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# *Report of Project Manager*

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*CENTER FOR BEAM PHYSICS*

*Muon Collaboration Project Manager*

**MUTAC Meeting-Fermilab**

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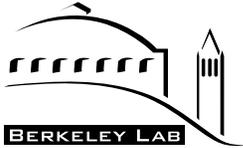


# Outline

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- Introduction
- FY02 budget
- FY02 accounting
- FY03 budget
- FY03 R&D goals
- Summary and outlook



# Introduction



- In FY03, the downward trend of the DOE-**MC** budget continued
- Summary for past years, and guidance for this year given below

Year	DOE-base (\$M)	DOE- <b>MC</b> (\$M)	NSF (\$M)	TOTAL (\$M)
FY99	2.8	2.2	--	5.0
FY00	3.3	4.7	1.2	9.2
<b>FY01</b>	<b>3.0</b>	<b>3.2</b>	<b>1.5</b>	<b>7.7</b>
FY02	3.0	2.8	0.9	6.7
<b>FY03</b>	<b>2.1</b>	<b>1.4</b>	<b>1.2</b>	<b>4.7</b>

B&B Level

- At this level, it is difficult to build components costing  $\alpha$ (\$1M) each
- Severe cut in FY03 was a shock
  - after considerable technical progress, good MUTAC review, support from MCOG, and favorable recommendation from HEPAP Subpanel
- Mitigated somewhat by effort provided by ICAR and base program support (sponsoring Labs cover physics staff costs)



# Introduction



- Hardware development was major focus of FY02 activity
  - tempered a bit by knowing that budget axe was to about to fall
- Simulation effort aimed at ring coolers made good progress
- Effort toward **MICE** proposal is coming to fruition
- Here I will cover:
  - FY02 budget
  - FY02 accounting and accomplishments
  - FY03 budget
  - FY03 R&D goals



## FY02 Budget



- FY02 budget prepared via iteration between Technical Board, Spokesperson and PM
- Main goals for FY02
  - design target **test magnet**
  - continue with **development of MUCOOL Test Area (MTA)** at FNAL
  - continue **high-power tests of 805 MHz cavities** (closed cell)
  - continue **201-MHz SCRF development (NSF supported)**
  - continue with **LH<sub>2</sub> absorber development** (includes **ICAR support**)
  - complete design of **201-MHz NCRF cavity**
  - work on **LOI and full proposal for MICE**
- **Primary support** for R&D program comes from **DOE** (base program and direct funding), with a significant contribution from **NSF** (administered by Cornell) and additional effort provided by ICAR universities



# FY02 Budget



- FY02 funding plan (only DOE-**MC** funds)<sup>†</sup>

Institution	COOLING	TARGETRY	COLLIDER	EFFORT <sup>a</sup>	RESERVE	TOTAL (\$K)
BNL		725				725
FNAL	815					815
LBNL	470				211	681
ANL				215		215
IIT				83		83
Mississippi	50					50
Princeton		75				75
UCB			60	30		90
UCLA	25		50			75
<b>TOTAL (\$K)</b>	<b>1360</b>	<b>800</b>	<b>110</b>	<b>328</b>	<b>211</b>	<b>2809</b>

<sup>a</sup>Includes beam simulation and diagnostics effort.

**†NSF has provided \$0.9M for muon R&D (mainly SCRF at Cornell) and ICAR has provided effort for muon R&D (mainly cooling)**



## FY02 Budget



- Before funds were distributed, each institution provided milestones agreed upon by PM
  - milestones reflect budget allocations for each institution, including base program funds
    - these will be presented in the accounting discussion to follow
- Project reserve was included in the budget to account for inherent uncertainties in R&D activity costs



# FY02 Accounting



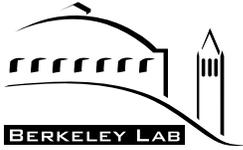
- During course of year, minor changes made to budget

Institution	Original (\$K)	Adjusted <sup>1,2</sup> (\$K)	Δ <sup>3</sup> (\$K)
BNL	725	825	100
FNAL	815	815	
LBNL	470	500	30
ANL	215	215	
IIT	83	83	
U-Miss	50	50	
Princeton	75	75	
UCB	90	90	
UCLA	75	75	
Reserve	241	81	-160
Sum	2839	2809	

<sup>1</sup>DOE recision reduced available funding by \$30K.

<sup>2</sup>Transferred \$100K to BNL for magnet design, \$30K to LBNL for 805 MHz cavity.

<sup>3</sup>Reflects distribution of project reserve, reduced by DOE recision.



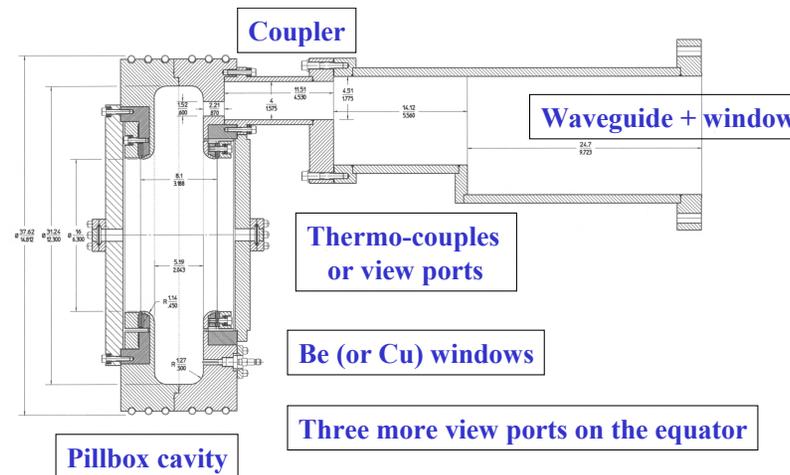
## FY02 Accounting



- At year's end, accounting information and accomplishments for each institution were collected
  - each institution has a designated contact person for budgets and accounting
- Total committed in FY02 was \$5.0M (DOE-base + DOE-MC + NSF)
  - augmented by ICAR effort (funded by state of Illinois)
- Summary report of spending and accomplishments prepared for MCOG approval
  - entire (draft) report included in hardcopy package
  - only a few representative examples will be presented here
- Significant accomplishments this year, despite decreased funding
  - conceptual design of target magnet completed
  - pillbox RF cavity tested
  - MTA bid package prepared (now signed)



- High-power pillbox cavity with replaceable windows (or grids)
  - reached 34 MV/m in Lab G with no solenoid field



- MUCOOL Test Area

- absorber, solenoid, and 201 MHz RF cavity will be integrated here



Original area



Present area



What it will look like when completed



# FY02 Accounting



## • Overall summary for FY02

Institution	Collaboration		Base Program	Overall	Contact
	Committed (\$K)	Uncommitted (\$K)	Committed (\$K)	Total (\$K)	
ANL	215	0	0	215	J. Norem
BNL	645	180	1025	1670	H. Kirk
FNAL [1]	235	960	659	894	S. Geer
LBNL [2]	305	433	251	556	M. Zisman
Princeton U.	75	0	200	275	K. McDonald
UC-Berkeley	64	41	18	82	J. Wurtele
UCLA	75	0	118	193	D. Cline
Mississippi	38	12	17	55	D. Summers
IIT	83	0	0	83	D. Kaplan
Jlab	0	0	20	20	A. Bogacz
<i>Cornell+NSF [3]</i>	<i>1000</i>	<i>530</i>		<i>1000</i>	<i>D. Hartill</i>
<b>TOTALS</b>	<b>1734</b>	<b>1627</b>	<b>2309</b>	<b>4043</b>	
<i>(including NSF)</i>	<i>2734</i>	<i>2157</i>		<i>5043</i>	

### Notes:

- [1] Uncommitted GPP funds include \$380K from FY01 and \$580K from FY02.
- [2] Includes \$154K uncommitted reserve funds.
- [3] Includes carryover from FY01.



M. Zisman  
Project Manager

**DRAFT**

**Institution:** Fermi National Accelerator Laboratory

Task	Muon Collaboration Funds			Laboratory Funds		
	Effort (\$K)	M&S (\$K)	Sum (\$K)	Effort (\$K)	M&S (\$K)	Sum (\$K)
<u>MUCOOL Studies</u>						
RF System Studies						
Test Facil. Operations (805 MHz)			\$ -	\$ 72.24	\$ 42.03	\$ 114.27
Linac Test Area	\$ 124.24	\$ 110.45	\$ 234.69	\$ 97.00	\$ 15.13	\$ 112.12
<u>Simulation Studies</u>						
Capture + Cooling				\$ 365.31		\$ 365.31
<u>Travel and General Operations</u>					\$ 67.38	\$ 67.38
<b>SUBTOTALS</b>	<b>\$ 124.24</b>	<b>\$ 110.45</b>		<b>\$ 534.55</b>	<b>\$ 124.54</b>	
<b>TOTALS</b>			<b>\$ 234.69</b>			<b>\$ 659.09</b>

Uncommitted	Muon Collaboration Funds		
	Effort (\$K)	M&S (\$K)	Sum (\$K)
Carryover		\$ 580.31	\$ 580.31
FY01 carryover		\$ 380.00	
<b>SUBTOTALS</b>	<b>\$ -</b>	<b>\$ 960.31</b>	
<b>TOTALS</b>			<b>\$ 960.31</b>



M. Zisman  
Project Manager

**DRAFT**  
**Fermi National Accelerator Laboratory**  
**(Accomplishments–FY2002)**

- Completed the rf commissioning of a prototype 805 MHz open-cell cavity in a 2.5 T solenoidal field; reached accelerating field of 22 MV/m and 54 MV/m peak surface field
- Commissioned LBNL single-cell 805 MHz cavity beyond its 30 MV/m design gradient, reaching 34 MV/m in the absence of a magnetic field
- Completed Title 2 design and prepared a bid package and Project Execution Plan for construction of Phase 2 of the MUCOOL Test Area (MTA), which will be used for housing absorber and rf tests; Phase 1 construction was completed in FY01
- Continued design of the liquid-hydrogen absorber filling system for the MTA, and studied safety requirements for liquid-hydrogen absorbers
- Developed a high-frequency bunching and phase rotation channel concept and verified this with the GEANT4 and ICOOL simulation codes
- Developed an initial quadrupole-based cooling channel design and studied its performance using COSY simulations
- Studied analytical performance criteria for viable cooling channels
- Coordinated emittance exchange and ring cooler studies for three promising cooling designs, and continued simulation and design work for one ring cooler design, using the GEANT, ICOOL, and COSY codes
- Continued R&D on very fast timing devices for potential use as cooling channel beam diagnostics

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## FY02 Accounting



- Milestone list (prepared and agreed to before funding was distributed)
  - included in hardcopy package
- Milestones this year were generally met
  - not always precisely on specified date (the nature of R&D)
- Main sources of missed milestones: delays associated with RF cavity work and AGS targetry program
  - 805-MHz cavity fabrication took longer than expected
    - this slowed down development of
      - 201 MHz cavity
      - Be window and Al grid tube designs
  - loss of AGS running in FY03 reduced our priority in FY02
- Lack of funding is also slowing our progress

**BNL [H. Kirk]**

**Milestone**

Define and justify technical requirements/specifications for target test solenoid  
 Complete conceptual design and initial cost estimate for target test solenoid (approx. 10 T) and its power supply  
 Final design of target test magnet  
 Begin tests of Hg jet with velocity of approx. 20 m/s  
 Fabricate a Wood's-metal jet target system  
 Develop detailed plan and schedule for AGS intensity upgrade, and cost estimate for the MC portion  
 Install AGS main ring sextupole power supply  
 Add higher harmonics to ICOOL bent solenoid model and examine performance sensitivity  
 Simulate Balbekov ring in ICOOL with real fields  
 Complete simulations of RFOFO ring cooler performance and optimize design  
 Simulate jet-magnetic field interactions

<u>Date</u>	<u>Deliverable</u>	<u>Status</u>
Feb-02	Review	Complete
May-02	Review	Complete
Sep-02	Bid package prepared	In progress
Aug-02	MC note prepared	Late
Mar-02	Inspection	In progress
Feb-02	Review	In progress
Sep-02	Inspection	Late
Apr-02	MC report prepared	In progress
Jul-02	MC report prepared	In progress
Aug-02	MC report prepared	In progress
Sep-02	MC report prepared	In progress

**ANL [Norem]**

**Milestone**

Document open-cell rf cavity background studies  
 Measure and characterize backgrounds from high-power pillbox rf cavity with various window and wall preparations  
 Test candidate detectors for MICE under realistic background conditions  
 Develop 6D linear cooling theory code for evaluation of symmetric bent solenoid channel

<u>Date</u>	<u>Deliverable</u>	<u>Status</u>
Feb-02	MC report prepared	Complete
Sep-02	MC report prepared	In progress
Jul-02	MC report prepared	In progress
May-02	Publication submitted	Complete

**UCB [Wurtele]**

**Milestone**

Complete analysis of how ICOOL handles scattering in magnetic field  
 Develop ideas to handle higher-order correlations in theoretical models  
 Complete analysis and implementation of upgraded integrator in ICOOL  
 Make estimate of MHD effects for mercury jet in magnetic field  
 Complete simulations and theoretical work for NUFACT02

<u>Date</u>	<u>Deliverable</u>	<u>Status</u>
Jan-02	MC report prepared	In progress
May-02	MC report prepared	In progress
Jan-02	MC report prepared	Complete
Feb-02	MC report prepared	In progress
Aug-02	Conference paper	Complete

**Princeton [McDonald]**

**Milestone**

Fabricate a Wood's-metal jet target system  
 Begin tests of Hg jet with velocity of approx. 20 m/s  
 Analyze BNL E951 second-round target experiment at intensity of approx.  $10^{13}$  protons per pulse

<u>Date</u>	<u>Deliverable</u>	<u>Status</u>
Mar-02	Inspection	In progress
Aug-02	MC note prepared	Late
Sep-02	MC report prepared	N/A



## FY03 Budget



- Budget exercise this year was *very difficult*
  - **MC** has made progress in past several years and is anxious to continue apace
- FY03 DOE-**MC** funds are \$1.429M (down by half from FY02)
  - **supplemental funding request** was submitted in May, 2002
- FY03 budget was **finalized by Spokespersons and PM in November**
  - has since been **approved by MCOG**
- **Simulations and Theory group** has been **reconstituted** by Spokespersons
  - led by **R. Raja**, with lieutenants for various subgroups
- Another “initiative” requiring resources: International **Muon Ionization Cooling Experiment**
  - presently requires mostly “effort” (base program funds)
- Proposal for **MICE** support **submitted to NSF**; **technical proposal sent to RAL**



# FY03 Budget



- **FY03 MC budget (approved by MCOG):**

Institution	COOLING	TARGETRY	COLLIDER	EFFORT <sup>a</sup>	RESERVE	TOTAL (\$K)
BNL		300				300
FNAL	400					400
LBNL	204				116 <sup>b</sup>	320
ANL				144		144
IIT				75		75
Mississippi				50		50
Princeton		50				50
UCB			5			5
UCLA	25		50			75
ORNL						0
JLab				10		10
<b>TOTAL (\$K)</b>	<b>629</b>	<b>350</b>	<b>55</b>	<b>279</b>	<b>116</b>	<b>1429</b>

<sup>a</sup>Includes beam simulation and diagnostics effort.

<sup>b</sup>Includes \$90K earmarked for simulations post-doc.

- **Also: salary support from BNL, FNAL, LBNL; support from NSF (mainly Cornell) of ≈\$1M; and support from ICAR (≈15 FTE)**



## FY03 Budget



- Supplemental request submitted to DOE in May, 2002 (priority order)
  - no response from DOE yet (their budget is still undetermined)

<u>Item</u>	<u>Request (\$K)</u>
0) AGS operation	50
1) 201 MHz RF cavity fabrication	350
2) Targetry magnet fabrication	400
3) Cooling simulation effort	200
4) 805 MHz RF cavity R&D	100
5) LH <sub>2</sub> absorber fabrication	100
6) Target studies	50
7) Solenoid coil design	150
8) Target simulations	50
<b>TOTAL</b>	<b>1450</b>



## FY03 R&D Goals



- Aspirations modest this year due to severe budget shortfall
- R&D priorities are:
  - Cooling
    - complete construction of MUCOOL Test Area
    - begin fabrication of 201-MHz high-power NCRF test cavity
    - fill LH<sub>2</sub> absorber in MTA or elsewhere (ICAR, NSF, DOE)
    - continue 805 MHz rf testing in Lab G
  - Targetry
    - complete design and begin fabrication of target solenoid
  - Acceleration
    - continue development of 201-MHz SCRF cavity (NSF)



## FY03 R&D Goals

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- **Diagnostics**
  - characterize, understand, and mitigate detector backgrounds arising from high-gradient rf cavity operation
- **Simulations**
  - study alternatives to Study-II approaches, e.g., rf phase rotation in place of induction linacs
  - continue development of analytic tools to guide system design
  - continue exploring and optimizing cooling ring performance

**FNAL [Geer]****Milestone**

Complete pillbox cavity tests with copper windows  
 Install Be windows in pillbox cavity and begin testing  
 Complete initial analysis of pillbox cavity results with copper windows  
 Report surface analysis of copper windows  
 Complete first tests of Be windows in pillbox cavity  
 Complete report on analysis of RF tests  
 Complete design of 805 MHz grid structure  
 Sign contract for MUCOOL Test Area Phase-II construction  
 Begin MTA site mobilization  
 Beneficial occupancy of MTA  
 Organize emittance exchange workshop  
 Implement ring cooler with realistic fields in GEANT  
 Match RF buncher channel into cooling channel

<b><u>Date</u></b>	<b><u>Deliverable</u></b>
Dec-02	Inspection
Dec-02	Inspection
Jan-03	Presentation
Apr-03	MC note prepared
Apr-03	Inspection
Apr-03	MC note prepared
Jun-03	MC note prepared
Dec-02	Signed contract
Jan-03	Inspection
Dec-03	Inspection
Nov-02	Workshop
May-03	Presentation
May-03	MC note prepared

**ANL [Norem]****Milestone**

Study conditioning and dark currents with Be RF windows  
 Continue optimization of dark currents and x-rays for MICE and MUCOOL  
 Organize workshop on surface effects and breakdown in RF cavities  
 Preliminary evaluation of RF breakdown mechanisms  
 Complete experimental setup to study RF breakdown effects  
 Perform (with IIT and NIU) experiment on e-beam generated turbulence in water with schlieren system

<b><u>Date</u></b>	<b><u>Deliverable</u></b>
May-03	MC report prepared
Sep-03	MC report prepared
Apr-03	Inspection
May-03	PAC03 paper prepared
Sep-03	Inspection
Jun-03	MC report prepared

**BNL [H. Kirk]****Milestone**

Complete engineering and cost estimate for Targetry test solenoid  
 Demonstrate 2 m/s continuous-flow Hg jet  
 Demonstrate 2 m/s continuous-flow Woods metal jet  
 Demonstrate 10 m/s Hg jet platform  
 Measure properties of irradiated invar samples  
 Simulate dipole-quadrupole ring cooler performance  
 Simulate solenoid-based ring cooler performance  
 Carry out analysis of FFAG acceleration parameters  
 Install TOF capability into Geant simulation package  
 Simulate experimental layout of MICE experiment

<b><u>Date</u></b>	<b><u>Deliverable</u></b>
Jan-03	MUTAC presentation
Feb-03	Inspection
Sep-03	Inspection
Sep-03	Inspection
May-03	PAC03 paper prepared
Dec-02	Post software on web
Dec-02	MICE technical proposal



## Summary and Outlook



- The past year was productive for the MC
  - NCRF cavity tests made progress (at 805 MHz)
  - approaches to study cooling rings developed
  - SCRF cavity testing started
  - absorber windows fabricated and tested successfully; improved design has been developed
  - MICE LOI submitted to RAL and U.S. funding proposal to NSF
- Milestones were largely met
  - talks during this meeting will demonstrate this
- Serious planning effort under way toward MICE
  - worldwide group (Europe, Japan, U.S.) meets at CERN in March
- Lack of funding is our biggest issue
  - strong MUTAC endorsement of our R&D accomplishments and plans surely helps
- Final comment: I have been asked to help with Tevatron commissioning, which could heavily impact my time as MC PM