

*Collaboration R&D Plans
and
Funding Perspectives for 2002*

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Collaboration Meeting-FNAL
May 2, 2001



Outline



- Introduction
- Collaboration near-term R&D goals
- FY01 R&D budget and activities
- FY02 budget guidance
- FY02 R&D plans and priorities
- Long-term outlook (as told to B&B)
- Summary



Introduction



- Last year, **MC** effort was augmented significantly by “new players” (**ICAR, NSF**)
 - Unfortunately, DOE decremented us by enough to cause a net reduction of available R&D funds
 - We were able to absorb the shortfall mainly by completing existing tasks and **deferring new items**
 - Here, I will discuss the following topics
 - brief summary of this year's highlights and budget
 - budget guidance for 2002
 - items “on the list” for 2002
 - strawman priorities for discussion
- ⇒ “frank and vigorous exchange of views”



Introduction



- I also want to share with you the **long-term outlook** given to the B&B subpanel recently (April 19)
 - this perspective needs to be reinforced...or modified...for Snowmass, so it is a proper time to think about such things
 - supportive comments should be directed toward me
 - complaints, of course, go to Andy
 - the time frame for a Muon Collider seems the most sensitive topic



Collaboration Near-Term R&D Goals



- Defined where we want to be in 2005 in all R&D areas, then determined what's needed to get there (funding and effort)
- By 2005 (**science/technology-driven schedule**)
 - all optics designs completed and self-consistent
 - validation experiments planned or under way
 - know what we want to build
 - know how to build “hard parts” (prototypes completed or designed)
 - ready to design and cost most components (\Rightarrow ready to begin CDR)
- Aim for “ZDR-level” understanding of Neutrino Factory in 2003–2004
- Aim to begin CDR in 2005 (complete in 1–2 years)
- **This aggressive schedule requires a reasonable funding level**
 - which we not quite getting! (**$0.1 \text{ FTE} \times 10 \text{ years} \approx 0 \text{ FTE}$**)



FY01 R&D Budget and Activities



- FY01 funding plan (only DOE-**MC** funds)[†]

Institution	MUCOOL Expt. & Generic Studies	TARGETRY Expt.	SALARY	RESERVE	TOTAL (\$K)
BNL	130	880	50		1060
FNAL	845				845
LBNL	180	30		180	390
ANL		25	180		205
IIT			60		60
Mississippi	70				70
Princeton		145			145
UCB			90		90
UCLA	65		30		95
ORNL	50	50			100
NHMFL	100				100
JLab			5		5
Cornell			5		5
Iowa	10				10
TOTAL (\$K)	1450	1130	420	180	3180

[†]NSF has provided \$1.2M for muon R&D (mainly SCRF at Cornell) and ICAR has provided \$2.1M for muon R&D (mainly cooling)



FY01 R&D Budget and Activities



- How we coped with \$4.7M → \$3.2M decrease
 - off-loaded absorber program entirely onto **ICAR**
 - **SCRF program** covered entirely by **NSF**
 - continued work on **805-MHz components** (open-cell cavity, Be-window pillbox cavity)
 - completed **Lab G test area** and launched new **absorber test area**
 - new area will ultimately have access to 400 MeV proton beam
 - began initial round of **targetry experiments**
 - continued **simulation studies**
 - completed (well...almost) **Study-II**
 - prepared for B&B Subpanel
 - **deferred start of 201-MHz cavity design and its test solenoid, induction linac prototype, targetry pulsed solenoid design**



FY02 Budget Guidance



- The present budget picture can be summarized as follows:

“This year was the good year we've all been waiting for”

- Next year, we still appear to be somewhat “targeted” for slowdown

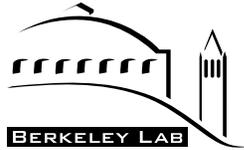
— $\$2.839M/\$3.180M = 0.893 \Rightarrow 11\% \text{ cut!}$

- but basically, we share in the cut that all but Fermilab and SLAC appear destined to take

Year	DOE-base (\$M)	DOE-MC (\$M)	NSF (\$M)	ICAR (\$M)	TOTAL (\$M)
FY99	2.8	2.2	--	--	5.0
FY00	3.3	4.7	1.2	--	9.2
FY01	2.1	3.2	1.2	2.1	8.6
FY02 ^a	2.2	2.8	1.2	2.1	8.3

^aPresent guidance from funding agencies.

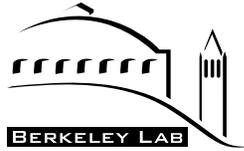
- We need increased funds to build components (NCRF cavity, target solenoid, absorber, klystron, induction linac module, SCRF cryomodule)
 - these are all expensive items



FY02 R&D Plans and Priorities



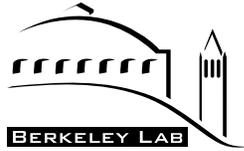
- FY02 highlights
 - begin **target-solenoid design**
 - begin **yield measurements** to benchmark MARS (π , n)
 - construct **prototype carbon target** and test with $\approx 10^{14}$ ppp
 - conceptual design of **induction linac** with internal solenoid and pulser
 - continue **Be window development** and launch **grid development**
 - begin fab of high-power **201-MHz NCRF cavity** and **test solenoid**
 - complete **LH₂ absorber tests** with beam (requires completing absorber test area)
 - develop **plans for cooling test** (internationally)
 - complete **acceleration and storage ring simulation studies** including errors and fringe fields
 - **test 201-MHz SCRF cavity** (CW and pulsed)



FY02 R&D Plans and Priorities



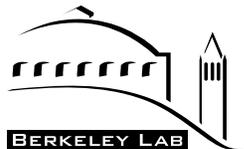
- **Strawman priorities (to seed a discussion)**
 - **Targetry**
 - continue AGS operations; increase beam intensity
 - begin target solenoid design (long lead time)
 - continue simulations, target (incl. band target), and facility studies
 - begin yield measurements
 - **MUCOOL**
 - start on 201-MHz cavity and test solenoid
 - carry out Be window and grid tests
 - continue absorber tests
 - continue test area development
 - plan cooling test(s)



FY02 R&D Plans and Priorities



- Phase rotation
 - test IL core samples
 - test effects of solenoid field on core
 - explore Li mini-cooling absorber
- Simulations
 - study emittance exchange
 - study beam dynamics in RLA and storage ring
 - study RF bunching + phase rotation
- Diagnostics
 - identify and test promising concepts in Lab G or absorber test area
- Bottom line: **expect to fall one year behind our technology-limited plan**



FY02 R&D Plans and Priorities



- Corresponding strawman budget

	FY02 (\$K)	FY02 (\$K)
	Desired	Available
Cooling	4240	1100
Test area prep	500	200
201-MHz cavity	800	400
Coupling solenoid	1000	150
Be windows/grids	400	200
RF power source	1000	0
LH2 absorber test	250	0
Cooling demo plan	90	90
Instrumentation	200	60
Targetry	2400	1090
AGS operations	500	300
Magnet	1000	450
C target studies	100	75
Simulations	200	100
Target station studies	100	75
Yield measurements	500	90
Diagnostics	280	220
Norem	180	180
Hardware	100	40
Phase Rotation	600	100
Induction linac	500	100
Mini-cool absorber	100	0
Simulations	150	150
UCB	90	90
ICAR	60	60
Management & Reserve	200	179
TOTAL	7870	2839



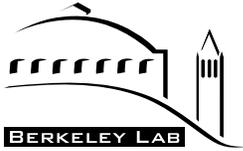
Long-Term Outlook



- View of the future presented to B&B
- Budgets based on **technology-limited schedule** prepared (FY01-FY05)

R&D area	FY01 (\$M)	FY02 (\$M)	FY03 (\$M)	FY04 (\$M)	FY05 (\$M)	Sum (\$M)
MUCOOL	4.9	3.8	4.3	11.3	11.2	35.4
Targetry	4.7	3.8	4.1	3.5	2.1	18.2
Beam Simulations	2.3	2.0	2.0	2.0	2.0	10.3
Acceleration/Storage Ring	1.0	0.7	0.7	0.7	0.7	3.6
Components	1.9	4.5	7.5	4.3	4.0	22.2
ZDR Preparation				4.0	6.0	10.0
TOTAL	15	15	19	26	26	100

- reaching the CDR stage will require about **\$100M**
- **Difficult to sustain component development program at funding level well below \$10M/yr**
 - below a certain threshold, R&D produces only “paper and plastic”

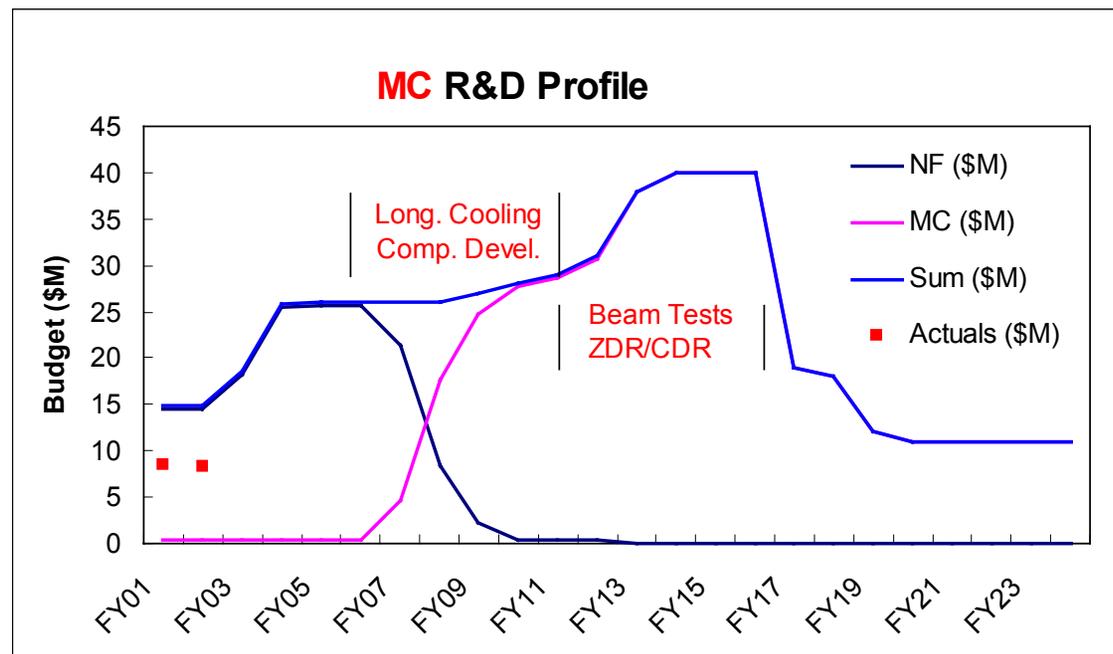


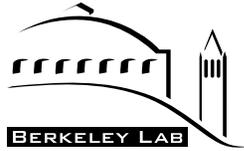
Long-Term Outlook



- Budgets projected into the out-years (basis: SWAG)
 - actuals for FY01 (and expectations for FY02) are indicated
 - decrease in FY17 and beyond would be filled in with R&D effort for MC-II

...if I had the nerve to draw it!



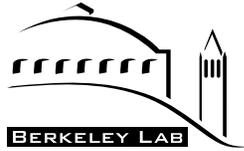


Long-Term Outlook



- The **technology-limited** schedule to start a Neutrino Factory physics program is expected to be:

2000-2003	R&D activities (ongoing)
2003-2004	Prepare Zeroth-Order Design Report (ZDR); continue R&D; cooling string tests begin
2005-2006	Prepare Conceptual Design Report (CDR)
2007-2012	Construct Neutrino Factory (assume 6 years)
2013	Experiments begin



Long-Term Outlook



- The schedule to start a Muon Collider physics program is expected to be much later:

2000-2006	R&D activities (ongoing; mainly theory and simulation effort)
2007-2012	Develop and bench test components for longitudinal cooling (bent solenoid, wedge absorber, diagnostics, ring cooler)
2010	Feasibility Study for Muon Collider
2013-2015	Beam tests of 6D cooling system
2013-2016	Prepare Zeroth-order Design Report (ZDR), followed by Conceptual Design Report (CDR)
2017-2024	Construct Muon Collider (assume 8 years)
2025	Experiments begin



Summary



- **MC** R&D program still has clear directions to proceed on all fronts
- **Long-range planning** of R&D program has been done
- **MC** budget shortfall in FY02 will slow us down by about 1 year
- **We need to continue to push for more accelerator R&D support if we are to make reasonable progress in a timely way**