Fast PC & CAMAC Based Multiparametric Acquisition System

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A dedicated list-mode acquisition system running in the KmaxNT environment has been developed for our experiments to study superallowed β-decay. It has evolved from the program module presented in the last annual report [1] and, in its present form, it has already been used for a measurement of β-decay branching-ratios in the decay of ^{22}Mg [2]. When activity is delivered periodically to a counting station via the fast tape-transport system, the system records the basic parameters defining each decay event and allows on-line monitoring of the data; it also allows us to correlate these data to the heavy-ion activity deposited on the tape in each cycle.

While the activity is being deposited on the tape, the acquisition system records signals, E_{HI}, from the heavy-ion scintillator located between the exit of MARS and the collection point on the tape. Then, during the counting portion of the cycle, it records multi-parametric decay events. Each event can be characterized by up to six parameters: the γ-ray energy, E_{γ}; the energy recorded in two β detectors, $E_{\beta 1}$ and $E_{\beta 2}$; the relative β-γ timing, $t_{\beta 1-\gamma}$ and $t_{\beta 2-\gamma}$; and the time elapsed since the last tape move, t_{cc}.

Our PC-based acquisition system is based on the KmaxNT software [3] and on CAMAC modules with FERAbus capability, which allows fast downloading of the data from the analog-to-digital converters. Some major improvements have been added to the system since our last report, allowing us a more precise event-definition and higher counting rates. The system now includes:

- Ortec ADC, model AD413A for E_g ;
- LeCroy QDC, model 4300B for $E_{\beta 1}$, $E_{\beta 2}$ and E_{HI};
- LeCroy TDC, model 3377, for t_{b-g} ;
- Stanford Research System 30-MHz Synthesized-Function-Generator, model DS345, used to label each event with a very accurate time stamp;
- LeCroy Universal-Logical-Module, model 2366 (programmed as a latching scaler and counting the pulse signals from the DS345); this module is used to measure the elapsed time since the last tape move;
- LeCroy FERA driver, model 4301;
- two dual-port FERA/CAMAC buffer-memories, LeCroy, model 4302, used to store the list-mode data; and
- an 800-MHz PC.

All converter modules, except the latching scaler work in their “zero suppressed” mode.

Events are list-mode buffered in the FERA memories, which operate in a flip-flop mode. The ping-pong selection scheme of the dual-port memories is now fully hardware controlled (see Fig. 1), which replaces the hybrid computer/hardware system described in [1]. In the new system the “normal” state for each memory is in FERA mode with a “veto” signal on. The start signal removes the “veto” on memory 1 (M1 in Fig.1); the memory then buffers events until it reaches a predefined value, when its “overflow” signal returns the memory to its “normal” state (i.e. vetoed).

The same “overflow” signal is used as a start signal for the other memory, M_2. The flip-flop process goes on until a stop signal sets both memories in their vetoed state.

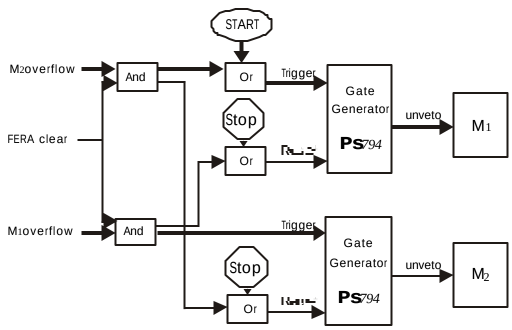

Figure 1: The flip-flop control of the two dual-port FERA/CAMAC memories M_1 and M_2.

The flip-flop process allows data to be downloaded from one memory while the other is being loaded. Each “overflow” signal prompts the computer for service: the filled memory is then temporarily set in CAMAC mode, a buffered-mode data transfer downloads the memory information and then the memory is set back to FERA mode. List-mode data are stored on the hard disk and can be scanned later with a companion program running in the same KmaxNT environment. The hardware control of the memory flip-flop and the computer upgrade now allows counting rates as high as 4,000 events/s, with each event comprising 10 words, six for the converted signals $E_g, E_{b_1}, E_{b_2}, t_{b_1-g}, t_{b_2-g}, t_{cc}$ and 4 header-words.

The new system allows for on-line monitoring of 5 one-dimensional spectra, E_γ, $E_{\beta1}$, $E_{\beta2}$, E_{HI} and $t$cc (see Fig.2), and 2 two-dimensional ones, $E_\gamma - t_{b-g}$ and E_γ–$t$cc. Horizontal and/or vertical gates can be set on the two-dimensional spectra, projecting out in either the horizontal or vertical direction. Among other things, this gives us an on-line monitor of the sample purity, since the decay of any selected (-ray peak can be determined by projection from the E_γ–$t$cc spectrum. The acquisition system was used in a branching-ratio measurement in 22Mg [4].

References

[1] V.E. Iacob and J.C. Hardy, *Progress in Research 1998-1999*, Cyclotron Institute, TAMU, p V.-25.

[2] J.C. Hardy *et al*, *Progress in Research 1999-2000*, Cyclotron Institute, TAMU.

[3] See http://sparrowcorp.com.

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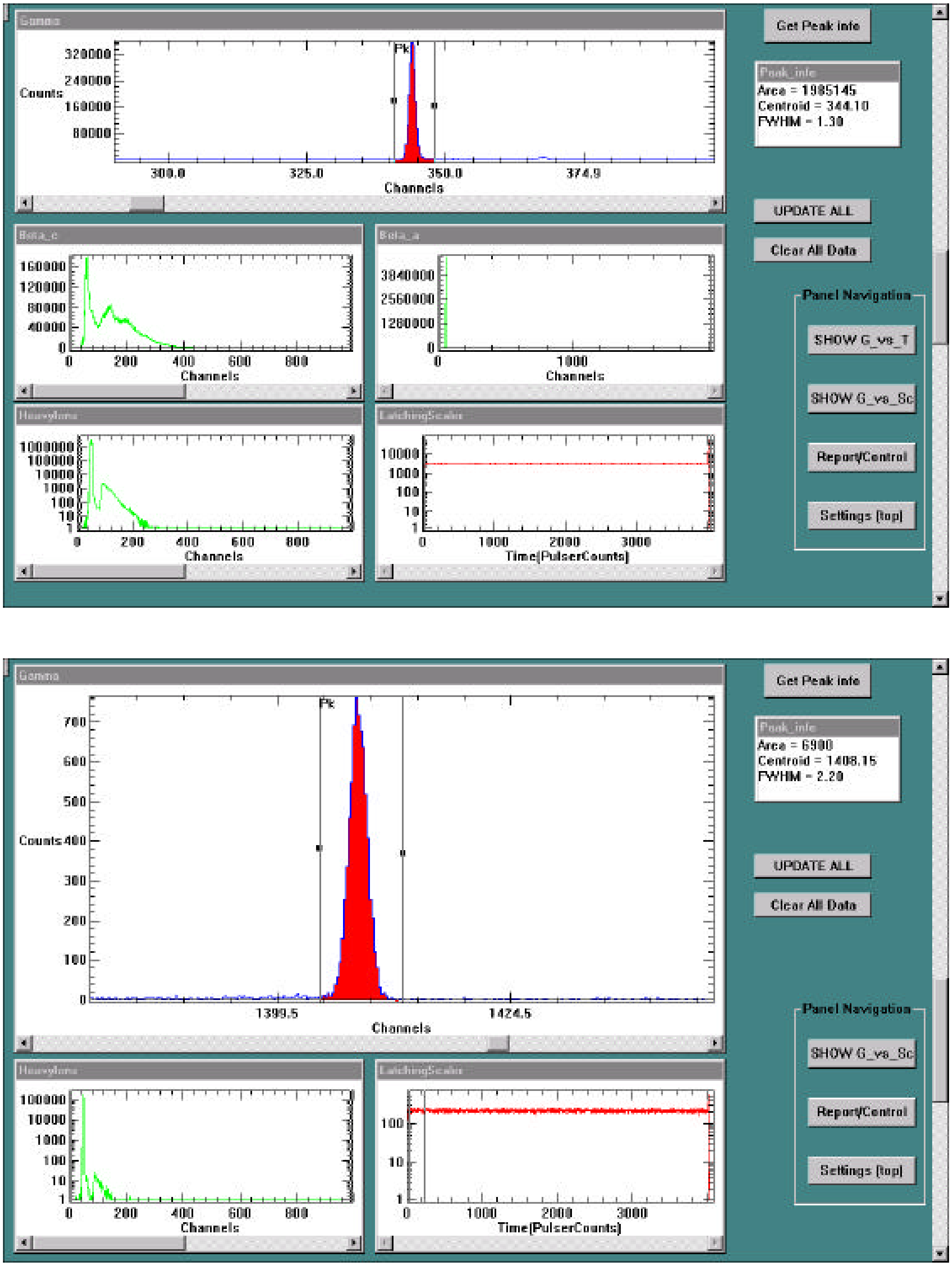

Figure 2: Panels with on-line one-dimensional control spectra as obtained in a ^{152}Eu source measurement: (a) for β-γ coincidence measurements; (b) for γ-ray singles measurements.