Fermilab Accelerator Advisory Committee Meeting
November 7-9, 2011

Final Report – February 2012

AAC Committee:

Members present: Roland Garoby (CERN), Steve Gourlay (LBNL), Katherine Harkay (ANL) (chair), Mark Hogan (SLAC), Lia Merminga (TRIUMF), Katsunobu Oide (KEK), Peter Ostroumov (ANL), Andrei Seryi (JAI)
Excused: Ilan Ben-Zvi (BNL), Andrew Hutton (JLab), James Rosenzweig (UCLA)

Tasks/Assignments:

Strategic direction and FNAL complex**:** K. Harkay (lead), R. Garoby
Project X R&D**:** P. Ostroumov (lead)
Technology Development: S. Gourlay (lead), L. Merminga
Advanced Accelerator R&D**:** M. Hogan (lead), K. Oide, A. Seryi
Muon Accelerator R&D**:** K. Oide (lead), A. Seryi

Contents:

Executive Summary

The Fermilab Accelerator Advisory Committee met from Nov. 7-9, 2011, to review the overall strategic direction of the accelerator program, and to assess the progress and plans for the Accelerator complex, Project-X R&D, Technology Development, and Accelerator R&D. This report summarizes the comments and recommendations resulting from this review.

Since the last AAC meeting, the Tevatron reached an important milestone. After nearly three decades of serving the U.S. High Energy Physics community at the Energy Frontier, the collider was powered down for the last time, delivering exceptional performance through its final hours. As the world's first superconducting synchrotron, numerous technological innovations enabled exceptional scientific achievements. The collider reached peak luminosities of 4×10^{32} $cm^{-2}s^{-1}$ and provided nearly 12 fb^{-1} of data at the CDF and DZero detectors. The discovery and precision measurements of the top quark and those of the W boson mass laid the groundwork for the search for the Higgs boson, which continues at LHC. A major achievement in neutrino physics was the discovery of the tau neutrino by the Tevatron's fixed-target program.

Fermilab's strategic plan for accelerators in the next two decades addresses the Intensity Frontier through development of Project-X and improvements of the existing accelerator complex. DOE organized a Workshop on the Fundamental Physics at the Intensity Frontier one month after the AAC review, which generated great enthusiasm for experimentation in neutrino physics and rare particle interactions. Fermilab's plan also addresses the Energy Frontier -- LHC and its upgrades, R&D for the ILC, and developments in view of a lepton (muon) collider -- through contributions in accelerator technology. The program is based on exploiting and enhancing Fermilab's world-class expertise in high-field magnets, superconducting RF, and beam dynamics/accelerator design and computation. The committee found that Fermilab's plan is well-aligned to the needs of the U.S. HEP program.

The Committee encourages Fermilab management to prioritize the components of the accelerator program at the implementation phase. We recommend that resource-balanced and prioritized schedules be developed within each of the following categories: the core mandate of Fermilab to operate and improve existing accelerators (including PIP and the Fermilab contributions to LARP); Project-X (including PXIE, which the committee endorses); and long-term accelerator and technology R&D. The prioritization process is particularly important given the large number of new ideas generated by the dynamic and creative staff. The Committee also recommends that Fermilab develop an integrated plan for high-power target design and operation. Details can be found in the full report.

One of DOE Office of Science's important missions is to address society's problems. IARC will create a new opportunity to transfer accelerator technology from Fermilab to industrial partners. The Committee strongly supports this effort. We encourage Fermilab to include industrial intellectual property protection in its business plan, and consider all of the laboratory's accelerator facilities for potential opportunities for industrial applications.

The Committee thanks the speakers for their efforts and expresses sincere appreciation to the FNAL directorate for its hospitality and planning for this review.

1. Strategic direction for accelerator activities

1.1 Response to charge

Is the program properly aligned with the strategic needs of the U.S. HEP program?

Observations

- The plan presented by the Fermilab management for the next two decades is clearly aimed at addressing the energy and intensity frontiers as outlined in the U.S. HEP program.
- The Accelerator program is well articulated in the context of Fermilab's 10-year goals. The program includes "Applying accelerator technology to society's problems", which addresses an important mission for the Office of Science.
- The high intensity frontier is addressed until ~2020 with the existing accelerators, which will benefit from the Proton Improvement Plan (PIP) and NOvA project for upgrading the beam power at 8 GeV (Booster) as well as at 60-120 GeV (Main injector) by a factor of two.
    - The main ingredient are the doubling of the cycling rate of the booster to 15 Hz and the conversion of the recycler as an accumulator to minimize the duration of the injection flat porch of the MI. Approved and planned experiments addressing neutrino, g-2 and Mu2e will immediately benefit.
    - In the meantime, development of Project-X is planned with the goal of starting construction in ~2016 (subject to project approval). A new initiative, PXIE, is dedicated to demonstrating key technologies. Project-X will provide, during that decade, an unprecedented amount of beam power of 3 MW at 3 GeV, 200 kW at 8 GeV and 2 MW at 120 GeV.
- The high energy frontier is addressed with contributions to the LHC and its upgrades (high luminosity as well as high energy), R&D for the ILC, and developments in view of a lepton (muon) collider. The program is based on exploiting and enhancing Fermilab's world-class know-how in high-field magnets for accelerators, superconducting RF, and beam dynamics/accelerator design. Test facilities are a key component, the new ASTA facility being a particularly remarkable one.
- In the view of funding uncertainties, Fermilab has adopted the practical strategy of being prepared to respond quickly to approval to proceed on long-term goals such as Project-X.

Recommendations

1. Actively participate in and be prepared to respond to the outcome of the DOE Intensity Workshop, which will be critical in establishing the science case for Project-X-type beams.

Are there other opportunities that are not contained within the lab's plan?

Observations

- There are opportunities presented by the ASTA and PXIE facilities that are not yet well articulated in the lab's plan. In particular, these facilities may open opportunities for development of industrial engagement and partnership.
- Present society's concerns for energy savings/sustainability are not included in the plan. Fermilab will remain an important user of energy and natural resources, and has the opportunity to apply its technological competencies to help minimize its future needs and potentially be applied elsewhere.
- Illinois Accelerator Research Center (IARC) will create a new mechanism that will enable close cooperation with industrial partners, knowledge transfer, and development of applications based on accelerator technologies. The present concept for IARC operation includes access to resources (engineering, support, etc) and facilities (RF, cryo, etc) as well as spaces in the beamline, much as it is typically done for scientific collaborators. It should be recognized that industrial R&D necessitates a focus on protection of intellectual properties. Solving this issue may require establishing dedicated enclosures (or otherwise separated areas) whereby one or more (even competing) industrial companies can conduct their tests and developments simultaneously.

Recommendations

2. Develop an integrated approach to the IARC. Consider including Fermilab accelerator facilities, such as ASTA and PXIE, to help identify areas of early engagement of industrial partners and to understand possible modification of the facility layouts. This can facilitate development of such industrial partnership. Potential opportunities include:
    a. KW-class silicon-carbide-based amplifiers
    b. Nuclear isotope production (PXIE energy is ideal for 90% of needed isotopes)
3. Consider incorporating energy sustainability in the design of future projects and in technology development. The solutions developed for that purpose would naturally increase the portfolio of IARC.
4. Include industrial intellectual property protection practices when developing the business plan for IARC. Continue dialogue with other labs nationally and worldwide that are developing similar industrial partnerships.

Are the components of the plan and activities properly prioritized?

Observations

- While the accelerator program goals are clearly articulated, their implementation does not clearly prioritize between its different components. This is amplified by the DOE practice to allocate resources directly to the programs.
- Fermilab scientists are very dynamic and inventive and there is no shortage of new ideas. This makes the prioritization process that much more important.
- High-power target design needs sufficient attention. A related issue is a plan for the costs of dealing with waste generated by high-power targets.

Recommendations

5. The committee encourages Fermilab management to prioritize the components of the Accelerator program at the implementation phase. We recommend that resource-balanced schedules be developed within each of the following categories:
    a. A focus on the core mandate of Fermilab to operate and improve existing accelerators for on-going and approved experiments. This includes the PIP and the Fermilab contributions to LARP.
    b. Project-X is a high priority as the favored option for regaining the leadership on the intensity frontier, and we endorse PXIE.
    c. For long-term accelerator and technology R&D, detailed recommendations are found in the following sections.
6. Develop an integrated plan for high-power target design and operation.

2. Fermilab's accelerator complex

2.1 Response to charge

Is the evolution of the Complex from present operation through the near-term plans, Project-X and beyond sensible and achievable?

Observations

- The plan starts with NOvA and the PIP, which includes upgrade and consolidation of the linac and booster to double the proton flux at 8 GeV and operate reliably until 2025. It continues with Project-X which will activate a new experimental program at 3 GeV and boost beam power at 8 and 120 GeV. The recycler will be modified in two phases, the first one for accumulating multiple booster proton batches using slip stacking (for NOvA), the second one for accumulating beam with multiple charge exchange injections from the 3-8 GeV Project-X linac.
- The presence of many technical challenges is a natural feature of a program concerning state-of-the-art technology. That begins with the PIP and culminates with the muon collider, more than 20 years later.

- In the short term, high-intensity operation of the recycler and reduction of beam loss in the booster are keys to the success of the PIP and ANU, as well as the Users.
- The committee has some concerns that PIP priority will suffer competition for resources with PX R&D.
- Initial plans for the transition from Project-X to a future muon collider are in the early stages, but the transition of operations from near-term to the Project-X era are not as clear.
- Lack of sufficient engineering support (rf, cryogenic, mechanical) is a concern.

Comment

- The short and medium term plan including Project-X is well articulated and matches very well the mission of Fermilab. Long term plans and the corresponding investment suffer by definition from more uncertainty. In that respect, studies and developments towards an MC (and possibly an NF as an intermediate stage) are of strategic importance.

Recommendations

7. Develop a resource-loaded schedule for PIP and have it reviewed.
8. Consider ways to highlight PIP priorities that can also benefit Project-X. An example is to consider putting a chopper in the front end of the Linac to reduce beam losses in the Booster. The design effort can also potential benefit Project-X.
9. Given the goal of doubling of the proton throughput, analyze in detail the limitations resulting from collective effects and beam loss in the accelerator complex and publish a comprehensive document outlining cures and /or mitigation measures.
10. Consider developing a plan for attracting and training rf/cryo/mechanical engineers to meet Fermilab's long-term needs, potentially working together with Argonne.
11. A plan should be prepared for dealing with the much increased quantity of radioactive waste that high intensity operation will generate.

3. Project-X R&D

3.1 Plans

Are the plans well-formulated?

Observations

- Reference Design of the Project X was established about 1.5 years ago as the preferred configuration and remains stable
    - First discussed at the July 2010 AAC meeting

- Only minor modifications since then
- Allows the team to focus on R&D and design of accelerator sub-systems

- The Reference Design supports
    - CW Linac with average beam current of 1 mA to 3 GeV
    - Pulsed Linac (3-8 GeV) will have a ~5% duty factor and will be capable to produce 200 kW beam
    - 2 MW at 60-120 GeV for long baseline neutrinos
- Current Status of the Project X:
    - Full set of CD-0 supporting documentation has been developed
- Collaboration MOUs for the RD&D phase between FNAL and 7 DOE Labs, 2 Universities and 1 virtual Lab (ILC) on R&D work has been established. Collaboration MOUs have been signed between FNAL and several scientific Labs in India.
- An Advisory Technical Board established with cross-collaboration membership of several National Labs
- Task Forces established to look at future connections
    - Muon Collider Task Force
    - Jointly formed by PX and MAP: Muons @ PX Task Force

Comments

- Both near-term and long-term plans on development and design of the Project X are very well identified. Complete set of documentation exists to immediately start the Construction Project as soon as DOE will request.

Recommendations

NONE

3.2 Technical Issues

Are the right issues being emphasized? Does the proposed program address the most urgent technical issues?

Observations

- Detailed R&D plan towards the design and construction of the Project X has been developed and targets risk mitigation associated with technical, cost, and schedule uncertainties
- The major new R&D initiative is the development and construction of the front end test facility - PXIE
    - High-intensity beam chopping with arbitrary bunch pattern in the MEBT

- Integration test of the RFQ, MEBT, HWR, SSR1
  - Two frequencies
  - CW RFQ
  - Two types of SC cavities and cryomodules
  - Beam instrumentation
- Additional primary elements of the R&D program include:
  - Development of an H- injection system
  - Superconducting RF development
  - Long pulse operation at 1.3 GHz
  - Linac design development
  - Upgrade paths: Muon Collider and Muons@PX Task Forces
  - R&D Test Facilities: NML, MDB (Meson Detector Building)

Comments

- The presented R&D plan adequately addresses needs of the Project X
- The committee welcomes the PXIE as a cornerstone of the R&D for near-term future
  - Tight schedule – start beam commissioning in the beginning of FY16
  - Ambitious task - deliver 1 mA, 30 MeV CW proton beam
- Design features of the Project X to support Muon Collider are being identified by MC Task Force
  - 5 mA average beam current in the CW Linac
  - Increased pulsed linac duty factor to 10%
  - Perhaps, requires variable RF couplers capable to support 1 mA average current for the baseline and upgradeable to 5 mA operation in future
- Significant progress since July 2010
  - H-minus ion source is operational
  - EM and mechanical design of LEBT, RFQ, MEBT and HWR are nearly complete
  - Several prototypes of SSR1, new single-cell low-beta 650 MHz cavity have been built, successfully tested and shown outstanding performance
  - Fabrication of the first high-beta 650 MHz prototype cavity is nearly complete
  - Beam physics in the CW H-minus linac is very well understood
    - Fermilab scientist, Valeri Lebedev discovered main source of the losses in an H-minus linacs – intrabeam stripping which is now confirmed experimentally at SNS
- Progress related to some critical R&D issues have not been presented in the Meeting

- Development of the fast chopper components
- Beam instrumentation
- High-power CW beam commissioning strategy and supporting hardware
- Reduction of cryogenic losses by lowering cavity residual resistance and optimized design of the cryogenic system

Recommendations

12. Develop a detailed resource-loaded schedule for the development, design and construction of the PXIE.
13. Identify critical R&D issues on development of beam instrumentation and high-power CW beam commissioning strategy.
14. Develop and implement upgradable cost-effective design of the Project X to support future high power proton driver for the Muon Collider.
15. Investigate cost reduction by staging the Project X Linac providing the best fit to the science case.

Technology Development Programs

Are the plans well-formulated? Is adequate progress being made? Are the right issues receiving the required attention?

4.1 General

Recommendations

16. In view of the critical role high power target technology plays in the near-term NUMI and NOvA projects but also in the longer-term Project X, FNAL is encouraged to prepare a plan on how to develop this expertise on site and to begin to assemble a core group of experts in high power targets and remote handling.
17. FNAL is encouraged to study the possibility of saving and recovering energy from Project X and possibly other accelerators on site, and pursue collaborations with other accelerator labs with similar sustainability goals. Possible partners are ESS, SNS and TRIUMF.

4.2 Superconducting RF

Observations

- FNAL has developed a strong and remarkably broad SRF program in a relatively short period of time. The SRF infrastructure and facilities are impressive and competitive internationally. SRF is rapidly becoming a core competency of the lab, and is enabling

FNAL to be prepared to support new accelerator initiatives within the Office of Science on and off site.

- In addition to technology development, the Fermilab SRF program extends into the fundamental science of RF superconductivity, which is both essential for continuing advances in the field, but also is not conducted in many places.

- A comprehensive SRF program has been developed under the ILC in support of the 1.3 GHz RF Unit Test. This opportunity, along with ARRA funding, has been effectively leveraged to create a world-leading test facility in ASTA.

Comments

- The committee has not been given evidence that the Project X gradient requirement of 25 MV/m for the 1.3 GHz SRF linac has been determined to be an economic optimum.

- Consider increasing the design gradient for the spoke cavities.

- In view of the excellent results from the JLab beta 0.6 cavity design, consider focusing development and optimization of the next cavity design of beta 0.9.

Recommendations

18. The Centrifugal Barrel Polish technique has yielded promising results to date and FNAL is encouraged to incorporate it as part of the baseline processing procedure.
19. The ILC funding has contributed substantially to the growth of SRF at FNAL, and plans should be developed by management to ensure the continuity of the program in the case ILC funding stops.

4.3 Superconducting Magnets and Materials

Observations

- The Fermilab Superconducting Magnet Program has a leading role in development of technology for accelerator-ready magnets. The long history of key contributions has evolved into a cutting-edge program investigating applications of new technology. The Nb_3Sn-based program is well developed and on the verge of implementing the first accelerator application of this material. They are key LARP contributors and their participation in the LHC luminosity upgrade will be essential given the excellent construction and test facilities and experience in integrating accelerator projects.
- The near-term program is focused on delivering 11T dipoles for the LHC. Success of this project is an important milestone in securing Nb_3Sn as an accepted option for future projects.
- The program has effectively used collaboration to leverage resources and move development forward. Fermilab’s role is well-defined.
- Creation of a Superconducting Materials R&D Department is excellent. It will be an important foundation for both the SRF and magnet programs.

- The program is aggressively pursuing development of HTS materials for very high field applications. Development of HTS into a viable magnet conductor will be very challenging. A vibrant conductor and materials program is essential for success. So far, the new Materials Department has made excellent progress.
- Several opportunities for expanding the program into large, high field solenoids; MICE, Mu2e, MC 6-D Cooling, final focus and ITER.
- National resource that must be preserved.

Recommendations

20. 11-T project should receive the highest priority.
21. As soon as possible, start to incorporate rad-hard materials into mainstream magnet development program.
22. Need to develop a transition plan from LARP to construction for the LHC upgrade(s).
23. The HTS program should not rely too heavily in the near-term on accelerator magnet applications as the main driver but rather high field solenoids when considering effective application of resources.
24. Choose expansion options carefully by ensuring that goals are aligned with program goals.

5. Accelerator R&D Program

5.1 NML/ASTA program

Are the plans for the program at NML/ASTA well-founded? Is adequate progress being made?

Observations

- ASTA represents an important opportunity to demonstrate a complete ILC RF unit and leverage this large investment to create a unique facility for advanced acceleration research at Fermilab.
- Space for beamline modifications, experimental apparatus and additional laser system(s) is a strength when compared to other facilities (AWA, ATF, FACET).
- The ILC-like pulse structure (beam power and more importantly rep rate) is unique to ASTA and sets it apart from other facilities.
- Experience from A0 with EEX to produce specialized longitudinal trains/profiles is an advantage and has been leveraged in the design of ASTA in anticipation of creating specialized current profiles to optimized beam driven wakefield experiments.
- A schedule allocating beam/facility time needs to be developed balancing priorities such as installation, commissioning, ILC SRF, AARD.

- Following recommendations from the previous AAC meeting, management has selected three initial experiments to focus on (x-ray radiator, IOTA-ring, DEEX line).
- The need to establish a panel of experts in targeted fields (accelerator physics, advanced accelerator research, photon science, beam physics) to review proposals in the context of worldwide efforts, help prioritize and select the best opportunities is recognized.
- Provided sufficient beam quality is realized, the ASTA pulse structure, repetition rate, energy and possibility for expansion represent an opportunity to grow into FEL research.
- HBESL offers a chance to continue the important educational aspects of the A0 program while pursuing valuable cathode/injector research in an environment with low programmatic risk and relatively low cost.
- The need to select a program leader for advanced accelerator research to coordinate AARD efforts across the sector and grow the user community is recognized.
- Construction of the IOTA ring seems compelling as a stand-alone project and especially when considered as part of a longer term goal of demonstrating optical stochastic cooling.

Recommendations

25. Continue to develop ASTA into a facility for advanced accelerator research focusing on the existing gun/cathode combination.
26. Develop a schedule and commissioning plan for ASTA that balances priorities between installation activities, RF tests, beam commissioning and beamtime for experiments. Keep the user community informed about evolving timeline.
27. Perform detailed beamline simulations and develop consistent set(s) of anticipated beam parameters that will be available as a function of time and beamline location. Work with users to understand the requirements for the currently planned experiments as well as for future beam-driven wakefield experiments (dielectric and plasma) and develop optimal machine configurations.
28. As time/effort allow proceed with plans to transform the decommissioned A0 facility into HBESL. Continue to engage partners at NIU, UChicago to attract and train young scientists.
29. Proceed with plan to recruit program leader to coordinate AARD efforts across the sector (HBESL, ASTA, Protoplasma) and develop the user community for ASTA & HBESL.
30. Fully understand radiation safety implications of beam loss with multi-kW beams at ASTA, specifically the impact on user areas and equipment.
31. Estimate the tolerance of machine errors for IOTA to sustain the integrability, including intrinsic disturbing effects such as fringe field, impedance, intrabeam scattering, etc. Develop a diagnostics/tuning plan to recover the integrability.

5.2 Accelerator computation

Observations

- Advanced computational physics in accelerator science at Fermilab has a history of more than 10 years. The development of advanced computational tools for high-performance computing is leveraged by resources from the SciDAC2 ComPASS project and support from the various Fermilab accelerator projects.
- The emphasis is on computationally-challenging problems (also involving multiphysics and/or multiscales), such as beam evolution under space-charge, beam-beam, electron cloud, and cooling effects; wakefields and multipacting in accelerating structures; and advanced acceleration concepts such as muon capture and acceleration, and laser and plasma wakefield acceleration. Specific examples include simulations of beam dynamics including space charge in the Booster for Run II, impedance of laminated structures in the Booster for PIP, beam-beam dynamics in the Tevatron for Run II, resonant extraction including space charge in the Debuncher for mu2e, electron cloud dynamics in the Main Injector for Project X, and plasma wakefield dynamics for the proposed protoplasma experiment.
- The activities appear to be effective in supporting operations, near-term projects, future proposed projects, and general R&D.

Recommendations

NONE

5.3 Other physics opportunities

Are there other physics opportunities that should be considered?

Observations

- The ProtoPlasma concept was introduced with some initial simulations modeling Fermilab proton beams (compressed 8GeV or uncompressed 120GeV) studies of proton driven plasma wakefield acceleration (PD-PWFA). The idea is intriguing and could represent another opportunity for Fermilab to expand into the area of advanced accelerator R&D leveraging capabilities that are unique in the US.

Recommendations

32. More detailed calculations, simulations and analysis should be done to narrow the parameter space, allow a more refined cost estimate and bolster the physics case. A parallel effort should evaluate if the proposed experiments are either complimentary to the MPI-CERN PD-PWFA collaboration efforts, a lower cost alternative with the same physics potential, or an expensive duplication of effort. This evaluation could be done in direct dialog with the collaboration that is planning the CERN-aimed proton plasma experiment. Fermilab should also consider where this effort would go after the proposed initial experiments and consider this in the light of other commitments.

5.4 Muon Accelerator Program

Is the Muon Accelerator Program properly focused and making adequate progress?

Observations

- The Muon Accelerator Program (MAP) is organized in 2010 under the new national initiative to unify the DOE supported R&D in the U.S. aimed at developing and demonstrating the concepts and critical technologies required for the Muon Colliders (MC) and Neutrino Factories (NF). The MAP will help the high-energy physics community to make an informed decision on the optimal path to a high-energy lepton collider and/or a next-generation neutrino beam facility. The MAP includes 15 participating institutions, more than 200 participants. The anticipated FY12 budget is 12M$. Fermilab's share in the MAP budget is about 60%.

- Through the R&D in the past decade, the basic strategy for the MC and NF has been more or less converged. The MAP builds-up on multi-year developments, which includes design study toward MC and NF (International Design Study for a NF – IDS-NF), which in particular resulted in development of a helical high field cooling channel, which combines RF and H_2 filled absorbers, providing 6D cooling.

- MAP also based on key technology developments, including proof-of-principle demonstration of a liquid Hg jet target in high-field solenoid, development of 800MHz and 200MHz RF cavities aimed at operation in 5T magnetic field, development of high field HTS 30T solenoids.

- MAP priorities will focus on key technology developments mainly for RF cavities in magnetic fields and high-field solenoids for final cooling. Rapid cycling magnets for RCS will be also developed with small seed effort. MAP deliverables will include a Design Feasibility Study which will answers the question on the feasibility of a multi-TeV Muon Collider by ~FY16, and will define the plan for the potentially needed 6D cooling test facility by the same time.

- As reported to the Committee, MAP also builds-up on the aspiration that the Muon Ionization Cooling Experiment (MICE), the multi-stage experiment at RAL, will be completed by ~2014.

- It has been communicated to the committee, that MAP management is aware of significant schedule risk for the completion of MICE step VI due to UK funding limitation, which may result in slipping of the completion of step VI to FY16 or beyond, and is preparing corresponding scenarios.

- In particular, if the final step VI of MICE slips well beyond FY16 (and depending if the step V still completed before 2016 or not), MAP will plan to understand the detailed schedule and re-evaluate the MAP part of the step VI plan. The decision on the feasibility of the MC then might need to be taken without completed results of MICE.

- An outline of the upgrade plan of Project X for MC/NF has been reported. The upgrade of the ion source, RFQ, collimators, CW & pulsed proton drivers seem feasible without any show stopper. Additional accumulator/compressor rings and the beam delivery to the muon target have been (pre-)conceptually designed, but a few concerns are reported in stripping, beam loss, instabilities, and beam size after bunch rotation.

Recommendations

33. The chance of MC as the next generation lepton collider can be increased depending on the result of physics in LHC in coming years. The MAP program must be accomplished not to lose such an opportunity.
34. Evaluate and re-develop the MAP schedule and priorities based not on the aspiration-driven, but on realistic funding and technically limited MICE progress. Together with MICE collaboration, develop a realistic plan that would optimize the use of global (US and international) resources and efforts most optimally.
35. Continue the design effort on the accumulator/compressor rings and the final focus system to the target.

Charge

Fermilab Accelerator Advisory Committee Meeting

November 7-9, 2011

The Fermilab Accelerator Advisory Committee is asked to assess and provide advice on the following topics:

1. **The overall strategic direction** for accelerator activities at Fermilab. Is the program properly aligned with the strategic needs of the U.S. HEP program? Are there other opportunities that are not contained within the lab's plan? Are the components of the plan and activities properly prioritized?
2. **The plans for evolving Fermilab's Accelerator Complex**. Is the evolution of the Complex from present operation through the near-term plans, Project-X and beyond sensible and achievable?
3. **The progress and plans for Project-X R&D**. Are the plans well-formulated? Are the right issues being emphasized? Does the proposed program address the most urgent technical issues?
4. **The progress and plans for the Technology Development programs**. Are the plans well-formulated? Is adequate progress being made? Are the right issues receiving the required attention?
5. **The progress and plans for Fermilab's Accelerator R&D program.** Are the plans for the program at NML/ASTA well-founded? Is adequate progress being made? Are there other physics opportunities that should be considered? Is the Muon Accelerator Program properly focused and making adequate progress?

Agenda

Fermilab Accelerator Advisory Committee Meeting November 7-9, 2011

Start	Duration	End	Speaker	Topic
Monday Nov. 7, 2011				
8:30	0:30	9:00		Executive Session
9:00	0:35	9:35	S. Henderson	Overview and Strategy
9:35	0:15	9:50		Discussion
9:50	0:30	10:20	R. Zwaska	Accelerator Complex in the Near Term:PIP and NOvA
10:20	0:30	10:50		*Coffee Break*
10:50	0:25	11:15	E. Prebys	Accelerator Complex in the Near Term: Muon Physics Program
11:15	0:30	11:45	S. Holmes	Project X Update
11:45	0:30	12:15	S. Nagaitsev	Project X R&D Program
12:15	0:15	12:30		Discussion
12:30	0:45	13:15		*Lunch*
13:15	0:35	13:50	R. Kephart	Integrated SRF Program
13:50	0:30	14:20	M. Champion	325/650 Program
14:20	0:30	14:50	C. Ginsburg	1.3 GHz Program
14:50	0:30	15:20	L. Cooley	SRF/SC Materials Program
15:20	0:10	15:30		Discussion
15:30	0:30	16:00		*Coffee Break*
16:00	0:30	16:30	G. Apollinari	SC Magnet Strategy and Program
16:30	0:30	17:00		Discussion
17:00	1:30	18:30		Executive Session
Tuesday Nov. 8, 2011				
8:30	0:30	9:00		Executive Session/Follow-up on Previous Day's Material
9:00	0:30	9:30	V. Shiltsev	Accelerator R&D Strategy and Program
9:30	0:20	9:50	Y. Sun	A0 AARD Program
9:50	0:35	10:25	P. Piot	NML/ASTA Beam Physics Program
10:25	0:30	10:55		*Coffee Break*
10:55	0:25	11:20	M. Church	NML Status and Plans
11:20	0:30	11:50	A. Valishev	Integrable Nonlinear Optics and IOTA Ring
11:50	0:20	12:10	C. Thangaraj	Protoplasma Experiment
12:10	0:10	12:20		Discussion
12:20	0:40	13:00		*Lunch*
13:00	0:40	13:40	S. Geer	Muon Accelerator Program
13:40	0:30	14:10	K. Gollwitzer	Project X as a Muon Facility Platform
14:10	0:30	14:40	V. Lebedev	Project X Low-energy Muon Task Force
14:40	0:30	15:10	P. Spentzouris	Computational Program
15:10	0:30	15:40		*Coffee Break*
15:40	0:45	16:25		Discussion
16:25	1:30	17:55		Executive Session
Wednesday November 9, 2011				
8:30	1:00	9:30		Follow-up with Committee
9:30	2:00	11:30		Executive Session
11:30	1:00	12:30		Closeout
12:30	1:00	13:30		Lunch for Committee