Fermilab

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Director's Office

April 15, 2004

Prof. Kevin McFarland
Dept. of Physics & Astronomy
University of Rochester
Rochester NY 14627

Dr. Jorge Morfin
Fermilab
MS 220

Dear Kevin and Jorge,

Thank you for your presentations to the Physics Advisory Committee (PAC). The presentations were well received, and the PAC deliberated in considerable depth. The PAC's written report is appended.

Following the recommendation of the PAC, I grant Stage I approval to MINERνA as proposed.

In addition to granting approval, I am accepting the advice of the PAC with respect to the scope of the experiment and its impact on Fermilab. We will monitor your progress towards full funding, and we will consider the experiment ready for Stage II approval when we determine that the available funding is sufficient for the proposed scope of the experiment. We also encourage further discussions between MINERνA and MINOS, to your mutual advantage.

Despite the cautionary words, we are very pleased that your experiment has met a rather high standard, and we very much hope that this approval can lead to the establishment of a soundly based funding plan. If there is any way we can be of assistance in this, please let us know.

Sincerely,

Michael Witherell

Attachment

cc: K. Stanfield
H. Montgomery
S. Holmes
J. Appel

Excerpt from April 2004 PAC Recommendations

P-938 MINERνA (McFarland/Morfin) Proposal to Perform a High-Statistics Neutrino Scattering Experiment Using a Fine-Grained Detector in the NuMI Beam

MINERνA proposes a program of neutrino physics in the NuMI beamline with a fine-grained detector located in front of the MINOS near detector. The physics program is interesting, with contributions to the understanding of low-energy nuclear/particle physics as well as impact on the reduction of systematic errors on future neutrino oscillation experiments. The collaboration has submitted an MRI proposal to NSF, which is currently being reviewed, and recently had their estimate of the impact of the experiment on Fermilab reviewed by a Laboratory committee.

The PAC recommends Stage I approval for the experiment as proposed. The detector cost is a concern, and the approval is based on the estimates presented. Further approval of the experiment should depend on validation of these estimates, and the realization of a funding plan that limits the impact on the Fermilab budget. Further work on understanding possible negative impacts on MINOS is also needed.

Contributions of MINERνA to Non-Oscillation Physics

Neutrino cross sections are not well known at low energies. The collaboration provided the Committee with an addendum to the proposal with improved estimates of MINERνA's capabilities. The MINERνA program would increase existing statistics for many exclusive processes by factors of 10 or more. These measurements are interesting both as 'engineering' inputs for neutrino oscillation experiments and in their own right.

Neutrino interactions are among the best ways to understand the axial-current component of weak interactions and MINERνA should be able to make definitive measurements of the axial form factor over a wide Q^2 range. The MINERνA program also includes studies of several exclusive channels on a light target and the A dependence of these channels. These studies could shed new light on the transition from non-perturbative to perturbative QCD and on the dynamics of hadron production in nuclear matter. They are complementary to the electroproduction measurements now being made at JLab. Around 40% of the collaboration comes from the nuclear physics community specifically to make these measurements.

Contributions of MINERνA to Oscillation Physics

Through precision measurements of the major low-energy neutrino scattering processes, MINERνA can make major contributions to our understanding of the details of neutrino interactions in the 1-18 GeV energy range. These detailed measurements will help minimize systematic errors from all neutrino oscillation experiments in the few GeV energy range. The MINERνA collaboration provided simulation studies of the effects of improved understanding of neutrino cross sections on benchmark oscillation measurements. For example, even for 7.4×10^{20}

protons on target, the additional information from MINERνA should lower the MINOS systematic error on Δm^2. As statistics improve, the reduction in error is larger. For later neutrino experiments, the reduction in errors on θ_{13} is equal or even more significant.

Impact on the Laboratory

A review of the impact of MINERνA on the Laboratory took place prior to the PAC meeting. MINERνA has requested that Fermilab contribute engineering, technical support, and materials for safety- and installation-related items. Issues called out were the cost estimate, the thermal load in the cavern, and the potential impact on MINOS operations. The MINERνA cost estimates were largely provided by the engineers who had done similar tasks for the MINOS installation. The review committee suggested that the engineering estimates were low and that additional contingency should be added. However, they did not feel the request was unreasonable. Almost all of the Fermilab costs are for salaries of existing personnel with very little M&S.

MINERνA is expected to add around 45 kW to the thermal load in the cavern. The ground water in the sumps is used for cooling, and the current flow rate of 240 gal/min is significantly lower than the 300 gal/min anticipated. There is already some concern about MINOS cooling at these decreased flow rates and the additional load from MINERνA needs to be considered carefully. Estimates made in response to the review indicate that if MINERνA runs at increased inlet temperature and another heat exchanger is added at a cost of order 10-20K$, the increased heat load can be accommodated.

Impact of MINERνA on the MINOS Detector and Run Plan

MINERνA does not request changes in the MINOS run plan.

MINERνA can be installed during MINOS running, although issues such as crane operations near magnets and welding could lead to lowered MINOS operating efficiency if performed during MINERνA installation.

MINERνA will be located in front of the MINOS detector in the NuMI Near Hall. MINERνA can either operate as a standalone detector with its own muon spectrometer at a wide range of locations in the hall or use MINOS as its muon spectrometer, in which case it must be located near the front of MINOS and some means of data sharing between the two experiments must be agreed upon. If MINERνA is close to MINOS, there will be increased backgrounds in MINOS due to the additional material. These could increase the existing backgrounds due to upstream neutrino interactions by 50-100%, leading to a maximal deadtime of 4-5% at low energy and up to 15% at high energy. MINOS could study these effects with a test mass and/or through simulations.

Funding and Schedule

The MINERνA collaboration has applied for an NSF MRI for $2M. These funds would cover the R&D and tooling as well as completion of ~ 20% of the final detector. An additional 2.5-3.5 M$ are needed to complete the detector, depending on the decision to build a standalone muon spectrometer. The collaboration is exploring other funding sources, through DOE nuclear science and the DOE and NSF university groups. The schedule proposed is very aggressive and requires substantial funding on short time scales. While a successful MRI proposal will get the project started, schedule slippage can be expected if additional funds are not available in FY2005.