

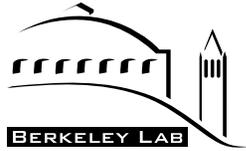


*Financing an International
Muon Ionization Cooling Experiment
(U.S. Perspective)*

Michael S. Zisman
CENTER FOR BEAM PHYSICS

Muon Collaboration Project Manager

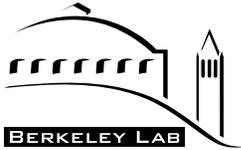
Muon Ionization Cooling Experiment Workshop-CERN
October 25-27, 2001



Outline



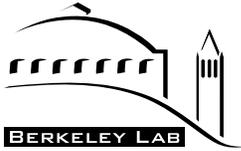
- Introduction
- Funding possibilities
- Summary and Outlook



Introduction



- Based on the “U.S.” designs being discussed at present, we expect the cost of the experiment to be in the range of \$30-40M
 - it is more favorable to operate with more rf cavities at lower gradient than vice versa
 - cost of rf power is high compared with cost of cavity
- Crude scaling for 201 MHz cavities
 - cost of cavity is roughly 1/10 cost of power source to drive it to design gradient
 - single rf cell costs \$125K; 5 MW rf source (e.g., diacrode) costs \$1.2M
 - still with big uncertainty!



Introduction



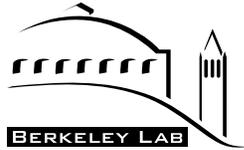
- There will be some **fixed costs** to set up the experiment (“infrastructure”)
 - the **hope** is that these will be **mainly covered by the host lab**
 - cooling water (LCW), AC power for magnets and rf system, cabling, computer connections, espresso machine
 - **safety interlocks will be a big deal**
 - LH₂ absorber safety (flammable gas, window break, cryogenics failure)
 - solenoid quench protection
 - protection for rf cavities and Be windows during quench
 - rf power protection (arcs in cavity or tube, reverse power, temperature, pps)
 - x-ray shielding
 - **all must be done in a way that satisfies host lab** (when in Rome...)



Introduction



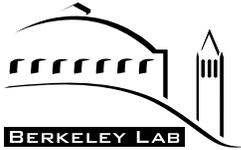
- Assume that funding contributions will be **split among the three regions**
 - but, given likely resources, “ideal” split (1/3 each) not guaranteed
 - for **planning purposes**, take the following ansatz:
 - U.S. (**40%**); Europe (**40%**); Japan (**20%**)
 - note that these are **“made up” numbers, not negotiated values**



Introduction



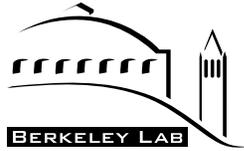
- Items to build or provide (**are any missing?**)
 - rf cavities
 - rf power source
 - cooling channel solenoids and PS
 - detector solenoids and PS
 - absorbers
 - cryogenics (one system or two?)
 - diagnostics
 - detectors
 - vacuum system
 - beam delivery system
 - infrastructure (AC power, interlocks, etc.)



Introduction



- Funding burden will be eased somewhat if the regions are contributing items they are planning to develop anyway
 - the rf system is an obvious example
 - if we choose 201 MHz, U.S. should build
 - if we choose 88 MHz, Europe should build
 - is the absorber system another?
 - if convection design, let Japan build
 - if forced flow, let U.S. build



Introduction



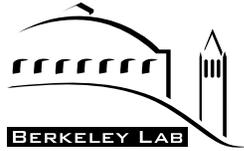
- solenoids seem less “territorial” (to me)
 - technically straightforward, so anybody could provide these
 - but, does not seem to translate well into “inexpensive” (**cost sharing?**)
 - actual design is tied to rf choice; **does this matter?**
 - whatever configuration is adopted, the support structure must accommodate forces due to various quench scenarios
 - **will require some serious mechanical engineering**
 - if experiment solenoids must also be newly built, should one region provide all solenoids?



Funding Possibilities



- In U.S., we would need \$12-16M based on the ansatz above
 - sounded hard at Snowmass...and it may be much harder now!
- DOE funding (as seen by **Andy Sessler and MZ**)
 - Dave Sutter has been approached about the experiment
 - response: **supportive but noncommittal**
 - initial discussions were based on using **one cell** of Study-II channel
 - expected cost for experiment was \$10-20M; U.S. share \$4-8M
 - over a 3-yr period, amount seemed plausible (\$1.5-2.5M)
 - now we consider twice that amount...not a helpful trend
 - present **MC** funding level cannot absorb cost of experiment
 - it must be "new" money
 - **international flavor is critical to success**



Funding Possibilities



- NSF (as seen by **Maury Tigner**)
 - take U.S. share as \$16M, split equally between NSF and DOE
 - NSF contributes \$8M
 - over a **4-year period**, this would be \$2M/yr
 - plausible amount for a **group of universities** to ask for as a grant
 - either ICAR or an ad hoc group could do so
 - is it better to have wider coverage (including other states) or an existing organization?
 - how important is it that group already be an NSF “customer”?
 - alternative of asking for the entire \$16M from NSF viewed as less likely approach
 - too small for MRE and too big for likely grant



Funding Possibilities



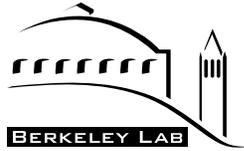
- We need to consider non-traditional funding sources (**Steve Geer**)
 - try to get state funding for another ICAR-like group
 - New York?...California?
 - Keck Foundation or other philanthropic organization
 - name the experiment after Bill Gates?
- These are basically uncharted waters for us, but worth an inquiry
- **Are there equivalent opportunities in Europe or Japan?**



Funding Possibilities



- **Challenge: could we get started for \$10-20M?**
 - can we use solid absorbers at the ends of the channel?
 - can we find suppliers to reduce the estimated costs?
 - can we make due with “used” solenoids?
 - for the detector
 - for the cooling channel (Lab G device)
- **Second challenge: develop a realistic time scale**
 - MUTAC thinks 2004 is not plausible and saying so lowers our credibility (I agree)
 - for funding reasons, likely to take 2-4 years to pay for all items
 - to get “new” money from DOE or NSF will surely take 2-3 years from now



Funding Possibilities



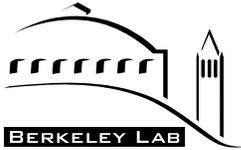
- Response to schedule challenge

2004 Commission beamline and detectors
⇒ Get control of systematics

2005 Install first rf cavity and/or LH₂ absorber
4 cavities at 8 MV ⇒ 11 MV/m

2005-2006 Begin initial round of experiments

- With this definition, we believe it is possible to “start” in 2004
- A minimal one-cell test could begin for ≈\$15M
- For PSI, Letter of Interest due November 16, 2001 for presentation at their January 8, 2002 program committee meeting
 - goal is to get green light for submitting full technical proposal
- Technical proposal to be prepared by January, 2002 (or earlier)
 - set up formal collaboration for experiment in 2002



Summary and Outlook



- **MUTAC** was enthusiastic about our plans to carry out experiment
 - but, they do not think timetable is realistic
- We do need a schedule that people will believe to maintain credibility
 - in the U.S., FY03 is expected to be very bad
 - earliest date for new money probably FY04 or FY05
 - if funds come from the agencies, likely level is \$1-2M/yr
 - from each, if we're **really** lucky
- Staged approach, with low start-up cost, would help get our foot in the door
- To me, it is most important that we build a set of components that can demonstrate cooling of a muon beam
 - what we choose to build (in the sense of trying to find the "best" solution) seems less important

Engineering view: **"Better is the enemy of good enough"**