Muon Collaboration

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September 2, 2003

Neutrino Factory and Muon Collider Collaboration
FY04 Supplemental Funding Request

DOE budget guidance for FY04 indicates a budget for the MC of only $1.4M. At this reduced funding level, it will be impossible to carry out most of the hardware development program intended for this year. This request for supplemental funds, prepared in consultation with MC Co-spokespersons Stephen Geer and Robert Palmer, outlines the key areas where additional funds would permit us to make technical progress during FY04. The total request for supplemental funds is $1560K; the ordering of the items listed reflects our view of their importance to the MC R&D program. In most cases, partial funding would still advance the program. Thus, in the event that we do not get the entire amount requested, we would plan to use the funds to optimize the R&D program based on the budget available. We note that MUTAC and MCOG have both strongly endorsed our R&D program directions, verified that we are using our funds efficiently, and indicated to DOE that we are sorely in need of a funding increment at the requested level to make progress in a timely way.

1) *201 MHz RF Testing* ($400K)

In FY03 we are completing the design, and have started construction, of a prototype 201-MHz high-gradient normal conducting RF cavity, which we desire to have ready for high-power testing in FY04. The cavity is a key component of a muon ionization cooling channel, and hence is on the critical path for the Muon Ionization Cooling Experiment (MICE) that has recently been granted scientific approval by Rutherford Appleton Lab.[1] Achieving sufficiently high gradient at 201 MHz is a critical issue for the successful construction of a muon ionization cooling channel, and experimental knowledge of the achievable gradient is required to guide Neutrino Factory design and cost-optimization efforts. At the reduced budget level, there will not be sufficient funds to prepare for testing at the MUCOOL Test Area (MTA) at Fermilab. These supplemental funds will permit us to install the 201-MHz infrastructure (RF power, HVAC, and mechanical setup) in the MTA this year, saving nearly a year on the R&D schedule. In addition to cavity testing, the funds will be used to carry through on partial fabrication of a second cavity. This will position us to take advantage of what the first cavity teaches us by having a spare on which to implement and evaluate new ideas (different materials for the nose cones, coatings, etc.).

[1]The U.S. MICE team will be responsible for providing the eight 201-MHz RF cavities needed for the experiment.

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2) *LH_2 Absorber Test Capability* ($460K)

By the end of FY03, we will complete the civil construction for the new MTA at Fermilab. The next step will be to equip the area to test 201-MHz RF cavities (see item 1 above) and fill liquid-hydrogen absorbers. To test absorbers, we must provide a liquid-hydrogen-filling system with all of the appropriate safety interlocks and suitable diagnostics for evaluating system performance. With the requested supplemental funding, the schedule for this activity would be accelerated by about one year. We have a Ph.D. student on this project (from NIU), whose thesis will be delayed if we cannot make faster progress. In addition, our Japanese collaborators have invested in the development of an absorber for our R&D program on the understanding that we will fill this absorber in the new facility at Fermilab. Fulfilling this commitment would be delayed by about one year in the absence of these supplemental funds. The State of Illinois has now invested significantly in absorber R&D, and test results from the MTA facility are needed to motivate continued investment. Thus, funding for this activity has the potential for significant leveraging. Finally, filling and testing absorbers is an important step toward MICE.

3) *Targetry Magnet Fabrication* ($400K)

Validating the target design for a Neutrino Factory requires that we perform beam tests—at realistic intensities and with realistic target parameters—in a high-field solenoid. During FY03, an engineering design for a pulsed magnet capable of operating at field levels between 5 and 15 T has been developed. The magnet is ready to begin fabrication in FY04 but requires supplemental funding in order to place the order. With supplemental funding, the magnet, along with its power supply and cryogenic system, would be available for initial testing in about three years[2]; without incremental funds, we anticipate a 1–2 year delay in operating the magnet.

4) *Coupling Coil Design and Construction* ($300K)

To fully test the 201-MHz RF cavity in the MUCOOL Test area, a large solenoid ("coupling coil") surrounding the cavity is needed. These funds would permit developing a full engineering design for the coil and ordering the requisite superconducting cable. Based on this start, fabrication could be completed in FY05, permitting us to begin to address one of the most difficult issues for a Neutrino Factory design and, in particular, for the MICE experiment—behavior of a high-gradient RF cavity in a strong solenoidal field. Lack of funds will delay the beginning of fabrication for one year, with a concomitant slowdown in preparations for the MICE experiment.

[2]Funding at the $500K level will also be needed in FY05 and FY06 to complete the fabrication.