

## Digital Gammasphere

Gammasphere has been operating continuously at ATLAS since March 2003. During this time, over 200 experiments have been performed. The spectrometer continues to be maintained and upgraded as the need arises. The project to upgrade the current analog data acquisition and trigger system with free running digitizers and a flexible trigger that incorporates a triggerless option is well under way. At present, both the analog and digital electronics is operated in parallel. Tests have shown that the Ge count rate can be increased up to 50,000 counts/sec with digital pulse processing while maintaining the losses due to pileup below 10% per detector and preserving good energy resolution.

The digital data acquisition for Gammasphere (DGS) consists of 44 GRETINA digitizer boards, 1 ANL master trigger module and 3 ANL router boards. Currently, the Ge pre-amp signal and the BGO summed pre-amp signal from a Gammasphere module are processed by the digitizers. In the near future, the side-channel information will be available for readout as well. New digitizer firmware has been developed to optimize performance for Gammasphere. A new energy filter has been developed which provides better energy resolution in comparison with the trapezoid filter at shorter shaping times. Firmware builds for leading edge and CFD timing have also been developed. In addition, the firmware allows for a capture of the waveforms associated with pile-up events. Triggering algorithms have been implemented which allow the experimenter to trigger on a multiplicity of Ge-clean hits, Ge-total hits or modular hits (either Ge or BGO) within a user defined time window.

In-beam test experiments have shown that reactions producing large gamma-ray multiplicity events can record triggered events at a rate excess of 50,000/sec. This should be compared to analog Gammasphere where the throughput is limited to ~15,000 high-fold events/sec.

With regards to auxiliary detectors, DGS is able to operate in time synch with the analog Gammasphere DAQ via a module which sits in the master trigger crate of analog Gammasphere. This allows for DGS and auxiliary detectors using the ECL readout of analog Gammasphere to share triggers with correlated timestamps. In addition, a VME module has been built called Myriad which allows a generic VME DAQ to have access to the DGS time stamp which in turn allows events from the two DAQ's to be merged offline.

For the final phase of DGS, the current VXI-based analog electronics will be replaced with modules that provide for slow control of detector high-voltages and Ge temperature readouts. In addition, these boards will provide four signals per Gammasphere module as inputs to the digitizer: Ge central contact, Ge side channel, BGO sum energy and a hit-pattern representing the BGO segments that contributed to the BGO summed energy signal. The latter signal is necessary to perform nearest neighbor Compton suppression and is not available in the current DGS implementation.

Contact person: Michael Carpenter – [carpenter@anl.gov](mailto:carpenter@anl.gov)