6.0 ELECTRONICS, COMPUTING AND DETECTOR INFRASTRUCTURE

6.1 Electronic equipment

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In addition to the normal maintenance and repair of the Nuclear Physics Laboratory electronic equipment, projects undertaken by the electronics shop this year included the following:

a. A pulsed current source for monitoring the performance of the QDCs in the gamma ray experiment was designed and constructed.

b. Extensive modifications were made to the emiT boards to improve their noise performance. These modifications will be included in revision b of the emiT boards.

c. Eight charge preamps were constructed for testing of NCDs during production.

d. The construction of the NCD current preamps has been completed except for final testing.

e. A PIN diode leakage current monitor was designed and constructed for emiT.

f. A liquid nitrogen flow controller was constructed for the detector cooling system of the emiT experiment.

g. Design of revision b of the emiT boards (see Sec. 6.4) is near completion. The boards will be laid out to have lower noise and increased reliability. The same boards with different shaping time will be used for the slow shaper in the NCD front end electronics. A fiber optic link has also been developed to provide electrical isolation between the emiT preamps and the emiT boards.

h. A 100 Mhz clock generator was constructed for use in testing of the SNO DAQ development rack.

I. Several PID temperature controllers were constructed for the cooling of detectors and temperature regulation of sensitive electronic systems in the positron-neutrino correlation in the 0^+ -> 0^+ decay of the ^{32}Ar experiment.

j. Several Bit3 VME controllers were modified to add more memory.

k. A 680 ampere low voltage power supply system was constructed that will be used for electropolishing the SNO neutral current detectors.

l. Missing pulse detectors for each of the three GORDO heart beats were constructed for the radiation safety interlock system.

m. Modifications of the SNO FEC32 cards were made at TRIUMF.

n. A high voltage power supply spark protection filter was added to the terminal ion source.

o. Design of the NCD front end electronics system is nearly complete. A prototype of the multiplexer has been constructed and is undergoing tests. After testing is completed, the printed circuit board will be laid out. Construction of the system is scheduled to begin this Spring.

6.2 VAX-based acquisition systems

M.A. Howe, R.J. Seymour, D.W. Storm and J.F. Wilkerson

We now have added another VAXstation 3200-based data acquisition system making a total of four. They consist of Digital Qbus-based VAXStation 3200/GPXs running VMS v4.7a using VWS/UIS as their 'windowing' software. Each VAXstation supports a BiRa MBD-11 controlled CAMAC crate. Our primary system is attached to a dozen dedicated 200 MHz Tracor Northern TN-1213 ADCs. Those ADCs and other CAMAC modules are coincidence-gated by a UWNPL-built synchronization interface, which includes monitor (Singles) and routing-Or capabilities. The system also has a bank of 32 10-digit 75 MHz scalers.

Our principal VAXStation's dual BA-23 cabinet has an MDB-11 DWQ11 Qbus-to-Unibus converter driving a Unibus expansion bay. The system's Qbus peripherals include a CMD CQD-220/TM SCSI adapter for a Seagate ST41650 1.38 gigabyte disk, an Iomega Jaz 1 gigabyte removable disk and a TTI CTS-8210 8mm tape drive. We also use a DEC IEQ11 IEEE-488 bus controller and a DEC DRV11-J. The Unibus bay contains a DR11-C, our Printronix lineprinter controller and a Unibus cable to the MBD-11.

The other acquisition systems each consists of a VAXstation 3200/GPX's BA-23 cabinet and an Able Qniverter providing a Unibus cable direct to stand-alone MBD-11s. One of these systems also has a Jaz drive. Unlike the 'principal' system, these do not directly control non-CAMAC-based equipment.

All four systems run acquisition software based upon TUNL's XSYS, with major modifications to their DISPLAY program.

6.3 Analysis and support system developments

J.G. Cramer, M.A. Howe, R.J. Seymour, D.W. Storm, T.A. Trainor and J.F. Wilkerson

This year has seen a significant and continuing upgrade of the Lab's network, compute servers and desktop presence.

Our existing network cable plant was a 2-DELNI, 9-port hubbed, single-segment 10 Mbs thinwire RG58 coax (10base2) ethernet with ad hoc BNC tees inserted as nodes were added.

We now have a switched fabric blending over 90 ports of in-ceiling and wall-mounted 100 Mbs twisted pair Cat-5 (100baseTX) ethernet, some 10baseT ports (until their nodes can be upgraded), and our existing legacy 10base2 net. We have made use of our HP 800T switch's flexibility to partition the old cabling into three segments, with the 100baseTX network divided into four segments, three with two 16-port stacked Linksys Stackpro hubs and the fourth with a single 16-port hub. The 800T's eighth port is a full duplex 100baseFX fiber uplink to the campus routers.

The desktop presence has jumped from a mix of ASCII terminals and a few 1989-era VAXstation 3100s by the purchase of twenty 233Mhz Pentium II-based systems. Each PC has an Asus L2P97 motherboard, 32MB ram, a 3 gig disk, 4 MB Matrox Mystique video cards, 17" Sony 200sf screen, and a 3com 3c905TX ethernet card in a mid-tower case. They are all running Windows 95, MS Office97, Novell LanWorksPro for X-server and NFS capability, and a variety of shareware, freeware and campus-site-licensed utilities. Additional ‘specialty’ packages, such as Fortran compilers, are installed as needed.

Our central compute-server base has gained a pair of dual-CPU Digital AlphaServer 4000/466s running Digital Unix. Each has a gigabyte of ram and a StorageWorks 4 gigabyte system disk. Each has an additional 9 gig dedicated drive and a central RAID server and DLT tape facility will be added soon. These machines benefit from Digital's Campus Software License Grant program for their updates, compilers and utilities.

The rest of our offline computing and analysis facility consists of:

- Our VMS cluster, consisting of five VAXstations 3100s, five 3200s and a single Alpha 3000/400. The cluster shares 26 gigabytes of disk space.

- The Ultra-Relativistic Heavy Ion's group of Hewlett Packard Unix systems, consisting of a pair of HP 9000/710s, four 9000/712/60s and a trio of 180 MHz PA-8000 C-180 workstations. The C-180s are running HP-UX v10.20, the rest run versions ranging from 9.01 to 9.05. One of the 9000/710s is the lab's World Wide Web server (www.npl.washington.edu).

  The nine HP machines NFS-share 19 disks totaling 62 gigabytes plus two Jaz drives. They have 8mm and two DLT2000XT tape systems.

  For compatibility with RHIC's RCF facility, we've installed Red Hat Linux on a 233 MHz Pentium II system.

- The SNO and emiT group has a collection of networked Macintoshes, including a number of Power Computing 200 MHz PowerPC Mac ‘clones’. They also have a Sun SparcStation 20 running Solaris 2.5.1 to provide CADENCE circuit layout facilities to our electronics shop, two Sun Ultras and two SparcStation 2s. Many of their systems have migrated to Sudbury, Ontario as SNO nears completion.

- We still share two VMS VAXstation 3200s providing Email and CPU cycles for the Institute for Nuclear Theory and the Physics Nuclear Theory group. We also have a Sun Sparc 5 for developing the Slow Controls software for STAR, a VAXstation 3200 serving as the Linac's control and display system, three PDP-11/23s and PDP-11/21s built into the Linac for cryogenics, vacuum and resonator control, and four PCs serving as controllers for the rest of the accelerator systems' interlocks, safety and vacuum system.

6.4 Custom data acquisition electronics for the SNO NCD and emiT experiments

M.C. Browne, A.W. Myers, R.G.H. Robertson, T.D. Van Wechel and J.F. Wilkerson

The data acquisition system for the NCD project of the SNO experiment has been largely designed, and is currently in the prototype and testing stage. This system utilizes GPIB and custom interfaces, but is principally controlled through VME (see Fig.6.4-1.). The system is designed to be capable of digitizing individual events, and recording event energies via peak-detect ADCs.[1] Digitization is accomplished by multiplexing the 96 NCD channels into the eight channels of two Tektronix's 754 digitizing oscilloscopes.[2] A two-channel multiplexer has been prototyped and tested. Much work has been done to refine the discriminator, signal delay, and noise characteristics of the system. Final testing is currently underway.

ADC data is taken with a custom VME-based shaper/ADC board. This board was initially developed and used for the proton segment of the emiT experiment. The design, development and testing of revision A of this board has been previously described.[3,4] A second revision of the board is now being designed with modifications to the ground planes, discriminator, and peak-detect networks. When prototyped, these changes demonstrated substantial improvements in individual channel resolution, and threshold response. Additional changes in the boards timing and operational logic are planned, and a FPGA with a larger capacity may be implemented. In addition to its use in the NCD electronics, emiT will employ the newer revision in future runs.

The majority of the remaining components in the NCD DAQ system have been identified and built or obtained. Further work is ongoing on the triggering system and digital interface. Preliminary DAQ software has been written and tested for the digitzers, and software exists to run revision A of the shaper/ADC boards. A minimal system has been sent to Sudbury, and is operational underground. This system will be used to verify that NCDs arrived underground safely, and to monitor NCDs prior to their deployment in SNO.

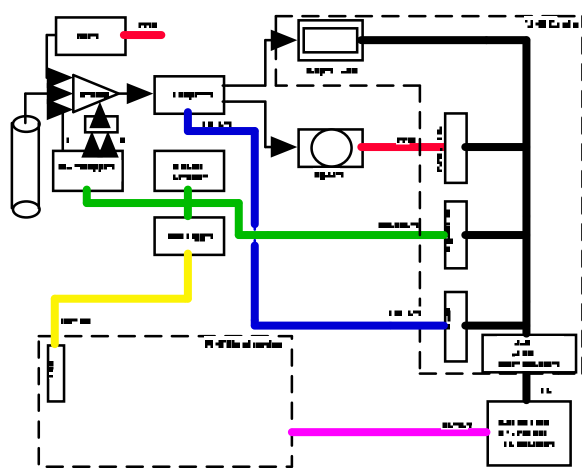

Fig. 6.4-1. NCD DAQ electronics flowchart.

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[1] Nuclear Physics Laboratory Annual Report, University of Washington (1996) p. 16.
[2] Nuclear Physics Laboratory Annual Report, University of Washington (1997) p. 55.
[3] Nuclear Physics Laboratory Annual Report, University of Washington (1996) p. 10.
[4] Nuclear Physics Laboratory Annual Report, University of Washington (1997) p. 56.