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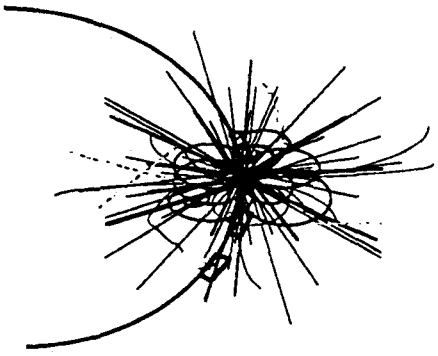

THE MONTHLY REPORT OF THE SOLENOIDAL DETECTOR COLLABORATION

JUNE 1992

INFORMATIONAL NOTE

This is the last SDC Monthly report of the format that was initiated in FY91. Only 4 institutions have submitted reports this month although there are over 30 institutions receiving SSC funding for SDC activities. The recent work of establishing the SDC Technical Design Report with a number of associated documents have understandably taken priority over monthly reporting activities.

It was learned recently that when SDC Technical and Executive Board members were added to the monthly report distribution (approximately 6 months ago), the distribution to contributing institutions was mistakenly subtracted. Thus some of you have not received reports since that time.

The July 21 memo of Tom Kirk to SDC systems managers and project staff establishes a revised method of institutional reporting to the systems managers. The reports of the systems managers will then be assembled into an integrated report for the month. This new procedure becomes effective for July 92 reports.

T.E.

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1. University of Wisconsin Physical Sciences Laboratory (PSL) - Trigger System

Calorimeter Level 1 Trigger

We have improved our SDC detector simulation Monte Carlo program to include proper decays of kaons, pions and other particles that decay in flight through the detector. We have also included the shower max detector parameterization and are in the process of studying it. We have collected high statistics data to study the electron trigger. This enabled us to improve upon our earlier investigation of the electron trigger rates and efficiency[1]. We compared the performance of various techniques like transverse isolation of electromagnetic energy clusters and cuts on low hadronic to electromagnetic energy deposition H/E. We found that electron trigger threshold can be reduced to as low as 16 GeV with a nominal rate of 3 kHz, by demanding isolation, $H/E > 0.1$ and a stiff track $(p_t > 10\,\text{GeV})$. Isolation improved the threshold from 23 GeV to 16 GeV. Photon energy threshold, i.e. not demanding a track, was 34 GeV with $H/E > 0.1$ cut alone, and 26 GeV when transverse isolation was included. These trigger rates were obtained for nominal luminosity of 10^{33} cm^{-2}-s^{-1}. At higher luminosity the importance of transverse isolation was even more pronounced. Efficiency of identifying electrons from W and Z decays was found to be as high as 86% in the best case scenario, i.e. using isolation, $H/E > 0.1$ cut, EM shower energy above threshold and requiring a matched track. It drops down to about 40% when no track is demanded and only EM energy over threshold trigger is considered.

We have considered the question of coarser granularity of calorimeter trigger data. The effect of using $0.2 \times 0.2\phi - \eta$ towers, compared to our nominal $0.1 \times 0.1\phi - \eta$ towers, results in an increase of about 5-10 GeV in threshold for each of the cases considered above. The drop in W and Z decay electron identification efficiency is about 10% for each criteria removed. In the next few weeks, we expect to have new results from shower max detector data, and, improved accuracy for the coarser granularity calorimeter trigger data case.

Trigger System Engineering

System Design

We have continued detailed studies of the new system design of the Level 1 trigger[2]. We have also evaluated the feasibility of various hardware realizations of the design. As part of this we have designed, simulated and fabricated a 4 X 12-bit CMOS adder, which is a common

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[1]T. Gorski, J. Lackey, W. H. Smith, W. Temple, *Isolated Electron Pattern Logic Design and Performance at the SSC*, U. Wisconsin SDC Note SDC-91-00087, 1991.

[2]T. gorski, J. Lackey, W.H. Smith, *Revised Level 1 Trigger Decision Design for the SDC*, U. Wisconsin SDC Note SDC-92-198, 1992.

component of several boards in the present circuit design. We have begun the testing of this device. As part of the development of the interface between trigger and front end electronics and trigger and data acquisition, we are designing the Trigger Emulation Module described below.

CMOS 4 X 12-bit Adder

A common component found in several places in the present trigger system design is an Application Specific Integrated Circuit (ASIC) that adds 4 12-bit numbers and can operate in the clocked 16-ns trigger structure. As a result, we have designed a pipelined domino logic two-stage adder[3]. The device has been simulated in CMOS technology and has achieved the design goal step time of less than 13 ns. The ASIC has been fabricated by MOSIS and 50 packaged chips have been delivered. We have designed and are now preparing to fabricate an evaluation board. The device takes as input 4 12-bit operands and as output a single 12-bit number. Carry in and out, reset, overflow, and diagnostic inputs and outputs are provided for.

Muon Trigger Studies

We have included the muon trigger parameterization in our Monte Carlo. We will obtain results for decay and prompt muon rates in the detector soon. We are in the process of including in our program, a hadron punch through parameterization obtained from CCFR data[4].

Trigger Clock/Control

System Design

We have studied and revised the global clock and control system. The basic system is outlined in our SDC Note[5]. We have evaluated the overall system timing[6] and potential impact of the revised correlated muon trigger[7].

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[3]D. Panescu, T. Gorski, J. Lackey, W.H. Smith, M. Thompson, *A Pipelined 4 X 12 CMOS Adder*, U Wisconsin SDC Note SDC-91-00087, 1991.

[4]P. Sandler et al., Phys. Rev. D 42, 759, 1990.

[5]W. H. Smith, T. gorski, J. Lackey, *SDC Global Level 1 Processor: Clock & Control*, U. Wisconsin SDC Note SDC-91-218, 1992.

[6]T. Gorski, J. Lackey, W. H. Smith, *The First Four Microseconds: SDC Level 1 Pipeline Length*,, U. Wisconsin SDC Note SDC-91-090, 1991.

[7]T. Gorski, J. Lackey, W. H. Smith, *Correlated Level 1 Muon Trigger Design for the SDC*, U. Wisconsin SDC Note SDC-91-141, 1991.

Trigger Emulation Module

We have revised the performance specifications for the Trigger Emulation Module (TEM)[8]. The TEM is designed to emulate much of the clock and control functionality anticipated for the final SDC Global Trigger System. Its purpose is to aid in the test bench debugging of Subsystem DAQ and trigger circuits, and to serve the basic functions of a trigger module for test beam experiments. The TEM is designed to operate as part of a bench test of front end electronics, where it provides patterns of Level 1 and 2 Trigger and clock signals that can be fed in from either pulsers, an external Pattern Generation Module (see below) or a DAQ processor. The TEM is also designed to operate in a test beam, where the clock is externally provided by the accelerator RF signal and the triggers are produced by beam hodoscopes. The goal of the TEM development is to provide a module to which front end electronics and DAQ systems can interface that resembles the final interface to the trigger clock and control system. The TEM is designed so that a subsystem that operates with it should find minimal difference when the TEM is replaced with the final interface to the trigger clock and control system. This should ease eventual integration of detector electronics subsystems into the global SDC trigger clock and control system.

[8]W.H. Smith, T. Gorski, S. Dasu, *SDC Trigger Emulation Module*, U. Wisconsin SDC Note SDC-92-250, 1992.

2. Fermilab (FNAL)

Calorimeter Design

An evaluation of the manufacturing capabilities of shops in Dubna, Russia and also of a private company in Sovelono was done in June. Basically, the Dubna shops have a wide range of capability and seem quite able to prepare and fabricate steel absorber for the calorimeter. We will continue to work with them as the design progresses, particularly on the end cap.

The calorimeter design group continued to spend the majority of its time on the full scale mechanical mock-up of the stacked EM calorimeter. The design was presented during the review at the SSCL to decide which technology to go with. As of this writing, all fo the pieces for the EM stack have arrived and are being assembled.

The remaining design issues to be worked out for the stacked EM calorimeter were the exact configuration of shower max, the fiber routing, and the front cover. There was a meeting at Fermi before the stacked/cast lead review with people from Saclay to discuss shower max alternatives. We will continue to develop the magatile shower max concept.

Work is being done to redesign the support structure of the calorimeter to eliminate the interference that currently exists between BWI muon chamber and the calorimeter support. An all day discussion was held with a representative from SSCL who will join the effort to solidify the design of the support and act as liaison for us with the muon and integration groups.

We also spent some time reviewing the hadron steel absorber design and cost estimate to look for ways to lower costs. the tolerances have been opened up considerably. The change form 1/64 wedges to 1/32 wedges gave us about a 105 decrease in cost. We will continue to evaluate alternative fabrication techniques in an effort to lower costs.

Solenoid Design

Technical Design Report

We received a draft version of the Report of the SDC Review by the SSCL PAC. The magnet designer at KEK (A. Yamamoto) prepared a response to the questions raised in the solenoid chapter of the report.

Cryogenics

The machining of the isogrid test panel was completed and the panel was sent to Fermilab where its dimensions were checked. When the piece was removed from the machining fixture, it bowed about 5/8". While the exact cause of this is not known, we believe it is in the direction to

oppose the anticlastic deformation that can occur during forming. The contract for forming the test piece to the 1m radius is in place and the forming will be done early in July. the three aluminum plates for the outer, isogrid shell of the prototype vacuum vessel have been delivered. the drawings are complete for the machining of the isogrid pattern and we will go out for bids as soon as funding is received form the SSCL.

A finite-element model of the vacuum vessel bulkhead was created to see whether the bolt size was adequate to pull down any reasonable gap that might occur because the bulkhead and/or the bolt flange are not flat.

Muon Support and Alignment R&D

Early in June we met with the barrel magnet design group to resolve the issues regarding alignment boreholes through the iron. A design for two piece mechanical fenceposts has been developed in detail. this system allows external removal, repair and correct positioning - alignment. the present proposal is to accommodate a working aperture of 10cm X 10cm with positioning busing adjustments of ± 10mm. Iron construction-placement tolerances must be added to these numbers. this corresponds to a total of 125-140mm which requires cutting into two blocks-plates.

The long term stability tests of a HORIZONTAL 5cm(X) X 10cm(Y) full length (6.1m) test fencepost and mock chamber sensor setup indicate RAW (no thermal corrections) standard deviations on BW1 readings of 20mm in X, 10mm in Y but larger BW3 standard deviations of 128mm in X, 58mm in Y. These deviations correspond to a temperature range of 79 deg F -7, +16 deg. Previous tests indicate that simple thermal corrections can reduce these deviations by x2.5 or more. However, these results indicate that we would like to increase the X section to 10cm.

Near uniform heating of local areas of the fencepost by 20 deg F, particularly in the magnet iron region, result in X, Y displacements (wiggles) of the BW3 post end by 200-300mm.

In an attempt to reduce deviations and thermal wiggle effects, we are now doing long term stability tests on a 10cm X 10cm post assembly. This is the structure (square, round) dictated by internal optics systems.

Testing of a number of capacitive proximity sensors for a prototype liquid level system have been completed. Doping of the water with ionic salts does not seem to have a significant effect. Detector assemblies, reservoir, electronics, etc. for a six sensor (point) are under construction. Tests of the best commercial sensors and electronics are underway.

Data Acquisition System Activities

Roughly three man-weeks were spend in June preparing various database outputs. Reworking some design errors in the Test Transmitter took place in June and will continue into July.

3. Westinghouse Science and Technology Center

Westinghouse provides SDC Subsystem Engineering Support. This work supports the Outer Tracker development and integration through engineering analysis and engineering studies including option evaluations, conceptual reviews, schedules, cost projections, and manufacturing plans for the subsystem.

In the time periods indicated, the following work tasks were completed:

APRIL

- Presented updated engineering studies at the SSCL Integration Meeting.
- Completed the Straw outer tracker WBS lowest level Dictionary.
- Completed the full outer tracker Cost and Schedule Analysis.
- Hosted a Straw Outer Tracker Subsystem electronics meeting.

MAY

- Transmitted the first draft to SSCL of three outer tracker test and prototype composite procurement specifications.
- Presented updated engineering plans at the SSCL Integration Meeting and a Straw Outer Tracker subsystem Meeting at the SSCL.
- Presented Cost and Schedule data at the PAC review.
- Transmitted the second draft to SSCL of three outer tracker test and prototype composite procurement specifications.
- Assisted in preparation of first draft of FY93 Straw Outer Tracker WBS driven construction budget.

JUNE

- Transmitted two final specifications with incorporated comments to SSCL of outer tracker test and prototype composite procurement specifications.
- Transmitted proposal to SSCL for FY92 Straw Outer Tracker work.
- Quantified the Straw Outer Tracker staging cost saving potential.

4. Martin Marietta

Task Accomplishments

- Continued development of the SDC Integrated Program Schedule (IPS) using Open Plan Multi Project Scheduling and databases obtained from the subsystem heads. Evaluated compatibility of input data formats with Open Plan.

- Completed Muon System resource allocation modeling. Developed schedules, milestones, and descriptions for each major assembly task and plots and tables of delivery needs, storage requirements, and manloading histograms by month.

- Presented results of SDC muon system assembly and installation study at a muon system engineering meeting on 23 June at the SSCL.

- The following Muon System cost related tasks were performed:

  - written responses to PAC requests.

  - muon system quarterly funding requirements developed for each WBS element based on the TDR cost estimates.

  - updates to the TDR muon system costs based on new information.

  - cost estimates developed for each possible muon system staging scenario.

  - assisted in the development of a new muon system WBS

  - compiled muon system unit cost report.

  - developed spreadsheets used for performing labor rate cost sensitivities for the entire SDC detector.

Deliverables

- Delivered draft copy of SDC Muon System Assembly and Installation Study, dated 12 June 1992 for review and comment prior to publication as SDC-92-283.