SDC-92-339

MONTHLY REPORT of the SOLENOIDAL DETECTOR COLLABORATION

AUGUST 1992

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I. PROJECT MANAGER'S SUMMARY

Project Managers Summary

Good progress continues on both technical and management aspects of SDC. Since this is the last period of R&D preparation for the SDC detector, there has been a strong push to conclude the technical baseline definition and to prove out the technology base. Likewise, rigorous efforts are underway to establish the planning and tracking tools that will be needed starting in FY1993. Many documents and reporting procedures (including this report) are being implemented prior to the formal baseline review of the SDC Project by DOE in late October, 1992.

In the Silicon Detector area, very good technical progress continues with all three hardware projects comprising the double-sided silicon detector chips (DSSDs), the electronic elements integrated with them and the mechanical means of edge bonding the wafers and supporting the detector on the cooling rings. This work is going forward cooperatively at UCSD, KEK, LANL, LBL and Oxford/RAL. Coordination of the work has been accomplished through UCSD which is also preparing material for the DOE Review.

The Straw Outer Tracker passed a significant R&D Milestone in August with the operation of straw modules by both Indiana and Duke at SSCL. Both modules met the straw tube specifications and realize the desired spatial resolution. Another significant achievement was the demonstration of the method and tooling to mount and demount straw modules from the support frame rings. This is a project of WSTC. In the electronics area, tests were made at Duke on the front-end electronics chips developed at Lecroy and Penn. The Penn SDC prototype revision shows greater sensitivity while maintaining full timing performance (130μ) KEK and ORNL have continued advancing the engineering design of their electronic and mechanical modules for bringing out signals and carrying out cooling models for temperature control. Electrical and wire support design proceeded at Colorado. Management of the straw detector system has been focused on improving the cost estimate for the upcoming DOE Review. Evolution of the full schedule and manufacturing methods proceeds.

R&D on substrate materials for the Gas Microstrip Detector continues. Beam tests were conducted on test modules during the summer at CERN. Basic issues concerning the geometry of electrodes, implantation and passivation are still unresolved and the need for several months of basic R&D is clear. Work related to the strips and substrates went forward at Carleton, Liverpool, Montreal, RAL, Purdue and Texas A&M. Electronics evaluation and development for the GMD went ahead at Carleton and Oxford. The GMD is likely to adopt the same front end chip used by the Si detector. This is a good attempt at commonality between systems. The mechanical support design has changed from an endcap mount to a barrel mount system and the detector plane retraction feature was eliminated, increasing mechanical strength and stability of the ITD. This work went forward at RAL. Useful work was reported on electronics cooling methods and simulation of performance.

Central Calorimeter work at ANL and FNAL was concentrated in completing the designs for the barrel prototype, including calculations confirming that the large spans proposed for the cost Pb EM will not cause unacceptable deflections of the plates. This situation appears to be under control. The hadron plate design is coming along steadily and details of the EM/hadron attachment, source tube geometry and barrel wedge support in the barrel detector continued to go forward. A wooden barrel wedge model has been built at Fermilab and is used in a rotation fixture to study fiber routing. The Endcap monolithic EM and hadron plug calorimeters are proceeding steadily at LBL. Plans for producing straight and slanted edge tiles for the prototype calorimeter are going forward at Tsukuba.

The Forward Calorimeter effort is still at the R&D state. Some work continues on high pressure gas as the active medium (Rockefeller) but most of the effort has been directed toward use of liquid scintillator in glass capillary tubes buried in a steel matrix. This work is being pursued at Toronto, Manitoba and Texas A&M. Issues of concern include chemical compatibility and

radiation damage studies to see if a successful scintillator fluid can be identified. Studies of cost and schedule have also been pursued in order to prepare for the October DOE Reviews.

Work in the Muon Subsystem proceeded in both the magnet and detector areas. For the magnets, finite element studies were completed at FNAL for the Muon Barrel Toroid undergoing dead weight, earthquake, assembly tolerance and jacking loads. These studies are being written up as reports. Analysis of the 3D magnetic field of the MBT produced some answers that were not completely self-consistent; studies and consultation with experts at FNAL, Bitter National Magnet Lab, LDJ, Westinghouse and NIST went forward. More work will be needed to resolve the technical issues here. Design of the coils for the MBT 1/9 Scale Model was completed at UW-PSL. Coil fabrication will start soon. This scale model is being used to verify mechanical calculations by FEA models also used for the full sized MBT and when the coils are ready, the model will be used for magnetic studies and measurements. Design of the main MBT coil also progressed at UW-PSL and the cost estimate was improved for the MBT.

Muon Measurement System work went forward in the areas of construction plans, fabrication procedure studies, finite element analyses, survey methods and simulation. Studies of muon tube extrusion and endcap sealing were also achieved. These studies and experiments were carried out at SSCL, Wisconsin, Washington, Tufts, Brandeis, Harvard, Maryland, Colorado, Fermilab, Ohio State and Martin Marietta. The coordination of all this work is itself a big job that is being well handled by the subsystem Manager, Jim Bensinger. Efforts for the prototype barrel detector module to be constructed in FY 1993 are given high priority.

In the SC Solenoid area, most efforts are concentrated on the coil winding demonstration for the 1/4 length prototype and on completion of the isogrid outer vacuum vessel wall. It has been shown that flat machined isogrid material can be rolled into cylinders of the size needed for the SDC coils. The coil winding work is going forward at KEK and Toshiba. The isogrid vacuum vessel work is carried forward at Fermilab and SSCL. The design specifications for the Solenoid Refrigerator are under active preparation at SSCL-EFD. Funding sources and design/fabrication of the refrigeration system are being discussed among the solenoid collaborators.

Electronics work in front end electronics DAQ and Trigger systems continued at a large number of institutions. The work is too multifarious for easy summary here, but in detailed system by system in the body of this report.

In general, the SDC detector R&D is rapidly being concluded in most areas in anticipation of the start of the SDC Construction Project. The associated decision making on technical elements is proceeding steadily.

II. SDC SUBSYSTEM REPORTS

1.0 TRACKING SYSTEMS R&D SUMMARY

1.1 Silicon Tracker R&D

Subsystem Project Leader: A. Seiden
Subsystem Technical Manager: A. Grillo
Reported by A. Grillo

Summary of Activities

There has been a lot of activity in all of the different areas and we are making good progress. Emphasis is now on prototyping each of the major components and upcoming tests of each. The mechanical people are working on designs of the assembly system

mechanical equipment and cooling wick prototypes. The electronics people are preparing for radiation tests at LAMPF and extended beam testing at KEK starting at the end of the year. A prototype double sided detector was received from Hamamatsu and is being tested. Preliminary results look very good showing that the "popcorn noise" problem has been solved. Alternate layouts for the forward region are being studied. Simulations will be run on the different layouts to study their relative performance.

Reports for the following Task Areas are included:

1.1.1 Main Mechanical Assembly
1.1.2 Internal Electronics
1.1.3 External Mechanical Systems 1.1.6 Assembly/Test/Special
1.1.7 Project Management Liaison/Integration Activities

1.1.1 Main Mechanical Assembly

Los Alamos National Laboratory

Technical Staff:Team Leader: W. O. Miller
Alignment/Assembly Work Station Development: R. Michaud, R. Ricketts, G. Jordan, H. Salazar, B. Wilds
Composite Structures: T. Thompson, C. Grastataro, G. Dransfield, D. Weinacht, E. Correa
Optical Alignment Development: J. Hanlon, W. Christensen, S. Schramm, D.C.Jones
Cooling System Development: K. Woloshun, M. Elder, J. Williams, L. Salazar
Reported by W.O. Miller

Alignment/Assembly Work Station Development

Preliminary design of the assembly system mechanical equipment is nearing completion, and detailed design of some components for the manipulator will commence in mid September. One senior designer is responsible for developing the overall design of the manipulator and rotary fixture. He is being supported by another designer who is concentrating on the development of specific details of the fixture. A third designer is working on the mechanical hardware for the optical alignment system. RFQ's for the translation and rotary stages, and the controller for the manipulator, rotary fixture, and alignment system have been forwarded to two potential vendors. Responses are expected by early September. We plan to coordinate the detailed design and

fabrication work with the procurement of this equipment so the software development work can begin as early as possible in the coming fiscal year. Both Huber goniometers for the rotary fixture have been received from Blake Industries, Inc. A fourth designer is working on a fixture for testing two kinematic mount concepts. Static and dynamic analyses of many components in the manipulator and rotary fixture, as well as the adjustable kinematic mount, have been completed.

Composite Structures

The compression molds for the cooling rings were sent out for Teflon coating to facilitate part removal. Cooling rings were then successfully fabricated with a 400 μm fiber length P75/954-3 composite material. This fiber length will increase the thermal conductivity of the rings, and is expected to increase their modulus of elasticity as well. Testing to verify improvements to the cooling ring transverse thermal conductivity is scheduled for September. In a parallel effort, cooling rings were also fabricated at Programmed Composites, Inc. using a spraying technique to uniformly apply the molding compound in conjunction with an inexpensive silicone rubber mold half. A part was produced, but additional development effort will be required.

Silicon module assemblies, similar to those which will be used in the final assembly of the SDC, were tested for structural integrity. The gluing materials and manufacturing techniques of the test piece represent our present fabrication scheme. The test piece included two modules glued to a graphite composite separator block. The block had the approximate cross section of a cooling ring. A fixture was fabricated to cantilever the test piece on one end and apply a known load and measure the deflection on the other end. A structural analysis using COSMOSM was also performed as a theoretical comparison. One of the above structural test assemblies is undergoing radiation testing at UCSC. The specimen is immersed in butane. The structural tests will be repeated after a radiation exposure equivalent to 10 Mrad's. Preliminary results indicate a very stiff structure both in bending and in torsion. A prototype 120 degree silicon arc shell segment was successfully fabricated. Assembly tooling was fabricated to aid in the manufacturing process. Initial adhesive "debonding" tests were completed on this silicon shell to establish the viability of removing the silicon module from the cooling ring without damage. Our preliminary conclusion is that the Locktite adhesive can be debonded for repair purposes. This is a very important consideration in our repair and maintainability scenario for the silicon modules.

Optical Alignment Development

We made a concerted effort in August to release all commercial equipment orders which will be needed to fabricate the silicon tracker optical alignment/assembly fixture. Orders were placed for the optical tables, mechanized slides, a control system, as well as the smaller hardware.

Good progress was made with the TV holography set-up during this period. Dynamic holograms were made for the first time. We are also now making consistent surface plots of static holograms. The Mathematica code for analyzing holograms is working reasonably well and is giving consistent results.

We set up for three tours and meetings. Tom Kirk, SDC Project Manager,and Tim Thurston, SDC Chief Engineer toured the area, and received first hand demonstrations of the TV Holography and related optical alignment experiments.

Optical equipment typical of what will be used in our silicon shell stability tests was moved into a controlled temperature space and monitored for several weeks. During that period the temperature was maintained to within +/- 0.10 degreeF and the pointing accuracy of the optical equipment was stable to 0.5 microns.

Electronics for the quadrant detectors which are part of the optical system for the assembly station were completed.

Software for the temperature controller, which regulates work space temperature for the detector assembly and stability measuring area, was modified in preparation for controlling the much larger work space volume.

Cooling System Development

Three cooling ring wicks and associated bulk samples for permeability studies were molded during August.

SEM's were generated to show the microstructures of the separate moldings, as well as the depth of penetration of two different epoxies into the wick structure. The specific gravity of all moldings was nominally 0.1 g/cc.

The range in pore diameter and permeability achieved to date are given in Table 1.

Table 1: Molded Wick Properties

Sample	Pore Diameter (Microns)	Permeability (10-13 m2)
1	2.2	0.82
2	4.0	1.2
3	9.6	1.7
4	18.8	3.6

The goal of the first wick molding was to prepare the smallest cell structure possible; this objective seems to have been achieved. The pore radius was nominally 2 microns. The second wick structure was prepared to investigate the parameters required to produce a more flexible, stronger wick structure. The rubbery condition was achieved, but removal of the wick from the mold was more difficult, and the pore structure was nearly closed, a result of too little surfactant. The third wick was constructed to reproduce an earlier wick that approximated the midpoint of the permeability span tested to date. However, difficulties in extracting the wick from the mold continued. The outer edge of the wick was unacceptably thin. The mold gap closed for reasons not completely understood, although several reasons have been postulated that will bear further study. For the time being, the mold cavity will be reworked to achieve the previously successful wick molding operations. Following subsequent molding operations, this area will be carefully reviewed to establish clearly what underlying reasons are responsible for the change.

Numerous hydraulic type tests, using liquid butane, were performed with molded wick segments that were adhesively bonded into prototype cooling rings. The transient behavior of these wicks during cool down and filling were subjectively compared with wick pore size and permeability characteristics. Following the hydraulic test series, thermal tests of the wick/cooling ring segment were initiated. These tests will continue for the near future. The results obtained to date suggest that the 1 mm artery must be enlarged to effectively handle the cool down transient and the design heat flux. It appears that the wick structure that provides butane flow to the heated surface is also marginal in thickness. Mold geometry changes are being made to thicken this critical area. While the mold is being modified, a separate wick material test series is being conducted to investigate the desired wick thickness and pore structure pertinent to the rather complex central region cooling ring geometry. Earlier tests which studied wick thickness were confined to one microstructure, and did not simulate the exact geometry. The importance of simulating the exact geometry was not recognized during earlier tests, and this omission is now being corrected.

1.1.2 Internal Electronics

KEK

Barrel Silicon System

Reported by T. Ohsugi

I) Sensor development

We have tested the first full-size prototype DSSS.

The major achievements from the prototype detector:

1) A full-size double-sided strip-sensor has been fabricated successfully.

   a) The leakage current : 300~400 nA/chip

   b) Breakdown voltage of decoupling capacitance: 90 V

   c) Full depletion voltage: 50~70 V (due to wafer resistivity variation) We can ask to select wafer resistivity, but push cost up.

2) We successfully solved the popcorn noise problem with new geometry of the implanted strip and the readout Al electrode. Now we are convinced that we have established how to design a double-sided AC coupling readout structure.

3) The interstrip capacitance (expected as a major source of readout capacitance) has been measured to be 1.2 pF (p-side) and 1.3 pF (n-side) at 1MHz. The p-side capacitance value is consistent with that from the model calculation. The n-side value is only 10% larger than that of p-side. This may be due to a good isolation achieved with the same geometry of strip width and pitch.

What remains to be solved:

1) What is the best passivation material?

2) To get an excellent breakdown voltage as well as an excellent production yield, what is the best structure of the decoupling capacitance?

II) Ladder Detector Integration

Bonding for the ladder unit detector has been investigated with 30 micron Al-Si bonding wire which is strong and easy handling. The subjects investigated were:

1) Double-row and double-layer parallel bonding of 50 micron pitch without back support in bonding area was tried to investigate how to make a double-sided bonding.

2) Fan-out angle bonding was tested with 50 micron pitch.

3) Three-row and three-layer bonding of 40 micron pitch was tried.

4) Bonding between different height bonding-pad for a bonding from detector to readout chip.

We have learned what are important parameters to be investigated for reliable double sided bonding from these tests.

The first support base for the double-sided bonding has been designed by taking into account of all knowledge learned from this test. See Appendix for revised Specification of the Full Size

LBL

Prototype DSSD

Forward Silicon Disk System

Reported by M. Strovink

No activity reported

Front End Electronics System

Technical Staff Involved: C. Corradi (LBL), J. DeWitt (UCSC), J. Iler (LBL), I. Kipnis (LBL), S. Kleinfelder (LBL), N. Spencer (UCSC), H. Spieler (LBL), R. Stone (LBL), C. Vu (LBL), K. Shankar (RAL),

Reported by H. Spieler

1. Module/Hybrid

   a) Thermal properties (Corradi, Stone) Studies of the thermal properties of the readout interface hybrid continued in two areas. The self heating of the detector due to radiation-induced leakage current was investigated. This analysis is continuing and a report is in preparation. The thickness of the Be shield should be minimized to reduce the amount of dead material and radiation length. This increases the thermal resistance between the readout ICs and the cooling ring, thus raising the temperature of the electronics. Calculations have begun to quantify these effects.

   b) Hybrid assembly (Corradi, Iler, Engineering Solutions/Fujitsubo) Assembly techniques for the readout hybrid were investigated in the following areas: Wire bonding to aluminum lines on Kapton substrates was tested. Preliminary tests yielded only about 80% bonds with acceptable pull strength. Closer inspection showed that most of the defective bonds had good welds with the breaks occurring at the wire. Further tests have been defined and are underway. An improved design for the low-mass connector has also been developed and test connectors are being fabricated. Work has begun on gluing techniques to bond the ICs to the Kapton substrate and the Kapton to the Be shield with minimum thickness and good uniformity.

2. Analog IC (Kipnis, Spencer) Work has progressed on a front-end circuit design for submission to Tektronix. This design has emphasized the reduction of dead time. Circuit designs for the Westinghouse process have also begun. Test files have been transmitted to Westinghouse and processed successfully. A full specification for the Westinghouse run was developed and submitted to Westinghouse with a formal request for quotation. A board with test devices from Westinghouse and the AT&T CBIC-V2 process has been assembled for radiation damage measurements. Preradiation

measurements were completed; the devices are to be irradiated at the upcoming LAMPF run.

3. Digital IC (DeWitt, Shankar) The design for the digital readout IC to be used in the beam test at KEK is nearly complete. Measurements have begun on test circuits for the time stamping, buffering and sparsification circuitry developed at Rutherford Appleton Laboratory.

4. Schedule: The schedule has been updated with substantial revisions to reflect our improved knowledge of fabrication times for vendor evaluation and prototype runs.

University of Oxford/RAL

Data Transmission, Liaison to Trigger & Data

Acquisition

Technical Staff Involved: Mr. K.Shankar, Dr. N.Kundu, Mr. N.Martin, Dr. B.Brooks, Mr. R.Wastie
Reported by R. Nickerson

Work in August adversly affected by holiday season.

Fibre optic LEDs characterised with the conclusion that they have a large capacitance and a bipolar driver transistor is required. C-V and I-V curves measured at 1MHz.

New fibre to pill pack attachment scheme developed and prototype parts fabricated. Hybrid structure with driver, LED designed and parts under fabrication. Order placed with Honeywell to develop ceramic LED/PIN package ($80k funded from Oxford).

PIN amplifier/discriminator chip specification developed, under consideration at RAL by Dr. P. Seller.

Receiver buffer chip design reached a conceptually complete state. Earlier problems with Hamming code use resolved. A RAM based system replaces the FIFO design for input buffering to allow random correction of errors should they be detected and correctable.

Digital front-end chip prototype chip was tested. Crucial CAM element seems to work. Back end of chip not understood; this is not the final back end, so minimal effort will be put into understanding the problem. Power consumption consistent with predictions, taking into account the different process and input pad designs. Chip paid for by Oxford ($15k). Yield very low: 2 operating chips from 20 Tests were performed at 35MHz, limited by current test system. Work on data formats and control functionality proceeds

University of California - Santa Cruz

Component Testing and Characterization

Technical Staff: E. Barberis, N. Cartiglia, D. Dorfan, S. Friedman, D. Goldin, D. Hutchinson, E. Spencer, W. Rowe, H. Sadrozinski, A. Webster
Reported by H. Sadrozinski

Testing of the 6 wafer fabrication run at Tektronix started at UCSC. The emphasis is on developing a fully automated testing procedure and understanding the yield of the Tektronix SHPi process.

1.1.3 External Mechanical Systems

No activity this month:

1.1.6 Assembly/Test/Special

No activity this month:

1.1.7 Project Management

Technical Staff Involved: A. Grillo
Reported by A. Grillo

The work in Project Management continues to focus on preparations for the upcoming DOE review and to set up systems for managing the project in the future.

1) The Cost Rollups and the Resource Loaded Schedule for the electronic part of the project was redone to reflect the numbers presented at the SDC Technical Board meeting in June. This included new plans for the Data Transmission system, inclusion of necessary prototype work, readjustment of labor rates, and much more detail in the later parts of the construction phase of the project.

2) An organization of Task Leaders and a Technical Board was set up and presented to the Silicon Group at our last subsystem meeting in August. The format of that and future meetings was modified to emphasize focus on the construction project before us. Each meeting will start with a status report from each Task Leader covering activity vs. schedule.

3) We are trying to implement a system of written specifications for each component being developed. A few specs have been written but they are hard to come by and the format and content has not been standardized. This and the necessary document control system will be slow in evolving until the planned addition to Project Management is on board. The first try at a standardized spec for the requirements of the Front-end Bipolar Chip is in the works and will be reviewed in September.

Liaison/Integration Activities

Mechanical Integration with SDC

Reported by J. Matthews

No activity reported

Los Alamos National Laboratory

Electrical Integration with SDC

Technical Staff Involved: H. Ziock

In the organization framework for the SDC silicon detector subsystem, Hans Ziock (LANL) has the responsibility for the integration of the electrical system of that subsystem with the rest of the SDC detector. During August the work done for that task was to provide Ken Hess* (SSCL) with a preliminary set of specifications for the silicon system. That included the following information:

1) Estimates of total space, total power requirements, and total cooling requirements for the electrical hardware in the underground hall,

2) Similar estimates for the silicon system in the counting house,

3) Specification of which systems need backup power: either emergency power (diesel generators), or truly uninterrupted power,

4) Specification of the AC power required to drive the heat exchanger for cooling the silicon front-end electronics,

5) Estimates of the space required for "cable" runs: both electrical and optical fiber,

6) An examination of the electrical requirements the silicon system space in the detector assembly building.

Offline Software Liaison to SDC

Technical Staff Involved: B. Hubbard, K.O'Shaughnessy (UCSC), D. Coupal (SSCL)
Reported by B. Hubbard (UCSC)

The main work in the offline software, which will continue through the fall, has been to improve the integration of the other tracking subsystems with the silicon in the track reconstruction program. This work is important for being able to compare different outer system configurations (straws vs fibers, and gas microstrip ITD vs silicon ITD). In the past month we have added the gas microstrip intermediate angle system in the same manner as the forward silicon layers, so that track segments in the gas microstrips are clustered with silicon segments. We have made two new designs to simulate, which are the compact forward system with 9 and 13 layers, and have begun to compare their performance with the gas microstrips. Other ongoing simulation studies include understanding and improving the reconstruction efficiency in jet events (D.Coupal), secondary vertexing for b quark tagging (B.Hubbard), and studying the effect of hit inefficiency for leptons in Higgs events. (K.O'Shaughnessy).

SSCL

Accelerator Interface

Technical Staff Involved: D.Coupal, T.Pal, A.Palounek
Reported by T. Pal

1) In the context of the energy deposition estimation to the silicon tracker due to beam-halo uinteractions in the vicinity of the low-beta quadrupoles, modifications have been requested to N. Mokhov, the author of the MARS simulation code. T.Pal is working with N. Mokhov in order to implement these modifications in order to proceed further.

2) Calculations are proceeding at LANL concerning the overall particle fluences and activation studies of the SDC apparatus using the LAHET/CINDER code. Preliminary results indicate that the neutron fluence is approximately 4*10E+12/cm**2/SSC year at the mean radius of the barrel silicon tracker (approx. 22 cm).

These results are for the configuration where the quadrupoles are at +/- 20m w.r.t the interaction point, and a 12 cm thick borated polyethylene shielding in front of the end-cap calorimeters.

3) Work is in progress, as a priority item, in the context of the accelerator interface meetings in order to have a preliminary design of the beam-pipe with particular emphasis to the silicon tracker, and related isuues: radiation length, vacuum levels, alignment w.r.t the beam line ...etc.

KEK

APPENDIX

Specification of the Full Size Prototype DSSD

T. Ohsugi, March 22, 1992
(correct some mistakesat Sep. 11)

a) Size

Over all size:	60 x 34.1 mm**2
Sensitive area:	58.5 x 32.7 mm**2
Readout area:	58.5 x 32.0 mm**2
(readout channels:	640 for each side)
common effective area on both sides:	58.5 x 30.8 mm**2

b) Axial-Stereo configuration:

Axial strip ---	Ohmic side
Stereo strip ---	p-n junction side

(In order to get better production yield, stereo strip side should have a simple structure.)

c) Strip :

Strip pitch:	50 micron (on both sides)

Number of strips on each surface:

640 (readout)+14 (for field shaping at edges) = 654

Stereoangle:	10 m radian

Physical dimension:

p-n junction side (value indicates mask size and expected size after processing is in parentheses.)

p+ implanted strip:	10 micron (12 micron)
Al electrode:	8 micron (6 micron)
n+ implanted strip:	10 micron (12 micron)
Al electrode:	8 micron (6 micron)
p+ blocking strip:	24 micron (26 micron)
gap between n+ and p+ :	8 micron(6 micron)

* Sizes are not optimized to the performance but determined by including some safty factors for breakdown and production yield.

d) Bonding pad:

implanted base :	52 x 152 micron**2
Al bonding pad:	50 x 150 micron**2

e) Passivation: low temp. SiO2

f) Bias resister: Poly-Si 250 +- 50 k ohm

g) Balance resister to fix ground potential:

Poly-Si straight line with:	50 ~ 80 M ohm x 2

(Balance between two resister is within 10 %.)

h) Electric properties

Initial leakage current: <2 microA / chip and <100 nA /channel)

Breakdown voltage of decoupling capacitor:>+-75 V
Breakdown voltage of junction: =>150 V
AC readout: Decoupling capacitance: ~ 25 pF/cm
Readout capacitance (interstrip capacitance):
~1.2 pF/cm for junction side
~1.8 pF/cm for ohmic side
Resistance of Al electrode: ~ 50 ohm/cm
(1.5 micron thick, 6 micron wide)
(*Important for readout waveform)
Resistance of the strip implanted: ~ 100 k ohm/cm
(* important for uniform bias feeding)

i) Fiducial mark for Integration
(pattern and position are defined in the figure.)
position accuracy relative to the strips: =<+-1 micron

j) Dicing
Full cutting by diamond saw
Cutting zone: +- 30 micron

1.2 Barrel Tracker R&D

Subsystem Manager: Harold Ogren, Indiana University

Summary of Activities:

1.2.1 Straw Tracker

Summary of Activities:

For the Straw System we have progress reports from Indiana University (Submitted by H. Ogren), University of Colorado(Submitted by W. Ford), Duke University (Submitted by A. Goshaw and S. Oh) ,QRS (Submitted by B. Dunn), Westinghouse Science and Technology Center (Submitted by D. Hackworth and and R. Swensrud),and Oak Ridge National Laboratory (Submitted by D. Davis)

Summary:

The principle activities of our group in August focused on the August 3-4 meeting of the technical board, reviewing the tracker subsystems. Indiana University and Duke University both moved a 4 meter module system to SSCL for the meeting. University of Colorado furnished an interface connection for one of the chambers, and also ,in collaboration with University of Pennsylvania, made available five 16 channel ASD boards for read out of the signal wires. The the drift time distributions on one module were recorded using a TMC module from KEK.

Westinghouse produced a working model of a module hold-down fixture and a tool for engaging and disengaging the module. ORNL and KEK demostrated several cooling options for the front end electronics. The exercise of moving a module to the lab and setting up the support and data acquisition equipment for a cosmic ray test was valuable to all groups. It is especially encouraging that both modules made the round trip with out developing problems.

Work also progressed on trigger module construction, with additional tooling completed, work under way on the graphite mold, shell production with cyanate ester resin, and progess on alignment tooling both for local calibration and for assembling the detector.

In prepation for the DOE review there where several meetings on budget, scheduling, and task management.

At all the universities there was continuing effort on detector simulation.

1.2.5.1 Module Tooling

Indiana

Reported by Tom Collins

The first straw clamp for the C1 trigger super layer was returned from the electro cutting supplier. The clamp was filled with short section of straws, and measured on an optical scanner. The positions looked satisfactory. Several small changes in the extreme corner straw postions were made, and the order for 6 more clamps was placed.

1.2.5.4 Tracking Detector Alignmen

Duke University

Reported by Al Goshaw, Tom Phillips, Bill Robertson

Quantum Research Services has begun X-ray simulation studies for the measurement of sense wire locations in straw tube drift chambers. The model used accounts for the module shell cross section, straw material, wire composition and detector efficiency. Initial results of pattern deviations of the X-ray scanner approach (for various wire diameters) look very promising. We will be reporting on the feasibility of this technique at the Industrial Radiation and Radioisotope Measurement Applications Conference September 9th and 10th as well as a formal report to you at the end of September.

As a part of our alignment integration effort, I met with Jack Hanlon (silicon) and David Veal (SSC lab) at Los Alamos National Laboratory, and I also met with Jacques Govignon at Draper labs to discuss global alignment integration concepts and ideas. We are going to hold a special alignment meeting at Duke University in the Fall in order to formalize some of the thoughts about this topic.

We are finalizing a design for the central tracker MODEL which we plan to build in the next 2-3 months. A formal memorandum on the model design will be passed around (Westinghouse, Duke, Indiana, SSCL, Draper) in order to gain consensus for the design. The size of the model will be radius-1.2M and length-2M and will include a portion of the intermediate tracker in order to simulate wire clearance requirements.

Finally, we are planning to test our module fiducial measurement technique as soon as D. Veal receives the Theodolite T3000 which he has ordered for the SSC lab. We are building some fixtures to conduct this test.

1.2.6.11 Straw Tracker Cooling Utilities

ORNL

Reported by: Rob Leitch, Doug Sparks

The cooling enclosure for the Oak Ridge version of the front end electronics boards has been refined and additional bench testing is underway. The test setup has been modified to better isolate the enclosure from room conditions. Results from this testing are being used to improve analytical models. Results continue to support predictions and indicate that air cooling of these boards is a feasible mode of cooling.

Drawings depicting the routing of cooling utility lines within the tracker volume are being updated to reflect the latest tracker dimensions.

WBS 1.2.6.1.1 *Straw Tracker Signal Electronic Utilities - Rob Leitch, Doug Sparks*

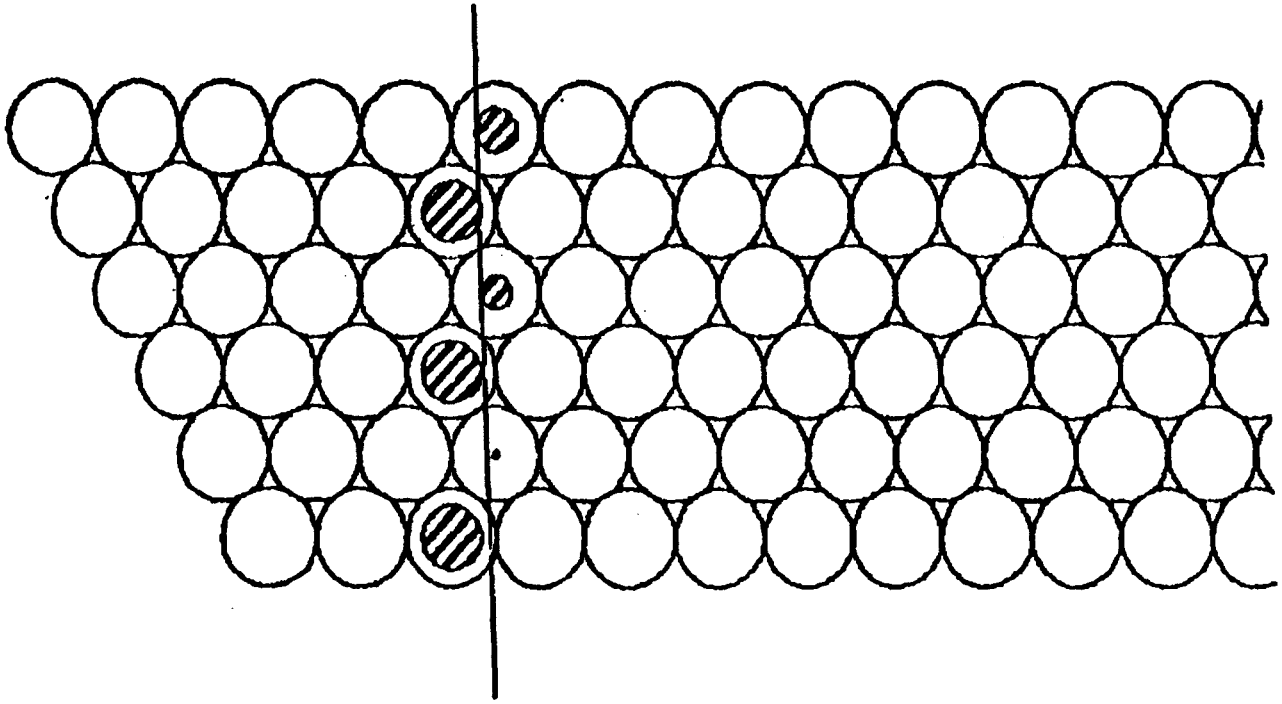
WBS 1.2.6.1.3 *Straw Tracker Program Management*

ORNL

Reported by: Rob Leitch, Dale Davis

Signal cable routing layouts were continued this month. When combined with other utilities and services layouts, an integrated set of utilities routing drawings will be available.

A cosmic ray track as measured in a six layer straw module.



1.2.11 Management

1.2.11.5 Management, Scheduling and Reporting

Westinghouse

Reported by Swensrud, Beninati

In the reporting period, the following work tasks were completed:

1) As anticipated, August was a vacation and a military duty month therefore design progress was slowed, but required progress was maintained.

2) Completed and transmit the updated cost data to SSCL by August 7th.

3) Completed and transmit the updated schedule rollup data to SSCL by August 19th.

4) Completed the top down WBS straw tracker total FY93 budget. The work was supervised by Indiana University who in turn is documenting institutional distributions.

1.2.11.4 Management and System Engineering

ORNL

Reported by Dale Davis

Initial agreements have been reached with the Straw Tracking Group (STG) for Fiscal 1993 ORNL funding levels. Bottoms up budget input is being prepared that describes in detail the scope of work for each WBS element.

1.2.12 R&D Prototypes

1.2.12.1.2 Module Prototype

Indiana University

Reported by T. Collins, E. Wente, D. Rust, B. Martin

A 4 meter long stereo module was set up at the SSCL for the Collaration meeting. This required aligning the holding fixtures on several new optical tables, assembling a new gas system to meet the SSCL laboratory gas safety requirements, and setting up a data acquisition system to read out over 40 channels. The final ASD chip was used and the timing was done with the japanese TMC. At the end of the meeting the module was moved back to Bloomington, and set up for continuing series of tests. A picture of a cosmic ray recorded in the module is included.

The prototype shells are under production at Composite horizons, Covina, Ca. The set up was inspected by T. Collins on a visit to the site in August. Discussion on quality control are continuing. Three shells constructed with a cyanate ester resin were manufactured in august and are being shipped to Indiana University. The preparation were begun for the construction of a second stereo module at Indiana University.

Colorado University

Reported by B. Broomer, E. Erson, G. Schultz, C. Zuelchner

Received delivery of 10 additional ECL level translator boards of our custom design.

Added a 4-inch thick lead filter and scintillator to the trigger of the cosmic ray test setup.

Tested a battery power supply system with the Faraday-shielded prototype 1-foot straw chamber and front end electronics. Found we can now operate the custom A-S-D8 boards at Vthreshold = 0.6V (3fCoulombs). Ordered low-noise power supplies and borrowed an AC isolation transformer in hopes of replacing the batteries while maintaining low noise.

Completed a measurement of resolution and residuals with the 64 channel prototype straw chamber setup as a function of high voltage, at Vthreshold = 0.6V. Best is about 160 microns resolution (140 micron residual), at 1800 volts with CF4-isoC4H10 (80/20). Observe apparent crosstalk at higher voltage. Ordered (70/30) mixture of gas for comparison test.

Initiated a program to track down the sources of crosstalk.

Initiated design of a new interface to the front-end electronics that will allow plug-and-socket like removal of the active component substrate.

More work in progress on wire supports. The vendor delayed production of the last 3000 parts to rebuild a worn-out mold part. Meanwhile we have new evidence of damage to the cathode conductive coating during insertion of the wire supports. We are working with the vendor to correct uneven surface features blamed for the cathode damage.

Attended facilities and management planning meeting of the straw group at SSCL.

Met with Colorado State University group to plan joint efforts for module fabrication.

Westinghouse Science and Technology Center

Reported by Swensrud, Barkell

1) Attended the SDC Collaboration meeting at SSCL on August 2 to 5 1992 and presented straw outer tracker engineering talk at the tracking review secession.

2) Demonstrated the prototype straw module shim ring attachment and actuating tool at the SDC August Collaboration meeting.

3) Calculated and confirmed that modules with alignment targets of 2 CM height have sufficient clearance for installation through the support structure.

4) Attended the SDC Outer Straw Tracker Meeting at SSCL on August 28 to 30, 1992 and presented engineering status report.

5) Recalled the issued Draft Straw Outer Tracker Subsystem Geometry Definition Report for a needed Revision. The revised report will issue next period.

Duke University

Reported by S. Oh, C. Wang

In August, we continue to test the 4 meter 159 channel module. We have replaced the Lecroy ASD (amplifier-shaper-discriminator) cards with the Penn prototype ASD cards to test their performance. We have found that the sensitivity of Penn ASDs is such that the operating voltage can be lowered by about 200 Volts (from 2100 V to 1900 V). The chamber gain at this voltage corresponds to about 40000, which is not much different from the gain we like to operate in the experiment. Moreover we have found that the residual is still about 130 microns comparable to the one obtained with Lecroy ASD cards at higher voltage.

For the collaboration meeting, we shipped the module with all the electronics and data aquisition to the SSCL. We set up the chamber in building 3 and cosmic ray tracks were displaced on line during the meeting. The module was brought back to Duke without any problem. The module is again operating at Duke beautifully.

We are continuing to improve the technique to measure the wire position using collimated Sr90 source. We have tried the technique to measure the position of sense wires inside a module, and the preliminary results show that the accuracy of measuring the wire position is better than 50 microns.

QRS

SIMULATION

Reports on simulation work were received from Indiana University, Duke University and Colorado University.

SDC TRACKER SIMULATIONS(Duke University)

We have hired Dr. Boatang Zou to work at Duke on various SDC simulation tasks. In particular he will get the SDCSIM program running at Duke and help with tests of tracking algorithms and with the evaluation of tracking detector placement and alignment requirements. Dr. Zou will arrive at Duke on October 1. He is being supported by a TNRLC infrastructure grant awarded to Duke as part of the SAHEP Consortium.

SDC SIMULATION (Colorado University)

More work on simulation of straw tracker performance and segment reconstruction. Support for Version 5 of SDCSIM, released in August. Measure false rate, improve occupancy calculation, include straw inefficiency in the model. Presented simulation results at straw review at Aug. 2-5 collaboration meeting.

SDC SIMULATION (F. Luehring, Indiana University)

Work this period involved continued studies of the occupancy and segment finding efficiency for luminosities well above design. Also work continued on the integration of the straw and gas microstrip intermediate tracker, with studies of segment finding efficiency in the intermediate system and linking between the ITD Disks.

1.3 Intermediate Tracker R&D

1.3.1 GMD (Gas Microstrip Detector) Tiles

Carleton/CRPP

Technical Staff: jP. Gravelle, E. Neuheimer, G. Stuart, S. Taylor
Submitted by M. Dixit

The CERN beam test data for the 400 microns pitch GMDs on plastic had indicated an increasing loss of efficiency with increasing distance from the anode pad connections to the amplifiers. The effect was studied in the lab by mapping the efficiency of the GMD using a collimated Fe55 source and is now understood to result from pulse height attenuation due to the high resistance of the anode traces connected to fast low input impedance current amplifiers. For the future tests, the effect will be minimized with higher input impedance amplifiers and better and thicker metalization for the GMDs.

A number of gold and aluminum GMD prints have been produced on the ion implanted UPILEX and Kapton substrates in collaboration with a local Ottawa company. We expect to improve the quality of these prints by using better methods to rigidly support the flexible plastic substrates during various process steps.

We have designed and produced a new mask with individual anode readouts. GMD prints using this mask design will be used for the next beam test.

The 8 keV copper target x ray machine is now operational.

Submitted by M. O'Neill

Suppliers have been contacted for information on material properties, supply and ROM quotes for frame and backing. Materials for fabricating prototype backings for the substrates has been ordered. An FEM model of the tile has been created to explore the mounting and layup requirements.

Methods for bonding plastic substrates to aluminum backing disks are being developed to allow the processing of plastic substrates using ion implantation as well as microlithography.

Liverpool

Technical Staff: S. F. Biagi, T. J. V. Bowcock, T. J. Jones, S. Kiourkos, A. Muir, E. Orme, C. D. King, J. M. Morton
Submitted by T. J. Jones

Analysis of data from the summer beam test at CERN is continuing. Bowcock presented initial results at recent Dallas conference.

The keystone geometry mask produced by UK industry has been scanned for faults. Several faults were found with an equal sharing between those implicit in the design and those generated by the mask production. The design errors have been corrected and, in collaboration with the manufacturer, we are making progress in the understanding of the faults produced in the mask fabrication.

In preparation for the forthcoming MSGC-UK test beam run we have modified an existing parallel geometry mask for compatibility with the RAL designed MSGC test module. Detectors based on this mask will be produced in the near future.

We have several samples of thin (80 to 300 micron) 4 inch square glass plates at RAL awaiting processing. In addition there are some smaples of ion-implanted quartz to be processed.

In preparation for the forthcoming beam test at CERN Liverpool have been involved in the design and construction of the mechanical support structures allowing several MSGC modules to be precisely aligned and positioned in the beam. In addition, we are building a rotary table allowing one of the chambers to be rotated with respect to the direction of the incoming beam giving the facility to investigate the MSGC performance as a functionof the track angle.

Liverpool are contuing to study the mounting of tiles on the support disks and the tile-disk interconnections. We are preparing to build a facility for checking the compatability of possible materials with candidate drift gases and have obtained large area samples of thin glass, from UK industry, for mechanical prototype development work.

Universte De Montreal

Submitted by P. Taras

We have deposited a layer of SiO2 1.25 microns thick on 7 Si wafers having a thickness of 300 microns each. The deposit of a-Si:H done by a new technician on these wafers did not stick. We are waiting for a new deposit to be completed. For comparison purposes, we are also in the process of depositing a-Si:H on glass plates.

Two commercial companies have also been contacted which could supply larger size Si wafers with up to 5 micron layers SiO2. Apparently, wafers up to 14" diameter could be obtained. We are waiting for the prices.

RAL

Technical Staff: J. F. Connolly, J. E. Bateman, R. Stephenson, A. Nichols
Submitted by J. F. Connolly

Detailed design layouts of the proposed "keystone" pattern of cathodes has been completed to enable a first prototype of a full sized, correct pattern mask to be made in industry, in parrallel smaller masks are being made within RAL. Fabrication of the components of test detectors to be used this autumn in a test beam at CERN is progressing satisfactoraly, as is the read out electronics. Development of new detector plate fabrication techniques, plasma etch and evaporation, has started. Tests continue on various substrate materials: custom made thin glass, "Pestov" glass, and ABS plastic.

Purdue

Technical Staff: I. Shipsey, P. Wang, T. Miao, M. Bishai, E. Gerndt, N. Menon
Submitted by I. Shipsey

LASER ABLATION

We are attempting to manufacture a large GMD using excimer laser ablation. We plan to try both direct write and liftoff, initially with tempax glass as the substrate. We have tested several masks built using e-beam lithography at Purdue in excimer laser beams. A chrome on quartz mask using a Hoya blank can stand 70 mJ/cm^2. This is a little less than one would like, however it should be adequate for liftoff and maybe for direct write too.

OTHER TESTS

We have continued to build working GMD's on Tempax at Purdue from our own masks using a KARL SUSS contact mask alligner. Metalization has been done either in-house or by GM Vacuum of California. We have found the commercial work to be of very low quality, many AL specks remain after etching. These specks result in chambers that break down at extremely low voltages. Pinholes are also a problem. Our best chambers so far have been obtained with our own hands. We are designing an x-ray test station for use with 8 KeV x-rays at Purdue.

Rochester

Texas A&M

Technical Staff: E.F.Barasch, H.P.Demroff, T.S.Elliott, R.M.Gaedke, L.T.Goss, T.B.Kasprowicz, V.P.Madduri, T.K.Mazumdar, P.M.McIntyre, Y.Pang, H.-J.Trost, G.Vanstraelen
Reported by: Hans-Jochen Trost

We have added ion-implanted kapton and a ceramic to our list of working substrates. Presently, the ceramic is intended for manufacturing exercises and is not considered a serious contender as a substrate for application e.g. in the ITD. Our first test at home after the short CERN tests was a check of P-10 versus Argon-Isobuthane (75:25), motivated by the gain of possibly 10000 we estimated from the observed signals in the pion beam at CERN. At first sight, the Fe/V chamber that was tested there did not show significantly different gains with the two gases in our lab, at equal voltage settings that we had used before already with P-10. We have repeated the exercise with the ion-implanted kapton. Tuning for the highest possible gain has not been attempted. Chambers using gold on ceramic have served as a base for successful wire bonding exercises. These will allow us to study the usefulness of QPA02 on-board preamplifiers from Fermilab. We are developing a more portable chamber package for our test chambers.

Triumf

1.3.2 Front End Electronics

Carleton/CRPP

Technical Personnel: G. Findlay, E. Neuheimer
Submitted by J. Armitage

In an effort to keep costs down, it is hoped that the GMD's can use the same Front End electronics as those already being developed for other parts of the SDC Group.We have therefore surveyed the available I.C. designs with reference to the requirements of the G.M.D.'s. Those being developed for the Silicon Strip electronics come closest and we find that the 64 channel (eventually 128) chip designed by U.C.S.C. is a good match to our requirements.

We have two of these chips and in the next few months will be designing a P.C. board to hold them and couple them to the G.M.D. prototype. The present I.C.'s are a little slower (35 ns) than we ultimately need, but the next stage of development will result in a faster chip (~20ns) being available in Jan '93. The P.C. board developed for the present chips will probably be able to be used with the new 128 channel chip, though will not use 64 of the channels. This will allow us to use chips with one or more dead channels that would be rejected for silicon strip work.

There have been several changes in the layout of the ITD which have affected the plans for D.C. power distribution. The biggest change has been that the support for the ITD is now provided solely from internal cylinder/cone and the external cone has very little mass, being only a gas enclosure. This was done to reduce the radiation length of the materials at the junction between the ITD and the Outer Tracker.

The D.C. power supplies are now routed along the inner cylinder. They are still constructed as aluminum conducters on a flexible Kapton support, but the "rings and spokes" design has been superceded by a radial "star" design which produces the same supply voltage at each GMD tile. In this design the aluminum condutor is brought out to the gap in between the calorimeter and the muon chambers. There it is connected to a heavy duty copper conductor for the remainder of the path back to the power supplies. For the currents used, the voltage drop along the supply cables is 180mV and there is a corresponding voltage drop along the return cables, making a total drop of 360mV.

Oxford

Technical Staff: K. Shankar, N. Kundu, N. Martin, B. Brooks, R. Wastie, B. Hawes
Submitted by R. Nickerson

Report largely in common with silicon system, since large overalp in elements.

Fibre optic LEDs characterised with the conclusion that they have a large capacitance and a bipolar driver transistor is required. C-V and I-V curves measured at 1MHz. New fibre to pill pack attachment scheme developed and prototype parts fabricated. Hybrid structure with driver, LED designed and parts under fabrication. Order placed with Honeywell to develop ceramic LED/PIN package ($80k funded from Oxford). PIN amplifier/discriminator chip specification developed, under consideration at RAL by Dr. P. Seller.

Receiver buffer chip design reached a conceptually complete state. Earlier problems with Hamming code use resolved. A RAM based system replaces the FIFO design for input buffering to allow random correction of errors should they be detected and correctable.

Digital front-end chip prototype chip was tested. Crucial CAM element seems to work. Back end of chip not understood; this is not the final back end, so minimal effort will be put into understanding the problem. Power consumption consistent with predictions, taking into account the different process and input pad designs. Chip paid for by Oxford ($15k). L-1 trigger logic also worked, although this is a simplified version of what is required. The system has the required four deep buffer, but no time stamping. Yield very low: 2 operating chips from 20 Tests were performed at 35MHz, limited by current test system. Work on data formats and control functionality proceeds

L-1 external trigger chip design underway. Matrix logic for current GMD device now under consideration by Hawes.

1.3.3 Mechanical Engineering

Carlton/CRPP

Technical Staff: M. O'Neill
Submitted by M. O'Neill

The radiation length study has been revised and is being circulated within the ITD group for comment. Calculations that provide an upper bound to some of the mechanical parameters are included in this report. Finite element analysis of the disks, support cones and tiles using ANSYS continues. A model with support cones and three superlayers with two disks per superlayer using composite elements was analyzed. Mockups of the tiles have also been made and work will continue in this area as mockup components are gradually replaced with actual parts. Work on generating the solid model of the ITD version 7.1 continues.

Suppliers have been contacted to initiate discussions on costing for the support disks and cones.

Liverpool

RAL

Technical Personnel: G. Tappern, A. Nichols
Submitted by G. Tappern

The design layouts have been changed to Version 7.2, and the mounting changed from the end cap to the barrel. The requirement of a sliding joint in the support cone to allow superlayer 1 to be retracted towards superlayer 2 has been removed, with consequent increase in the stability of the detector. The effects of the mounting positions on the stability of the detector are under study. It would appear that more, or different, mounting locations are required to reduce the deflection of the ITD under gravity load to meet the specification.

Study of the proposed materials to be used for construction continues, and will do for some months. Quotations from industry have been requested for a 1.2 m X 0.6 m panel of carbon fibre skins and carbon fibre honeycomb core, to be used for test purposes.

1.3.5 Gas System

Carleton/CRPP

Submitted by J. Armitage

We have looked at the resistance to chemical attack of several common substances used in GMD fabrication, when exposed to DiMethyl Ether and (separately) CF4. We have left these materials in a container of gas at 4 atmospheres for periods in excess of 50 days. The results will be used to design a GMD container for test beam running.

1.3.6 Cooling

Carleton/CRPP

Submitted by J. Armitage

We are developing two programs to calculate heat loss. One is based on a spreadsheet and the one is written in FORTRAN. They are used to cross check the results from each other.

Calculations have been made for the cooling of both the GMD substrate and the associated electronics. Power is dissipated in the substrate by the small ohmic current that flows between anode and cathode. It is estimated to be 5W per sq m. if the surface resistivity of the substrate is 10**13 ohms per sq. This can be cooled by convection to the counting gas but requires a large flow of gas which may not be available. It can also be cooled by conduction through the substrate and extraction of the heat from the underside of the tile either by forced air cooling or further conduction to a cooling ring.

For the electronics, convection cooling is not sufficient. At 5 mW per channel we could be dealing with 1 W of heat to be dissipated in a small area of 20cm by 2.5cm. The removal of heat by conduction through to a liquid cooling ring is required. This can be accomplished with a 10 degree C temperature difference at reasonable flows of coolant - up to 1L/min, at medium pressures, up to 65 p.s.i. (This is equivalent to the pressure in the domestic water supply).

1.3.8 Installation

Carleton/CRPP

Submitted by M. O'Neill

A preliminary layout and description of the ITD requirements for the surface assembly has been prepared and submitted to M. Hechler.

RAL

Submitted by G. Tappern

Discussions on the integration of the ITD into the SDC have been held with Mike Hechler, and will be ongoing.

1.3.9 Project Management

Carleton/CRPP

Submitted by M. O'Neill

Revisions to the resource loaded schedule have been made to make it consistent with the costing spreadsheet.

Simulation

Submitted by P. Estabrooks

There have been several substantial improvements to the ITD simulation, otherwise known as the PM and PR packages of the SDC SHELL, over the past month.

- The latest version (v7.1) of the geometry has been implemented (as file PMGEOM_V71_SPLIT.CTL)
- The description of material in the ITD has been improved to be a better approximation of an actual detector
- There have been a substantial number of bug fixes and small improvements for the version 5.0 SDCSHELL release.

2.0 CALORIMETRY SYSTEMS R&D SUMMARY

In August effort on the calorimeter barrel wedge design continued on the major structural components. The barrel EM design based at ANL and the barrel HAD absorber being designed at Fermilab are being integrated to produce drawings for the preproduction prototype. Further refinements were made in EM design to reduce deflection. These were reported at a Special Design review held on August 3, 1992. Final configuration decisions were made on the HAD absorber.

The fiber routing model is almost complete and ready for fiber routing studies. The intention is to provide feed back on the proposed fiber routing schemes. These studies will also impact the configuration of the surface of the wedge and on assembly procedures now being developed.

Tasks for FY1992 (WBS 2.9.1)

1. Optics Development
2. Photomultiplier Tubes and HV
3. Scintillator Development
   a. Material Development
   b. Material Evaluation
4. Simulations
5. Radiation Damage
6. Calibration
7. Engineering
   a. Engineering Design
   b. Tile Production Optimization
   c. Preproduction Prototype
   d. Project Management
8. Forward Calorimeter
9. Research & Development

2.1 Barrel Calorimeter R&D

Rockefeller University

Photomultiplier Tubes and HV

Technical Staff: A. Bhatti, R. Rusack, P. Melese, A. Maghakian

The Rockefeller group has been working on the following projects:

1) Characterize APD arrays for the APD and APD PMT readouts;

2) Complete analysis and write up the results from the 1992 test beam on the massless gap and the shower maximum performance and,

3) Continue with simulations on the separation of gammas from neutral pions in the shower maximum detector.

ORNL

Simulation

Technical Staff: T. A. Gabriel

ORNL, in coordination with the University of Tennessee, Argonne National Laboratory, University of Arizona, and the University of Mississippi, is studying two areas of interest to the Solenoidal Detector Collaboration (SDC). These include particle punch through and triggering via artificial neural networks. During the past two months (July and August, 1992) calculations have been carried out to determine the number and energy spectrum of neutrons and gamma rays leaking from the rear of iron, lead, and uranium targets for various energies of incident particles. The results of these calculations are being incorporated into an SDC note. Calculations are also underway to determine the ability of an artificial neural network to detect two jet events. The preliminary results indicate approximately 90% success. The results of these calculations will be presented at the Conference on Computing and High Energy Physics in Annecy, France, September 21-25, 1992.

Argonne National Laboratory

Technical Staff: D. Carbaugh, V. Guarino, N. Hill, C. Keyser, L. Kocenko, J. Nasiatka, E. Petereit, R. Stanek

EM Section Prototype Design

During the month of August, the following work was accomplished on the design of the full size Cast EM prototype: The layouts were changed to reflect the new module length of 4389 mm as specified by the SSC Integration Group. The St. Steel spacers and plates at the EM outer radius were detailed and sized, and the source tube layout was completed. The EM weldments and assemblies were taken to approximately 80% completion. The St. Steel weldment subassembly is presently in the shop for evaluation and estimating.

A full analysis was performed on the EM/HAD1 adaptor plate, and preparations have been made to assemble a test section of the Welded St. Steel Structure at the outer radius of the EM.

Wooden Fiber Routing Model (Trojan Horse)

The EMC sections of the Barrel Calorimeter were finished in August, and successfully attached to the HAD1/2 section at FNAL. Fiber routing schemes are currently being studied.

Mechanical Design Optimization and Testing

The following items for optimizing the design of the EM section were performed in August.

1. Additional tensile tests were performed on the 1.3% Tin lead alloy (#L50750), the results are shown in Fig. 1.

2. Additional analysis was done on the eta = .10 span deflections, and test apparatus was designed to analyze these deflections alone, and with the addition of perforated, lead-filled, steel reinforcing tubes (see Fig. 2).

3. Test apparatus was designed for the Calcium-Tin alloy creep test, and potential vendors for the strain gauges and data acquisition systems have been interviewed.

4. The data on the FEA calculated deflections of the high-eta end of the EM section were analyzed. These were presented at the Sept. 1st teleconference between ANL, SSCL, and FNAL. They are partially represented by Figs. 3-6.

Preliminary Calorimeter Assembly

A preliminary study of the Barrel and Endcap Calorimeter assembly schedules was performed, and layed out for the Title I design submittal. This work is partially represented in Figs. 7 & 8. An additional study including In-Hall assembly of the Calorimeters is currently being performed.

Cast Mechanical Test Model

Due to inconsistent data resulting from improper grounding of the strain gauge readouts and high electronic noise levels, the mechanical test model was re-instrumented with additional gauges, and steps were taken to correct for the high noise levels as well as excess motion in the holding fixtures.

Fermi National Accelerator Laboratory

Technical Staff:

Scientific: W. Foster, T. Freeman, S. Gourlay, D. Green, P. Mantsch
Engineers: M. Banas, L. Bartoszek, Da.Silva, B. Hahn, Y. Lee, E. Larson, J. Missig, R. Richardson

7a. Engineering Design:

The wooden mock-up is nearly complete. The EM sections have been attached and the module is mounted on the assembly fixture in the Industrial Center Building at FNAL. A set of fiber routing drawings has been made for the high eta end. Preliminary work on fiber routing will begin this week. Virgil Barnes has loaned us on of his source drivers. It will be used to study source tube routing problems. We are in the process of obtaining mock-ups of other systems that attach to the barrel backbone (e.g. electronics crates, shower max readout, flasher system, etc.) As resources allow we will begin looking at the layout of PMT's, etc. on the backbone.

Work is continuing on refinement of the prototype cost and schedule in preparation for the October DOE review. As the design of the EM and hadron absorber mature, preliminary work has begun on tooling, fixturing and factory setup for the prototype.

In August the Design group completed its experiments on the stacked lead EM calorimeter. We measured the pressure in the stack by placing Fuji paper between layers and we cut out fiber routing slots for the shower max detector. We are still analyzing the data from the pressure measurements, and the deflection of the lead around the shower max fiber routing slots was not as bad as was expected. The maximum deflection of the lead into the largest slot was about .75 mm. We will be writing a summary document that answers all of the action items from the cast vs stacked review shortly.

We also began the process of laying out the barrel wedge steel for the prototype by getting a number of questions answered about the design of features on the wedge. We estimate that the production drawings for the steel will be finished by the end of November, but we will have a set of summary drawings to aid the quotation process within a few weeks.

Several space conflicts have come to the fore with the muon system and are being worked through with the Integration group at the SSC. In particular, we need to determine if the penetrations through the space between the barrel and endcap (for alignment with the trackers) can be modified to allow the plates which take compressive load from the solenoid to also act as connections from wedge to wedge in the barrel. We are still working out some problems with the radioactive source tube routing on the wedge. The real problem is whether or not we need to bring

tubes out at the eta=0 end of the calorimeter, which would force us to have tubes coming out both ends. This poses an interesting challenge for the design and placement of the source driver.

The FNAL calorimeter group also began weekly interface meetings with the ANL calorimeter group to establish the boundaries of the EM and hadronic calorimeters. We have worked out the conceptual design of the connection between the hadron steel wedge and the EM section.

In August we also received the wooden mockups of the EM section from Argonne and the shower max module from Saclay. They were installed on the wooden mockup of the steel wedge and fiber routing trials will be beginning shortly. The wedge has been mounted in Industrial Center Building on some tooling which allows it to be rotated 360 degrees for easy access during fiber routing tests. Work platforms have been ordered to aid this work and begin to assemble the tooling necessary for actual wedges.

7b. Tile Production Optimization

7c. Preproduction Prototype

7d. Project Management

A Special Barrel EM Design Review was held Monday, August 3 to determine if the cast lead EM design team had successfully solved the structural problems and had addressed other concerns raised in the June 22-23 Cast / Stacked EM review. The review committee concluded that the deflections were controllable but raised a number of continuing concerns. In particular there was a concern about the cost of the actions taken to control deflection.

The Calorimeter Project WBS assembly underwent more revision. Detailed plans including procedures and tooling enabled more precise estimation of costs. The FY1993 budget request was revised to reflect improved task definitions. Revisions continued on the Calorimeter Project Management Plan and Calorimeter Project Specific Quality Implementation Plan.

Weekly meetings have been established to implement central calorimeter configuration control. The meeting is held either at ANL or FNAL with meeting notes and action items provided to all attendees to maintain accountability. Progress is being made on establishing a system for easy electronic transfer of drawings between the various laboratories.

SSC Laboratory

Physicists continued effort on specification parameters for the SDC calorimeter system. No technical staff were involved in this activity. Activity budgeted for this year includes purchase of a laser for light flasher studies.

University of Texas at Arlington

Technical Staff: L. Sawyer, P. Draper , G. Sickland
Reported by: P. Draper

We are gathering components for a laser calibration development system, with an eye to implementing the first prototype for the Fermilab calorimeter prototype. We are building a light box, and have acquired Hamamatsu monitoring PIN-diodes and cooling system. A Laser Photonics nitrogen laser and dye cell have been selected (Sawyer). We are in discussions with G. Pauletta (Pisa) over collaborating on the work and remaining equipment purchases for R&D and prototype systems. (Sawyer, Draper)

We now have a Macintosh-based data-acquisition system using Labview to read a GPIB-driven CAMAC crate for these tests. (Draper)

We have finished some aspects of the design for a front-end charge-injection pulser and we are ready to wire-wrap a test version to look at the transparency of the analog MUX for phototube signals. (Sickland)

We are continuing Monte Carlo studies of radiation damage to tiles and recoverablility of response using in situ signals. (Draper)

2.1.9 Tile/Fiber Fabrication

University of Tsukuba

Technical Staff: K. Takikawa

Design of prototype barrel EM tiles for eta ~ 0.6 and 1.4, beveled and straight edge tiles.

Trial manufacture of mini-mega-tiles. This is done in conjunction with the CDF plug upgrade.

Pressure dependence of tile/fiber assemblies. Tuning-up of a setup which pressurizes a tile/fiber assembly up to 10 atm.

Raddam and Endurance Tests

Simulation of effects of transverse uniformity degradation.

Radiation damage test of Kurary sample tiles S1 - S12. This is done in conjunction with the CDF plug upgrade.

Design of endurance tests of fiber bends and tile/fiber assemblies. The results of initial tests were presented in the SDC May meeting at KEK. We intend to improve the initial tests.

PMT/bases

Design of PMT test benches.

Midterm test of a new CW base being produced by Rin'ei Co.

Design and simulation of CMOS ASIC for the digital readout of the shower maximum detector.

2.2 Endcap Calorimeter R&D

Lawrence Berkeley Laboratory

Technical Staff: R. W. Kadel, W. Pope, W. Thur, M. Hoff, D. Le, A. Lim, Y. Minamihara

7a. Engineering Design

SDC Endplug

Brief reports have been prepared covering all operational /fabrication aspects of the SDC Endplug in anticipation of a formal Request for Quotation:

- SSCL Surface Assembly Operations
- Fiber Routing and PMT Mounting
- Pizza Pan and Source Tubes Fabrication and Installation
- Request for Quotation and Scope of Work (absorber structure & flanges)

Details from these have been transformed into detailed shop fabrication drawings of the #197# 100 tonne absorber structure and Endplug support flanges. These drawings, etc. are part of a Bid Package which is scheduled to leave LBL on Friday, 9/18/92.

An extended statement of work has been prepared for MCR Associates to complete the FEA structural analysis and optimization work on the Endplug Absorber Structure.

Work on the hydraulically driven calibration source (alternative) is proceeding slowly--the principle (vendor) difficulty being finding a suitable, compact, non-magnetic source of adequate strength and half-life which can be enriched in a reactor.

Monolithic Endcap EM

A Request for Quotation for EC/EM parts (materials supplied by LBL) was mailed to prospective bidders. We are investigating the use of thin Stainless Steel sheet for the "curtains".

Transporter

A trip was made to FNAL to investigate using spare parts from the Zeus transporter for the SDC transporter. Also the possible experimental areas were visited. Each experimental area would require a different design for the transporter. Therefor, in meeting with Steve Gourlay (FNAL) it was agreed that LBL would design the transporter and that FNAL would find an appropriate beam line for the device.

SSC Laboratory

6. Calibration:

Technical Staff:

2.2.1 Barrel Calorimeter Calibration R&D

Purdue University

Technical Staff: V.E. Barnes, A. F. Garfinkel, A. T. Lassanen, J. Ross, C. Zhao
Reported by: V. E. Barnes

Three source drivers were delivered from the Purdue Central Machine Shops, and then had their wiring and electrical components installed and were mechanically tuned up. These drivers incorporate a number of mechanical design improvements based on experience with heavy use of source drivers in the past year at testbeams at FNAL and BNL.

PC and Vax programs were completed to exercise the source drivers. The programs control, via CAMAC, the source driver motors read the index and reel counters, and log information about wire extensions and retractions. Long term wear tests were initiated using a

dummy source wire and a set of ten 15 gauge source tubes, each with three 90-degree bends of 3-inch radius. After 16,800 extensions into the source tubes (at a rate of about 1200 extensions per day), the source wire broke at a point 18 inches from the tip, through fatigue failure. This corresponds, for example, to 7 years of use assuming 200 channels are accessed on a monthly basis. We are receiving theoretical advice from Purdue Professor of Mechanical Engineering Ben Hillberry, who is an expert on fatigue failure. More failure data points are essential, and long term wear tests are continuing and will be expanded to quantify safe cycle lifetimes of the source wires. Wear of the wire tip was not observed.

The source drivers have held up very well under these tests, and in particular the new K27 gear heads are so far giving no problems. The motors, which are nominally the same as the ones installed in 1984-85 in the CDF endwall and central calorimeter source calibration systems, are also giving no problems so far. Heavier-duty motors and gear heads have been on back order and may eventually be tested, depending on the experience with the present design

A PC program has been developed by C. Zhao, working at ANL with R. Stanek, to take source data using the ANL signal conditioner and multiplexer CAMAC modules to measure the phototube DC currents with high resolution. Transverse scans have been made of the cast lead EM prototype using the above modules and also, for comparison, using the DSP2032 scanning autoranging 32-channel DVM which we have been using for most sourcing in the past year. Since only 8 depth samples were provided with source tubes in this prototype, longitudinal source scans have also been made using tubes located outside of the skin. The modulation of the average response by individual tiles is small. We are studying the accuracy of longitudinal source scans for measuring individual tiles within a tower.

Measurements have been made at Purdue of the change of response of a tile when a source tube is moved away by interposing various small thicknesses of plastic layers. A "soft" component is seen to be present, especially when a lead "reflector" sheet is placed above the source tube, and leads to a -4.6% response from adding the first 100 microns of plastic and -26% from adding 1 mm of plastic. We have a computer program to calculate response variations analytically, using our measurements of the attenuation lengths of Cs137 662 keV gamma rays in thick layers of plastic. Our calculations fit the data well in the region where more than 1.5 mm of plastic lies between the source tube and the tile. However, the calculations account for only about one-half of the response variation when very little material is added between the source tube and the tile. We attribute the excess variation to component(s) of the radiation with shorter attenuation lengths: electrons and perhaps softer photons. This excess variation is not apparent when moving the source relative to the tile in air.

We also have a computer program to calculate sharing fractions when the source is one or more calorimeter layers away from a tile. Using our measured values of the Cs137 662 keV gamma attenuation lengths in plastic and lead, our calculations are in excellent agreement with sharing fractions measured in several actual calorimeters: the 60-layer stacked lead EM prototype tested this spring at BNL, the CDF Plug Upgrade EM calorimeter prototype, and a typical RAD Hardness testing calorimeter (Fermilab/Purdue 20-layer single tower). The measured attenuation lengths lie roughly midway between the two curves given in the 1984 Particle Data Tables, for photon mass attenuation with and without multiplication by the fraction of primary photon energy loss.

2.3 Forward Calorimeters R&D

Rockefeller University

Technical Staff: Nikos Giokaris (physicist), David Khazins (physicist), Jerry Zimmerman (engineer), Mike Morgan (engineer)

Finish the design of the calorimeter. Place orders for the basic elements of the calorimeter (i.e. electrical feedthroughs, tubes, rods, spacer material and filler material)

Development of Front End Electronics for the High Pressure Gas Calorimeter

Technical Staff: David Khazins (physicist), Nikos Giokaris (physicist), Fred Lobkowicz plus students and other technical staff from the University of Rochester

Design, build and test four prototype preamplifiers that will read out the signals of the tubes of the hadronic prototype calorimeter

Radiation Damage Test on High Pressure Gases

Technical Staff: Nikos Giokaris (physicist), Luc Demertier (physicist), Mike Morgan (engineer), Jerry Zimmerman (engineer)

Design, build and test before, exposure to radiation, a short tube-rod high pressure vessel that will be used to test the radiation hardness of a high pressure gas calorimeter

2.3.1 Design Documentation

University of Toronto

Technical Staff: G. Stairs, R.S. Orr

Preparation of Project Plan for Forward Cal. Work has proceeded on costing, schedule, and generation of work breakdown structure.

2.3.2.1 Construction of Liquid Scint Test Modulwe

University of Toronto

Technical Staff: D. C. Bailey, Y. K. Chi, A. Kiang, S. Shelley, R. S. Orr, K. Todd

Construction of a liquid capillary test module in order to examine response to electromagnetic showers. Construction of module is complete. The module is 20x20x50 cms, the capillaries are 3mm internal diameter with center to center spacing of 8mm. Wave shifter bar, and fibre light collection systems are being studied using cosmic rays. System is being prepared for possible beam test in early November.

Tests of bulk attenuation length in the test module are being carried out with two different scintillator compounds.

2.3.2.3 Measurement of Capillary Attneuation Lengths

University of Toronto

Technical Staff: J. D. Prentice, A. Kiang, J. Oppenheim

Construction of computer controlled measuring machine to allow systematic study of liquid scintillator/quartz tube systems. The design is based on the present machine in operation at Texas A&M. All components of machine have been assembled. Control software has been written and debugged. System has been successfully tested. Several samples are in preparation.

Earlier the attenuation lengths of some samples of Isopropyl Biphenyl based scintillator were measured in a "manual" setup. These samples are being exposed to various metals in order to understand whether there is an absorber material which does not react with the scintillator base solution. Metals studied are mild carbon steel, zinc plated steel, nickel plated steel, steel treated with epoxy paint, copper, brass.

Discussions have proceeded with both BICRON and NE Technologies in order to develop an understanding of the factors influencing attenuation lengths. NE Technologies states that the attenuation length depends sensitively upon the purity of the mono-isopropyl biphenyl solvent. The company has up until now purified the solvent using silica, the possibility of vacuum distillation is being reviewed. NE is preparing several samples of a green scintillator liquid. BICRON has supplied quantities of two blue scintillators.

University of Manitoba

8. Forward Calorimeter

Technical Staff: G. Smith

R&D on Capillary/Fiber Optical Coupling (July & August, 1992)

Construction of light tight box containing mockup of liquid capillary/readout fiber coupling. The optical coupling is designed to allow flow of liquid scintillator down capillary.

Materials Studies. Studies on the interaction of the scintillator liquid with various plastic materials.

Texas A & M University

Technical Staff: J.T. White, Mei Gui

July:

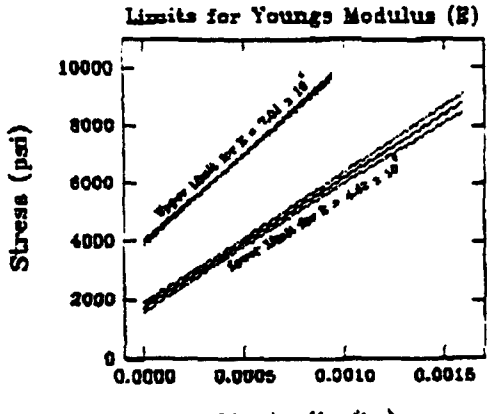
Presented latest radiation damage studies of liquid scintillator in capillaries at SDC meeting at the SSC. Observed attenuation lengths exceeding 4 meters in both pyrex (2mm OD, 1mm ID and larger) and quartz (3mm OD, 1.5 mm ID) with 480 nm optical filter. These were obtained using Bicron 599-13 liquid scintillator. Irradiated pyrex tubes (dose > 100 MRads) had slightly longer attenuation lengths. Geant studies indicate that resolution will be better than required with 3 meter attenuation lengths using 2 mm ID tubes spaced 4 mm center to center.

August:

Continued radiation damage and attenuation length studies. Designing system to test in situ replacement of liquid. Test device will be placed next to the core of the TAMU nuclear reactor. Light output will be monitored and liquid will be replaced periodically by pumping in fresh liquid. Also constructing stand for light guide development and designing electromagnetic prototype.

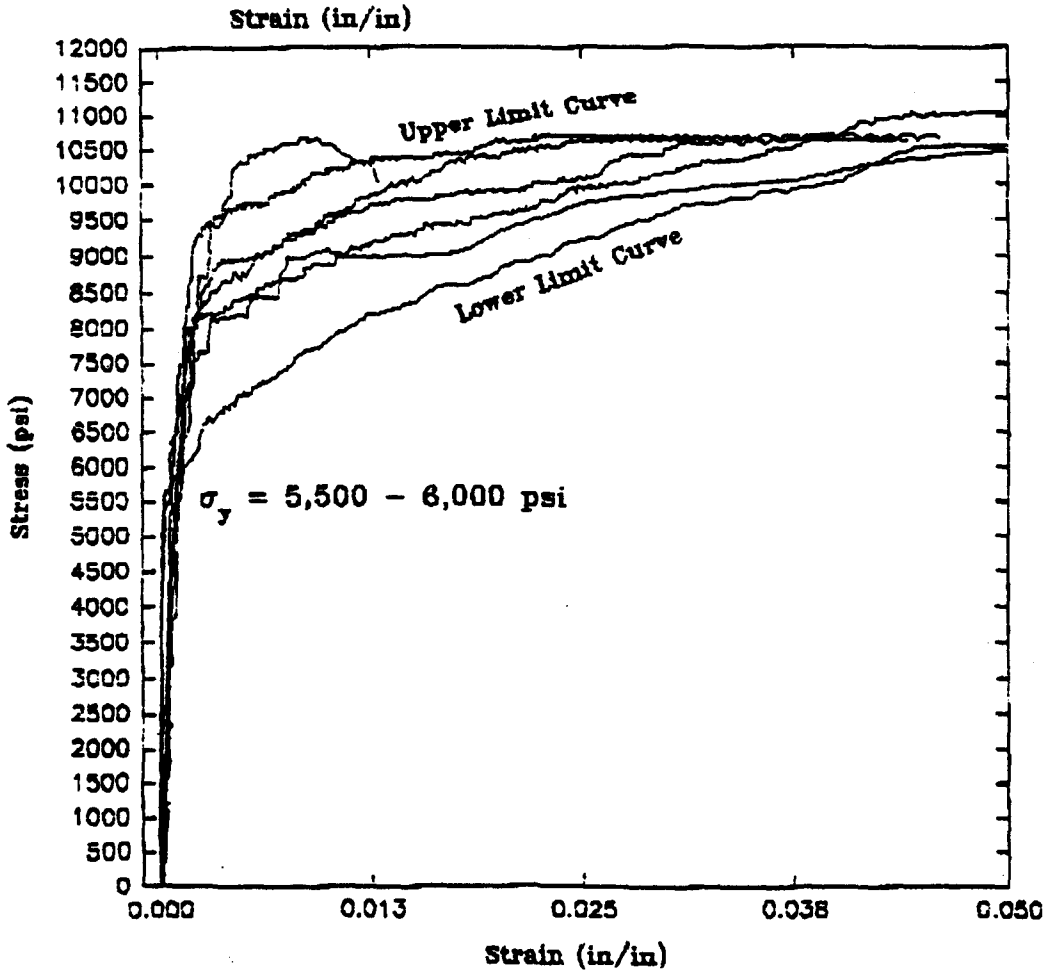
insert graphic

Stress - Strain Curves for L50750 Lead Alloy
0.06% Ca 1.3%Sn



σ_y = 5,500 - 6,000 psi

E = 5.36 x 10^6 psi



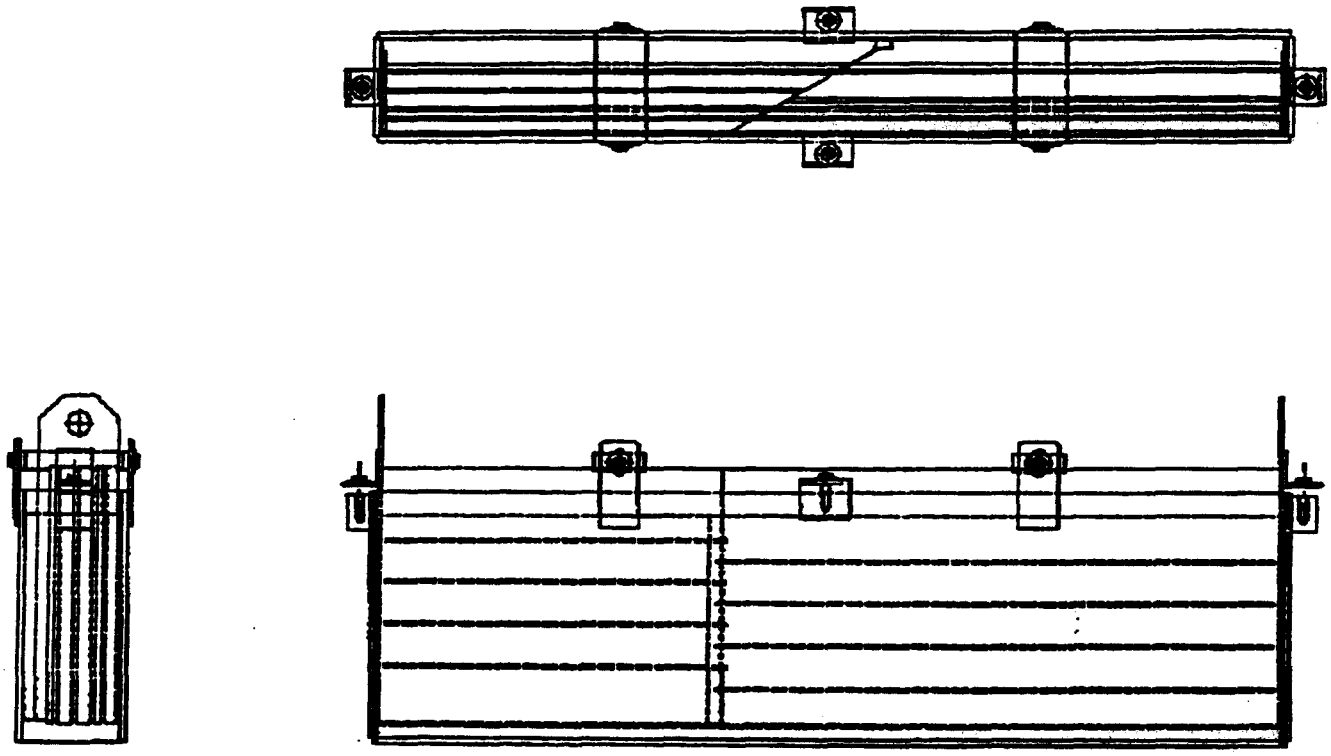


Fig. 2

Figure 3:

TOWER 9–10

RADIAL DISPL.– 12 O'CLOCK

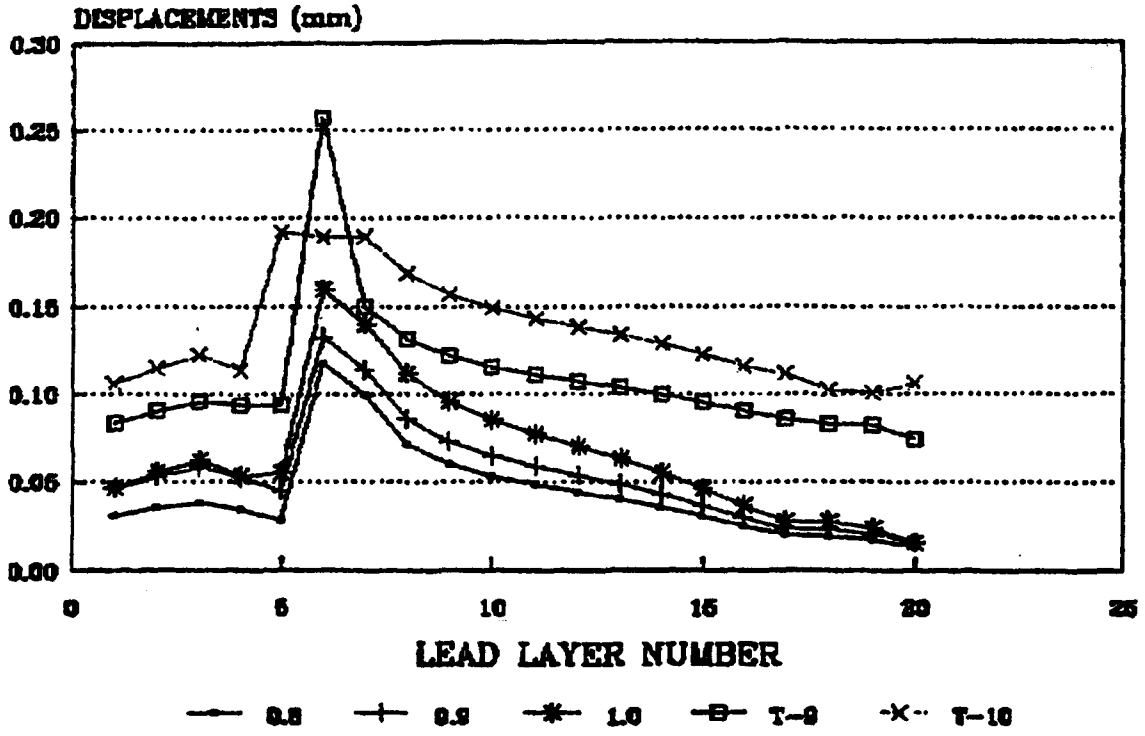


Figure 4

TOWERS 11–12

RADIAL DISPL.–12 O'CLOCK

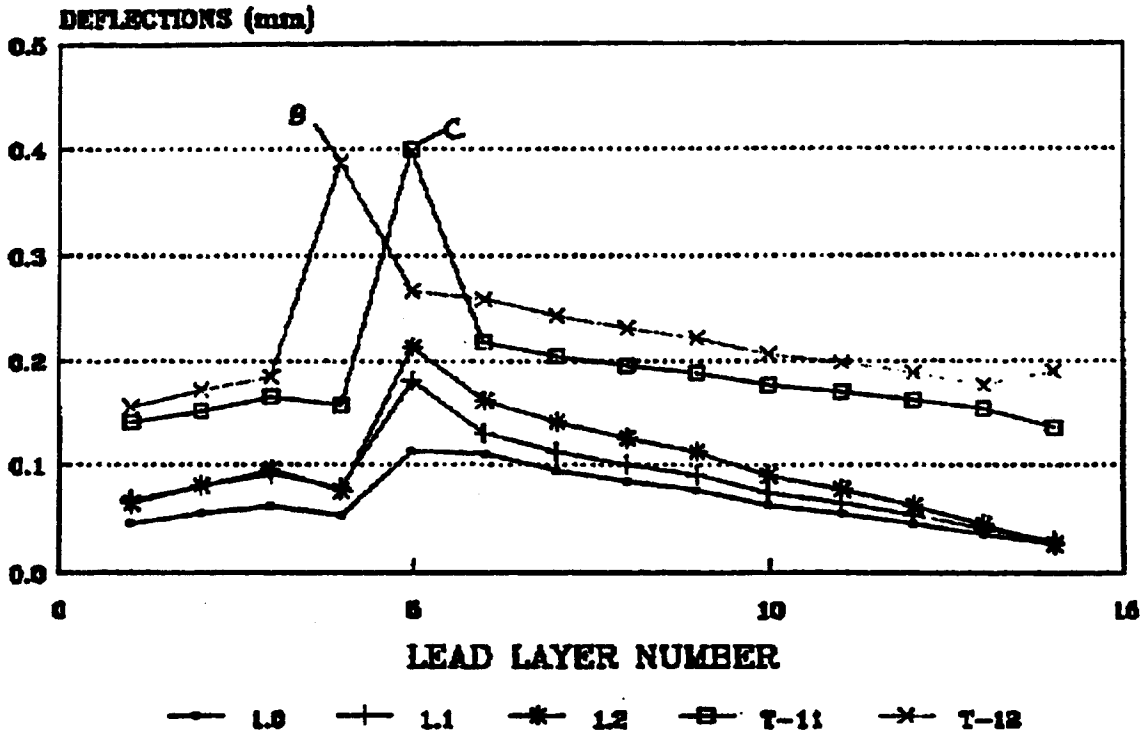


Figure 5

TOWER 13–14

RADIAL DISPL.-- 12 O'CLOCK

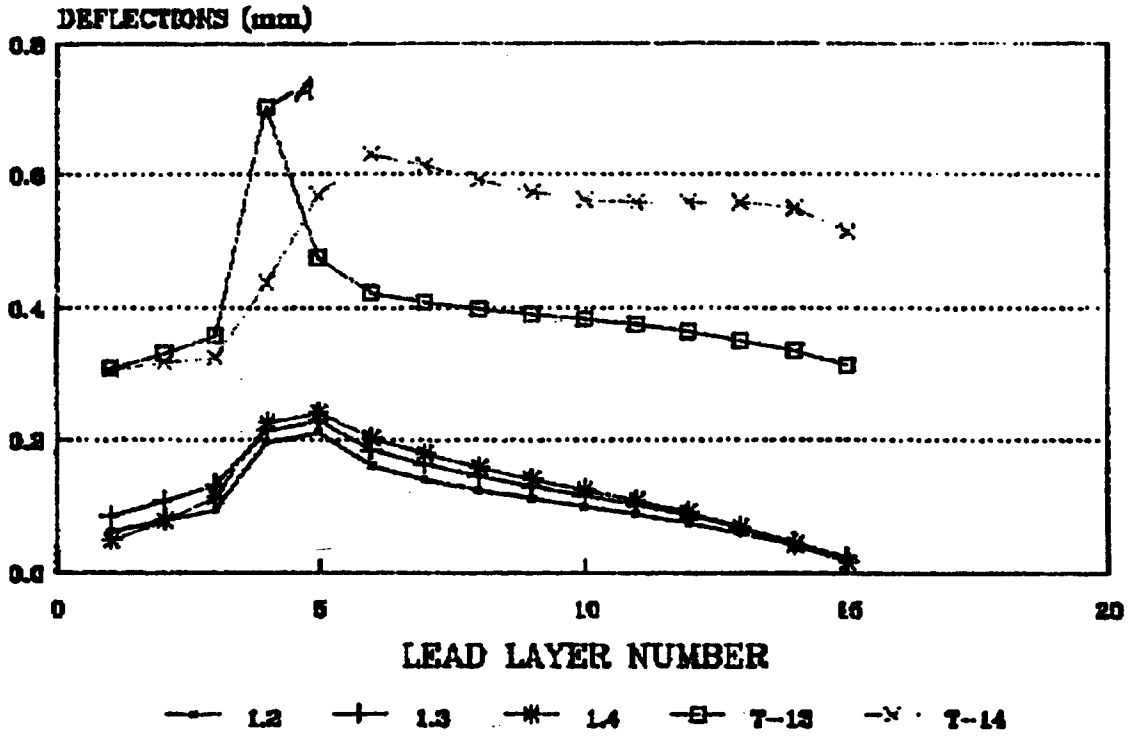
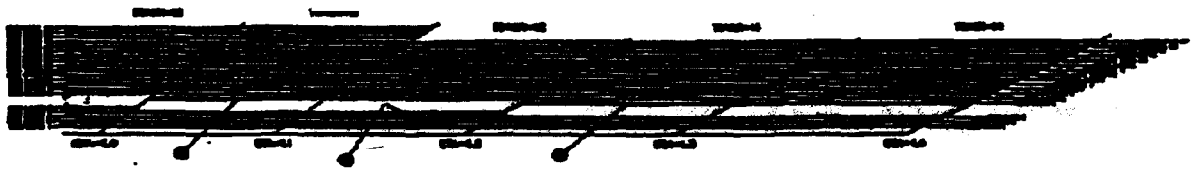


Figure 6



LAST TOWERS OF EM MODULE

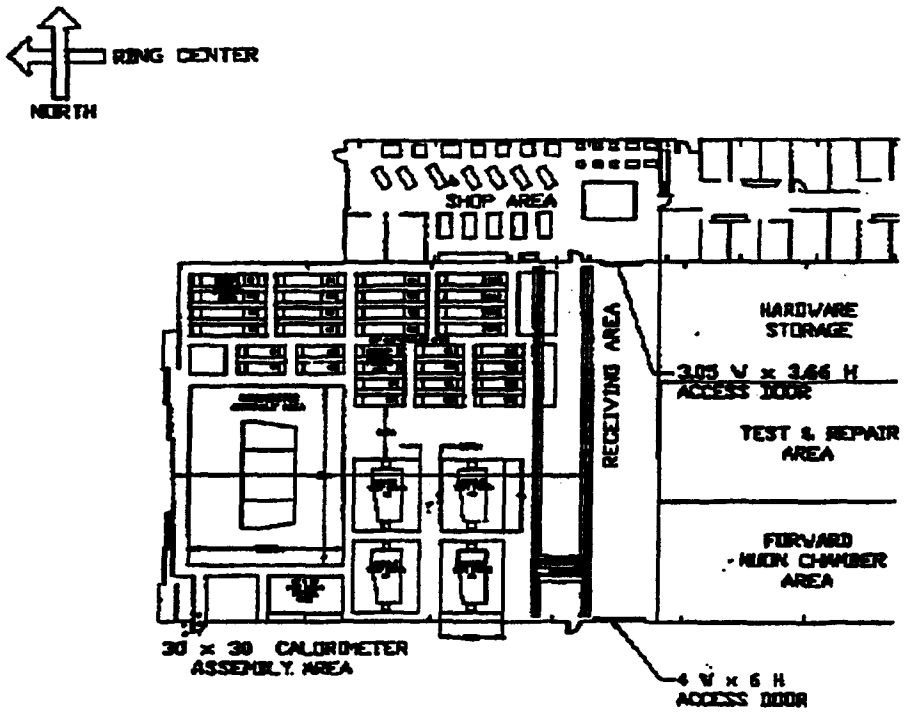

RING CENTER
NORTH
SHOP AREA
HARDWARE STORAGE
3.05 W x 3.66 H ACCESS DOOR
TEST & REPAIR AREA
RECEIVING AREA
FORWARD MUON CHAMBER AREA
30 x 30 CALORIMETER ASSEMBLY AREA
4 W x 6 H ACCESS DOOR

Figure 7

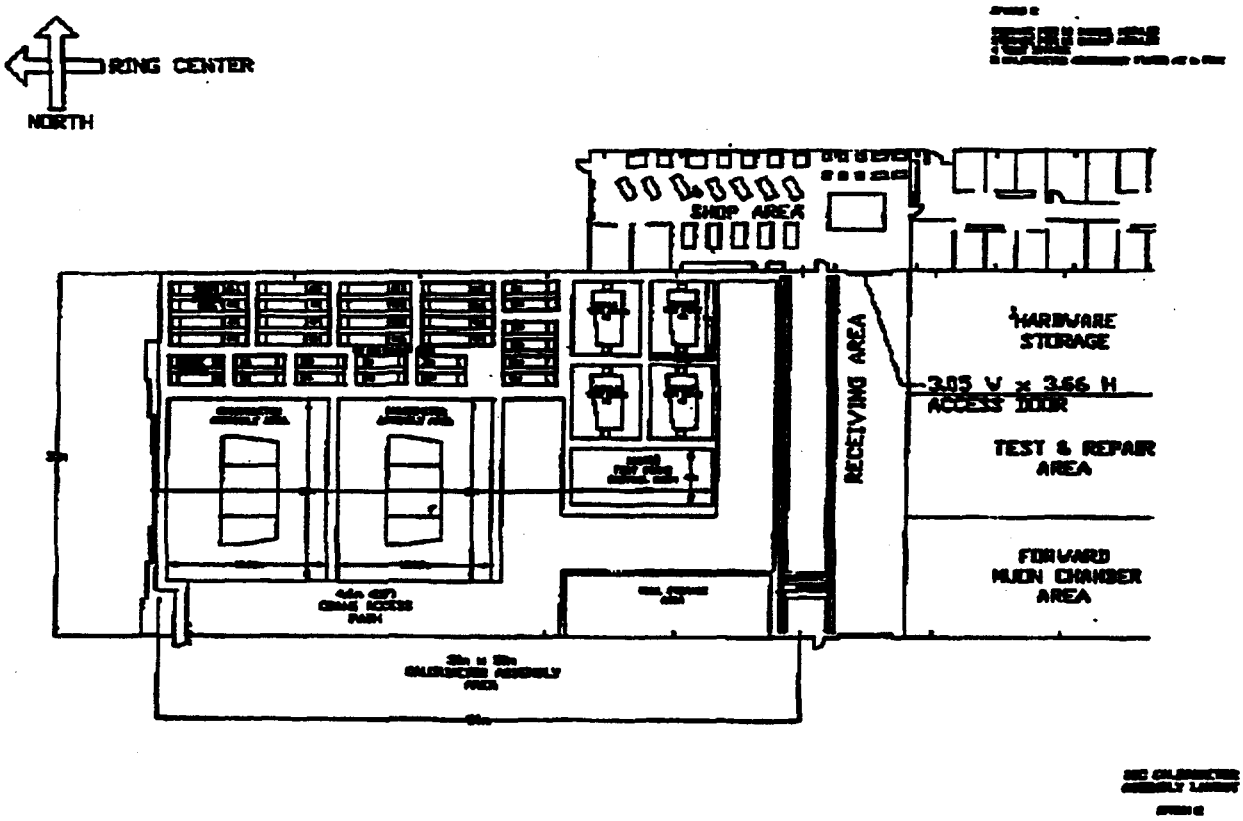

RING CENTER
NORTH
SHOP AREA
HARDWARE STORAGE
RECEIVING AREA
ACCESS DOOR
TEST & REPAIR AREA
FORWARD MUON CHAMBER AREA

Figure 8

3.0 MUON SUBSYSTEM

Activities relating to development of the muon magnet design included preparations for the upcoming visit to Russia by G. Trilling, G. Gilchriese, and T. Thurston. This included preparation of documents, analysis, development of specifications, and preparations of talking papers. We also continued preparation for the Preliminary Design Review, jacking studies and analysis for the support structure, and a magnet engineering meeting was held on August 20-21 to review progress in the development of the muon magnet system.

On the muon measurements system work continued on the barrel, intermediate, and forward regions for chamber development and detector design. Workshops were held to review progress on the supertower prototype on August 5-6, muon on site assembly to initiate the second round of the Resource Allocation Model on August 19-20, and an Alignment workshop primarily to prepare for the supertower project on August 25-26. Management devoted itself to preparations of the cost estimate and schedule.

3.1 Magnet

3.1.1.1 Barrel Magnet

Fermilab

Technical Staff: Bob Wands
Author: Bob Wands

The finite element analysis of the barrel with platform was completed for all dead weight load cases, earthquake loads, assembly tolerance loads, and jack load variation effects. A rough draft of the main text and appendix related to the barrel toroid assembly was completed and sent to SSCL.

Attended the muon structural analysis meeting at SSCL on Aug. 20-21.

SSCL - Group A

Technical Staff: Gary Pennycuff
Author: Henry Lubatti, Patricia McBride

G. Pennycuff has been assisting with the test of the scale model of a section of the toroid.

University of Wisconsin - Madison

Technical Staff: Glen Greyerson, Carl Baumann, Jeff Cherwinka
Author: Jeff Cherwinka

The steel work this month at UW-PSL has focused on defining interfaces, magnetic testing, model coil design, investigation of hydraulics, and management of the barrel design effort. The location and clearance volumes for the muon alignment fence posts have been set. This work required a meeting at FNAL, a meeting at SSCL, and some drawing layout work. The location of the coils, muon barrel chamber rails, and muon intermediate chamber supports have been tentatively set. This work required a meeting at FNAL, a meeting at PSL, load calculations, bearing literature review, and construction of a 3D intergraph model. Further chamber analysis needs to be done before these locations can be fully accepted. The testing of magnetic properties for the MBT has produced confusing and conflicting results. To help resolve this issue papers on magnetic measurement were acquired and studied, experts at FNAL, Bitter National Magnet Lab,

LDJ, Westinghouse, and NIST (formerly NBS) were consulted, and past test results were reviewed. NIST has agreed to test a few samples and LDJ will rerun all their test results after comparison with the NIST results. Magnetic testing will also be done on the MBT model.

The design of the coils for the model was done at UW-PSL. The materials were specified at PSL, ordered through the SSC, and have been received. Coil fabrication will begin soon. To help with the support design effort some investigation was done on hydraulic cylinder, pump and control system specifications, as well as potential vendors. This information has been passed onto SSCL. UW-PSL was also consulted on the stand for SDC calorimeter test beam work since UW-PSL built the test stand for ZEUS. This work involved several phone call, looking up records, and a trip to FNAL. In addition to technical contribution to the design effort, the management of the MBT steel design is coordinated at UW-PSL. This work included phone calls and E-mail to the engineers at SSCL and FNAL to coordinate work, an analysis meeting at FNAL, a design meeting at SSCL, discussions with project management on the upcoming preliminary design review, planning for the upcoming trip to Russia, meetings with Lars Leistam from EAGLE, review of hydraulic cylinder specs, steel specs, and conceptual rigging design rfq written at the SSCL, and cost and schedule meetings.

3.1.1.2 Barrel Coils

University of Wisconsin - Madison

The barrel coil work this month at UW-PSL has focused on costing, improved drawings, and braze tests. The coil fabrication, tooling, design, and auxiliary equipment (supports, water and electrical interconnects) were all recost. The new numbers were passed onto the SSCL. The old cost was based on a scaling of ZEUS coils, but the new cost is from labor and materials estimates. There was a substantial reduction in the cost estimate because the tooling and design costs are divided over a larger number of coils for SDC than for ZEUS. The coil drawings have been updated to a full 3D intergraph model. The clamp system was redesigned during this update. The brazing fixture and some sample copper bars were sent to ELVA for testing the induction braze method. The tests were made this month at ELVA, but the bars are not back yet.

3.1.1.3 Barrel Support

Fermilab

Technical Staff: Zhijing Tang
Author: Bob Wands

The stiffness requirements of the assembly fixturing were studied. The support platform inclined plate was looked at with an eye for justifying a thinner plate.

3.1.2.1 Forward Iron

Reported by Valery Kubarovsky

I. Iron Toroids.

Our group of designers prepared the report and drawings of the Forward Muon System that include

- FT1,FT2 iron toroid's design;
- FMS toroid's assembly;
- FMS assembly;
- Coils for FT1 and FT2;
- Toroid's support;

- FMS transport system;
- Absorber's design AB1,AB2,AB3,AB4;
- Absorber assembly;
    - Service space trusses for FW1,FW2,FW4,FW5;
- Scintillator counters FS4,FS5;
- FMS cable network;
- SDC beam-pipe;

These materials will be presented on October SDC meeting.

II. Tracking for Forward Muon System of SDC.

1. We continue to work with a data obtained during test runs.

2. At our central workshops we pushed the work for the model production. The main idea of this work - to produce in our workshops with available technologies a geometrical model on which we could really measure with an optical instruments the available accuracies. About 40 percent of necessary work were made.

3. We started to work with Cf neutron source and Co gamma sources with different tubes options and various shielding trying to understand the various tubes sensitivity to various soft backgrounds. We find out that the behaviour of so called "standard" shielding is absolutely different (from our point of view) from trivial. It became clear that such work should be continued.

4. We produce a 8 meter model of drift tube with wire field-shaping electrodes, and started to measure the mechanical properties of such a tube with different HV. The main idea of this measurement was - to show that such a long tube with wire-field shaping could work and give an accuracies compared with a small ones.

III. Scintillator Counters.

IHEP group continues the R&D on barrel scintillator counters. The test sample of these counters will be delivered to SSCL on October.

IV. Simulation

The simulation group were calculating the soft neutrons and gamma backgrounds in various FMS detectors, and trying to estimate drift tubes efficiencies in various background fields.

3.1.2.2 Forward Coils

3.1.2.3 Forward Support

3.1.3.1 Power Supplies

No activity.

3.1.3.2 Monitor & Controls

No activity.

3.2 Muon Measurement System

3.2.1.1 BW1 Module

3.2.1.2 BW2 Module

No activity.

3.2.1.3 BW3 Module

No activity

3.2.1.4 BWT Tower

SSCL - Group A

Technical Staff: Gary Pennycuff, J. Thunborg
Physics Staff: H. Lubatti, P. Schuler
Author: Henry Lubatti, Patricia McBride

Preparations for the prototype tower to be constructed in the muon lab at the SSCL are proceeding. H. Lubatti and J. Thunborg have been working with Steve Dryer (lab facilities engineer) in developing a layout of the assembly hall and finalizing a design for the assembly pad. The pad design for the prototype is expected to be fixed by early September. J. Thunborg and G. Pennycuff have been ordering parts for the prototype and this effort will continue throughout September. P. Schuler has begun working on the gas and high voltage system for the prototype tower with a focus on the final gas and high voltage distribution system.

Authorization to hire three new technicians through Physics Research has been obtained. The first round of interviews for one of the positions conducted by H. Lubatti, G. Pennycuff and J. Thunborg has been completed and a candidate chosen. This is currently stalled as all new positions are not being processed beyond Mr. Sisken's office. In the meantime the second round of postings is being prepared for the remaining two positions.

3.2.1.5 Barrel Region (shared items)

Harvard

Technical Staff: Ed Sadowski
Physics Staff: Peter Hurst, Gary Feldman, George Brandenburg
Author: George Brandenburg

Extrusion dies and a prototype run of material was ordered for the 9 cm tube at Mideast Aluminum Industries in Dayton, N.J. Delivery of test run at the end of September. A high voltage test was performed on the noryl field shaping board mounted in the 9cm tube. It's purpose, to determine the breakdown voltage for this material. 9.2KV was reached before breakdown. There is an on-going developmental work to determine machining specifications for shrinking the end cap into the tube, for a good gas-tight fit. This effort is being supported by Tufts and Brandeis physics department.

University of Washington

Technical Staff: C. Daly, P. Reinhall, W. Song, Y. Chen
Physics Staff: H. Lubatti, R. Davisson
Author: C. Daly, H. Lubatti

Design and analysis of mounting system: revised deflection and bearing support forces have been found for the SDC baseline dimensions given at the SDC meeting. Based on this, optimum rail and bearing positions have been found for all modules except octant 5 for which dimensions are not yet fixed. A test jig has been designed and is being fabricated to determine the static load capacity of the Lee Controls bearings. The possibility of using 2" instead of 3" bearings for BW1 and 3" instead of 4" for BW2 is being explored and should be resolved shortly. (C. Daly)

A draft of a proposed assembly procedure for the muon modules is being prepared and will be added to over time as the level of detail is increased. (R. Davisson,C. Daly,H. Lubatti)

The barrel muon modules will be notched at each corner to accommodate the alignment fenceposts. A mechanical structure has now been designed to provide sufficient strength and stiffness. This design now has to be analysed in detail to verify its properties. Mounting details for the alignment transducers are being worked out. (C. Daly)

Attended SDC collaboration meeting Aug 2-5, and Intergraph Training Aug 10-14. (C. Daly)

Dr. Reinhall commenced work on finite analysis of several aspects of the barrel muon modules. Initially he is concentrating on analysis of the shear stiffening spacers needed in those regions where the tubes are sparsified and on the load distribution spacers needed at the module mounting points. (P. Reinhall)

Dr. Song began working on the details of the module assembly process and will collaborate with the Martin-Marietta group to develop detailed input to the RAM model. (W. Song)

The circuit design of a trigger board for KEK mini-tower trigger test has been completed. This design uses programmable gate array technology. It can be used to test all possible trigger algorithms currently under consideration. The design of the printed circuit board has begun. (Y. Chen and T. Zhao) This work carried out with NSF funds.

Monte Carlo calculation of the the level-1 muon trigger efficiency using the angle difference method has been completed. This trigger scheme uses BW1 and BW2 theta tubes. Calculations are also made combining this trigger and the exit angle trigger using BW2 and BW3. Trigger efficiencies of the sparsified and non-sparsified arrangements are compared. Results will be reported during the next collaboration meeting at SSCL. (T. Zhao and L. He)

Tufts University

The Tufts group is preparing a new factory area for the purpose of manufacturing and testing extruded cylindrical drift tubes of the SDC muon system design. Construction is nearly complete of a dedicated clean room for the factory. Fabrication areas will need to be developed and instrumented to carry out specific tasks along the assembly line. At the outset (during fabrication of tubes for the prototype muon supertower) it is likely that the extrusions and field-shaping inserts will need to be cleaned carefully. The materials will then be isolated in the clean room wherein mounting of the field-shaping elements, high voltage signal wire, and endcaps onto the drift tubes will be carried out. Once assembled and sealed, the drift tubes will need to be subjected to four or more quality assurance tests. The tests will check for electrical continuity, gas tightness, high voltage stability, and proper tension. Instrumentation will be needed to allow execution of these tests in an automated way with computerized record-keeping.

Developments during August included:

i) A 'dry-run' production cycle in the new clean room. The exercise turned up several problems which are currently being addressed, including the necessity of air-conditioning the filtered air being introduced into the enclosed workspace, and a need for numerous distributed power outlets.

ii) Purchase and setup of tooling needed to carry out horizontal boring and machining of long (up to 9 meters) extruded tubes.

iii) Preparations related to setup of massive, metal-top assembly benches.

3.2.2.1 IWT Tower

3.2.2.2 Intermediate Region (shared items)

University of Wisconsin - Madison

Technical Staff: Alan Pitas
Author: Alan Pitas

My efforts this month were evenly divided between two tasks: developing a design for the table on which the IW modules would be assembled, and determining the space needed to assemble IW modules into IW towers in the Muon Assembly Building at the SSC. The design for the module assembly table has just begun. There are many issues of tolerance and technique that have yet to be resolved. We narrowed the design of the table surface to two alternatives. Cost and stability were investigated. We made a preliminary choice of using a vibrationally annealed welded structure with a finely machined sacrificial top plate.

A prelimary estimate was made on the space required to assemble IW towers at the SSC. The estimate was predicated on several design assumptions which have not been fully tested. However, a report was generated based on the best information available at this time. The report's conclusions will be reviewed after details of the tower design have been refined.

3.2.2.6 Intermediate System Design

3.2.3 Forward Region (summary)

3.2.3.1 FW1 Module

No Activity

3.2.3.2 FW2 Module

No Activity

3.2.3.3 FW3 Module (option)

No activity.

3.2.3.4 FW4 Module

No activity.

3.2.3.5 FW5 Module

No activity.

3.2.3.6 Forward Region (shared items)

University of Maryland

We finished our test beam work at BNL in the B1 beam line on July 31. The test beam setup was dismantled by University of Maryland technicians and the T816 beam chambers as well as SSCL and Washington electronics was shipped to the SSCL. Dismantling was finished by August 15.

Dr. Doug Fong has been working on pattern recognition and track fitting. The first pass at reconstructing the data has been completed and the nominal resolution for several test tubes has been determined. Care had to be taken because of multiple scattering caused by the very same devices whose resolution was being determined. Early results are encouraging. Further data analysis is in progress.

Engineering work also continued on the two variants of the FMS station designs with loaded and unloaded frames. FE analysis is continuing on both the Maryland and Protvino versions of the support frames for the FMS stations. FE analysis work on the 3-point mounting scheme for the FMS frames has also started.

Work on the Martin RAM model for assembly of the FMS at the SSCL was also continued. Frank Desrosier (our senior mechanical engineer) attended several days of meetings at the SSCL on the assembly and installation modelling.

3.2.4.1 Global Tube

Brandeis University

Technical Staff: Dimitri Lorenzo, Allan Wellenstein.
Physics Staff: Herman F. Wellenstein
Author: Herman F. Wellenstein

A) Securing Endcaps: To heat-shrink the end caps into the muon tubes contact heating as an alternative to infrared or induction heating was explored. A two part heating clamp consisting of two times four individually heated brass pads was used to heat-expand the ends of the bored-out 75 mm muon tube. The heating clamp was kept at 150 degrees C and after 12 seconds of contact the tube expanded by 0.15 mm (0.006") corresponding to a temperature of 120 degrees C. The muon tube is deformed by the pressure exerted by the heat clamp, hence the clamp will have to be released just before insertion of the endcap. It was also found that the variation in wall thickness in the bored-out ends of the muon tube caused an uneven expansion. A heat clamp for the 93 mm tube was constructed and will be tested at the endcap-insertion-stage at Tufts

B) The x-ray diagnostic system developed for the "Boston" muon tube was redesigned for the "Washington" tubes. "Hoods" inserted over the "boss" and "flat" end of the tubes containing four pairs of fiducial wires allow 50 kV x-ray film pictures to be taken at +/- 45 degrees to the axis of the tube. The wire could be located to better than 10 microns with respect to the hoods. The alignment of the two hoods with respect to each other and the long axis of the tube still has to be solved, two possibilities are available. An "on line" x-ray technique was explored: using a x-ray vidicon tube on loan from Teltron with an image processor and frame grabber from Hamamatsu, images were recorded on video tape and analyzed by a computer code. This approach looks very promising but requires 90 kV sources and has a price tag of about two times $20k per test station.

University of Colorado

Technical Staff: Bruce Broomer, Eric Erdos, Gerhard Schultz.

Physics Staff: Mark Christoph, Quentin Van Egeren, Mourad Daoudi, Victor Slonim, and Uriel Nauenberg
Reported by: Uriel Nauenberg

In Colorado we are working on three aspects:

1)We are building an accurate cosmic ray tracker to use in R&D work building muon drift tubes. This work should be completedby November, 1992 except for the readout system. The amount of fundsspent on this project is approximately $4 K. The scintillator phototube arrays to do the trigger is completed. We are almost done building the tracking drift chambers. These costs were covered by our regular DOE funds (non SSC related).

2)We are doing simulation in collaboration with Shuichi Kunori, Walter Toki of Colorado State University, Sue Willis and Vladimir Sirotenko of Illinois, Steve Ball of U. of Kansas, and Jon Bakken of Martin Marietta Science Systems. The people in Colorado are Mourad Daoudi, Victor Slonim and myself. Our program is to work on the track fitting, track matching and pattern recognition. We will also work on the barrel trigger algorithms. The salary of Morad Daoudi and Victor Slonim are partly covered by RMCHEP funds and partly by our regular DOE funds.

3)We are designing a new Cockroft Walton phototube base that has a faster charging time and hence will be more stable in high rate situations. No money has been spent on this except for engineering time. This has been covered by TNRLC funds for the RMCHEP program. This section is also being submitted to Andy Lankford as part of electronics.

SSCL - Group A

Physics Staff: T. Fukui, H. Lubatti, P. McBride
Techinical Staff: K. Bramble, S. Day, Gary Pennycuff, J. Thunborg
Author: Henry Lubatti, Patricia McBride

Review of the end cap design was conducted during the month of August. K. Bramble, S. Day, H. Lubatti and J. Thunborg have been reviewing and checking the drawings. This work is being carried out in close collaboration with R. Davisson and T. Zhao at the University of Washington. P. McBride and G. Pennycuff have begun to assemble a short drift tube in order to test the assembly procedure and develop expertise in the muon lab.

T. Fukui continued his study of the resolution of the 75 mm tubes in the prototype module. He has obtained a resolution better than 250 microns over the entire tube.

He has also compleated an article for the proceedings of the Como Instrumentation Conference.

T. Fukui and A. Wang have continued to work on the analysis of the SDC muon chamber (90 mm tubes) test beam data taken at BNL in July 1992.

Tufts University

Technical Staff: L. McMaster, D. Dupuis (Physics Dept. shop technicians),
Physics Staff: Tufts SDC faculty plus three graduate students.
Author: Anthony Mann

We completed a collection of studies relating to the measurement precision of the 9cm diameter field-shaping drift chamber cells being developed for use in the SDC muon system. This precision depends not only upon the gas and the electrostatic field configuration but also upon the sense wire location, which in turn depends upon the wire tension and on the interplay of

gravitational and electrostatic forces. A precise control of these factors during detector cell manufacture and knowledge of them during detector operation is imperative. Problems investigated included electrostatic simulations of the drift-time and isochrone dependencies upon sense wire positions, and predictions of the electrostatic effects on equilibrium wire configuration, stability and mechanical vibrational spectrum. Also undertaken was an electrostatic simulation showing the effects, on field and drift-timing, of the plastic supports to the metal field-shaping electrodes. It is hoped that these studies will provide a theoretical underpinning to laboratory observations and their interpretation in shop and field. The studies should facilitate the invention of practical quality control systems such as might be based upon measurement of the mechanical wire vibration frequencies.

These studies are being written up in the form of two SDC Notes, to be submitted during September.

University of Washington

Technical Staff: Y. Chen, L. He, S. Han
Physics Staff: R. Davisson, H. Lubatti, T. Zhao
Author: H. Lubatti, T. Zhao

Preparation of the tube assembly facility is in progress. Necessary equipment is being designed or acquired. (R. Davisson, H. Lubatti and T. Zhao)

A systematic study of argon-CO2 mixtures as drift chamber gas is in progress. Mixtures containing 8% to 20% of CO2 are measured in 1% steps. It appears that properties of 88:12 or 87:13 mixtures match requirements of our drift tubes very well. More detailed study is under way. Results of this investigation will be reported during the next collaboration meeting. (S. Han, L. He, Y. Chen and T. Zhao)

Ohio State University

Technical Staff: L.S.Durkin, T.Y. Ling, D. Fisher, R. Wells
Author: T.Y. Ling

We have identified an extruder and have placed an order for 90mm Al extrusions (Washington Design). Initial samples of the extrusion looks good. Measurements of the tube dimensions are withing specified tolerances. Parts to assemble the first few tubes are being procured/acquired.

We have cleaned and renovated a lab for initial construction and testing of the muon drift tubes. Work is proceeding in setting up a cosmic ray telescope for testing purposes.

3.2.4.2 Global Alignment & Monitoring

Brandeis University

Technical Staff: None
Physics Staff: Steve Behrends
Author: Steve Behrends

The requirements placed on Supermodule alignment tolerances by the full off-line muon momentum measurement system have been studied. Off-line measurement of Pt was shown to consist, to a good approximation, of three independent measurements: (a) CTD tracking, (b) bend in the toroids as seen by the theta-chambers, and (c) matching in phi of the muon stub with the exit-point of the muon in the CTD. An analytic expression for the off-line resolution vs. Pt was

derived as the (weighted) average of these three techniques. Using this expression, displacements of individual supermodule (translational and rotational) can be translated into effects on momentum resolution. Tolerances per Supermodule were derived by demanding that misalignment contributes less than 10% to momentum resolution at 2 TeV.

Fermilab

Technical Staff: J. Morrison (senior designer)
Physics Staff: D.Eartly

J. Morrison has been working on the detail design of half fenceposts, sensor mountings, and sensor configurations for muon chambers at the Octant 4-5 and 5-6 boundaries and within Octant 5. This has involved modifcations in the barrel magnet and support designs as well as the calorimeter support rail designs. Fencepost-chamber support rail position issues are being resolved.

D. Eartly has continued analysis work on the 102 mm x 102 mm test fencepost. Results were presented at the Muon Alignment workshop (Aug 24-26). An outline of alignment activities through the Muon system fabrication and installlation was developed and presented at the Muon assembly workshop (Aug 19-20). First short term resolution (2 um) results on the prototype liquid level system were presented at the Muon engineering meeting (Aug 4-5). Long term tests through August have resulted in RAW long term standard deviatiions on a group of liquid level sensors of 11-25 um over a 3 m star configuration and 10 deg F temperature fluctation. We have calibrated the system in detail and are preparing a sensor cluster study to determine intrinsic fluctations.

Harvard

Technical Staff: John Oliver,
Physics Staff: Peter Hurst, Gary Feldman, George Brandenburg
Author: George Brandenburg

Work is in progress on the specification and design of the Range Emitter Receiver (RER) to be used for global muon alignment. Two main techniques are under investigation namely, optically coherent and optically incoherent, and examples of both are being studied from the existing literature. The optically incoherent technique is attractive since it utilizes an inexpensive diode of the type used in compact disc players. In this technique, an amplitude modulation is imposed on the light carrier and is detected using two photodiodes and a phase detector. The measured phase is proportional to the range and our target accuracy is 100 microns over a maximum range of 100 meters. This will enable range determination for any target within the experimental hall.

A technique using a phase-locked multiphase phase detector is under investigation. This technique utilizes an accurate external timebase to phase lock the critical signal paths to insure thier stability during the phase measurement. The multiphase measurement will allow the modulation frequency to be relatively low, in the neighborhood of 25-50 Mhz. A single phase measurement to provide the required accuracy would require a clock in the range 0.5 to over 2 Ghz. This will require that a custom high speed CMOS phase detector chip be designed so that all critical paths are closely matched. Initial design and simulation work on this device is being done. We anticipate submitting this chip for fabrication early this fall.

A temperature control loop is required to keep all critical path components at constant temperature. The required circuitry using Peltier effect heat pump, has been designed and tested to a stability of 0.1 deg C. This accuracy level is reasonably standard for precision laser diode operation.

SSCL - Group A

Physics Staff: P. McBride
Author: Patricia McBride

P. McBride has continued to work on alignment and monitoring development. In particular in planning test for the prototype modules.

University of Washington

Physics Staff: R. Davisson
Author: H. Lubatti

Layout of the straight line monitors, temperature sensors and strain gauges for the prototyp modules was initiated. A global alignment scheme for the muon system was was developed. This scheme relies on angle measurements and not range measureing devices. Meetings in Boston and the SSCL were attended to present the schemes.(R. Davisson)

3.2.4.3 Global Trigger Counters

3.2.4.4 Global Surface Facilities

University of Washington

Technical Staff: C. Daly, W. Song, R. Storch
Author: C. Daly, R. Storch

Thermal analysis of a proposed design of the module assembly pads shows acceptable stability for the expected environment in the assembly building. It is recommended that this design with a 18" concrete pad supported by 16 2'x2' piers be used. The assembly surface should consist of sections of 0.75" aluminum jig plate. (C. Daly)

Work has started on a study of material flow during the module assembly process. A variety of material storage and flow layouts have been derived based on several layouts of the assembly pads in the assembly building. Although not ideal from a flow standpoint, a layout with the pads 6m from the wall will be used to accommodate some other constraints. This is the only issue which affects construction of the building. (W. Song, R. Storch)

3.2.4.5 Global Gas System

No activity.

3.2.4.6 System Engineering

SSCL

Technical Staff: J. Thunborg
Physics Staff: H. Lubatti
Author: Henry Lubatti, Patricia McBride

The design of the SDC muon assembly building has been carefully studied by H. Lubatti and J. Thunborg. They have tried to examine the module assembly proceedures and define the requirements for the assembly building.

Martin Marietta

Technical Staff: Jon Bakken, John Brogan, Rich Hund

1) Prepared a presentation of the RAM (Resource Allocation Modeling) work for the muon engineering meeting scheduled 4-5 of August at the SSCL. Developed a list of inputs needed from the muon group for the next RAM iteration.
2) Began to incorporate the comments from the SDC RAM meeting into the RAM data files.
3) Changed the internal structure of the resources id's to make them more flexible for users.
4) Automated the input of function and resource data directly into the RAM program.
5) Automated flow process diagrams from user's inputs.
6) Increased the detail of the RAM output to include a lower level of functions and time flows.
7) Ported RAM output to Open Plan. This provides Gantt charts, time analysis and networks.
8) Assessed impacts of final muon facility layouts used for Title I inputs on muon chamber assembly process, floor space availability, assembly pad locations, and facility door sizing.

Technical Staff: Rich Hund

SDC Muon System Safety

1) Interfaced with the SDC Environmental Safety and Health (ES&H) organization to better understand the safety responsibilities of the SDC Muon Group.
2) Prepared a preliminary chart outlining the safety responsibilities of the SDC Muon Group.
3) Began outlining a plan to better define future Muon Group safety activities.

SIMULATION:

SSCL - Group A

Physics Staff: T. Fukui, N. Khalatyan, P. McBride, A. Wang
Author: Henry Lubatti, Patricia McBride

T. Fukui, N. Khalatyan, P. McBride and A. Wang have formed a simulation group at the SSCL to study in detail the physics reach of the SDC muon system. The preliminary work has centered on the detector geometry and trigger studies.

4.0 SOLENOID MAGNET SYSTEMS SUMMARY

Summary of Activities:

- Prototype coil winding being prepared (KEK/Toshiba).
- Prototype Isogrid vacuum shell under construction (Fermilab/AMRO, Camarillo).
- Cryogenics design modification being discussed with SSCL/PR/EFD,
- Share of Responsibilities for the detector magnet and cryogenic being discussed (SSCL, Fermilab and KEK).

1) Prototype R&D

Prototype coil winding machined has been completed and winding practice is in progress. The machine is functioning as expected to wind high strength aluminum stabilized supercondutor with an inner coil winding technique. The practice winding will be made up to a coil length of 30 cm with surveying for an optimum winding conditions and is to be finished in September.

Prototype isogrid vacuum shell is being prepared for machining to be started in September. Basic R&D has been finished with successful isogrid-machining and bending with break-forming technique. Inner vacuum shell is in fabrication and bulkheads is prepared for contract.

2) Cryogenics design work:

Recently, Experimental Facility Department in SSCL/PR has joined the SDC cryogenics conceptual design. Two technical decisions are expected to be made; (1) cryogen in radiation shield (LN2 or GHe) and (2) possibility to eliminate the control dewar to simplify the cryogenic scheme. The decision will be required soon to proceed the pre-procurement.

3) Discussions for Responsibilities

A meeting has been held at Fermilab on Aug. 28, to discuss share of responsibilities for the detector magnet and cryogenic system. The SDC project manager, T. Kirk, has proposed for KEK to have major responsibility for the detector magnet including cryogenic and electrical systems to optimize global responsibilities in the SDC collaboration. KEK is studying this possibility.

5.0 ELECTRONICS SYSTEMS SUMMARY

Work in general focused on (1) continued development of system designs and of critical components, (2) preparation of electronics for detector prototypes, and (3) preparation of cost and schedule information for the upcoming DOE review. Progress is detailed below.

5.1 Front End R&D

Reports for four WBS items follow:

5.1.1 Scintillating Fiber Tracker Front-End Electronics
5.1.2 Straw Tracker Front-End Electronics
5.1.3 Calorimeter/Shower Max Front-End Electronics
5.1.4 Muon System Front-End Electronics

5.1.1 Scintillating Fiber Tracker Front-End Electronics

Fermilab

Technical Staff Involved: A. Baumbaugh, A. Romero, K. Knickerbocker, S. Hansen
Reported by: A. Baumbaugh

The fiber storage/trigger/readout board which was used in the test beam effort is now being looked at in terms of modifications which will bring it more in line with the final system boards, and in preparation for a several thousand channel test. These include the use of a single-ended receiver for the card, replacing the differential pair now used (This will decrease the connector space required and allow us to test single-ended data transmission), and minor artwork corrections so that the next set of boards will not require any hand modifications.

We have also begun the task of putting together a test stand for use with tracking boards as well as boards used by the calorimeter. We have procured an IBM clone and a Bit3 interface card from the PC to VME so that we can set up simple DAQ and control functions from the PC into the VME crate. This setup was basically what was used in the test beam at BNL using equipment from UT Dallas. We are duplicating this environment since it will save us software development time and since it is a cheap alternative until the "standard" crate is decided upon.

We continue working with the Fiber Tracking Group and Rockwell to set the specifications for the VLPCs and cassettes.

5.1.2 Straw Tracker Front-End Electronics

University of Colorado

Technical Staff Involved: B. Broomer, E. Erdos, C. Zuelchner
Reported by: W. Ford

Finalized board layout details for T4 16-channel front-end boards of Colorado/Penn design based upon the Penn custom A-S-D8 8-channel amplifier-shaper-discriminator chip, and ordered 20 more boards. (Erdos)

Initiated design of a new interface to the front-end electronics that will allow plug-and-socket like removal of the active component substrate (Erdos)

Oak Ridge National Lab

Technical Staff Involved: G.T. Alley, M.S. Emery, R. Maples
Reported by. G.T. Alley

As reported last month, we felt we could expedite the fabrication of the printed circuit boards (totaling seven) that make up the straw readout module by coordinating this effort through the University of Pennsylvania. Five of the boards have now been received from U. of Penn, with the remaining boards expected soon. We have also received four packaged ASD chips from U. of Penn. Three of these have been mounted along with the necessary passive components on the printed circuit boards. Tests on this and the remaining boards will begin during the next reporting period.

We attended the SDC collaboration meeting during the first part of August. Discussions at that meeting spawned additional ideas about how one might cool the straw readout modules. As a result, further cooling tests have been conducted. The results are not available at this time, but will be available soon. Forced air cooling continues to look promising. This work is being conducted in conjunction with Rob Leitch of ORNL Engineering Division.

University of Pennsylvania

Technical Staff Involved:

N. Dressnandt	R. Van Berg
T. Eckenberg	T.Y. Yau
F.M. Newcomer	

Reported by: R. Van Berg

Retrofitted and repaired ASD-T2 boards in use at Duke. Protection diodes added on board. These will be added on all boards using the current version of the Straw ASD. Continued work with ORNL and PCI on revised version of ASD/HV board for use with ASDs in EPIC package format. (Newcomer)

A small evaluation board suitable for two EPIC packages has been designed and is being fabricated. (Dressnandt)

We have worked with ORNL in trying to expedite a full density ASD version of the ORNL HV assembly using EPIC packages. End boards and one six layer board (60 channels) have been produced - the six layer board works well (see below). In consultation with the fabrication house changes were made to the six layer design to reduce board costs for the other two boards required for the full assembly. These boards should be delivered soon. (Van Berg)

25 Tektronix ASD's have been bonded into 68 pin EPIC packages (25 mil pin spacing). Testing presents somewhat of a problem. Two chips were soldered onto the ORNL designed front end board and with some minor fixes, both board and chips in the EPIC package work well with input signals as small as a few femptocoulombs. The tests were performed on an open lab bench, with the discriminators directly driving a meter of cable. (Newcomer)

Measurements continued on a variety of cable constructions and a variety of cable driver circuits were breadboarded and measured. (Newcomer, Dressnandt)

The layout and simulation has been completed for the prototype Level 2 interface chip (L2I) and the design will be submitted to MOSIS for fabrication in their Sept. 16 run. (Ekenberg)

University of Toronto / McGill University

Technical Staff: G. Stairs, A. Holscher
Reported by: P. Sinervo

The design of the first prototype of the Front End Multiplexor (FMUX) ASIC was the focus of the R&D effort. This first prototype is scheduled to be submitted to the Canadian Microelectronics Corporation (CMC) on September 9, 1992 for fabrication in the Northern Telecom 1.2 micron CMOS process.

Due to the amount of space available in this CMC run, this chip is limited to 42 input/output pads. The design goal is to produce a chip that will read out two TMC/L2B prototypes employing the L2 Interface ASIC under design by the University of Pennsylvania group. The chip presents its data via a 16-bit bus (complete design will incorporate a 32-bit bus). The design incorporates a fifo to hold the 24 bits of information for each datum read out of the TMC/L2B and a state machine to control the readout of each TMC/L2B when valid data is ready to be read out of the TMC. The minimal functionality to multiplex data from two TMC chips is included in the design, although certain ancillary logic functions are not included in this prototype.

G. Stairs also began to develop a more detailed layout of the proposed prototype design for the Crate Interface Card (CIC), which accepts the data from a number of FMUX chips.

5.1.3 Calorimeter/Shower Max Front-End Electronics

Fermilab

Technical Staff:

R. Yarema	C. Rivetta
J. Hoff	A. Romero
M. Sarraj	A. Baumbaugh
S. Hansen	K. Knickerbocker
D. Grauptman	

Reported by: G.W. Foster

REPORT MISSING

Lawrence Berkeley Lab

Technical Staff:

T. Collins	I. Kipnis	R. Minor	E. Theil
S. Dow	S. Kleinfelder	L. Pope	S. Wunduke
J. Franck	L. Luo	P. Salz	J. Zelver
G. Gabor	O. Milgrome	D. Santos	
R. Jared	T. Merrick	T. Shimizo	

Reported by: R. Jared

The effort in this period was associated with five main areas: Switched Capacitor Array development, Beam Test Card development, Optical Fiber Communication, Preamplifier design, and System and Management.

Switched Capacitor Array Development

The design of the new version of the SCA was completed in this period. This version will have address latching, low-level CMOS receivers, and subdivided Cap and Op reference levels.

Parts will be received in September. Preparations were also made for the Calorimeter front-end electronics review. The effort spent was 0.82 man months. (Kleinfelder, Milgrome)

Beam Test Card Development

The fabrication of the Beam Test Card was completed in this period. The card is separated into an analog section and a digital section. Testing of the digital section is complete and integration of the two sections has started. Preparations were also made for the Calorimeter front-end electronic review. Effort spent was 1.80 man months. (Wunduke, Minor, Jared)

Optical Fiber Communication

There was some fabrication of test cards. Preparations were also made for the Calorimeter front-end electronics review. Effort spent was 0.23 man months. (Gabor, Minor)

Preamplifier Design

The current splitter and transimpedance amplifier designs were refined in this period to obtain a dynamic range of 4*10**5. Preparations were also made for the Calorimeter front-end electronics review. Effort spent was 0.46 man months. (Dow, Jared)

System and Management of On-Going Effort:

Direction of on-going efforts, development of system designs, preparation of budget material and attending meetings are the main effort in this area. Preparations were also made for the Calorimeter front-end electronics review. Effort spent was 0.70 man months. (Jared, Minor)

5.1.4 Muon System Front-End Electronics

Harvard University

Technical Staff: J. Oliver, H. Hill
Reported by: J. Oliver

Work continued on ASDs for the muon supertower prototype. Three hundred channels of ASD electronics will be constructed using Penn. single channel preamps and hybrid circuit tail cancellation shapers. Three hundred and sixty of these shaper hybrids were received and tested. The peaking times of these units are adjustable by changing a single surface mount capacitor. Modifications were made so that one third each of the total channel count has a peaking time set at 7ns, 11ns, and 14ns. This will allow us to determine the optimum tradeoff between risetime, resolution, and pickup noise immunity in the supertower prototype.

The Penn preamps will be mounted on SIP surface mount plug-ins along with surface mount pulse transformers for impedance matching. The completion of these plug-ins awaits the delivery of the pulse transformers in surface mount packages which are on order.

The mother board which contains the preamps, shapers, discs, and test pulse circuitry has been designed and went out for fabrication. It is a six layer board with sensitive lines buried between ground planes.

The octal test pulse injection chip has been designed and was sent out for prototype fabrication to Orbit Semiconductor. It will be fabricated using 1.2-micron nwell CMOS.

The remaining 300 channels required for the prototype will be constructed using Penn octal ASD chips.

University of Michigan

Technical Staff:

K. Hashim	J. Sirage
B. Hill	C. Weaverdick
J. Mann	E. Weil
C. Murphy	

THIS WORK IS REPORTED BELOW UNDER WBS 5.3 TRIGGER SYSTEM

5.2 Data Acquisition R&D

Brown University

Technical Staff:
Reported by R. Partridge

Brown University has developed models of data flow in high speed DAQ systems. These models include generic models relevant to a wide class of SSC architectures and very detailed models of a specific architecture used by the D0 experiment. Progress this month has continued to focus on improving the model for the D0 DAQ system and making measurements of throughput for the actual data acquisition system.

University of Illinois

Technical Staff: T. Brandys, M. Haney, E. Hughes
Reported by: J. Thaler

Work continued on DAQ architecture studies and DCC design. At the next SDC electronics group meeting, we plan to discuss detector-wide DAQ issues, and we hope that a consensus can be reached for a uniform implementation. Response to our proposal to build a prototype DCC chip indicates that there is some duplication of effort. We hope to improve communications with the other groups designing DAQ components in order to reduce this duplication.

5.2.1 DAQ Project Management

Fermilab

Technical Staff Involved: E. Barsotti
Reported by: I. Gaines

Work continued on cost, schedule, and DAQ project management issues in preparation for the DOE review.

5.3 Trigger R&D

University of Chicago

Technical Staff: R,. Northrop, H. Sanders
Reported by G. Sullivan

SDC Trigger Room Crate and Rack engineering and electronics room layout:

Work continued on standard crate and rack for SDC trigger electronics. Rich Northrop continued collaboration with SSCL's Ken Hess. Work continued on layout of crate/rack function in trigger electronics room.

Level 1 Trigger Conceptual Design:

Work continued on Level 1 design issues of crate counts and connector/fiber density into level 1 crates.

Fermilab

Technical Staff: A. Baumbaugh, A. Romero, K. Knickerbocker

THIS WORK IS REPORTED ABOVE UNDER 5.1.1 SCINTILLATING FIBER

5.3.1.1 First Level Straw Trigger

University of Michigan

Technical Staff: K. Hashim, C. Murphy
Reported by: J. Chapman

The straw trigger project has continued both in simulation and in the development of radiation hardened chips. The first UTMC fabrication of radiation hardened chips is complete and test are beginning on these chips to evaluate their performance compared to the radiation soft chips previously constructed. Test fixtures are designed and are currently in fabrication.

Straw Trigger Simulation:

The simulation work has resulted in a transfer to Dr. Chiba at Tokyo Metropolitan University the code used at Michigan for trigger studies in the straw tracker. The research group at TMU has available 40 DECstations. On this cluster of machines they have managed to simulate nearly 10,000 events. The results are consistent with the smaller sample generated at Michigan. The discrepancies can be traced to the fact that the TMU events were generated without the silicon detector enabled. This choice removes the simulation of silicon material in the particle path to the straw detector. Work with TMU is continuing. We anticipate that they will execute the program for simulations including code for the recently installed muon package.

At the RMCHEP this past July a standard set of muon system labels was defined and a set of muon trigger data was specified for simulations. The code now incorporates this data and work is proceeding at Michigan to provide the additional code to generate a set of trigger files that will permit study of the muon trigger and straw tracking trigger simultaneously.

This will enable us to do correlated trigger studies for both level 1 and level 2 triggers.

5.3.1.2 Calorimeter Level 1 Trigger - Electron Trigger Studies

University of Wisconsin

Technical Staff: T. Gorski, J. Lackey, W. Temple
Reported by: S. Dasu, W. Smith

We are continuing our work on improving electron trigger rate calculations. The new data includes the effects of the shower maximum detector. We are studying the rates at nominal luminosity of $10^{33}cm^{-2}s^{-1}$, and at rates 10 times higher and lower than the nominal. We are also

studying the rates with a coarse calorimeter trigger tower sizes of 0.2×0.2 in η and ϕ. We are also studying the efficiency of finding electrons from top quark decays as a benchmark, in addition to W and Z boson decays. Specifically, our simulation work has concentrated on improving the statistics for electron trigger studies. We are in the process of writing a report about the results on electron trigger performance at luminosities of 10^{32}, 10^{33} and $10^{34}cm^{-2}$-s^{-1}, under various conditions. The results will include the rates and the benchmark studies of efficiencies for identifying electrons from top quark decays, and W and Z boson decays.

5.3.1.3 First Level Muon Trigger

University of Michigan

Technical Staff Involved: K. Hashim, C. Murphy
Reported by: J. Chapman

University of Michigan staff supported in part by SDC and TNRLC funds contributed major sections of the muon system design and description represented in the TDR. Initially the level 1 muon trigger work focused on the general trigger design and connectivity.

A choice of coordinate configuration[1] was made that utilizes toroids for an independent momentum measurement. The modularity of the muon system was chosen to keep the physical units of the system manageable in size. The design incorporates projective wires and scintillation counters.

Two components of the trigger scheme[2,3] are naturally implemented in custom IC devices. The first is the scintillator signal processing unit for crossing determination and the second is the wire pair processing unit for momentum selection. For each of these functions a prototype CMOS chip has been designed and fabricated. Successful performance of the scintillator chip is illustrated below. The prototype of the wire chip has just been received from the fabricators and has been observed to perform as designed in all features tested to date. These preliminary test results are also presented.

Test Chip Results:

The scintillator signal processing chip performs mean timing of the two signals from the phototubes located on opposing ends of a single scintillator slat, outputs timed pulses in four positional segments along the slat, latches these pulses for each 16ns crossing, and stages the latched hit for N (programmable) crossings. The operations listed above are accomplished in a series of steps within the chip. Our testing of the chip exercises separately the steps performed.

The wire signal processing chip performs differential timing of the projective wires as required to select the p_t regions, in a second stage it widens these signals to guarantee coincidence with the delayed scintillator signals, and in the last stage forms the scintillator coincidence. The p_t selections are independently programmable and result in separate signal paths in the remainder of the chip. Both the high and medium momentum outputs work. The stretcher length is demonstrated to be programmable and retriggerable.

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[1]Iron-Scintillator Configurations for SDCMuon Triggers, R. Thun, SDC-90-00077, (1990)
[2]SDC Muon Trigger Preliminary Conceptual Design, J. Chapman and R. Thun, in preparation (Fall 1991)
[3]SDC Trigger Preliminary Conceptual Design, W. Smith \etal , August 1991

Muon Trigger Rates:

Myron Campbell, J. Chapman, Seong Hong, Khurshid Hashim, and Colleen

Murphy attended Rocky Mountain Consortium Workshop July 18-25 to work on SDC muon level 1 and 2 trigger rates and to present material on various aspects of the muon trigger development. Several new analysis were performed during the workshop. The sharpness of the muon triggering threshold was determined for various combinations of data from both the muon system and from combinations of the muon and tracking systems. The threshold determined from the resolution studies was folded with the cross sections for muon production to derive the triggering rate for various possible trigger schemes.

Mini-tower Test:

Plans are underway to construct a muon scintillator trigger card and a wire trigger card to be used in a mini-tower prototype test to be carried out at KEK in Japan during March 1993. This test will be in conjunction with our Japanese SDC collaborators and will be the first actual beam test of the SDC muon chambers with the scintillators and trigger electronics in place. Results from this test will guide the development of scintillators and trigger circuits for the full supertower test planned for late 1993 in Dallas. The KEK test will involve the use of the SDC standard portable data acquisition system, the Japanese supplied SDC TDC cards (called the TMC cards), and our trigger cards. One of the prototype scintillator units developed at Michigan will also be used in the test.

5.3.1.5 Global Level 1 Trigger System

University of Wisconsin

Technical Staff Involved: T. Gorski, J. Lackey, D. Panescu
Reported by: S. Dasu & W. Smith

System Design

We have continued detailed studies of the new system design of the Level 1 trigger[4]. We are also evaluating the feasibility of various hardware realizations of the design. As part of this we have designed, simulated, fabricated and are now testing a 4 x 12-bit CMOS adder, which is a common component of several boards in the present circuit design.

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 fabricated a pipelined domino logic two-stage adder[5]. The device has been simulated in 1.2um CMOS technology and has achieved the design goal step time of less than 13 ns. We have designed a tester for the ASIC that contains a VME interface, 4 blocks of memory for the operands, 1 block of memory for the result and a controller.

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[4]T. Gorski, J. Lackey, W.H. Smith, {\it Revised Level 1 Trigger Decision Design for the SDC}, U. Wisconsin SDC Note SDC-92-198, 1992.

[5]D. Panescu, T. Gorski, J. Lackey, W.H. Smith, M. Thompson, {\it A Pipelined 4x12 CMOS Adder}, U. Wisconsin SDC Note SDC-92-218, 1992.

This tester board is being fabricated. We have begun an investigation of the performance of the adder when fabricated in the new 0.8um CMOS process now available at MOSIS. We have begun an article on the design and performance of this device.

Muon Trigger Studies

We have also continued studies of the muon trigger rates in the SDC detector. Specifically, we have been working on incorporating the correct muon geometry into the calculations. In addition, we have been studying the implementation of energy loss and multiple scattering experimental data into the Monte Carlo parameterizations.

5.3.1.6 Level 1 Clock & Control

University of Wisconsin

Technical Staff: T. Gorski, J. Lackey, D. Grimm, A. Penpek
Reported by: S. Dasu & W. Smith

System Design:

We are continuing to study the revised global clock and control system in light of our experience in designing the Trigger Emulation Module (see below) and our interactions with other subsystems as part of this process. The basic clock and control system is outlined in Ref.[6]

Trigger Emulation Module:

We have continued work on fabrication of the Trigger Emulation Module (TEM)[7] . 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.

In the early part of the month we completed the initial version of schematics for the TEM, and subsequently began the PCB-design phase of the project. During this month we began to look at cable technology to carry Clock and Control I/O on and off of the TEM, with our efforts centered primarily on individually-shielded twisted-pair cables. We also began the parts procurement for the TEM. This submitting Requests for Bid to our regular lists of vendors, and the subsequent processing of those bids into actual purchase orders.

We are setting up a VME crate with Motorola processor to debug the Trigger Emulator Module (TEM). We have started writing software for debugging and testing TEM modules when they become available in few weeks.

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[6]W. H. Smith, T. Gorski, J. Lackey, {\it SDC Global Level 1 Processor: Clock \& Control}, U. Wisconsin SDC Note SDC-91-090, 1991.

[7]W.H. Smith, T. Gorski, S. Dasu, {\it SDC Trigger Emulation Module}, U. Wisconsin SDC Note SDC-92-250, 1992.

5.3.3 Trigger Project Management

University of Wisconsin

Technical Staff Involved: R. Craven, T. Gorski, J. Lackey
Reported by: S. Dasu & W. Smith

The resource-loaded trigger schedule has been developed in collaboration with SDC project management at the SSCL. The overall schedule has been reviewed. The cost estimate has been checked for internal consistency and compared with other SDC electronics cost estimates. The layout and design of the trigger crates, racks and rack layout has been studied.

6.0 COMPUTING SUMMARY

III. SDC SUPPORT AND MANAGEMENT SUMMARY

7.0 CONVENTIONAL SYSTEMS SUMMARY

8.0 INSTALLATION AND TEST SUMMARY

8.1 Test Beam R&D

8.1.1 Fixturing

LBL

8.1.2 DAQ

SSCL

FNAL

8.1.3 Labor

FNAL

No activity.

8.2 Installation and Assembly

SSCL

Reported by Jonathan Piles

During the month of August the main items the installation and assembly team worked on were assembly building, underground hall spatial requirements, and the installation and assembly plan. Each are summarized briefly below:

Assembly Building- Comments were collected and compiled for the SDC Assembly Building. This report was then sent on to EFD for inclusion into the Title I review comments.

U/G Hall spatial requirements- 3D layouts showing the spatial requirements of the detector installation in the hall were generated in order for PB/MK to place the stairs, walkways and elevators so as not to interfere with the detector. These drawings were given to them during the regularly scheduled working group meetings.

Installation Plan- Efforts were started in updating the installation and assembly drawings and plans that were started by Kaiser Engineers

9.0 PROJECT MANAGEMENT SUMMARY

9.1 Project Planning & Tracking

Prepared by Dave Etherton

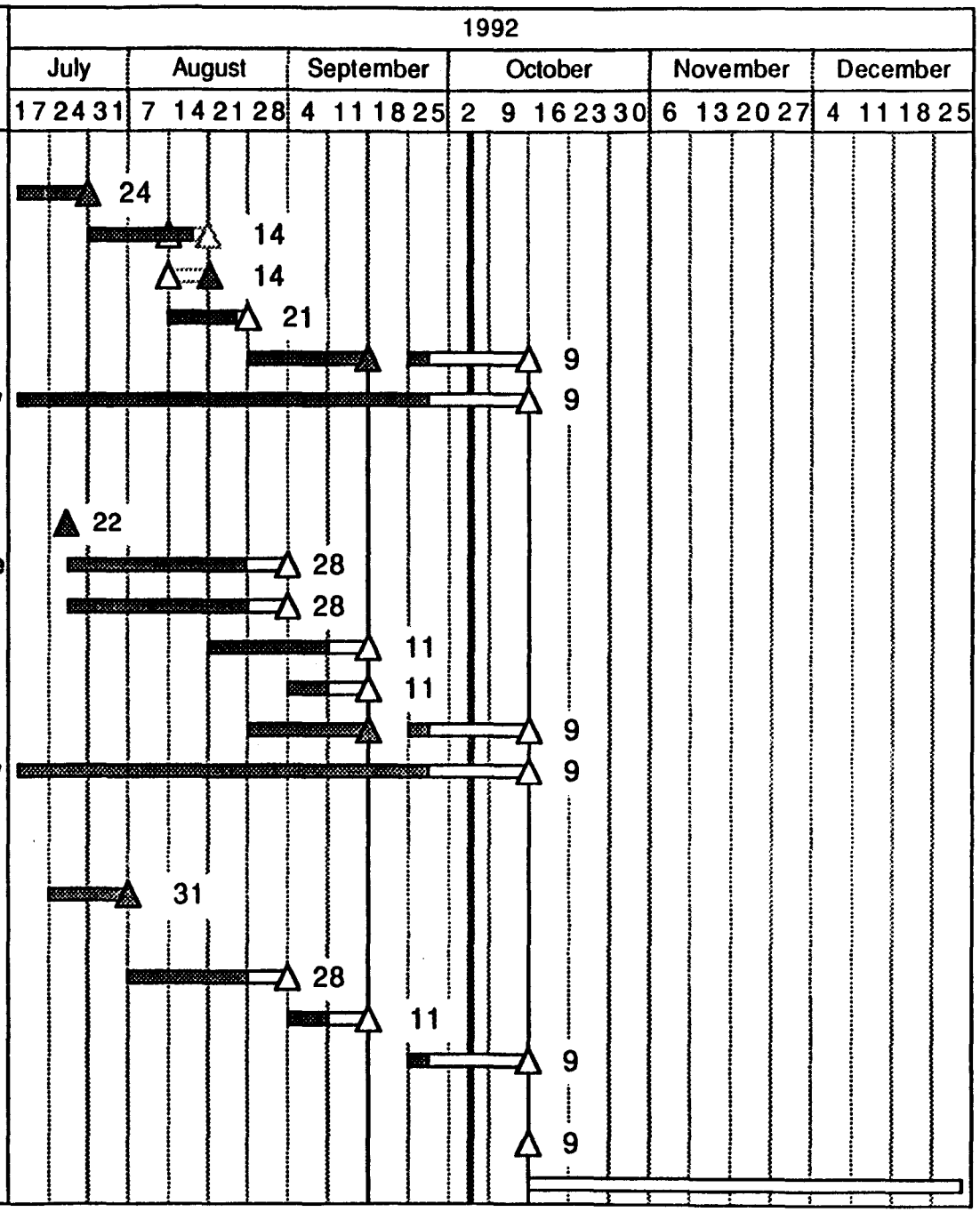
The activities of the SDC Planning and Tracking group had several major focii in August and September. These included the revision of the SDC U.S. equivalent cost estimate and integrated project schedule and the development of a SSCL Performance Measurement Baseline that implemented SSC guidelines for establishing cost and schedule control. The activities and results are summarized below.

Program Plan Development - This activity includes the completion of a revised U.S. cost estimate, the development and integration of resource loaded subsystem project schedules into an SDC Integrated Project Schedule (IPS), the revision of the International Funding Model including planning funding against the schedule, and the development of reporting and tracking procedures for SDC monthly monitoring. To date, the cost rollup is nearing finalization with the remaining effort to correct errors or mistakes and make final adjustments associated with funding and organizational issues. The integrated project schedule is coming together with the effort currently being to debug and correct translation errors from native schedules. The international funding plan is being revised and a time-phasing developed consistent with the schedules. Finally, we are working toward an understanding of the tracking and reporting requirements and are developing the procedures and the culture for doing this. We are working toward an October 10 date to complete a revised SDC Summary Cost and Schedule Book for submittal to DOE in preparation for the October 26 review. Other upcoming activities include preparing the final detailed documentation for cost estimates, schedules, and funding to present for review at the end of October. We are presently behind schedule due to late changes in cost estimates, and schedule problems in debugging and reporting. Attached is the statused schedule for completing the Program Plan to support the October review.

Performance Measurement Baseline - We have planned the detector Performance Baseline at a detailed level for FY93 and a summary level for the remainder of the project. This will allow us accounting visibility heading into the next fiscal year while also giving flexibility to better plan our baseline when funding becomes more definitized. Detailed budgeting for FY93 remains to be accomplished pending release of official targets from SSCL PMO.

Other activities included FY92 expenditures monitoring and the accomplishment of contracting for the remainder of FY92 purchases. In September, three major contracts were released (or are very close) including Space Frame Characterization for Barrel Tracker, Support Cylinder Prototype Fabrication for Barrel Tracker, and Installation Study for Muon Barrel Steel. We expect to close the fiscal year with expenditures very close to budget.

SDC Cost/Schedule/Funding Review and Validation



I. Cost Estimate Review/Validation

- Analysis of Subsystem Cost Methods
- Revise Estimates/Work Action Items
- Provide New Input to SDC
- Roll-up and Reconcile U.S. Cost Estimate
- Prepare for Reviews
- Complete Documentation for DOE Review

II. Project Scheduling

- Revised Schedules due
- Integrate into Multi-project and summarize
- Check/Validate resource loading
- Exercise Resource-limited scheduling
- Develop Cost/Funding profiles
- Prepare for Reviews
- Complete Documentation for DOE Review

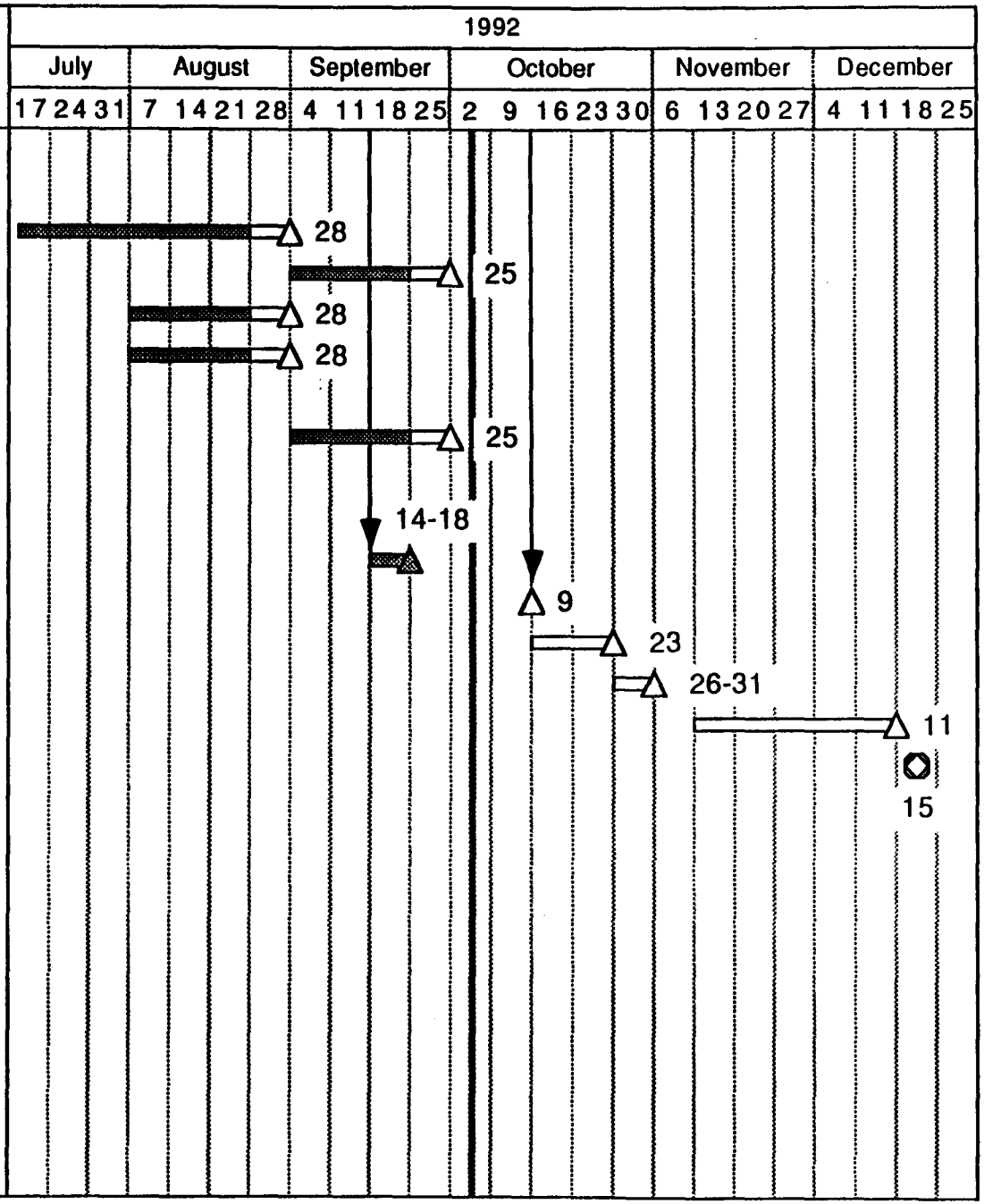
III. Funding Plan

- Implement International and other funding in database system
- Revise funding model
- Assign funding to summary schedules
- Develop and Print Reports for time-phased funding by Source
- Submit funding profiles with data-package
- Plan offset resources into schedules

Etherton

Tuesday, September 2[illegible] 1992

SDC Cost/Schedule/Funding Review and Validation



IV. Cost/Schedule Tracking

- Finalize FY93 Budgets
- Plan and assign COBRA work packages
- Finalize system for C/S of SSC funding
- Develop approach for International and Other funding activities
- Document approach in SDC PMP

V. Review/Validation/Approval

- SDC/SSCL Cost/Schedule Review
- Submit Data Package to DOE
- Finalize Presentations for DOE Review
- DOE Review (proposed)
- Resolve Action Items
- Stage II Approval (proposed)

D. Etherton

Tuesday, September 29, 1992

9.2 Detector Integration

SSCL

Reported by Jonathan Piles

Detector integration is separated into three groups for purpose of reporting progress for the month of August. They are mechanical, electrical, and tracking integration. Each are summarized below:

Mechanical

During August, the main foci of the mechanical integration group were detector alignment, parameters book, utility routing and configuration issues. These are briefly described below:

Detector Alignment-Initial responses from the subsystems concerning alignment and positioning requirements were requested during the collaboration meeting along with presenting what the current known factors were. The information received was then compiled, formatted and sent back out for initial feedback.

Parameters Book- The current revision of the Parameters Book, Rev E July 9 draft, was issued to the subsystems for comments along with informing them of how we plan on controlling the next release of the parameters book and the process of updating it. Tom Kirk asked that any additions should be in by Sept. 2 for inclusion into the controlled version.

Utility Routing- The cabling and utility runs through the calorimeter were continued to be modeled in 3D to show the spatial constraints of the gap between the endcap and barrel. This was presented to all subsystems at the collaboration meeting for comments and changes. These changes will be taken, evaluated and inserted into the parameters book.

Configuration- The largest configuration change dealt with the BW3 and IW2 overlap BW3 was extend over IW2 making the access for cabling and personnel to change configuration. Another configuration change was a request from the calorimeter group to increase the length of the barrel. After evaluating the change the decision was made to keep the calorimeter per the dimensions in Rev. E of the parameters book.

Electrical

During the month of August a layout of all muon crates were created showing the location and quantity. This was forwarded to the muon group for comments which were incorporated with a new drawing to be redistributed. A complete 3D layout of the Low and High Voltage galleries' was also completed. This will be forwarded to the EFD group for inclusion into the baseline of the Underground Hall. A new cable shaft was proposed to reduce radiation dosages at the top of the shaft. This configuration was taken and evaluated for cable length and routing changes. No major problem were seen therefor change was approved.

Tracking

Proposed long range plans for future SDC integration meetings. Schedule and subject proposals were sent out for comments. The overall response was favorable and was used as a basis for the upcoming Oct. 1 & 2 integration meeting. The requirements of the tracking system assembly within the surface assembly building were updated and submitted to PB/MK for Title I design.

9.3 Systems Engineering

Reported by Norm Wells

Work Breakdown Structure Dictionary--Prepared a first draft of the WBS Dictionary down to the lowest level (over 3100 entries) for distribution to the component managers for completion of descriptions. This document is required for the DOE review in October.

Configuration Management Plan--A draft has been completed and is awaiting coordination.

Technical Design Review Procedure--An SDC Practice on technical review procedures covering the procedures for Preliminary Design Requirements Reviews, Preliminary Design Reviews, Critical Design Reviews, and Acceptance Test Plan Reviews has been incorporated into the Project Management Plan (Appendix M). The PMP also incorporates the Engineering Management Plan. The procedures will be first used for the Muon Barrel Preliminary Design Review (Oct 14).

Parameter Book--Facility parameters from the SEFUR as well as new data on electronics power and cooling requirements have been included in a new revision. The Parameter Book will be distributed to some individuals by name, with a return receipt requested to ensure that all detector designers get a copy.

Detector Specification--Started writing the Level 3B specification for the SDC detector. The major current thrust is to determine the requirements for component positioning accuracy and range. A memo has been sent to all detector component managers requesting position measurement requirements. These are important inputs to the studies on detector construction, and adjustment and alignment.

Interface Book--A draft of the book structure and format for interfaces between major detector components and between the detector and other systems/facilities has been completed and distributed for comments.

Interface Status

Preparing an Interface Control Document (ICD) for the SDC Detector to Accelerator interfaces. A procedure has been established within the Accelerator/SDC Interface Working Group for passing questions, in a prioritized list, to the Accelerator Division for action. The answers will be incorporated into the ICD with the understanding that we can use these parameters for design work.

Studies and Analyses

Detector Alignment and Adjustment Study--Being revised to incorporate new information. Subsystem requirements have been requested to be able to determine the global requirements.

Detector Construction Scheme Study--The consensus is that the muon barrel magnet should be built level, but that the final decision can wait until the rigging company that will be doing the job can have an input. The rest of the detector will be built on the slope.

Technical Design Reviews

The Preliminary Design Review for the Muon Barrel Toroid (Magnet System) is scheduled for October 14-16.

Test Program Status

No action yet.

Configuration Management

Procedures have been developed on how the SDC change control process will operate. The Technical Board will continue to have a major role in this process. A draft of the PRD Policy for Configuration Management was prepared to integrate the SDC procedures with those of the SSCL and to ensure that the approval chain was fully defined.

Management Information Systems

Have developed and are testing an upgrade of the Document Tracking and Storage System (DTASS) that provides improved capabilities for the Document Control Center.

Industry has responded to the SSCL Document Management System RFP. Award is planned by the end of FY92 with the new document tracking capability operational early in 1993. However, it will not have the capability to store documents and drawings, which will require the continued use of DTASS.

Developing a name and address electronic database for SDC. System testing is underway.

Quality Assurance

No action.

Issues

None

IV. COST SUMMARY

WBS	ITEM/ INSTITUTION	COSTS THIS MONTH	FY92 COSTS TO DATE	FY92 COMMIT-MENTS	FY92 BUDGET	SOURCE OF FUNDS
1.1	Silicon Tracker R&D					
	LANL	115,000	1,863,000		1,975,000	
	UCSC	7,291	20,975		532,000	
	LBL	48,984	279,715		560,000	
1.1.1	Main Mechanical Assembly					
1.1.2	Internal Electronics					
1.1.3	External Mechanical Systems					
1.1.6	Assembly/Test/Special					
1.1.7	Project Management					
1.2	Option -- ORNL				235,500	
1.2.1	Barrel Tracker R&D					
	Indiana University	13,549	96,742		370,000	
	Duke University*	5,000	6,200		175,000	
1.2.11	Management					
1.2.12	R&D Prototypes					
	University of Colorado	524	10,348		97,000	
	QRS	13,700	16,2001		29,918	
	WSTC	66,542	212,383		387,680	
	ORNL	25,733	77,098		164,000	
2.1	Barrel Cal R&D					
	ANL	28,000	325,800		572,000	
	Fermilab	63,800	1,003,800	38,300	1,128,100	
	Rockefeller					
	SSCL	0	0	0	10.0	
	U. of Texas-Arlington					
2.1.9	Tile/fiber fabrication					
	U. of Tsukuba					
2.2	Endcap Cal R&D					
	LBL	55,900	261,900		400,000	
	ORNL	0	40,000	0	40,000	
2.2.1	Calibration					
	Purdue					
2.3	Forward Calorimeter					
	Rockefeller					
2.3.1	Design Documentation					
	U. of Toronto					
2.3.2.1	Construction of Liquid Scint Text Module					
	U. of Toronto					
2.3.2.3	Measurement of Capillary Attenuation Lengths					
	U. of Manitoba					
	Texas A&M					
3.1.1.1	Barrel Magnet					
	U of Wisconsin	9,600				
3.1.1.2	Barrel Coils					
	U of Wisconsin	3,000				
3.1.1.3	Barrel Support					
3.1.2.1	Forward Iron					
3.1.2.2	Forward Coils					
3.1.2.3	Forward Support					
3.1.3.1	Power Supplies					

3.1.3.2	Monitor & Controls					
3.2.1.1	BW1 Module					
3.2.1.2	BW2 Module					
3.2.1.3	BW3 Module					
3.2.1.4	BWT Tower					
3.2.1.5	Barrel Region (shared items) Harvard Tufts	 15,300 12,600	 41,000	 30,400		 TNRLC Tufts,TNRLC
3.2.2.1	IWT Tower					
3.2.2.2	Intermediate Region (shared items) U of Wisconsin	 6,400				
3.2.2.6	Intermediate System Design U of Wisconsin	 9,400				
3.2.3.1	FW1 Module					
3.2.3.2	FW2 Module					
3.2.3.3	FW3 Module (option)					
3.2.3.4	FW4 Module					
3.2.3.5	FW5 Module					
3.2.3.6	Forward Region (shared items) U of Maryland U of Maryland	 8,000 2,000				 SSCL R&D University
3.2.4	Global (summary)					
3.2.4.1	Global Tube Brandeis University University ofColorado Ohio State University	 6,900 4,600 2,500	 6,900 34,830 8,000	 150		 TNRLC TNRLC University
3.2.4.2	Global Alignment & Monitoring Fermilab Harvard	 3,940 9,200	 59,140			 SSCL R&D TNRLC
3.2.4.3	Global Trigger Counters					
3.2.4.4	Global Surface Facilities					
3.2.4.5	Global Gas Systems					
3.2.4.6	System Engineering					
4.0	Solenoid Magnet Systems Sum					
5.1	Front End R&D					
5.1.1	Scint. Fiber Tracker FE Electronics Fermilab				 100,000	
5.1.2	Straw Tracker Front End Elec. University of Colorado**				 50,000	
5.1.3	Cal/ShowerMax FE Elec. Fermilab					
5.1.3.1.1	LBL					
5.1.4	Muon Systems FE Elec					
5.2	Data Acquisition System University of Illinois	 0	 31,273	 48,000	 50,000	
5.3	 U. of Wisconsin Michigan				 170,000 71,458	
6.0	Computing					
7.0	Conventional Systems					
8.1	Test Beam R&D					
8.2	Installation and Assembly					
9.1	Project Planning&Tracking					
9.2	Detector Integration					
9.3	Systems Engineering					