



Fermilab

July 16, 2009

Bob Tschirhart  
MS 370

Dear Bob,

Thank you for your presentation on rare processes and a possible mid-term kaon program at the recent Physics Advisory Committee (PAC) meeting. The PAC was clearly very moved by the potential of what you presented. The specific comments to me by the Committee were:

*The Committee reiterates its view that a high-statistics, on the order of 1000 events,  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$  experiment represents very compelling science. While this was previously thought to be achievable only with the high power of Project X, the Committee was excited to hear about the prospects for such an experiment using the existing combination of the Main Injector and the Tevatron, operated as a stretcher ring, employing the well-studied techniques developed at Brookhaven National Laboratory where the initial observation of  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$  was made. Such a high-priority experiment would considerably strengthen Fermilab's intensity frontier program in advance of Project X.*

*The Committee strongly recommends that Fermilab evaluate the cost and feasibility of various options for making the Tevatron available for the  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$  and possibly other experiments. Should the Laboratory decide to proceed with this program, the Laboratory should ensure that the timeline is internationally competitive.*

*In light of the physics interest in rare-kaon experiments, it would be valuable for Fermilab to explore the full physics potential of the 120 GeV Main Injector and Tevatron stretcher opportunity as part of their Physics with a High Intensity Proton Source workshop series.*

In an earlier part of the report, the PAC commented:

*The broad research program of Project X described in the "Golden Book" includes long-baseline neutrino experiments, neutrino interaction experiments, ultra-rare muon and kaon decay experiments, quark flavor experiments, and experiments with antiprotons. The Committee strongly recommends that Fermilab include budget estimates for the highest priority projects, such as muon-to-electron-conversion,  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ , and  $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$  experiments, in the budgetary planning for Project X in order to insure a broad initial program of high-impact intensity frontier physics.*

*The long-baseline neutrino experiments and rare-decay experiments benefit most directly from the high beam power afforded by Project X. Although the design of the Project X*

*accelerator complex described in the Initial Configuration Document (ICD-1) provides for the beam power required for the long-baseline neutrino program, the high beam power produced at 8 GeV is not readily available for a full rare-processes program. As a result, the accelerator group is considering ICD-2 based on a 2 GeV CW linac containing some ILC-like modules, providing both higher beam power and a more flexible beam distribution scenario for the rare-processes program. This would be followed by a 2-8 GeV accelerating section similar to the SC linac of ICD-1 or a rapid cycling synchrotron. This combination can provide great prospects for satisfying the broad goals of Project X. The ICD-2 can drive the long-baseline neutrino program while also providing nearly ideal beams for the important Project X rare-processes research program.*

*The ICD-2 concept is extremely promising. The Committee strongly endorses further study of the prospects to realize the great potential of the high-sensitivity studies of rare muon and kaon processes which will be essential elements of the intensity frontier explorations of new physics at high mass scales. The Committee strongly encourages Fermilab to further develop the accelerator aspects of this proposal, including cost considerations, and to continue to consider the synergy with the ILC linac technology. The Committee supports further detailed studies of the ICD-2 kaon and muon beams to confirm their suitability for next generation experiments.*

I am pleased to transmit these comments to you, and look forward to working with you and the larger kaon and muon physics communities to understand in more detail the potential of such a program and what it would take to implement it. Clearly, active participation in the fall workshop can be an important step in this process.

Sincerely,



Piermaria Oddone

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