GEM TN-92-252

Report of the Superconducting Super Collider Program Advisory Committee

December 2-4, 1992

Abstract:

Report from the PAC on the operations of the SSC Laboratory. Included is a discussion of Test Beams; Neutron Background; GEM Detector; SDC Detector; and an agenda.

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SSC Laboratory, Dallas, Texas

1. GENERAL

The Program Advisory Committee met from December 2 to 4, 1992, at the SSC Laboratory in Dallas. The principal issues for this meeting were introduced by Laboratory Director Roy Schwitters. The committee heard presentations from Laboratory staff on the project status and detector funding plans, from DOE on its recent SDC review, and from members of the SDC and GEM collaborations on the status of the two detector projects.

The issues for discussion are listed in Appendix I and the agenda is given in Appendix II. The conclusions and recommendations of the PAC are given below.

1.1 Test Beams

As the development of the SDC and GEM detectors evolves, the availability of test beams to verify prototype performance will become even more crucial than it has been in the past. The PAC would like to review the test beam situation at its summer 1993 meeting, and requests that the Laboratory prepare a review of test beam needs and availability for that meeting.

1.2 Neutron Background

The GEM collaboration has highlighted the problem of neutron fluence in the muon detection systems. The sources of the fluence and the detector-specific responses to the neutrons are not currently known to sufficient accuracy. The problem applies to both SDC and GEM, and is under study by both collaborations. The Laboratory should coordinate the neutron background studies among the SDC and GEM collaborations and the accelerator division.

2. GEM

The committee heard a series of reports describing GEM's recent choices of detector technology and their plans for preparing a technical design report (TDR). The committee is pleased that important technical decisions have been made, and looks forward to further demonstration that the physics goals expressed by the collaboration will be achieved.

2.1. Conceptual Detector Design

The GEM collaboration has made several technology choices by which the overall structure of the detector is now fairly well defined. The collaboration has chosen a hybrid calorimeter design. The electromagnetic section uses an accordion construction, employing lead and liquid krypton in the barrel and liquid argon in the end caps. Resolutions were measured with various prototypes and

found to be in close agreement with Monte Carlo calculations. The beam energy was, however, too low to permit measurement of the constant term for the prototypes.

Behind the electromagnetic section is a lead-noble liquid hadronic section that extends to 6 interaction lengths. This is a lead tile design, similar to that of SLD. The hadronic section also employs liquid krypton in the barrel and liquid argon in the end caps. A scintillator-copper coarse hadron calorimeter is located beyond the cryogenic vessel, extending from 6 to 11 interaction lengths. The axial scintillators are read out at both ends and provide both time and energy deposit information. While the hadronic components have now been conceptually designed, performance characteristics have neither been measured in prototypes nor simulated. The mechanical design is also at a conceptual stage.

Cathode strip chambers have been chosen for use throughout the muon detector. These devices yield two-dimensional information. The proponents intend to use these chambers in the trigger to define the associated bunch crossing. The system involves approximately one million readout channels and four million wires. The performance has been demonstrated with a prototype. The cost implications of the large number of readout channels have not yet been evaluated.

The collaboration has chosen to move the final quadrupoles from 20 m to 35 m from the interaction point to allow greater access for opening the detector if necessary and to reduce the neutron fluence caused by high energy particles striking the quadrupoles. As noted above, there is a potential for severe background in the muon chambers due to the neutron fluence, and optimization of the shielding is necessary.

2.2 Technical Design Report (TDR)

It is expected that the TDR will meet the requirements described in the laboratory document *Review of Major SSC Experiments*. The collaboration has recently made a number of important technical decisions. They need enough time to make detailed engineering designs, to understand the performance of the integrated detector, to complete detailed simulations of physics processes, and to carry out a complete cost estimate. The deadline for submission of the TDR should be as late as possible, compatible with completing the PAC review process at the summer meeting. April 30 appears to be a suitable date. The accompanying cost estimate should be of sufficient detail and should be completed early enough to be used in the process of detector optimization.

Because major components of the GEM detector have only recently been defined, the physics performance of the integrated detector has not yet been evaluated. Nor has it been demonstrated that the choice of design parameters is optimized to meet the physics goals within cost constraints. The committee expects that the TDR will address these issues as well as the complementarity of GEM to SDC, including overall performance as a function of luminosity.

For example, detailed simulations are expected for standard model and nonstandard model Higgs physics and backgrounds, and for physics relying on missing transverse energy measurement. Simulations of photon/electron identification and muon measurements (including triggering and

pattern recognition as a function of luminosity) are also expected. The main technical detector parameters (for example, detector granularities and inter-detector boundaries) should be justified on the basis of estimated cost and projected performance.

2.3. Detector R&D and Engineering in FY93

GEM's plans and funding requests for R&D and engineering in FY 1993 were not presented in sufficient detail to allow a critical evaluation by the PAC, largely because the choice of calorimeter and muon systems had been made so recently. The collaboration should submit a detailed plan to the laboratory as soon as possible. Although much progress is being made on R&D, prototyping, and engineering design, many of the issues raised in our July 1992 report remain unresolved.

The PAC notes that the production and testing of a full-scale calorimeter prototype cannot be completed before 1994, and that the hadron calorimeter design is still at the conceptual level. It is, therefore, urgent that substantial effort be focused on the engineering design of this crucial detector element.

The collaboration has made good progress in organizing efforts to simulate and evaluate the performance of the detector. Nevertheless there is concern that substantially increased effort will be needed to produce results at the level appropriate for the TDR.

The PAC reaffirms its statements in its July 1992 report concerning the solenoid engineering program.

3. SDC

3.1 Status

SDC representatives described the present status of the experiment and its management. The committee recognizes that important progress has been achieved since the PAC meeting in July 1992. A comprehensive DOE review of SDC was carried out in October 1992. It found the technical design to be generally sound, the schedule to be extremely tight, and the cost estimates to be realistic, with potential for reducing costs by optimization. The collaboration is progressing well towards the realization of the detector.

The committee noted the continued subsystem R&D and prototyping activities, in particular, the short, full-diameter test winding of the superconducting solenoidal coil, the construction of full-size parts of the central tracking system, and the full-scale muon module. The PAC looks forward to a decision by the collaboration on technology choices for the outer layers of the central tracking system.

The PAC is pleased with the progress in understanding the construction and installation schedules, and with the identification of critical items. The committee notes, however, that the schedule is uncomfortably tight and every effort should be made to see that the detector schedule be matched to the turn-on of the collider. The PAC concurs with SSCL that the Phase II review should be held as early as possible, so as not to put further strain on the already tight schedule of the SDC detector.

The PAC is concerned about the potential problem of neutron background in the muon detector. Neither the neutron flux nor the detector response is known at present with sufficient accuracy. Since the shielding of neutron sources could influence the detector layout, the problem should be addressed as soon as possible.

The PAC remains concerned about the risk to the silicon tracker of substantial damage that could be caused by loss of the beam, especially during the commissioning of the accelerator. In view of the central role of the tracker in SDC, it is important to perform a serious analysis of this risk and to take steps to deal with it, if necessary.

3.2 Management and Manpower

The PAC was impressed with the progress SDC has made on implementation of its management plan and development of an integrated project schedule. Since July 1992, several senior physicists and engineers have joined the core management team. The team is, however, not yet complete and it is important that it be strengthened rapidly. This is a high priority.

It should be emphasized that the SDC collaboration is a truly international one, and its success depends crucially on the strong participation of all its collaborators.

3.3 Financial Plan and MOUs

The SDC financial plan has not changed significantly since July 1992. There has been continued progress in reaching agreements on allocation of technical and financial responsibilities among the collaborators. An effective procedure for creating and executing Memoranda of Understanding (MOU), including annual amendments, was described. A beginning has been made on the execution of these MOUs with the collaborating institutions.

3.4 Plans for Detector R&D and Engineering in FY93.

The plans and spending requests for FY 1993 R&D and engineering for SDC were not presented in sufficient detail to allow a critical evaluation by the PAC. The collaboration should submit a detailed plan to the laboratory as soon as possible.

It is appropriate that the SDC plans for FY 1993 mainly focus upon completion of prototype fabrication and tests of detector components. In a few cases, R&D remains to be performed and

choices still have to be made. These decision milestones should be met in order that the detector design can be finalized. In particular, one of the remaining technical choices is between the straw central tracker - gas microstrip intermediate tracker and a scintillating fiber tracker. The current stage of development of both the gas microstrip chamber and the scintillating fiber tracker makes this a difficult choice.

Considerable attention will be given to assembly and installation plans. These are crucial as they connect intimately with the ongoing design of conventional facilities as well as with the design of the detectors, electronics, cabling service access, etc.

Prototyping of front end electronics will go forward for all systems. The data acquisition and trigger designs are not finalized. Both should be pursued vigorously in FY1993, in order to permit the use of SDC systems in large integrated tests with their own on-line software. A working prototype of the data acquisition and trigger design would allow time for iteration.

Appendix I: Issues for the PAC Meeting of Dec. 2-4, 1992

GEM -Readiness for TDR (tentative date March 15, 1993)

-Conceptual detector design

-Plans for detector R&D and engineering in FY 1993

SDC -Project status and response to DOE review

-Status of MOUs with collaborating institutions

-Financing plan

-Plans for detector R&D and engineering in FY 1993

Appendix II: Agenda for the PAC meeting of Dec. 2-4, 1992

Wednesday, December 2

9:00 a.m. - 9:15 a.m.	Welcome/Charge to the Committee	Schwitters
9:15 a.m. - 10:45 a.m.	Accelerator Design and Construction Progress Report	Dugan/Ives/ Lundin
10:45 a.m. - 11:00 a.m.	Break	
11:00 a.m. - 12:00 a.m.	Plans and Schedule for Detector Funding FY 93 and beyond	Gilman
12:00 noon - 1:00 p.m.	Lunch	
1:00 p.m. - 1:45 p.m.	GEM Project Overview (Status of Preparation of TDR, project cost/schedule and funding plans, plans for detector engineering and construction in FY 93)	Barish
1:45 p.m. - 2:00 p.m.	Discussion/Questions	
2:00 p.m. - 2:30 p.m.	Calorimetry	Willis
2:45 p.m. - 3:00 p.m.	Discussion/Questions	
3:00 p.m. - 3:15 p.m.	Break	
3:15 p.m. - 4:00 p.m.	Muon System	Taylor
4:00 p.m. - 4:15 p.m.	Discussion/Questions	
4:30 p.m. - 5:00 p.m.	Tracking System	Baltay
5:00 p.m. - 5:30 p.m.	Discussion/Questions	
5:30 p.m. - 6:40 p.m.	Discussion of GEM	

Thursday, December 3

8:30 a.m. - 9:30 a.m.	Discussion of GEM Project	
9:30 a.m. - 10:00 noon	Report of SDC review by DOE	Diebold
10:00 a.m. - 12:00 noon	Status of SDC Project (Summary of Resource Loaded Schedule, assignment of responsibilities and status of MOUs, results from R&D and prototype detector tests, plans for detector engineering and construction in FY 93)	Trilling/Kirk
12:00 noon - 1:00 p.m.	Lunch	
1:00 p.m. - 2:00 p.m.	Discussion of SDC Project	
2:00 p.m. - 7:00 p.m.	General Discussion - Preparation of Report	

Friday, December 4

9:00 a.m. - 12:00 noon	Preparation of Report and Conclusions