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Document

Report from ANU Sept–Oct '97

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This document details the work carried out in ANU during September and October 1997. It got long, possibly because a LOT of work was completed! Persons present: SPGC/NMC/DLW/WDMR/BRF/SMS/SSJ/Leigh Crosby/Simon Hart. The present status of MEGHA and associated Data Acquisition is summarized. The work left to be completed is also listed. Work deemed essential to running in January 1998 with the strip array is marked with an asterisk (*).

1 Progress on preamplifiers

1.1 Preamps for strip detectors

1. Eight 40-channel preamp units have been fixed into a mobile rack so that they can be moved if necessary. Each unit has only 32 channels populated with MEGHA preamps chips to suit strip detectors. The rack also has the new 10-channel pulser system from Oxford, a fan tray and two +/-12V linear power supplies which will run up to 12 preamp units.

2. The cables to MEGHA have been moved in the overhead gantry/cable tray to bring them into a more useful position for the strip preamps, and allow easier access for rolling back the MEGHA chamber when separated. It is intended to fit hooks on the concrete block wall to hold the cables clear when required.

3. Six adaptors have been made to convert a 41-way Amphenol socket to two ribbon sockets;these are bolted to the rear of the preamps so that connection of a strip detector is via a quick bayonet 41-way plug.

4. Noise problems were encountered in the ANU linac hall which were not observed during tests in Birmingham; the noise was reduced through better earthing of the front and back panels of the preamp units and by strapping the whole mobile rack to the MEGHA chamber via a short thick earth braid. WARNING: Reckless addition of more earth braid CAN increase noise again!

All 11 preamp units (8 installed + 3 spares on shelf without chips) were modified as follows:-

a. two thick earth wires soldered to the front panel BNC earth bus and taken to the back panel where they are bolted to the rear panel

b. paint removed from under one front BNC to improve earthing

c. earth braid connecting all preamp units (on back panel) and the rack

5. Earth braid installed between all patch panels and connected to MEGHA and main earth wire; output noise on most preamps is ~2mV (with detectors) yielding ~100mV with a x50 amplifier and resolutions for pulser from ~100 to ~170keV. There remains some 50Hz noise at ~12mV p-p.

1.2 MEGHA preamps

1. Each MEGHA preamp unit contains a removable main PCB which has 18 chips; the front panel and the back plane PCBs are both connected to the main PCB by multi-pin ribbon-type connectors; all housed inside a metal can.

2. During our 1996 experiments we had problems with noise and oscillations on the MEGHA preamps which defied attempts to cure them; often we resorted to isolating the cans to reduce oscillations.

3. Tests with a small detector confirmed that the MEGHA preamp units were more noisy (~130keV) than others using the same chips (~ 22keV) but showed no sign of the oscillations observed in ANU.

A new PCB was designed at York with the following features:-

a. 18 chips are split into 3 groups of 6, each with separate power filters

b. New earth busses for all ground pins instead of just two end pins

c. Pads for inductor/resistor(L/R) filter network on input of each chip

4. Tests on the existing MEGHA preamp in the RIGHT module showed oscillations at ~ 70MHz on ALL preamp outputs; noise varied from 0.1-0.5V p-p (P signals) to 0.5-2V p-p (Gas,E)!

5. Tests with the new PCB (with L/R filters) showed reduced noise, but oscillations were present which diminished when cans were isolated. Oscillations disappeared when the preamp was tested on the bench OR plugged into the empty DOWN module, so must be connected with the MEGHA detectors. Oscillations could be seen for preamps plugged into MEGHA with no power on the unit! Are the flexible gas pipes an aerial/conduit for RF noise which is then picked up by gas grids?

6. The Following modifications have been made to all frontpanel/back plane PCBs -

a. Earth braid on 3 SHV cables to rear PCB are earthed to the earth bus on the back plane

b. New earth wire run from rear L/H PCB to front panel solder tag near power skt.

c. New earth wire soldered to solder tag, front panel PCB and SHV solder tags.

7. Modifications produced good improvements with single preamp unit plugged into MEGHA module and allowed operation with the cans bolted/earthed as intended; noise was reduced to 3-6mV on E signals with bias on detector; 5-8mV on gas signals and 5-7mV on position signals.

8. Tests with the new earth wires, but old-style main PCB showed P,E signals with little sign of oscillations(6-7mV), but larger oscillations (up to 150mV) on gas signals. Conclude that input line L/R filters are valuable.

9. Tests showed that switched mode power supply produced only slightly worse noise (~5mV) than linear power supplies (~4mV), so it is not worth changing these.

10. Oscillations still occur at power up, and last from 30-60secs until chips warm up.

11. A single conhex connector leading to a patch panel (and not onwardly connected) is sufficient to set all channels in oscillation at ~70Mhz; when about half the conhex connectors are fitted to the front panel, the oscillations suddenly cease.

12. Noise figures increase slightly when MEGHA is pumping; for most E signals the noise is about 5-6mV out of preamp which produces about 25-30mV noise output from an Ortec 571 amplifier (2us bipolar and x12 gain). Thus preamp noise is not simply amplified by the gain factor, there is some attenuation of the preamp noise via the bandwidth of the main amplifier.

1.3 Preamp Work Completed

1.3.1 Strip detector preamps

1. 11 Preamp units modified for lower noise; output noise ~2mV when earthed

to MEGHA; pulser resolution ~100-170keV.

2. 5 out of 10 Adaptors for 41-way Amphenol connectors have been completed

3. 8 out of 10 preamp units installed in mobile rack

4. Oxford Pulser unit tested and installed in mobile rack. Pulser resolution measured in spectrum is in the range 100 (assuming 10mV/MeV for preamp) to 170 keV (assuming pulse height comparable to 6 MeV alphas).

5. Cables moved for easier access for strip expts, and allows MEGHA to roll back. Bias supply patch panel provided on rack.

1.3.2 MEGHA preamps

1. Earthing improved on chamber/patch panels

2. Earth wires on front panel/back plane PCBs in preamp produces major reduction in noise/oscillations; 19 units modified

3. New PCB with L/R filters reduces tendency of preamp to oscillate

4. Earthing still critical- unconnected cables act like aerials; impedance to earth on front panel is also critical

5. Preamp output noise about 5-6mV (biased) producing about 25-30mV in x12 amplifier.

6. Switched mode power supplies are OK at present level of noise

7. New style preamps installed on the modules in positions R, U,L. Preliminary test for Noise and with pulsers seem satisfactory.

1.4 Preamp Work Outstanding

1.* Order 500 preamps chips! We need 96 +spares to complete the ANU strip preamps; 80 + spares to complete GANIL preamps - this swallows >200 ! [DLW]

2.* Five more to complete 10 Amphenol to ribbon adaptor boxes for strip expts (Six to return to ANU) [SPGC]

3. Change remaining main MEGHA PCBs to new style at York [DLW]

4. Re-install all fully modified MEGHA preamps onto all modules, re-cable and test [DLW]

5.* Populate with chips and Install last two Nobby Preamp boxes [SPGC].

2 Strip detector Array

2.1 Strip Array Work Completed

1. New flange installed with 10 connectors wired and tested ready to go. Chamber evacuated with flange up to 2x10-6.

2. 10 41-way outside chamber flange to preamp cables completed.

3. Four Inside chamber detector to flange cables completed.

4. Array mounting ring and plate installed and aligned. RING IS NOT TO BE MOVED!

5. Tested that SPGC 4 detector mount still fits inside chamber.

6. Problem with some positions of PSSD's clashing on new mount. PSSD drawing in design 3mm shorter and 2mm narrower than actual.

2.2 Strip Array Work Outstanding

1. 6 more to complete 10 inside chamber cabling (7 to return to ANU) [SPGC].

2. Calculate/Measure PSSD positions on new mount. Complete information required! the disc and all detector mounts are being returned to the UK so that the problem of the detectors clashing can be resolved.

3. Order another batch of detectors (8 minimum).

3 Data Acquisition

3.1 D.A. Work completed

1. All amplifiers modified.

2. Recabled with twisted pair. Replaced broken control cables. Repaired poor contact on Fiacre front socket. Data corruption reported between Data Stacks did not show itself again.

3. Installed and tested MIXER unit to provide simple trigger.

4. CATCH, the latest incarnation of the FETCH module installed.

5. WAG accept out failures traced to failures of 74F240 chips in position U11.

6. Run through of channels with new pulser system:
Problem with CAT–TDC ringing revealed when firing many amp channels at once.

7. Alpha+pulser tests with 4 PSSDs:
Data taken to tape.

8. Software updated plus additional memory installed in Suns.

3.2 D.A. Work Outstanding

1.* Investigate WAG chip U11 failures. Replace slow with fast chips in 5 Units marked 'slow -chip @Ull' [RH].

2.* 2 (+1) Mixers for hardware trigger [RH].

3.* Investigate and rectify CAT–TDC "ringing" producing Fiacre errors for multi-hits (as seen with 32 channel pulser) [SPGC/RH].

4.* Repair faulty Amplifiers [SSJ].

5.* Repair Scaler [SMS].

6.* Repair tester unit [RH].

7.* Repair faulty TAIL [RH].

8.* Examine alpha/pulser data on tape [SPGC/SMS].

9.* Repair faulty CAT [RH].

10.* All Exabyte drives to be refurbished [SMS].

11.* Put DA recovery documentation on server (in MANUALS/MEGHA-DA) [SPGC/SMS].

12.* Mods to amp and bias control programs [SMS].

13.* Check with VP re: spare disk [SMS].

14.* Order 50 Ohm lemo terminators [SPGC].

4 Chamber & Other Work

4.1 Chamber & Other Work Completed

1. New Gas manifolds installed.

2. Second target ladder installed and aligned.

3. Target motor drive installed. **The control cable must not be removed from either drive motor unless the mains power to the drive has been switched off for at least 20 seconds. If this precaution is not taken then the motor can be damaged.**

4. Target positions calibrated.

5. Chamber now splits with relative ease. This is now the method of access for inside chamber work. To prevent damage avoid removing the amphenol feedthru flange.

6. Valve operation checked. PLC program modified to allow for slower valves.

7. Tidied yet again! Inventories taken and put on server (see later).

8. Chamber and mounts cleaned. USE GLOVES WHEN WORKING INSIDE CHAMBER.

9. Have cabled up for strip detector experiments planned for January so please do not undo our hard work!

10. Alignment of MEGHA chamber and Strip mounting ring etc has been checked. A summary document can be found on the server "INVENTORY/ANU/megha_alignment".

11. Examination of the collimation system highlighted a few problems some are discussed in the alignment document. The most important point is that we MUST not run without collimators when there are detectors in the chamber.There are 'burn marks' in the collimator access box (the small box just in front of the main target chamber that show we can drive the beam into the base of the box (a distance of approximately 5 cm from the beam axis). We even managed to melt a small part of the stainless steel tube that holds the colimators. There is a small pit in it about 1mm in diameter and approximately 1mm deep.

4.2 Chamber & Other Work Outstanding

1. Complete and install automatic target motor drive [DLW].

2. New trigger system:

Purchase 2 racks and install where poster board is. Relocate bias supplies and target drive to these racks. Install new trigger where bias supplies were to RHS of D.A.

3. Cooling required to the rear of D.A.!

4. Service pumps on gas rig etc. Maintenance by Andy Rawlingson has been arranged.

5. New Large O-rings for chamber and the strip array plus 2 spares [DLW].

6. Right angle Swagelok fittings to be obtained for the gas manifolds.These are to prevent the pipes being damaged by passing 'traffic' [DLW].

5 Remarks

A lot of effort has now been spent gearing up for running at ANU. We have encountered severe problems with noise in ALL parts of the system from preamp to DA. The electronics, cabling and earthing arrangements reflect the culmination of weeks of effort to optimize things. Bear in mind that we do not want to reproduce this work should you decide to change things. Similarly, the chamber, mount and target alignments should not be compromised.

Loss and misplacement of special cabling, tools and equipment has severely hampered our efforts at ANU. Please operate in a more orderly fashion and respect the time and effort gone into the manufacture and organization? of the kit. In particular, there are several boxes containing parts for the modules, strip detector array and data acquisition. The contents of these boxes should NOT be used as general spares. They are required for the modules of the array and other parts of the system and include a number of"specials". There are plenty of misc nuts/bolts, vacuum blanks, cables etc. in the cupboards.

6 New Documents on the Server

A comprehensive set of inventory, shipping and other documents can now be found on the server "http://nnsa.dl.ac.uk/Charissa/documents/HTML/". Those under INVENTORY/ANU are listed below. Manuals for running MEGHA and the Data Acquisition are also available.

a) Detector Inventory "detectors_oct97".

b) Status of MEGHA modules and spares "megha_spares".

c) Comments on the chamber alignment "megha_alignment".

d) Updated electronics list "electronics".

e) Target Inventory "targets"

f) Inventory of the equipment returned to the UK "shipping_oct97".

7 Status of Equipment at ANU

a) Chamber and beam line under vacuum but with turbo pump valves closed.

b) Turbo pumps left running on Standby.

c) Computer all running but peripherals and monitors turned off.

d) Electronics cabled for a strip detector run.