

June 29, 2012

Stephen Holmes
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Dear Steve and Bob:

Thank you very much for taking time in the middle of the Project X Physics Workshop to make your presentations and participate remotely in the June meeting of the Fermilab Physics Advisory Committee (PAC). The Committee explicitly mentioned its appreciation of the time and effort required of the proponents and presenters to prepare the reports for this PAC meeting.

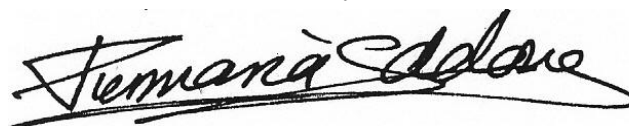
Project X and its planning were a major consideration at this meeting, and your efforts were crucial for the informed discussions which were held. You will find attached the text of the relevant part of the introduction and later text on Project X and the overall Intensity Frontier strategy which the PAC has sent to me in their Comments and Recommendations document.

As you will see, the PAC continues to recognize the importance of Project X to the long-range future of Fermilab. So, it is especially important to get off to a good start, making the strongest case possible for the first, and each stage of the Project X. The Committee made some suggestions about additions to the case for the first stage, and I understand that you have already worked to incorporate these in the Workshop and the efforts which will follow.

Again, thank you for your help in informing the PAC about the progress in defining the staging of Project X and its physics program. We all look forward to your continued progress, and I wish you the best of luck in this effort.

Please continue to keep me informed about the progress, and of any impediments you may find to getting to the strongest possible case for a staged Project X.

Sincerely,



Piermaria Oddone

cc:

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Overview

Fermilab's plans for pursuing the Intensity Frontier with Project X have also been modified recently to incorporate phasing of the accelerator and physics program to accommodate constrained budgetary projections. The Committee heard presentations on the technical and scientific prospects for the phased Project X program. In addition, the PAC received presentations on the currently planned muon program including the g-2 and Mu2e experiments, and on the ORKA experiment, a precision measurement of $K^{\pm} \rightarrow \pi^{\pm} \nu \bar{\nu}$ decay, which was granted Stage I approval after the previous PAC meeting.

Project X

Project X is the centerpiece of the Fermilab strategy for the development of a world-leading Intensity Frontier program. It would provide a high-power proton source enabling the study of neutrino oscillations, rare processes (for kaons, muons and neutrons), nuclear physics, and nuclear energy applications, while providing a path towards a future neutrino factory or muon collider. Budgetary constraints have led to the need for a staged approach, with each stage costing significantly less than \$1B, each stage with compelling physics opportunities, and using existing elements of the Fermilab complex where possible.

The PAC received a document describing the proposed Project X performance by stage, and heard presentations on the phasing of Project X, and on its physics, given remotely from the physics study workshop that was proceeding in parallel. The three proposed stages consist of first replacing the existing 400 MeV linac with a 1 GeV CW superconducting linac with the capability of delivering flexible beam formats to multiple experiments; second, extending the CW linac to 3 GeV; and finally completing the reference design with a pulsed linac for acceleration to 8 GeV. A fourth stage, going beyond the Reference-Design-Report performance, is also under discussion.

The PAC understands that the physics case for each stage is a work in progress and must be further developed. Stage 1 will provide an increase of Main Injector beam power by up to 70%, from 700 kW to 1.2 MW, of significant interest for the long-baseline program at NOvA and LBNE. Nevertheless, this application uses only 2% of the available power. Another ~8% might be used to increase the power to the Mu2e experiment, but the practical value must be better understood. The PAC recommends that the physics case be strengthened through further investigation of potential Stage-1 applications, such as the neutrino and muon programs, and neutron EDMs. Other ideas, such as hidden-sector searches and muon cooling, should also be investigated and clearly articulated. The PAC looks forward to hearing a more fully developed physics case for Stage 1 at its next meeting.

Enhanced power for kaon physics will be possible at Stage 2 when the beam energy is increased. At Stage 3, at least 2 MW of beam power will be available at an energy of up to 120 GeV for the long-baseline neutrino program. Good progress is being made in the study of siting options for each stage. PXIE (the Project X Injector Experiment) is a program of system tests for the front end of Project X. It is considered by the PAC to be well conceived and is strongly supported. It will give impetus to the development of this rich program.

Overall Intensity Frontier Strategy

Over the past six months, it has become clear that both LBNE and Project X must be phased programs. There has been intense parallel activity in both these areas. The PAC commends the Laboratory for its strong leadership and execution in dynamic circumstances.

One interesting result is the possibility of interleaving the phases of these projects so that Phase 1 of Project X could start significantly earlier than previously foreseen.

However, the resulting stretched timescale due to budgetary limitations is a concern. To deliver physics as soon as possible, the PAC encourages the Laboratory, in close consultation with the various interested community groups, to look for opportunities to optimize the phasing to make these programs mutually beneficial as the phases are interleaved.

In the current notional timeline, Phase 2 construction for either project would not be complete until 2030 or later. This long timescale has several important implications:

- The physics cases for each phase must be independently compelling at the anticipated timescales, with particular emphasis now on the physics case for Phase 1.
- It is essential to continue to press the importance of the later phases.
- The reliability of aging infrastructure must continue to be assessed as the details of the phasing are formulated.

The PAC urges that the updated physics cases for the phased programs be intensively discussed as soon as possible with the rest of the particle physics community, starting with those working at the Intensity Frontier, as well as with the broader scientific community.

Finally, the PAC appreciates the efforts of the Laboratory towards realizing a diverse program, and encourages continued efforts to maintain opportunities for high-priority smaller projects even as the very large projects proceed.