STAR-SVT Project
Quarterly Report, 9/99-12/99

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SVT Project Summary

The project highlight of the first quarter of FY00 was the successful completion, assembly, installation, and operation of the first 'real' SVT ladder into the STAR detector.

In addition, potential problems in the manufacturing of the electronics carrier and the hybrid assembly were solved. A new assembly schedule has been developed based on the latest delivery schedules and assembly time estimates.

The readout electronics components were re-designed as a result of the RDO review in July, the subsequent system test and the experience during the STAR cosmic ray run in December.

The cable production as well as the cable installation into STAR proceeded throughout the quarter according to plan.

First online and slow control software programs were put into place and exercised during the December cosmics run. The single SVT ladder was also successfully implemented into the STAR DAQ and Trigger systems. The integration into the STAR Online and Slow Controls systems is planned for the second quarter of FY00.

WBS 4.1.1. Mechanical Structures

Personnel:

BNL: Rolf Beuttenmueller, Bill Leonhardt, Bob Soja

Sao Paulo: Jun Takahashi

WSU: Rene Bellwied

After the cancellation of the Beryllium Electronics Carrier Order with Brush-Wellman we ordered Carbon-Fiber test material and reached an agreement with the BNL machine shops to fabricate the full order of SVT electronics carriers based on Carbon-Fiber material instead of Beryllium. First tests in September and October showed that all carrier parts can be manufactured reliably and to the original specifications with Carbon-Fiber as the material of choice. The assembly of the three independent Carbon-Fiber pieces into one single electronics carrier was less successful. All fully assembled test pieces exhibited leakage when used in a pressured water system. After further review of other existing Carbon-Fiber material we converged on a specific fiber that was also used in Space Station and High-Energy Experiment applications, called M55-J. A reliable local fiber vendor was also identified. Tests in late December proved successful and the complete fabrication of all carriers is now scheduled for the second quarter of FY00. The delivery schedule spans over eight weeks for the full order, thus we expect to have all parts in hand by March.

The remaining mechanical SVT components that are still in fabrication are: the water manifolds and the Beryllium components that support the SVT ladders (end rings, struts, brackets). All other components have been fabricated and were delivered to BNL.

Based on the experience of the first complete ladder assembly we also modified assembly and installation tooling as well as ladder storage units. For all of these parts we have a sufficient number to commence the SVT assembly. In the second quarter of FY00 we will proceed with fabricating the final production quantities as well as the main SVT assembly fixture for the coordinate measuring machine (CMM).

WBS 4.1.2. Wafer Production

BNL: W. Chen, D. Elliott, V. Eremin, I. Ilyashenko, Z. Li, L.J. Zhao
WSU: S. Pandey
Sao Paulo: J. Takahashi

The original contract with SINTEF, our commercial supplier of Silicon drift wafers, ran out in August 99 after three batches were successfully delivered. Out of a total of 325 wafers, 205 wafers met all the necessary requirements which corresponds to a very satisfactory yield of 63% for batches 1-3. The original agreement with SINTEF stated that after three batches we would re-evaluate the necessity for a fourth batch. We need a total of 216 wafers for the SVT itself, plus 34 spares. Thus, we re-negotiated a contract for a fourth batch, and SINTEF started production in September 99. The first 30 wafers were delivered by mid December. Subsequent testing shows a yield comparable to the yield of the first three batches. The complete batch is scheduled to be delivered by March 00.

WBS 4.1.3. Cooling System

Personnel:

BNL: Bill Leonhardt, Bob Soja

In the fall of 99 we purchased a commercial air conditioning system for the SVT/TPC cooling system. The system was successfully installed in November 99 and was first used for the STAR cosmics run in December 99. The purchased air conditioning unit is part of the overall SVT/SSD/IFC air handling system and the remaining components will be purchased in the second quarter of FY00. The present layout of the A/C unit is sufficient to cool the SVT Year-1 ladder but does not meet all requirements for the complete system.

The main commercial components for the SVT water system have not yet been ordered but are expected to be delivered in May 00 for installation during the summer shutdown of 00.

WBS 4.1.4. Miscellaneous Systems
Personnel:
OSU: Helen Caines, Tom Humanic, Evan Sugarbaker, Robert Willson
BNL: Bill Leonhardt

All Radstone boards for the SVT slow controls system were ordered through Ohio State University. Presently one of the boards is installed for the operation of the SVT year-1 ladder. All other boards will be installed in the summer shutdown 00.

Temperature monitoring devices were installed on the detector and the transition boards as well as the air conditioning inlets and outlets. The air conditioning monitors will be included in the global interlock system.

WBS 4.1.5. Assembly and Testing
Personnel:
BNL Physics: P. Kuczewski, B. Leonhardt, D. Lynn, B. Soja
BNL Instrumentation: R. Beuttenmueller, D. Pinelli
LBL: B. Minor
WSU: R. Bellwied, S. Pandey
OSU: R. Willson
Sao Paulo: J.Takahashi
UT Austin: J. Hoffmann, G. Ott, J. Schambach

After completion of the first fully functional SVT ladder we stopped further assembly to review our assembly plan and check the assembly equipment (lasser cutter, hybrid bonder, NIKON video system, Sheffield Coordinate Measuring Machine) for production. We worked out a new assembly schedule in which ladder assembly begins in January 2000 and is completed by July 2000. SVT assembly begins in May 2000 and is scheduled to be completed in August 2000. SVT installation is scheduled for September/October 2000.

The assembly time is determined by the assumption of an uninterrupted procedure from the hybrid bonding and the wafer cutting all the way to the final ladder assembly. Problems in the hybrid bonding, though, persisted throughout the first quarter of FY00. After several attempts to involve commercial outlets in the bonding process were unsuccessful, we had several meetings in December at BNL Physics and BNL Instrumentation to arrive at a realistic assembly plan utilizing physics and instrumentation manpower. Results obtained by the end of the first quarter seem to indicate that a reliable bonding procedure has now been established and can be maintained for the next six months. In return for additional manpower provided by Instrumentation we agreed to fund a job-shopper for up to six months starting in the second quarter of FY00. This is a change in scope based on the original WBS. The above timelines reflect the consensus of the meetings with Physics and Instrumentation.

The main testing phase of the SVT in this quarter was dominated by the year-1 ladder test after installation into the TPC and STAR. The test procedure consisted of two phases, namely the testing of the ladder in stand-alone mode and the testing of the ladder in the STAR cosmic ray run. Standalone tests were performed for two weeks from early November until mid-November. The one week cosmics run commenced in late November.

During the standalone tests we were able to reproduce our noise measurements from the test bench. The implemented shielding and grounding plan of the detector was confirmed and the noise levels are such that the SVT ladder is ready for year-1 data taking. The number of inactive channels is well below the requirement of less than 2%.

Problems arose when we implemented the SVT into the RDO/DAQ/Trigger system. Some of the clock and trigger signals were out of synch and we spent most of the cosmics run debugging the integration between us and the main STAR systems. During the last day of the cosmics run we took data as part of the main data stream at a slower event rate. We identified the clocking problem and we will continue to resolve the integration issues in January. Most of our problems are very similar to the initial TPC integration problems.

WBS 4.1.6. SVT Electronics

Personnel:

BNL Physics: David Lynn, Phil Kuczewski
BNL Instrumentation: Rolf Beuttenmueller, Don Pinelli
LBL: Bob Minor
OSU: Robert Willson
Sao Paulo: Jun Takahashi
UT Austin: Jerry Hoffmann, Granville Ott, Jo Schambach

During the summer of 99 we experienced a serious setback in the SVT assembly when it became obvious that the complete Switched Capacitor Array (SCA) batch, which had been successfully fabricated, tested, and diced in early 99 was not useable because wire-bonds did not adhere to the chip. After several attempts to salvage the batch by using different bonding techniques at BNL and at commercial outlets were unsuccessful, we had to submit a new SCA order to SUPERTEX. These chips arrived in September. They were immediately tested not only for performance but also for bonding characteristics. The new batch has a 90% yield and the bonding did not show any of the previous problems. At this point all PASA's, all SCA's, and about 30% of the hybrid circuits are produced. Another 40% of the hybrids is scheduled to be completed by early March.

All readout electronics components (the AMB (Analog Multiplexing Board), the PTB (Power-Timing Board) and the FOB (Fiber-Optic Board)) are being modified based on the system test experiences in the last quarter of 99. The final production of boards will start to arrive at BNL in March. Most of the modifications are minor and relate to connectors, cables, and some of the on-board components. This final iteration is more of a 'clean-up' of a few remaining issues.

All SVT cable production and orders are managed through LBL. The cone cables (from detector to RDO) were delivered and installed in August-October 99. The cables from the TPC wheel to the platform and the counting house are being delivered and installed in three installments. The first installment was delivered and has been installed in October 99. The second installment will be delivered and installed in January/February 00, and the final installment will be installed in the summer shutdown of 2000. By February 2000 around 40% of the SVT cables will have been installed. The final cable order will be completed by July 2000.

Based on the experience during the system test we decided to not further expand the SVT HV system to allow for independent regulation of the focussing voltages on the detector. The focussing voltage will be deduced from the detector voltages on the SVT transition boards. This is a change in scope of the original WBS.

WBS 4.1.7. SVT DAQ

Personnel:
UT Austin: Jerry Hoffmann, Granville Ott, Jo Schambach
BNL: Mike Levine, Tonko Ljubicic

We continue to order SVT-DAQ components through Mike Levine and his group. SVT receiver boards are scheduled to be completed in the second quarter of FY00. Presently one of these boards is installed for the year-1 ladder. The receiver boards are essentially identical to the TPC boards except for their software loading and their memory capacity. Thus, TPC boards can be switched into SVT mode if necessary.

WBS 4.1.8. SVT Computing

Personnel:
OSU: Selemon Bekele, Helen Caines, Robert Willson
WSU: Rene Bellwied, Claude Pruneau
Sao Paulo: Patricia Fachini, Marcelo Munhoz, Jun Takahashi
UT Austin: Jo Schambach

The SVT Slow Controls monitor for the STAR control room has been purchased. The online control system monitor will be part of the STAR online system and should be delivered in the first quarter of 2000.

The SVT software development progressed well and was further integrated into the STAR analysis framework. Some datasets of MDC2 contained the so-called year-2 configuration, and we contributed software to the tracking as well as the vertex finding components of the main detector. Additional year-2 configuration simulations are run as part of the nightly reconstruction tests at RCF. Within the SVT software, the cluster finder and the vertex finder were modified. Major progress has been achieved in the areas of slow controls and online monitoring software. New code that had been developed for the SVT system test has been successfully applied to the SVT year-1 ladder monitoring during the December cosmic ray test.

WBS 4.1.9. SVT Installation
Personnel:
BNL: Bill Leonhardt, Bob Soja
OSU: Robert Willson
WSU: Rene Bellwied, Sanjeev Pandey
OSU: Robert Willson
Sao Paulo: Jun Takahashi

The SVT cone, which was installed in early spring of 99 for the RHIC engineering run was removed during the first week of September to allow installation of all SVT and SSD cables from the SVT detector volume to the TPC wheel. The usage of the specifically manufactured railing system which provides the support for the removal of the cone through the inner field cage of the TPC, turned out to be very successful. A procedure has been established that allows us to remove or insert the cone within three days including the erection and removal of the installation platform. After removal from the TPC the cone was moved into the SVT assembly tent in the STAR assembly building. During the next five weeks the cone was cabled up with all the required power, signal and control cables for the SVT and the SSD plus their respective shields. In addition the water and air cooling hoses and ducts were mounted to the cone. The cone was finally sealed with the molded shields that were produced in September 99 to prevent any HV breakdown between the SVT and the TPC. By mid-October the cone was moved back onto the platform and the SVT year-1 ladder was installed together with all the necessary shielding towards the beam pipe and towards the TPC. The fully cabled and instrumented cone was re-inserted into the TPC in the last week of October.

One of the twelve SVT readout electronics boxes on the west side of STAR was fully instrumented and installed to allow readout of the year-1 ladder.

The SVT/TPC air conditioner was installed on the east side and two out of four air ducts were connected between the unit and the air manifold which is mounted to the TPC wheel. A second air manifold (outlet) was installed on the west side. During the cosmic ray run only reduced air flow was necessary due to the low power load of a single SVT ladder. Thus only two out of four inlets were connected. The remaining two inlets will be connected to the conditioning unit and the remaining air handling hardware will be installed before mid-February 2000.