Report of Project Manager

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CENTER FOR BEAM PHYSICS

Muon Collaboration Project Manager

MUTAC Meeting–LBNL
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Outline

- Introduction
- FY04 accounting
- Recent R&D accomplishments
- FY05 budget
- FY05 plans
- Longer-term plans
- Summary and outlook

Introduction

- Since FY03, the MC budget has been nearly flat-flat
  - expected to remain near that level for next several years

Year	DOE-base ($M)	DOE-MC ($M)	TOTAL ($M)
FY00	3.3	4.7	8.0
FY01	3.0	3.2	6.2
FY02	3.0	2.8	5.8
FY03	2.1	1.4	3.5
FY04	2.2	1.8	4.0
FY05	1.9	1.7	3.6

- Starting this year, we have DOE permission to commit funds to MICE
  - level is $300K (for FY05–07)
- By juggling projects across fiscal year boundaries and careful prioritization, we have continued to make progress
  - but it is getting harder
- Proposed elimination of BNL muon group would be very harmful to MC program, especially if nearly 30% of our funding disappears also

Introduction

- Hardware development continues as major focus of FY05 activity
- Simulation effort aimed at reducing Neutrino Factory cost ("Study IIa") gave good results
  - a substantial part of the working group report based on this work
- Effort toward MICE is coming to fruition
  - passed Gateway 2-3 review on Phase 1 of MICE in December 2004
    - PPARC released UK funds (£9.7M) in March 2005
- MICE funding is now available from MC funds
  - need more; applied for NSF MRI grant (Kaplan)
- Here I will cover:
  - FY04 accounting and R&D accomplishments
  - FY05 budget and activities

FY04 Accounting

- FY04 budget finalized by Spokespersons and PM in November
- International Muon Ionization Cooling Experiment is starting to become a significant draw on resources
  - last year required mostly "effort" (base program funds)
  - this changed in FY05
    - M&S funding is now needed

FY04 Accounting

- **FY04 MC budget (approved by MCOG):**

Institution	COOLING	TARGETRY	COLLIDER	EFFORT[a]	RESERVE[b]	TOTAL ($K)
BNL		275		10		285
FNAL	400					400
LBNL	100				104	204
ANL				144		144
IIT				77		77
Mississippi	30			20		50
Princeton		50				50
UCB				5		5
UCLA	25		50			75
UCR						0
ORNL						0
JLab	100			10		110
TOTAL ($K)	**655**	**325**	**50**	**266**	**104**	**1400**

[a] Includes beam simulation and diagnostics effort.
[b] Modest project reserve used to account for uncertainties in R&D activity costs.

- **Also: salary support from BNL, FNAL, LBNL; support from NSF (mainly Cornell) of ≈$1M; and support from ICAR (≈9 FTE)**

FY04 Accounting

- **Supplemental request submitted to DOE in September, 2003 (priority order)**
  - **priorities decided in Technical Board discussions**
    - **DOE approved $400K in July, 2004**

Item	Request ($K)
1) 201 MHz RF testing	400
2) LH_2 absorber test capability	460
3) Targetry magnet fabrication	400
4) Coupling coil design and construction	300
TOTAL	1560

FY04 Accounting

- Main goals for FY04
  - begin fabrication of targetry test magnet
  - continue development of MUCOOL Test Area (MTA) at FNAL
  - continue high-power tests of 805 MHz cavity
  - continue 201-MHz SCRF development (NSF supported)
  - continue with LH_2 absorber development (includes ICAR support)
  - complete fabrication of 201-MHz NCRF cavity
  - obtain funding for MICE
  - continue exploring and optimizing cooling ring performance
- Aspirations this year consistent with modest budget

FY04 Accounting

- **Before funds were distributed, each institution provided milestones agreed upon by PM**
  - **milestones (example below) reflect budget allocations for each institution, including base program funds**

FNAL [Geer]

Milestone	Date	Deliverable
Complete HVAC installation in MTA	May-04	Inspection
Install 805 MHz RF capability in MTA	May-04	Inspection
Relocate Lab G solenoid to MTA	May-04	Inspection
Install 201 MHz RF capability in MTA	Sep-04	Inspection
Test solid 4x4 grid structure at 805 MHz	Sep-04	MC note prepared
Test curved Be windows in 805 MHz pillbox cavity	Sep-04	MC note prepared
Study RF buncher, phase rotation and cooling channel performance for APS Neutrino Study	Jun-04	MC note prepared
Complete design of cooled 805 MHz grid structure	Sep-04	MC note prepared
Participate in APS Neutrino Study	Jun-04	Write-up prepared

ANL [Norem]

Milestone	Date	Deliverable
Initial tests with field ion microscope	Mar-04	MC report prepared
Prepare proposal for RF surface studies (DOE, DARPA, NASA, or EPRI)	Mar-04	Proposal submitted
Prepare paper on MICE cavity surface treatment	Sep-04	Paper prepared
Evaluate 805 MHz pillbox cavity performance with precurved Be windows	Sep-04	MC report prepared
Test breakdown behavior of small samples in 805 MHz cavity	Sep-04	MC report prepared
Calculate shielding requirements for MICE experiment	Apr-04	MICE note prepared
Review MICE rf backgrounds for rebaselined configuration	Sep-04	MICE note prepared

FY04 Accounting

- **Summary of FY04 spending is shown below**

Institution	Collaboration		Base Program	Overall	Contact
	Committed ($K)	Uncommitted ($K)	Committed ($K)	Total ($K)	
ANL	145	0	145	290	J. Norem
BNL	241	0	1056	1297	H. Kirk
FNAL [1]	45	355	952	997	S. Geer
LBNL [2]	281	562	309	590	M. Zisman
Princeton U.	20	30	190	210	K. McDonald
UC-Berkeley	15.5	5.5	3	18.5	J. Wurtele
UCLA	75	0	59	134	D. Cline
Mississippi [3]	62	0	21	83	D. Summers
IIT [4]	38.5	0	0	38.5	D. Kaplan
Jlab	43	67	25	68	R. Rimmer
Cornell + NSF Contracts	*898*	*988*	*0*	*898*	*D. Hartill*
TOTALS [5]	**966**	**1019**	**2760**	**3726**	
	1864	*2007*		*4624*	

NOTES:

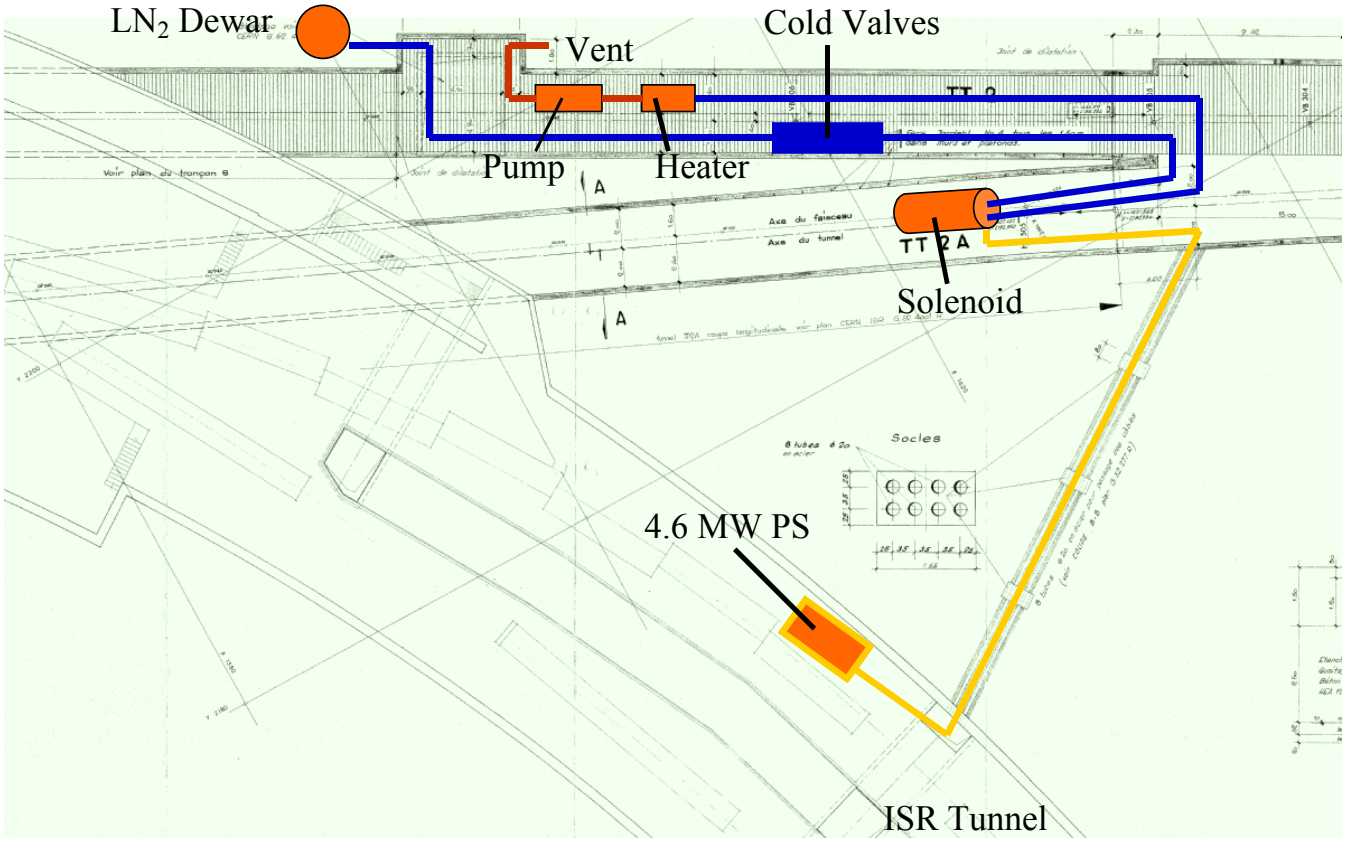
[1] Uncommitted funds for MTA cryogenic system, to be installed in FY05.
[2] Includes $162K in uncommitted Project Reserve funds maintained by LBNL and $250K of FY04 supplemental funds received in August '04.
[3] Includes carryover from FY03.
[4] $38.5K of planned FY04 funding was deferred until FY05.
[5] DOE totals in Roman type; *additional NSF funding shown in italics*.

Recent R&D Accomplishments

- R&D progress being made on all fronts:
  - Targetry
  - Cooling
  - Acceleration
  - Simulations
  - MICE

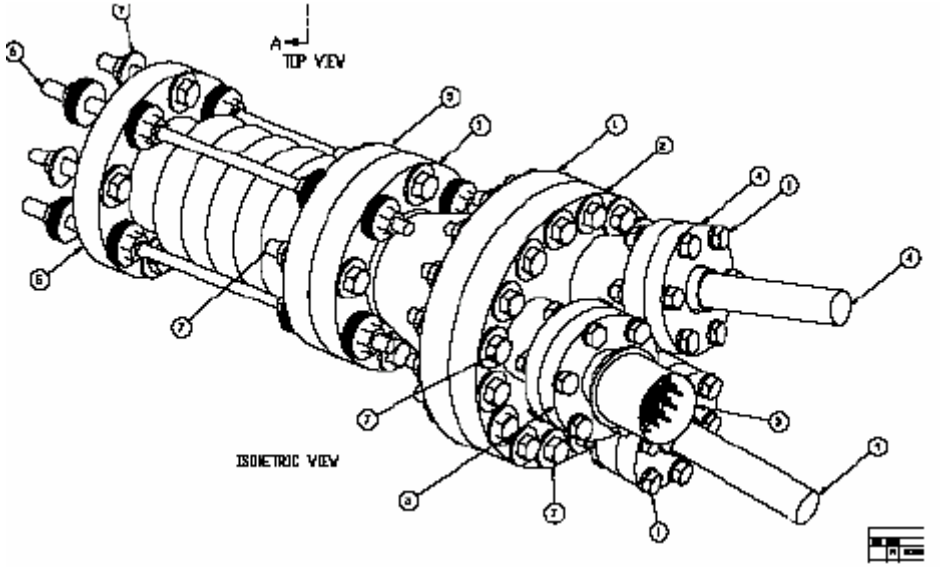
Recent R&D Accomplishments

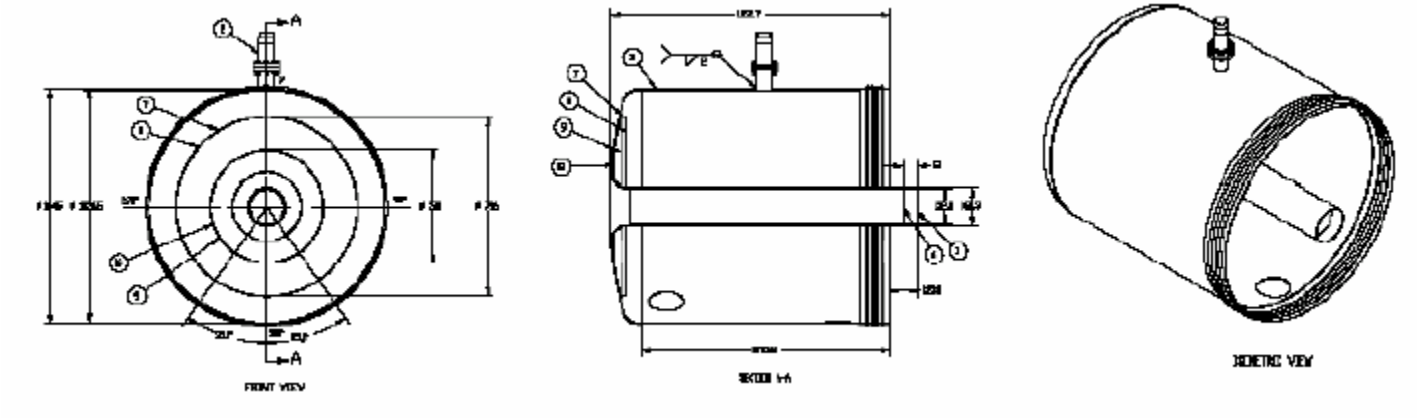
- Proposal for targetry experiment at CERN submitted April, 2004 (and now has final approval "nTOF11")
  - venue change necessitated by elimination of continued A3 line running at BNL



Recent R&D Accomplishments

- Fabrication of 15 T magnet cryostat under way at CVIP





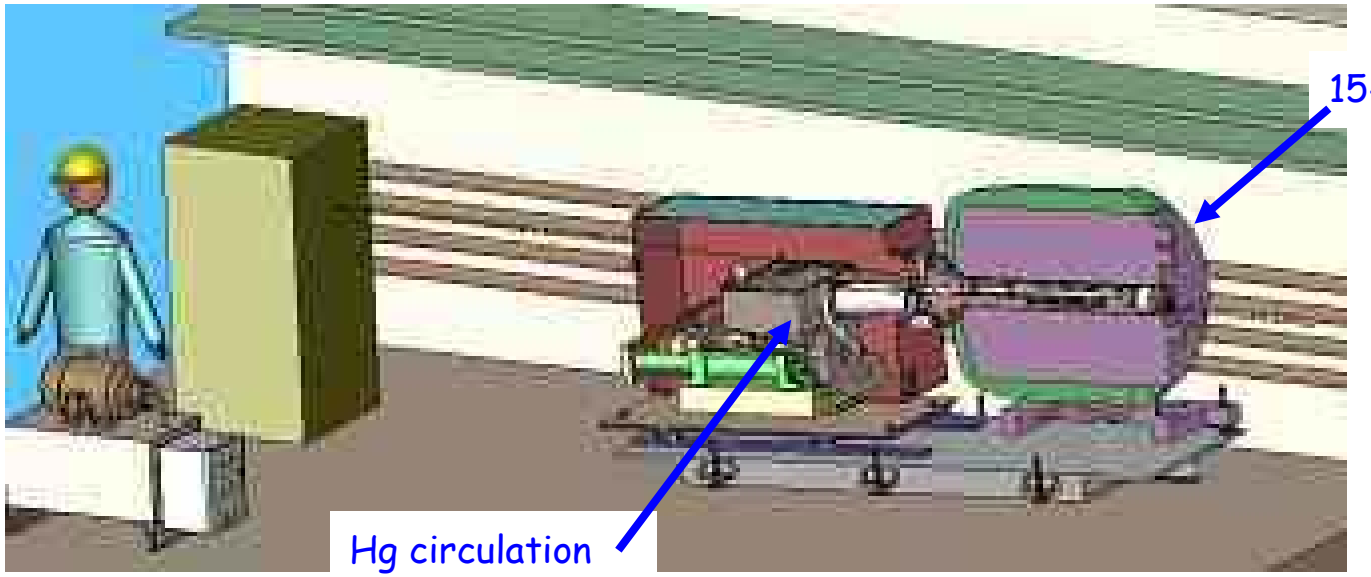
Recent R&D Accomplishments

- coil winding is also in progress at Everson-Tesla

First layer, coil segment 2

Recent R&D Accomplishments

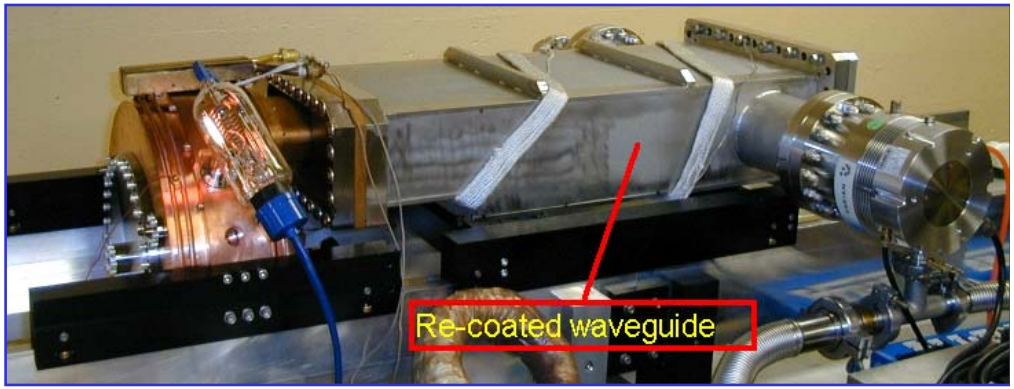
- Concept for Hg jet system for CERN target test experiment being developed in collaboration with ORNL
  - details still being optimized

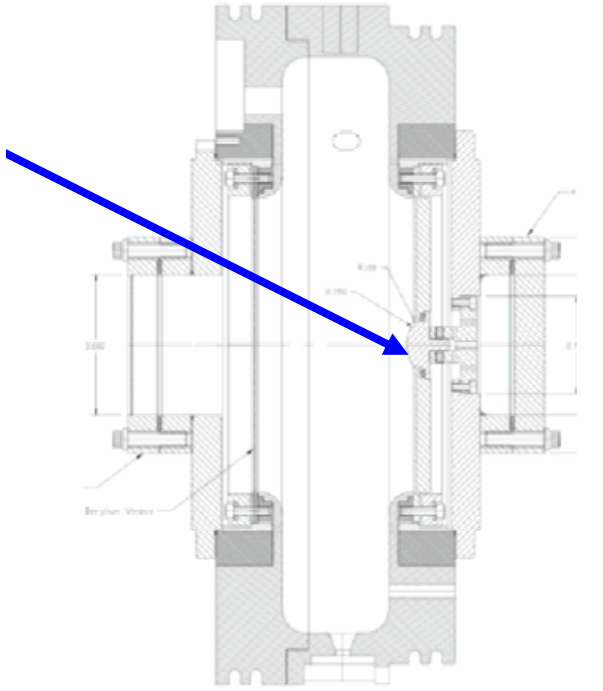


Recent R&D Accomplishments

- Planned tests using pillbox cavity with replaceable windows, grids, or "buttons"
  - cavity fits in bore of Lab G solenoid
  - tests delayed by abrupt termination of Lab G RF capability in December 2003

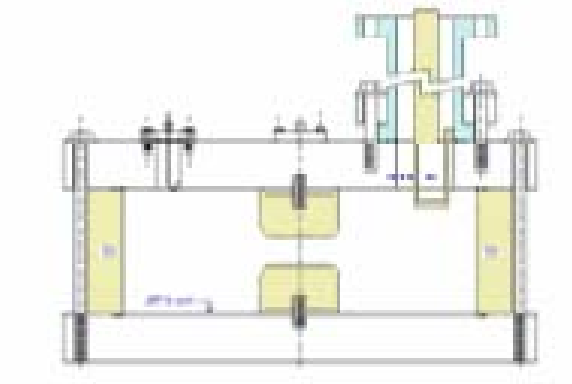
"Button" for materials tests





Recent R&D Accomplishments

- Also plan to test pressurized version of button cavity (Muons, Inc.)
  - use high pressure H_2 gas to limit breakdown
    - this project also put on hold due to demise of Lab G facility



Recent R&D Accomplishments

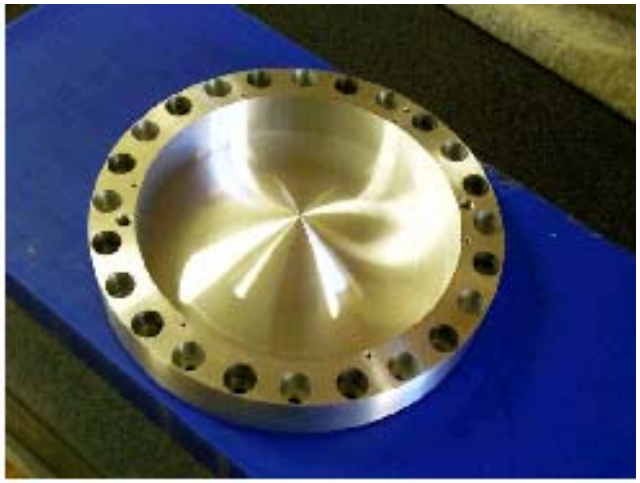
- RF test plan has been prepared for both 805 MHz and 201 MHz
  - not yet carried out due to lack of RF test facility
- 805 MHz program will resume as soon as MTA outfitted with RF power
- Initial tests of 201 MHz cavity will also commence
- 201 MHz rf cavity completed (LBNL, Jlab, U-Miss collaboration)
  - cavity presently undergoing low-power tests at Jlab

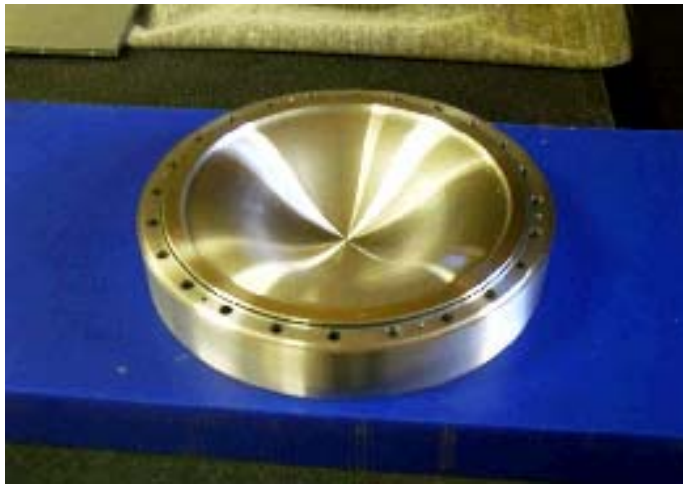
Recent R&D Accomplishments

- Remaining fabrication steps:
  - clean interior and electropolish
  - attach tuning apparatus and pump
- Expect delivery to MTA in May
- Curved window for 201 MHz cavity fabricated in industry
  - first window completed, another being fabricated now

Recent R&D Accomplishments

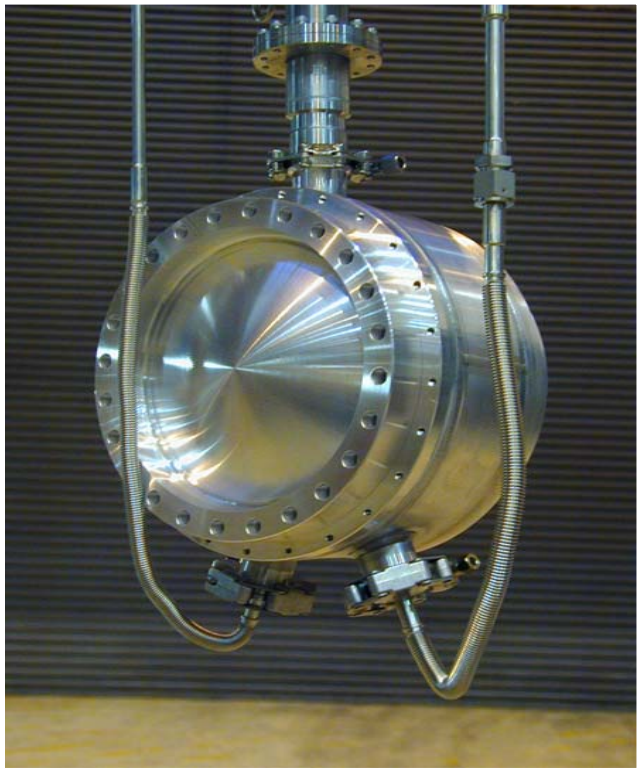
- Absorber group has developed strong, thin windows
  - new stronger (⇒thinner) design built (at U.-Miss.) and tested successfully at Fermilab
    - 125 μm window is 3x stronger than original design
    - burst at 140 psi





Recent R&D Accomplishments

- Initial absorber LH_2 filling tests carried out at MTA last summer
  - convection-cooled absorber prototype fabricated at KEK



Prototype LH_2 absorber

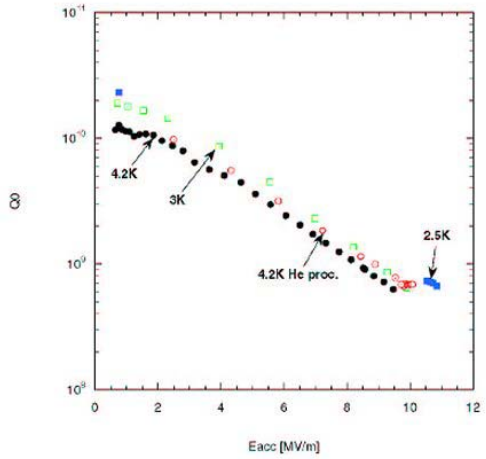
Test cryostat at MTA

Recent R&D Accomplishments

- Construction of MUCOOL Test Area at Fermilab completed
  - absorber, solenoid, and 201 MHz rf cavity will be integrated here
    - infrastructure for RF and absorber tests almost completed

Recent R&D Accomplishments

- Work on 201 MHz scrf cavity for the acceleration system has shifted gears
  - now trying to understand *Q* slope in terms of impurities and Nb coating properties



- Cavity back at CERN for recoating
  - building 500 MHz cavity to study Nb sputtering techniques
    - can study phenomena more cost-effectively with smaller cavity

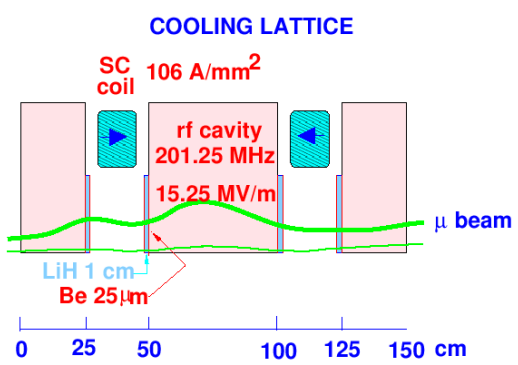
Recent R&D Accomplishments

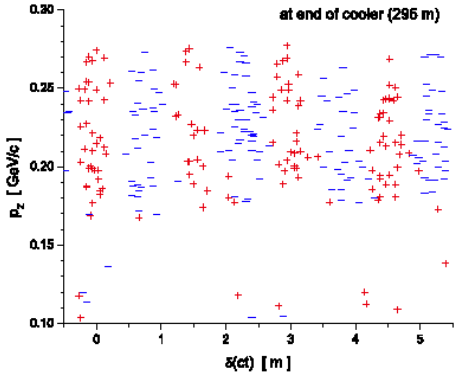
- Simulations
  - main focus in past year was to participate in APS Multi-Divisional Neutrino Study (http://www.aps.org/neutrino/)
  - detailed report written by "Neutrino Factory and Beta Beams Experiments and Development Working Group" (led by Geer and MZ)
    - http://www.aps.org/neutrino/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=58766
  - considerable progress made in simplifying front-end systems while maintaining performance
    - developed RF bunching and phase rotation scheme; simplified cooling channel; FFAG scheme for final acceleration stages
  - estimated cost of Neutrino Factory reduced 30–40% by this work

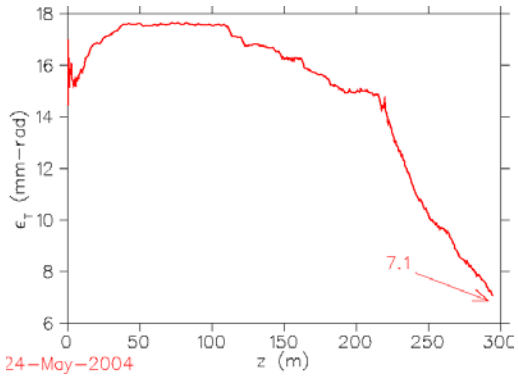
	All ($M)	No PD ($M)	No PD & Tgt. ($M)
FS2	1832	1641	1538
FS2a-scaled (%)	67	63	60

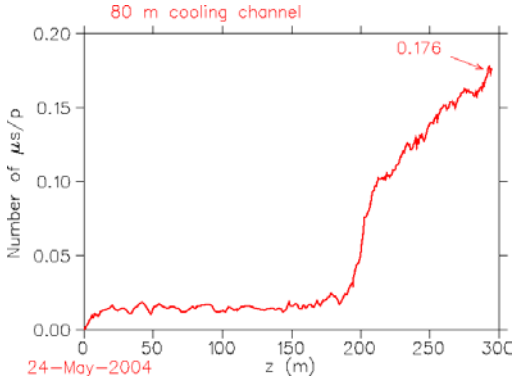
Recent R&D Accomplishments

- Use simplified cooling channel
  - shorter, fewer magnets and cavities, simpler absorbers (replace LH_2 with LiH)
  - performs acceptably for both μ^+ and μ^- (with larger downstream acceptance)



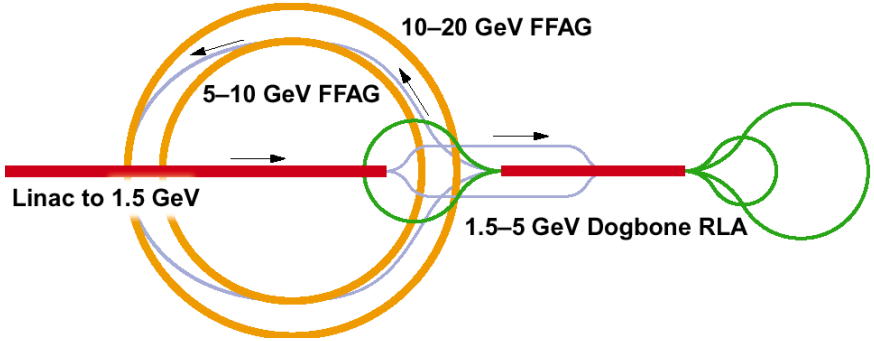


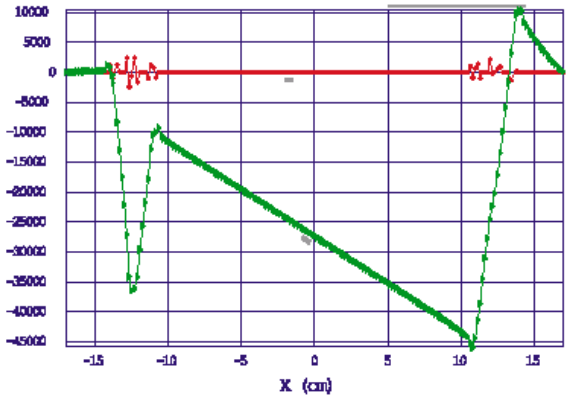


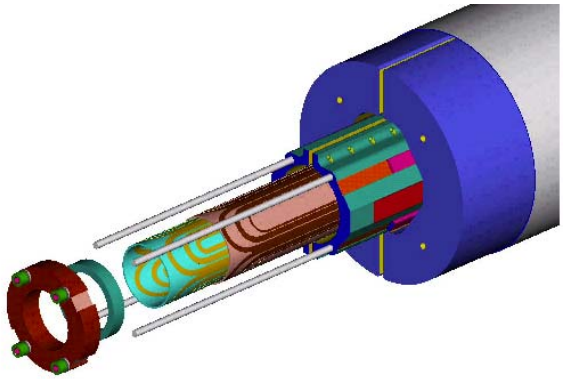


Recent R&D Accomplishments

- Looked at FFAG scheme for cost-effective acceleration
  - below 5 GeV, linac + RLA scheme looks more cost effective
  - required combined-function dipoles appear feasible and affordable
  - discussion of building an electron model of FFAG continues







FY05 Budget

- Prepared initial budget for FY05 based on guidance of flat budget
  - Tech Board discussed and approved it
- Budgetary "goal" is to maintain university programs while making some progress on key fabrication activities
- More recently, got permission from DOE to earmark $300K to MICE (for 3 years)

FY05 Budget

- **FY05 MC budget (only DOE-MC funds)†**

Institution	COOLING /MICE	TARGETRY	ACCEL./ COLLIDER	EFFORT[a]	RESERVE	TOTAL ($K)
BNL		578				578
FNAL	187					187
LBNL[b]	365				50	415
ANL				150		150
IIT				115		115
Mississippi	20			15		35
Princeton		40				40
UCB				5		5
UCLA	25		50			75
UC-Riverside						0
ORNL		85				85
Jlab	5		10			15
TOTAL ($K)	**602**	**703**	**60**	**285**	**50**	**1700**

[a]Includes beam simulation and diagnostics effort.
[b]Includes MICE funding of $300K.

†Also: salary support from BNL, FNAL, LBNL; support from NSF of $1M (uncommitted from last year)

FY05 Budget

- **Supplemental request submitted to DOE in September 2004 (priority order)**
  - **priorities decided in discussions between Spokespersons and PM**
    - **no response from DOE yet (and I'm not optimistic)**

Item	Request ($K)
1) Targetry magnet cryogenics system	525
2) Coupling coil design and construction	400
3) Tests of RF surface techniques	100
TOTAL	1025

FY05 Plans

- Targetry
  - complete fabrication of 15 T magnet and refurbish power supply
- Cooling
  - test 201 MHz high-gradient cavity (17 MV/m)
  - test 805 MHz cavity with curved window, grid, and "buttons"
- Acceleration
  - study *Q* disease and develop mitigation techniques
  - continue design work on FFAG-based systems
- Simulations
  - continue developing cost-optimized front-end for Neutrino Factory
  - explore realistic Muon Collider scenario(s)

FY05 Plans

- MICE
  - develop plan for component fabrication
  - assemble and test prototype tracker
  - continue to seek funding
- Management*
  - develop 5-year R&D plan for MCOG and MUTAC

*Yes, even we must work sometimes!

Longer-term plans

- Continued low funding and launching of MICE pose challenges for the MC
  - MCOG has asked us (Geer, Palmer, MZ) to prepare a 5-year R&D plan and indicate the corresponding funding needs
    - realistic plan should assume "flat-flat" funding (baseline)
    - optimistic plan could perhaps double our directly funded program
- MCOG wants evidence that we have a plan and that we have (roughly) the wherewithal to follow it
- Strawman budgets developed for two funding scenarios
  - activities lumped into four broad categories
    - Cooling: MUCOOL component R&D
    - Targetry: development of high power targets and collection systems, including beam tests at BNL, CERN, or elsewhere
    - System Studies: work on acceleration, ring coolers, colliders, performance studies
    - MICE: purchase or fabrication of MICE components

Longer-term plans

- **Summary of baseline (flat-flat) case is**

Activity	FY05	FY06	FY07	FY08	FY09	FY10
Cooling	492	245	345	705	615	225
Targetry	713	640	625	100	100	100
System Studies	195	195	195	295	295	195
MICE	300	620	535	600	690	1180
TOTAL	1700	1700	1700	1700	1700	1700

  - **comments:**
    - **assumes base program funds remain as now: BNL ($1.0M); Fermilab ($0.6M); LBNL ($0.3M)**
      - **"threat" to BNL base program adds uncertainty to plan**
    - **priorities in FY05–07 are CERN Targetry experiment and first MICE spectrometer solenoid**
    - **allocation of MICE funding depends on what happens with NSF MRI proposal**
    - **split between Cooling and MICE somewhat flexible**

Summary and Outlook

- Past year productive but more difficult than usual for the MC
  - fabrication of Targetry test magnet progressing
  - 201 MHz NCRF cavity fabrication making progress
  - cost-effective Neutrino Factory design developed ("Study IIa")
  - improved absorber window design tested, and first absorber filled with LH_2 (slowed by ICAR demise)
  - SCRF cavity R&D direction changed to "get back to basics"
  - Muons, Inc. initial gas-filled cavity tests encouraging
- MICE gaining momentum
  - PPARC approval for Phase 1 given (£9.7M); some U.S. funding in place (DOE: $900K over 3 yrs; NSF: $300K over 3 yrs)
- Strong MUTAC and MCOG endorsements of R&D accomplishments and plans are needed to maintain or enhance our budget
  - *MC will continue to hold up its end of the bargain!*