider Physics Workshop

Machine - Detector - Physics November 10-12 (Tuesday-Thursday), 2009

Fermilab Home Fermilab at Work Fermilab Directorate

Home

Registration

Registrants List

Scientific Program

Workshop Organizers

Project X

Muon Collider

Steering Group Report (2007)

P5 Report (2008)

Fermilab Users Meeting

Directions to Fermilab

Local Hotels

Map of Local Hotels

Transportation and

About the workshop

This is the organizing workshop for the study of physics, detectors and backgrounds at a Muon Collider in the 1.5 to 5 TeV energy range (a benchmark 1.5 TeV and 3.0 TeV machine parameters). The goal is to deliver within one year a report on the physics potential of such a Muon Collider. This study should set requirements on luminosity, energy, determine acceptable background event rates and suggest feasible methods of attaining these levels. The impact of the polarized beams, energy spread, and detector fuducial volume should be evaluated. The physics opportunities should be compared to the CLIC option and take account of the substantial running of LHC after a luminosity upgrade. Synergies with the ILC/CLIC and LHC detector R&D should be exploited.

There will be three Working Groups - Physics, Detectors, and Machine-Detector Interface (MDI). Each of these studies are essential to determining the overall physics potential at a Muon Collider.

- Physics WG: Study the various Beyond the Standard Model physics opportunities (SUSY, Extra Dimensions, Little Higgs, Strong Dynamics, etc.) at the Muon Collider. Set energy and luminosity requirements for the various physics options. Develop Monte Calro studies to Explore dependence on polarization, beam energy spread, angular coverage of the detector. Compare to CLIC.
- Detectors WG: Determine the design requirements for detectors at the Muon Collider. Specifications for performance, background rejection, radiation tolerance, calibration and triggering are to be developed. Synergies with ILC/CLIC and LHC detector R&D will be identified and exploited. Develop a simulation framework in colaboration with the physics and MDI working groups.
- MDI (Machine-Detector Interface) WG: Study the detector backgrounds for a Muon Collider, Determine how to reduce this to an acceptable level. Starting with the existing shielding design look for opportunities for improvement. Consider how to make precise luminosity measurements and measure the beam energy and spread. Study how to reduce the effects of muon decays.

DOE OHEP Visit.

September 21-22, 2009 – V.Shiltsev

Input on Directions of AARD at FNAL



http://apc.fnal.gov/ARDWS/index.html

FOR ACCELERATOR R&D AT FERMILAB

May 11-13, 2009 - Lake Geneva, WI

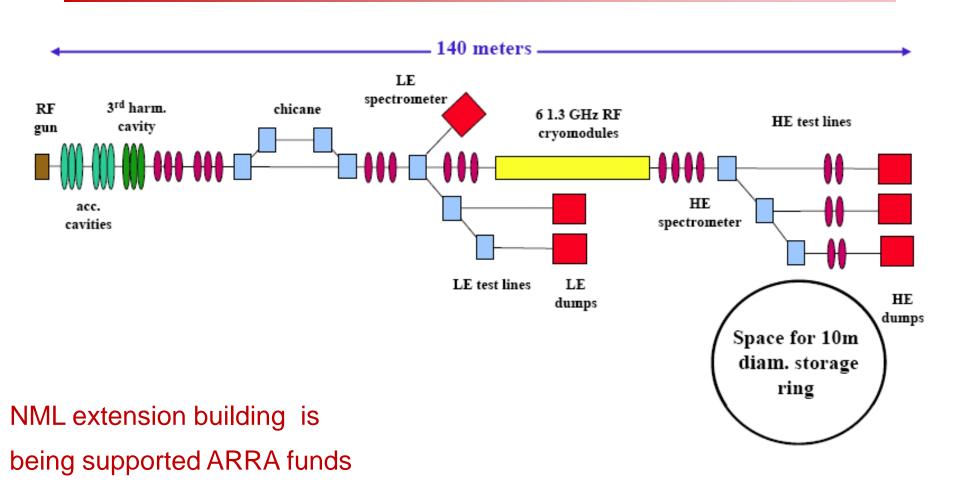
50=25+25 participants with many world experts

CHARGE: -solicit&evaluate ideas for a future Acc. R&D program in NML

- solicit&evaluate proposals for high beam intensity R&D (Pr-X, MC,ADS)

AARD *User's* Facility at NML (>2012)





Workshop Summary



NML has the potential to be a unique User's Facility:

- ♠ Energy range of 40 1500 MeV; beam power up to 80 kW; pulse train up to 3000 bunches; "flat beams"
- Infrastructure capability (cryogenics, RF, lasers, floor space for storage rings, expandability)
- Extensive accel. operational experience + users support experience

>20 proposals presented, including:

♠ Dielectric wakefield accelerator tests in microslabs, plasma wakefield tests with long bunch trains, optical stochastic cooling proof-of-principal test, photoproduction of μ at 300 MeV for homeland security, test of "integrable optics" concept for high intensity rings

Summary



- FY2009: KA150102 spending are on budget,
 - with expected carryover to FY10 of 775k\$
- FY2010: Accelerator Science budget still has ~0.5M\$ uncertainty:
 - IFP + Carryover = 11,635k\$
 - Presidents Budget + Carryover = 11,870k\$
 - Summer'09 Budget Plan = 12,161k\$
 - Dec'08 Accel Sci request was 12,702M\$
- Depending on the final \$\$, budget distribution will be adjusted with higher priority to be given to Muon Accelerator R&D
 - MC/NF budget is significantly behind their needs
- There was significant technical progress since Dec'08 DOE Review of Accelerator Science

MCTF: Progress since December - 1



- ♦ Physics, Detectors & Backgrounds
 - Workshop planned for 10-12 November.
 - Baseline MC parameter list for workshop agreed upon
- ♦ Ring design
 - New lattice with better performance being finalized
- ◆ MICE
 - Decay solenoid commissioned
 - New target designed, built & commissioned
 - Fiber trackers complete & commissioned
- ◆ RF R&D
 - MTA reconfiguration in preparation for beam completed
 - Preparations for HPRF beam test advanced
 - Next generation of 805 MHz test cavities design in progress, new rectangular cavity nearing completion

MCTF: Progress since December - 2



- ◆ Magnet R&D
 - Planning for an extended MC magnet R&D program within TD started
 - Although not directly MC R&D, we note that funding of the national HTS collaboration is helpful.
- ◆ IDS-NF (= Muon Collider front end).
 - International organization progressing, and is in line with U.S. contributions as per 5 year plan.