Contribution ID: **116** Type: **invited**

Trends of FEE instrumentations for Spiral2 detectors

Tuesday, 8 June 2010 18:10 (20 minutes)

Along with the implementation of SPIRAL2 , the second generation of RIB accelerator of the GANIL laboratory , have emerged projects of new detectors and instrumentations which comply with new constraints brought by high intensities RIB, such as higher counting rates, higher number of channels, higher data readout rate, fast link connections between DAQ instrumentations, experimental cave accessibility. European and French laboratories have collaboration in nine projects of new instrumentations for the future SPIRAL2 detectors: Exogam2, DESIR, ACTAR, PARIS, AGATA, FAZIA, GASPARD, S3, and NEDA.
Representatives of these detectors instrumentations have met within the Electronic Group of the Instrumentation Coordination Committee (ICCEG) for the SPIRAL2 detectors. The ICCEG aims to find synergies in hardware, firmware and embedded software fields in order to share and to retrieve developments undertaken for these instruments, as well as to exchange knowledge on systems and technologies. Templates of specifications of these detectors and their respective instrumentations show a wide range of specifications: kinds of detectors (HPGe, Si, scintillators, and gas), number of channels (from 100 to 20000), counting rate (from 1 kHz to 300 kHz), total data rate (from 1Mb/s to 1 Gb/s), number of trigger levels (from triggerless to 2). Among the nine SPIRAL2 detector instrumentation projects, four projects are either in the demonstration phase (AGATA), either in early development phase (Exogam2, ACTAR, FAZIA). It is worth to notice:
- Two instrumentation architectures are emerging: one based on the implementation of analog asics which integrate filters and sampling memories (ACTAR) and one based on the implementation of flash ADC associated to digital processing.
- Fast serial communication protocols such as Gigabits Ethernet, PCIe and Eurora using copper or optical media are widely deployed; these links are managed in embedded software FPGA.
- The choice of the electronic standard is widely opened: customized racks, NIM, ATCA, µTCA. Nevertheless, digital modules are mainly designed in the ATCA and µTCA standards due to their resources in high speed communication and in high frequencies bandwidth signals transmissions.
- A system which provides a reference clock (200MHz), time stamps parameters and returns trigger decisions is required.
GANIL is involved in two projects. In the ACTAR one, GANIL has taken in charge the development of the trigger and local clock distribution system, so called MUTANT and BEM; both modules are in µTCA standard. In the Exogam2 project, GANIL manages the collaboration of several labs for the design and the implementation of the instrumentation. Its architecture is based on the AGATA instrumentation one; it retrieves the GTS system but not the complex ATCA standard. The digitizer is the key development. Synergies with NEDA, PARIS, and S3 have been pointed out during ICCEG and last SPIRAL2 week meetings. Thanks to the FADC mezzanines concept and the firmware flexibility, the EXOGAM2 digitizer will be made versatile enough for dealing with the different frequency bandwidth analog inputs and for running specific digital processing.
When coupling several detectors, the critical issue is how compliant are their instrumentations. The ICCEG had a meeting about what systems for clock distribution, time stamping and trigger. Three systems were examined: the TDR running at Jyvaskyla, the GTS implemented in AGATA and the BUTIS and White Rabbit under development at GSI. The GTS has been found a comprehensive system, having a possible connection to BUTIS. GANIL suggests deploying the GTS system in NIM form for the GTS fanin fanout levels and in µTCA form for the trigger processor level. Thanks to the µTCA resources, high speed signals and high level messages could be exchanged between various instrumentations and DAQ of detectors involved in an experiment.

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Session Classification: Working Group - Synergies in Data Acquisition

Track Classification: working group on synergies in electronics and data acquisition