Minutes of the RISING EDAQ working group meeting on
"New Electronics for the Cluster Detectors at RISING"
held at GSI, Darmstadt 11.02.2004, 11:00-16:00

Present:

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1. **JN welcomed the participants and opened the meeting.**

2. **PB reviewed the RISING experiments time table and the current status of the VXI electronics used up to date for the Cluster Ge detectors.**
   - VXI electronics for the Cluster detectors was installed at GSI in August 2003. Since this time commissioning runs and 3 experiments with fast radioactive beams have been performed. Overall use of beam time during this year was 5 weeks. In the year 2004 four weeks of RISING measurements are sheduled. Similar amount of a beam-time per year will be probably allocated to RISING in the successive years 2005 and 2006. Starting from autumn 2004 the MINIBALL Ge detector array will be also used in the RISING fast beam measurements.
   - The VXI system at RISING consists of 2 VXI crates equipped with the former EUROBALL electronics: RMs, VREs , 15 Cluster Ge cards, and the MK2 trigger card. In addition to that a VME time stamp block - TITRIS is plugged into one VXI crate. The time stamp is used for merging the Cluster events with data originated from other RISING detector branches. The data read-out is performed throughout a VXI-VME interface - D2VB.
   - The first RISING measurements showed malfunctioning of few Cluster cards and insufficient number of spare components. Only 14 Ge cards out of the total number of 17 existing worked in a stable way and were useful for experiments.
     Problems in setting-up and reading-out some Ge cards sharing the same VXI crate with the VME timing module were encountered. The working VXI configuration was strongly asymmetric with 5 Ge cards in the first crate and 10 in the other one.
   - The in-beam measurements showed that the external triggering of the Ge system by a beam detector is necessary in order to select interesting gamma-beam coincident events. The overall trigger rates turned to be of several kHz for in-beam gamma singles and of the order of 100 Hz for gamma-beam coincidences.
   - Preamplified Ge detector signals watched in beam suffered from a contamination of oscillating components with huge amplitudes. They were attributed to the interaction of energetic charged particles in a Ge crystal. It was pointed out that in the future measurements a signal processing allowing for filtering-out of such signals may be useful.

3. **NK showed basic requirements concerning the connectivity of any further electronics with the MBS DAQ system used at RISING.**
   - The data readout has to be performed throug VME.
   - A time stamp synchronized with other acquisition branches has to be added to every event.
   - Interfaces allowing a read-out of data from the standard GSI bus throughout MBS were shown.

4. **NW described the MINIBALL array and discussed the way of connecting it to the RISING MBS DAQ system.**
   - Currently MINIBALL consists of 24 six-fold segmented Ge crystals. In the future it will be extended up to 28 six-fold segmented Ge crystals and 3 twelve-fold segmented Ge crystals. Each crystal provides one energy signal per segment plus a core signal.
   - The signals are processed using commercial DGF-4C CAMAC based cards produced by XIA.
     Each 6-fold segmented crystal is connected to 2 DGF-4C modules. A core signal is used to define a local trigger for all channels in a capsule.
   - A DGF-4C card has 4 input channels, with 40Mhz sampling ADCs. A signal processing is done in two steps:
     1. real time filtering by FPGA independent for each channel
     2. analysis of a validated event performed by a common DSP
   - The cards are read-out via CAMAC through the CC32/VC32 controller from VME. The system is already interfaced with the MBS.
   - Time stamp for the MINIBALL events is generated by external 40MHz Clock. This clock has to be synchronized with the RISING TITRIS clock working at frequency of 50 MHz. Both clocks could be zeroed at each spill. The final solution still needs to be worked out.
   - MINIBALL detectors can provide a multiplicity signal useful for the RISING trigger logics. However, the signal is 500ns delayed and has a lot of jitter.
     External gate signal can be used to trigger the read-out of DGF cards. At RISING the beam gate will be used.

5. **ML introduced the DDC-8 digital card designed by W. Skulski. He discussed the DSP algorithms implemented for the DGF cards.**
   - DDC/XLM module is a 8 channel VME board with 10 bit, 40 MHz ADCs featuring a variable gain amplifier and input offset adjustment. Signal processing is implemented in the FPGA but a fast DSP processor is available as an option (for pulse shape analysis). The energy resolution is sufficient for fast scintillation detectors (NaI, CsI), i.e. less than intrinsic resolution. Energy Resolution with Si and HPGe detectors will be determined in Heidelberg. A 8 channel VME board with 12 bit, 65 MHz ADC could be available in 2005. The XLM board is already available from:
     www.jtec-instruments.com
   - Programming of a DSP in the XIAs DGF cards has to be done in the assembler programming language. The company provides several tools as precompiled codes, template files, a makefile, a manual as well as a convenient GUI.

6. **PM showed a performance of the TNT card developed and tested in IRES.**
   - TNT is a digital card enabling a fast read out of preamplified signals from a Ge detector. Each signal is sampled with 12.5 ns (80 MHz ADC) time step. The signal treatment (a peak detection, filtering algorithms) is done by a common FPGA

(VITREXII). The algorithms are similar to those elaborated for AGATA. A prototype card with 2 input channels was presented. A 4 channel version (TNT 2) will be available in 2004.

- TNT 2 cards are power supplied by a NIM crate, the slow control is done via USB2, and readout either via USB2 or 2.5Gbits/s LVDS.
- There is a possibility to connect several TNT 2 modules (up to 40 channels) in a daisy. An additional clock/trigger card has to be used in this case in order to distribute a common time stamp and to synchronize triggers.
- Recent ^{60}Co source tests with a planar detector at count rates of 2kHz and 11kHz for 1.33 keV gamma-rays showed an energy resolution of 2 keV and 2,1 keV respectively.

7. IL presented the GRT4 digital card designed in NPG Daresbury.

- GRT4 was designed as a digital card to test tracking algorithms for segmented Ge detectors. It uses 14 bits 80MHz ADCs and 2 step FPGAs for validating and shape processing of the incoming impulses. The card has 4 independent inputs and a VME bus interface. Each channel timestamps its data with a 48 bit timestamp stored by a trigger. The clock for these timestamps is not common- each channel has its own 80MHz crystal.
- In the performed tests a GRT4 card used an external NIM trigger signal, nevertheless internal digital trigger mechanisms are also implemented. Neither a synchronization by a common clock nor communication between different cards is possible. Therefore GRT4 is not intended for high rate multi-channel systems. However, a successful test with 2 VME crates was performed in Cologne.
- A new card, currently called SMARTPET, will be developed for a Ge strip detector. It will use 14 bit, 100 MHz ADCs, and a common time stamp. Communication between cards will be enabled. Bus interface will be VME or CPCI for control and Gbit Ethernet for data read out.

8. JN initiated a discussion on the issues addressed in the presentations.

- The participants agreed that the VXI configuration used so far could cause unstable work of the electronics. As a short term solution it was recommended to use a VXI system with 3 VXI crates , if possible using as many new VXI crates as possible (a new VXI crate has been ordered by IReS and can on request be made available for RISING. A revision of not working Cluster cards by engineers from Strasbourg and Orsay was advised.
  A proposal of connecting the signals from at least one Cluster detector for read out through DGF cards during the experiment in May 2004 was highly appreciated.
- Features of the presented digital cards important for their usefulness at RISING were summarized:
  a) DGF: already works with Clusters and MBS, available now, has a large SB delay of 0.5 μs, 1 DSP per card causes a common dead-time.
  b) PIXIE (XIAs compact PCI card , not discussed) no interface to VME available.
  c) DDC8: Not available yet, not suitable for a Ge detector (not sufficient resolution due to 10 bit ADC), has VME interface
  d) TNT 2: No interface to VME available, will operate with up to 40 chs with one clock/trigger card, availbale fall 2004
  e) GRT4: VME interface exists, has no common time stamp, available now.
  f) SMARTPET : VME or CPCI, ready in summer 2005.
- The following conclusions were made:

1. **Action:** The test of using three VXI crates, with as many new crates as possible, should be at the RISING experiment scheduled for May 2004.
2. Currently there is no completely ready and tested solution for replacement of parts of the VXI Cluster electronics, but several options, that need further testing, exist.
3. **Action:** Test reading out at least one Cluster detector using DGF cards during the RISING experiment in May 2004. The result of this test should be evaluated and reported to the RISING EDAQ working group as soon as possible after the experiment.
4. The development of the SMARTPET card is very interesting and the progress of it should be followed closely by the RISING EDAQ group.
5. There are serious discussions (Orsay, JYFL) of replacing also the VXI electronics of the 45 EUROBALL Phase I detectors. The selected solution might be TNT 2 or SMARTPET. It would be a large advantage to coordinate the efforts of renewal of the VXI electronics of the EUROBALL system. Therefore, the developments regarding electronics for the Phase I detectors should be followed closely by the RISING EDAQ group.