Fermilab Accelerator Advisory Committee

Report of the December 4-6, 2006 Meeting

January 30, 2007

Committee

J. Corlett (LBNL, Chair), S. Chattopadhyay (TJNAF), G. Geschonke (CERN), G. Hoffstaetter (Cornell), K-J Kim (ANL), S-I Kurokawa (KEK), M. Minty (DESY), H. Padamsee (Cornell), S. Peggs (BNL), T. Raubenheimer (SLAC), H. Weise (DESY),

Introductory remarks

The committee recognizes the hard work of many Fermilab staff involved in preparing for this meeting. We would like to thank the presenters for well-prepared materials and for informative and interesting discussions, and administrative staff for assisting the committee with travel arrangements and hospitality.

Executive Summary and General Comments

The committee was charged to take a broad view at the entire Fermilab accelerator R&D program, accompanied by a more detailed look into areas in which Fermilab is planning new initiatives to provide enhancements to the accelerator R&D program aimed at the post-Run II era. The context for these discussions is the changing nature of high-energy physics activities in the near future, in particular the end of Tevatron operations on October 1, 2009. Energy frontier physics experiments have been the mainstay of operations at Fermilab for twenty-three years, and long-baseline neutrino physics at Fermilab is also a world-leading program. Other facilities will come on-line elsewhere in the near future, and in preparation for loss of the energy frontier and competition in neutrino experiments, the laboratory is implementing and developing strategies to remain a pre-eminent experimental high-energy physics facility. The laboratory has two strategic accelerator technology goals:

- Energy frontier, involving work on LHC (LARP), ILC, Muon Collider, and AARD.
- Neutrinos, involving work on NUMI/MINOS, NOVA, SNuMI, HINS, and Neutrino Factory.

Plans to reorient the Fermilab accelerator organization to provide R&D support to meet these future needs were presented, with an emphasis on strategic vision. Aligned with these plans, the science strategy of Fermi Research Alliance (FRA), which was awarded the Fermilab operating contract beginning January 2007, includes neutrinos, particle astrophysics, and a strong commitment to locating the ILC in northern Illinois, as well as creation of an Accelerator Physics Center (APC) at Fermilab to drive the R&D program.

A balanced accelerator R&D program was presented that not only addresses the short-term needs of FNAL, but also aims to be sustainable in the long run. The committee welcomes the

establishment of the APC. The APC is expected to provide a necessary focal point for a strong and diverse program in directed R&D, needed to retain flexibility and options for the future.

The committee applauds the steps being taken to secure the ILC at Fermilab, the excellent work to date in developing superconducting RF technology and infrastructure relevant to ILC and other future accelerators, and development of plans for an ILC test accelerator. The creation of an ILC management position in the Directorate is welcome, and reflects the need for the ILC program to have access to all laboratory resources. Outreach to local communities and state institutions is important, the good work to date in communicating with local organizations and state bodies is recognized, and further developments encouraged. Expanded presence of Fermilab in the ILC GDE organization is encouraged as a means to enhance global understanding and recognition of Fermilab's desire to host the ILC.

Fermilab, given its role nationally and internationally as one of the stewards of accelerator-based high-energy physics, must put its activities in facility development, large-scale global projects such as the ILC, and accelerator R&D, in the national and international context before establishing internal positions on them.

The near future sees the "sun-setting" on the antiproton complex. The committee recognizes this facility as a great accomplishment of Fermilab, and a resource for the worldwide scientific community. Communications with a broad range of scientific disciplines should be made to assess potential applications of the complex, and ensure that modifications made to the infrastructure that may influence the viability of resurrecting the anti-proton source are done so with full knowledge of the potential impact to the scientific opportunities.

There appears to be a competition for resources among a large variety of accelerator projects at Fermilab: LHC/LARP, ILC, neutrino beams, neutrino factory, muon collider, and advanced accelerator R&D. At the same time resources are limited and there are uncertainties in the level of funding in the short term and long term. It would be advantageous to establish relative priorities depending on various long-term funding scenarios, as well as to show the effect of shorter term funding situations on the strategy.

Bringing together the many accelerator physics talents distributed over the laboratory into the APC to carry out a coordinated plan of activities in accelerator R&D would provide an exciting venue to stimulate new approaches, and much synergy to facilitate progress. It would provide an ideal home for education, and staff and student development. The priorities and the scale of the various activities need to be made consistent with the general priorities of Fermilab's mission. There needs to be a good mechanism for strongly coupling the needs of the divisions to the activities pursued by the APC, considering that the divisions would be missing some of their key players. This is especially pertinent to the operation of existing accelerators.

More detailed comments and recommendations for each point of the charge (see Appendices) are given below.

R&D Program Overview

Findings – R&D Program Overview

The committee was presented with a comprehensive overview of the laboratory's accelerator R&D program, which includes activities supporting Tevatron operations, LARP, ILC, neutrino physics, muon collider, and emerging plans towards an Accelerator Physics Center, as well as towards a multi-purpose test facility around an ILC test accelerator.

Plans for establishing significant superconducting RF (SCRF) infrastructure, including cavity preparation and testing, cryomodule assembly, an ILC cryomodule test facility with RF and beam (the ILC cryomodule test accelerator, ILCTA), and consolidating the A0 injector into an advanced accelerator test facility co-located with the ILCTA, were all presented. Collaborations with other institutions have been developed in all areas of Fermilab's R&D.

Comments – R&D Program Overview

The goal of increased attention to long-term R&D is welcome and strongly supported by the committee. The move to expand from Fermilab's traditional focus on activities in support of operations would enhance options for the future of accelerator-based HEP facilities, and allow greater flexibility in Fermilab's approach to future activities.

The committee makes the following comments and recommendations on the overall R&D program:

- Accelerator R&D activities at Fermilab are in general well balanced and integrated with Fermilab's entire accelerator program. The committee applauds the diversity of activities as appropriate and essential for the development of options for accelerator-based high-energy physics.
- Fermilab should take a position as a role model in large-scale accelerator initiatives and projects, including accelerator R&D. Obtaining a broad perspective with input from participants in the global accelerator community would enhance the strength of Fermilab's leadership.
- Fermilab should seek further engagement of university faculty in accelerator R&D programs.
- To assure that FNAL is well prepared for the challenges to be faced with facilities of the far future such as a muon collider, it must take a stewardship role to advance the necessary technologies towards readiness for such time that the concept and community matures towards its implementation.
- The A0 photoinjector facility, currently supporting Fermilab's advanced accelerator R&D (AARD) activities, will close in summer 2007, and it will take up to 2 years to establish a new beam test facility at the ILCTA. The committee understands that establishing completely separate facilities for AARD and ILC-related tests may not be practicable. We recommend that serious attention be given to optimize the design of the ILCTA such that it may be integrated with a new AARD facility and share common infrastructure.
- The laboratory management exhibited a serious and cautious approach towards establishing a laboratory-directed R&D (LDRD) program, which is still under consideration.

The International Linear Collider (ILC)

Findings - ILC

The Fermilab ILC program was presented in five talks describing activities, which have a focus on the development of SCRF technology and test facilities for the main linac. The program is now organized, along with SCRF efforts, as an office in the Directorate. Activities include design and R&D on SCRF cavities, cryomodule and components, controls, instrumentation, LLRF systems, cryogenics systems, magnets, test facilities for accelerator and detector components, conventional facilities, tunnel layout and installation, and accelerator design, in addition to cost and schedule estimates, and planning for a bid to host the ILC. Two major components are the buildup of significant infrastructure to support the SCRF cavity program, and the ILCTA to be located in the New Muon Lab (NML).

The main activities of the current and near-term ILC program are design studies and globally coordinated R&D. As part of the Global Design Effort (GDE), FNAL's stated goal is to help design the machine, estimate the cost, and gain international support to host the ILC. Fermilab has taken responsibilities for the main linac accelerator physics and technology, and has established itself as an international collaborator and leader.

Many Fermilab personnel are involved in the Reference Design Report (RDR), and while the scope and goals of the next stage of ILC design – the Engineering Design Report (EDR) – are still being developed at both the ILC Americas Regional Team (ART), and GDE levels, Fermilab has initiated planning to support the EDR. Significant resources in engineering, design, and project management are available at Fermilab. How these may be best used to support the ILC is currently under discussion within the national and international collaborations.

Fermilab is preparing to bid to host the ILC, and the necessary development of technical expertise and site-specific civil design is well under way. Outreach to the local community has begun, collaborations with nearby scientific institutions (e.g. ANL, Illinois universities) are being strengthened, and Fermilab is working to explain the benefits of hosting the ILC to the state of Illinois. Funding for a $35M building on the FNAL site, the Illinois Accelerator Research Center, is in the Illinois Capital Bill.

R&D on the SC cavities and cryomodules has proceeded primarily in collaborations with DESY, Cornell, J-Lab, Argonne, with smaller efforts at MSU, LANL, and elsewhere. Activities are in alignment with guidance from the GDE R&D Board (RDB) S0, S1, and S2 task forces. Progress has been made in the past year in building infrastructure for cavity preparation and SCRF hardware. A 9-cell SCRF capture cavity delivered from DESY, to be used in the ILCTA, has been re-assembled, and the cavity has achieved a gradient of 31 MV/m. A horizontal test cryostat vessel has been fabricated and delivered to Fermilab, and deployment of the full test system is expected in March 2007. Construction work is in progress for a vertical test stand, to be completed by summer 2007, and room is available for two more vertical test stands. The Cryomodule Assembly Facility (CAF) clean room for cavity string assembly is in an advanced stage of construction. A significant number of cavities have been ordered, 4 in FY05, 20 in FY06, and are starting to be processed at Jlab and Cornell. Building of a new BCP-EP facility in

collaboration with ANL is proceeding, and the ILC cavity electropolishing facility at Argonne is expected to be operational in 2007.

Cryomodule design is proceeding in collaboration with INFN, DESY, KEK, and CERN, with a goal to build an improved (type-IV) cryomodule at Fermilab by FY09. The CAF will be used to assemble two type-III cryomodules before then, requiring completion of the clean room, assembly fixtures, test preparations, et cetera.

Design and fabrication of 3.9 GHz cavities for the FLASH facility at DESY has been a pilot program for much of the Fermilab SCRF infrastructure. Delivery of the cavities has been delayed by problems with Higher Order Mode (HOM) couplers, and is now expected in 2008.

A test beam program to support ILC detector development is being established, and a workshop is planned for January 2007 to discuss options. Impact on Fermilab infrastructure is expected to be minimal, requiring only minor modifications, planned to be completed in 2006.

Comments - ILC

The committee applauds Fermilab for taking strong leadership and collaborative roles in defining the reference design and costs for the ILC Reference Design Report (RDR), particularly with regard to the SCRF cavity and cryomodule.

The committee strongly supports Fermilab's bid to host the ILC, and recommends that stronger roles in ILC leadership be established to enhance their prospects in this regard. Fermilab is already actively involved in many segments of the GDE and ART, and a larger role for Fermilab at the higher levels should be secured. At present there is no Fermilab representation on the executive council of the GDE, and as the RDR transitions into the EDR, this would be a timely opportunity for Fermilab to seek involvement. It may be expected that the GDE will become more centralized in the EDR phase, and a natural evolution is to establish a design center in each international region to clearly define contact points and reduce unnecessary duplication in activities. The committee recommends that FNAL pursue such a role as host to the ILC Americas design center. Exchange of personnel with other design centers, particularly in Asia and Europe, is recommended to further strengthen international collaboration and for staff training, and build confidence in the ability of FNAL to host the ILC. Additional suggestions are to increase communications with ART leaders, to base the ART Director at Fermilab, to continue to strengthen and expand international collaborations, and to establish international leadership for various tasks for the EDR including cryomodule design and costing, coordination of cavity development, and civil engineering design and costing.

Construction of the Illinois Accelerator Research Center on the Fermilab site would be a significant step in strengthening ties with the state. The committee applauds the Fermilab efforts to secure this building through state funding, and we hope for a positive outcome.

Fermilab has demonstrated impressive leadership in the SCRF R&D and RDR programs, engaging in national and international collaborations, and coordinating activities in the ILC SCRF program. There has been excellent progress in planning and building cavity preparation and test hardware. An example is the capture cavity, which has been successfully re-

commissioned at Fermilab, an important result demonstrating co-ordination of several groups: cryogenics, cryomodule assembly, RF, LLRF, and facilities. The CAF is well developed and looks impressive on the floor. Results from activities at collaborating institutions are coming in, and there is an opportunity for Fermilab scientific and technical staff to obtain training in cavity and cryomodule technology, and linac operations, at other institutions. The committee supports Fermilab plans for development and deployment of the SCRF infrastructure needed for ILC and other SCRF-based accelerator projects.

In order to achieve the goal of 35 MV/m accelerating gradient in the main linac, the task of demonstrating a reproducible process for production of cavities is of highest priority. The GDE RDB S0 task force has defined a "tight loop" cavity processing demonstration using existing world-wide infrastructure, with goals to understand SCRF surface physics and establish process controls to reliably achieve high gradient. Fermilab is successfully leading the coordination of U.S. efforts in support of these goals.

FNAL is also driving the effort to engage U.S. vendors for SCRF cavity production, and work has begun with AES and other companies in producing cavities for subsequent conditioning and testing in the new facilities. There is a need to develop U.S. vendors and industry should be engaged in a systematic way. Plans for the industrialization should be developed during the EDR. While the program to industrialize fabrication is important, it will likely be funding limited and must be balanced with the R&D and design efforts.

DESY's participation in supplying hardware and knowledge in SCRF is extremely valuable, and a good example of an effective collaboration that has been ongoing with Fermilab for many years.

The committee recognizes the need for test beams for ILC detector development and strongly supports the Fermilab program.

Significant activities are being considered for the next 3-5 years, and strategic planning and prioritization is now required. More detailed schedules should be made to ensure that the plans are realistic, and to better prepare tradeoffs in light of possible funding shortfalls. A comprehensive and integrated timeline for the flow of activities, such as cavity production and preparations for "tight loop" processing, helium vessel welding, horizontal cold test, cryomodule production and testing, beam testing, et cetera, needs to be developed. Such a schedule will be extremely valuable in helping to organize the large numbers of activities and participants. It would also be very helpful to the GDE in understanding the real timeline to meet the milestones relative to the timeline for the EDR.

The Fermilab Accelerator Physics Center (APC)

Findings - APC

The Accelerator Physics Center will be created in late spring to early summer 2007, to support Fermilab's vision of future accelerator-based physics at the energy frontier and in neutrino physics. The mission to perform R&D for the energy frontier involves LHC (through LARP), ILC, and muon collider. For the neutrino sector, work involves NUMI/MINOS, NOVA, SNuMI,

HINS, and NFMCC. The APC will also be home for AARD activities at Fermilab. The laboratory envisions the APC as providing a greater focus on longer term R&D, strengthening it's role as the primary U.S. center for accelerator-based high-energy physics, and positioning itself as an internationally preeminent center in accelerator R&D.

The laboratory plans a strong start with an initial complement of about 40 personnel, matrixed to the Center primarily from the Accelerator and Technical Divisions, and with anticipated involvement of the Computer and Particle Physics Divisions. The APC will provide support for the existing operations, but is not imagined as having line responsibilities for the Fermilab accelerator complex operations program. It will train accelerator physicists, and establish facilities for a broad accelerator R&D program. A comprehensive range of functions and support for related applications will be provided; in theory, design, and modeling for LARP, ILC, and generic energy deposition; in experimental beam research at facilities at FNAL and elsewhere including AARD at the ILCTA facility, for the high intensity neutrino source (HINS), and for muon and neutrino programs at the Muon Test Area (MTA); in education and training under the Fermilab Ph.D. program, USPAS, summer students, and fellowships.

The FNAL directorate noted, and the committee agrees, that accelerator projects at Fermilab and nationally suffer from a lack of qualified Ph.D. level accelerator physicists. If the production of Ph.D.s stays at its current level, this problem is likely to increase significantly. The educational possibilities at the APC are therefore very welcome, and we strongly encourage efforts to involve university groups from around the country.

Findings – ILCTA and AARD

Plans for the ILC Test Accelerator, to be located in the New Muon Laboratory, were presented. A staged approach is planned, leading to testing of an ILC RF unit (three cryomodules plus associated power supplies, controls, and other infrastructure), and is consistent with the ILC needs as described by the GDE RDB S2 task force. The initial layout concepts presented to the committee appear reasonable, and allow for flexibility as the design evolves. A new cryogenics system will be required for the ILC RF unit test.

Beam tests are planned at the ILCTA, and components and personnel from the A0/FNPL photocathode test facility will be used in building the test beam source. Alternate configurations of the injector were presented. There is interest from outside the ILC to have access to the ILCTA, or co-located facilities, for the purpose of experimental advanced accelerator R&D, using the electron beam. Some of the test beam configurations allow production of high-brightness beams for AARD, as well as beam testing of the ILC cryomodules, and potentially the use of accelerated beams in an experimental area downstream of the cryomodules. An extension of the NML is required to accommodate the desires of a "long" injector (25 m), which would provide beams of high quality suitable for AARD, and an AARD experimental area, together with an ILC RF unit.

Findings - Muon Collider R&D

A Muon Collider Task Force (MCTF) has been constituted by the Fermilab Directorate to develop a plan for advanced R&D in technologies required for a muon collider (MC), as a potential long-term path for extending the energy frontier. The MCTF is lead by Fermilab, but

includes members from BNL, LBNL, and Muons Inc. Muon collider designers have achieved a conceptual breakthrough, in demonstrating (on paper) the first design of a complete and self-consistent cooling channel. This is achieved by injecting multiple bunches that are merged after the first cooling section. Currently the baseline design uses one or more helical "Guggenheim" structures to generate large dispersion, and using wedge absorbers, for upstream muon cooling. The first Guggenheim incorporates 201 MHz RF cavities, and has a circumference of 33 m. Baseline muon survival fractions around 50% are anticipated. Alternatively, it may be possible to replace the Guggenheims with a much shorter helical cooling channel, incorporating RF cavities inside a 15T helical solenoid. Downstream cooling is anticipated using 50T solenoids.

APC MC activities areas were presented in three areas:

- Collider design and simulation to establish required cooling parameters.
- Component development in helical magnets, high temperature superconductor (HTS) high field solenoids, and pressurized RF cavities. The need for magnet design and development is reflected in APC collaboration with the core High Field Magnet program in the Technical Division (TD). For example, the ~50T solenoid for the final cooling section must be made from HTS, to reduce power consumption.
- Beam tests and experiments with high intensity proton beams and muon beams. Two of the three main experimental activities are in Europe – the MERIT targetry experiment at CERN, and the international MICE cooling experiment at RAL. The third experiment, MUCOOL, is being performed in conjunction with Muons Inc, in the MTA area fed by the Fermilab linac.

It is proposed to have completed prototype helical cooling channel magnets for the 6D cooling experiment tests in the MTA, and to have built a prototype high field HTS solenoid, by the end of FY10. The MCTF magnet effort provides co-ordination with other labs (BNL, LBNL, NHMFL) and Muons Inc. At Fermilab, the proposed magnet work would take place inside the core High Field Magnet program of the Technical Division. With MC involvement, TD would then be pursuing nine core superconducting magnet activities: 1) LHC/LARP, 2) HINS, 3) ILC, 4) MC, 5) Tevatron support, 6) Nb3Sn Mirror dipole, 7) Nb3Al collaboration with NIMS, 8) HTS R&D, and 9) Nb3Sn conductor development.

Comments – APC

The committee supports the creation of the Fermilab Accelerator Physics Center to provide a focused driving force for accelerator R&D aligned with the Fermilab mission, with particular emphasis on the post-Run II era. The vision of integrating various accelerator R&D elements tied to short-term, medium-term and long-term programs of the laboratory, managed by staff who have matured through direct operational experience of accelerator facilities on campus, is a first in the history of the laboratory. It is a welcome development. As it becomes the sole accelerator-based high-energy physics facility in the U.S., FNAL has a natural interest in stewardship of resources necessary for future facilities for high-energy physics.

The mission and organization of the APC within the laboratory appear to have been carefully crafted and established to significantly enhance Fermilab's capabilities and profile in the accelerator community. The list of topics suggested for APC involvement is broad and comprehensive. The APC needs to prioritize this list, and (regretfully) only engage in those areas where it can reasonably expect to make significant contributions to the laboratory's plans. APC

activities should also be strongly coupled to the needs of the Accelerator and Technical Divisions.

The creation of the APC presents an opportunity to define a model institution that not only serves the science, but also establishes priorities in mentoring the next generation of scientists for developing innovative accelerators to serve in decades to come. The APC is expected to help attract students into the field of accelerator physics, to provide a good environment for these students, and to contribute to overall improved coordination of college-level and graduate student training. For successful functioning of the center, the institution will have to embrace 'matrix organization' with a properly enlightened attitude and spirit.

The following comments and recommendations are in the spirit of further strengthening the positive attributes of the APC:

- Establish a peer review of the proposed advanced accelerator R&D in the context of adding the highest quality and value relevant to the future of FNAL. In this exercise it is important that the neighboring laboratory ANL be brought into consultation, particularly through the involvement of the Argonne Accelerator Physics Institute, due to its long history of AARD, and common management through the University of Chicago.
- It is recommended that Fermilab seek enhanced participation of university faculty in the APC, beyond its current portfolio of local institutions, to increase the educational role of the APC and its test facilities.
- Seeking input from the international community will add credibility to FNAL as a role model, with positive implications for the ILC as well as the APC, providing an avenue for further consolidating international support.
- The APC should retain an appropriate level of involvement in activities relevant to operations, in service to the Accelerator Division. It should embrace continuing intellectual association with accelerator scientists and engineers based in AD and other divisions. The continuing role of a good fraction of the matrixed scientists and engineers in the APC in support of accelerator operations will be crucial to the viability and relevance of the APC, and protect its activities from becoming decoupled from laboratory's needs. This means the APC staff would be involved in supporting Tevatron and neutrino program operations, as well as having more direct responsibilities for R&D facilities for ILC, muons, neutrinos, and LARP activities.
- It is recommended that the laboratory compare and contrast the AARD environments offered at various other facilities nationally and internationally, and establish a program that is complementary and of the highest caliber.
- The APC should have significant involvement in physics studies for the ILC, particularly in the area of beam dynamics simulations.

Comments - ILCTA

The committee applauds the creation of the ILCTA program, critical to the ILC in evaluating main linac performance and reliability. The program to test the fully dressed superconducting cavities, in cryomodules, with beam is of great importance - many issues can only be tested with beam, such as beam loading and associated performance aspects of the cavity tuning system, effects of Higher Order Modes (HOMs), and the ability to cross-calibrate and improve measurement accuracy of accelerating gradients via measurement of the beam energy. Past

experience with LEP, where off-line testing of SCRF cavities with beam was not done, and problems were encountered after cavities were installed in the machine, clearly demonstrates the necessity of such tests.

The ILCTA gun design gradient of 50 MV/m is greater than typical experience with similar guns, and may result in increased dark current. The committee recommends that other optimizations be explored in collaboration with DESY/PITZ staff experienced in operating such guns.

Comments – ILCTA and AARD

The committee supports the provision of facilities within the ILCTA for AARD, and for ILC-related R&D beyond the main linac components, such as deflecting cavities. However, the time scale of the ILC cavity R&D program is very short, the goals are ambitious, and much work is still required to bring the cavity performance up to specifications and to achieve reliable industrial production, demonstrated in a test facility. It is clear that ILC must have priority over AARD in the test facility. Therefore it is very important to decouple the two activities as much as possible, to provide priority to ILC for its needs in cryomodule testing, and to not have other programs relying on the ILC components of the facility. The ILC needs for electron beam are probably less stringent than AARD demands, and a relatively simple injector may well be adequate for ILCTA purposes. While preserving the synergy between AARD and ILCTA, and even leveraging it to extend its eventual technical reach, attempts must be made to make the AARD activities as independent of ILC cryomodule and RF test activities as possible.

The committee recommends that a layout which will best accommodate both ILC and AARD needs with minimal interference be developed, including the possibility of a building extension to the NML to accommodate a larger facility. Two separate electron sources may be contemplated; a simple one for ILC purposes, and one with high brightness for AARD applications. Additional funding for this more expensive injector design and facility layout may be sought from the DOE HEP Advanced Technology R&D program. To defend the creation of such a program at NML, a list of experiments and the beam parameters required should be developed. The AARD topics may include some ILC–specific activities with the SCRF cryomodules and their RF testing, et cetera, but a large majority will be independent of ILC activities. Some experiments may eventually need a GeV class beam that is potentially available.

Comments – Muon Collider R&D

The committee applauds the vision of laboratory leadership in promoting the necessary R&D towards demonstrating eventual feasibility of a Muon Collider, as part of a balanced research portfolio for FNAL. The establishment of the MCTF to guide this activity is welcomed, and engagement of entrepreneurial small business such as the Muons Inc., and working with other national labs and universities, is exemplary. Recent breakthroughs in muon cooling system concepts provide exciting new prospects; combining many bunches during the cooling process offers the first self-consistent cooling channel design suitable for a muon collider.

Still missing in the design of the MANX 6D cooling experiment proposed for the MTA area are a solution to the problem of matching into the cooling channel, and the incorporation of RF

cavities. In addition, beam parameters associated with the newly designed cooling channel should be propagated to the rest of the muon collider, in order to ensure overall viability of the muon collider project. These components should be included as fully as possible, stressing the need for comprehensive paper studies before "metal is cut".

The MCTF effort is encouraged to continue to explore the availability of resources and skills at other U.S. laboratories and institutions, and to help maintain the global Muon Collider infrastructure. The relationship of the MCTF to the NFMCC should be made clear. Complementarity with BNL, LBNL and industry programs should be a leading philosophy.

Enough resources need to be applied to the MCTF to make steady progress. However, the MCTF effort in general, and the magnet activities in particular, do not have a fixed end date or rigid milestones. The MC magnet development program should be performed on a "best effort" basis, depending on available funding and on successes (or setbacks) with these very exciting new technologies. The primary activity of the Fermilab core High Field Magnet program is to support the development of Nb3Sn quadrupoles for the LHC IR upgrade, consistent with the key LARP goal of "demonstrating the viability of Nb3Sn magnets by 2009". Already the High Field Magnet program is pursuing seven other activities, mostly minor in comparison to the LHC activities. This is a testament to the vitality of SC magnet R&D as an enduring enabling technology. However, if the HFM program were to take on the additional major activity of MC magnet development, there is a real risk of compromising the LHC program, unless significant additional resources were to be provided to the program.

APPENDICES

i) Charge
ii) Committee assignments
iii) Agenda

Fermilab Accelerator Advisory Committee

December 4-6, 2006

Charge

At its December 2006 meeting the Fermilab Accelerator Advisory Committee will take a broad look at the entire Fermilab accelerator R&D program, accompanied by a more focused look in areas in which Fermilab is planning new initiatives to provide enhancements to our advanced accelerator R&D program aimed at the post-Run II era. The primary topics for review and discussion are:

1. Overview of the Current Accelerator R&D Program

We will provide a brief overview of the accelerator R&D program at Fermilab. Topics to be covered include the ILC, LARP/LHC, Neutrino, Muon, and Advanced Accelerator R&D programs. The primary intent of the overview is to provide a contextual framework for more detailed discussion on new initiatives. However, the committee is invited to provide any comments, suggestions, or recommendations they might have regarding the overall strategy, balance, and effectiveness of the program as a whole.

2. Fermilab Strategy on the International Linear Collider

In our role as the preferred U.S. site of the ILC, Fermilab has a special responsibility for providing leadership within the ILC development effort while preparing itself, and northern Illinois, for a possible host role. We will be discussing Fermilab's strategy for ILC activities leading up to a possible decision to construct. The goal of this strategy is to have Fermilab fully prepared and recognized as an outstanding host site for the ILC if the decision to construct is made at the end of the decade. We would like comments and recommendations from the committee regarding all aspects of Fermilab's strategic approach including: technology development & industrialization, accelerator design, site specific design, state of Illinois involvement, and community outreach; and the integration of these activities within both local and international efforts. The committee will recognize that many of these strategic elements are not currently fully developed. Nevertheless, we are asking the committee to look at all these elements from the Fermilab perspective in providing us with advice and/or guidance.

3. Creation of the Fermilab Accelerator Physics Center

In order to enhance the Fermilab accelerator R&D program aimed at the future, we are in the initial stages of creating an Accelerator Physics Center at Fermilab. The goal is to create an effective organization for support of the Fermilab mission, with particular emphasis on the post-Run II era. The APC will bring under one roof staff dedicated to providing direction and/or support to all accelerator R&D activities aimed toward the future. We will be describing our current vision of the goals, strategies, and plans for the center. Particular emphasis will be placed on the possibilities afforded for enhanced accelerator physics activities in support of ILC, on opportunities opened up by migrating the AARD program currently centered at the A0 photoinjector to the ILC Test Area being planned for the end of the decade, and on possibilities of undertaking an expansion of our muon program to explore more deeply the long-term possibility of a multi-TeV lepton collider based on muons.

AAC input is important at this time since the plans for the APC are not yet set in stone. The committee is asked to review and offer comments, suggestions, and/or recommendations on all aspects of the APC as currently proposed, including: goals, strategy, organization, and implementation. Commentary on specific unique opportunities that could be realized through this initiative would be greatly appreciated.

As usual the committee is invited to issue comments or suggestions on any aspect of the programs discussed beyond those specifically included in this charge. It is requested that a concise report responsive to this charge be forwarded to the Fermilab Director by February 1, 2007. Thank you.

Committee assignments to address points of the charge:

1. R&D Program:
    Swapan Chattopadhyay
    John Corlett

2. International Linear Collider:
    Gunther Geshonke
    Shin-ichi Kurokawa
    Michiko Minty
    Hasan Padamsee
    Tor Raubenheiner
    Hans Weise

3. Accelerator Physics Center:
    Swapan Chattopadhyay
    John Corlett
    Gunther Geshonke
    Georg Hoffstaetter
    Kwang-Je Kim
    Hasan Padamsee
    Steve Peggs

Fermilab Accelerator Advisory Committee
Agenda

December 4-6, 2006
Comitium, Wilson Hall 2SE
Revision 5-Nov-2006

Monday, December 4

8:30-9:00	Committee Executive Session	J. Corlett
9:00-9:45	Welcome, Presentation of Charge, and Overview of Accelerator R&D Program	S. Holmes

International Linear Collider (Organized by Bob Kephart and Marc Ross)

9:45-10:30	Context and Current ILC Program	R. Kephart
10:30-10:50	Break	
10:50-11:25	Accelerator Design and R&D Issues	M. Ross
11:25-12:05	Plans for Future SCRF Infrastructure	S. Mishra
12:05-12:30	Discussion	
12:30-1:30	Lunch	
1:30-2:30	Tour	
2:30-3:00	Plans for ILC RF Unit Test Facility	S. Nagaitsev
3:00-3:20	Test Beam and ILC Detector R&D	M. DeMarteau
3:20-3:40	Discussion	
3:40-4:00	Break	

Accelerator Physics Center (Organized by Vladimir Shiltsev and Sergei Nagaitsev)

4:00-4:45	Fermilab Accelerator Physics Center: Mission, Goals, And Organization	V. Shiltsev
4:45-5:00	Discussion	
5:00-6:30	Committee Executive Session. Requests for supplementary or breakout presentations on Wednesday	
7:00	Dinner	

Tuesday, December 5

Accelerator Physics Center (cont.)

8:30-9:00	Plan and Opportunities for Migration and Integration of the Photoinjector into New Muon Lab	M. Church
9:00-9:30	NML Users Facility and Experimental Program	P. Piot
9:30-9:45	Discussion	
9:45-10:05	Break	
10:05-10:35	Muon R&D Plans and Proposed Muon Collider Initiative	S. Geer
10:35-11:05	Muon Collider and Ionization Cooling Issues	Y. Alexahin
11:05-11:35	Proposed 6D Cooling Experiment at Fermilab	A. Jansson
11:35-12:05	Fermilab MCTF Magnet Development Programs	M. Lamm
12:05-12:30	Discussion	
12:30-1:30	Lunch	
1:30-5:00	Supplementary presentations and/or breakout discussions as requested by the committee. Committee Executive Session	

Wednesday, December 6

8:30-11:00	Committee Executive Session
11:00-12:00	Closeout
12:00	Adjourn

Supplementary presentation

Fermilab Priorities in Allocating Core Funds to R&D Activities S. Holmes