Timing-board modification in GAMMASPHERE

M. R. Maier, M.Cromaz, G.J.Lane, A. O. Macchiavelli and M.J.Press

The GAMMASPHERE efficiency for the detection of low energy gamma rays (<250keV) decreases with energy, a consequence of the way the processing of a pulse is triggered (See Fig. 1). In the GAMMASPHERE VXI boards, a constant fraction discriminator (CFD) starts the processing electronics, producing a signal only if the timing is determined by the constant fraction part of the circuit, ensuring good timing performance [1,2]. If the timing comes from the enabling leading edge discriminator no signal is produced, thus rejecting pulses with slow rise times. Events in the closed end of the GAMMASPHERE detectors with low energy deposition generate this condition. These are single interactions, i.e. mostly full energy (photo peak) events, in the front part of a GAMMASPHERE detector. This leads to a significant decrease of the detecting efficiency in the low energy region of the spectra.

In order to improve the low energy efficiency we modified the CFD daughter boards. In this modification the processing is started even if the leading edge comparator determines the timing of the pulse. This, however, leads to tailing in the time spectra for low energies. Tails can go up to several hundreds of nanoseconds depending on the carrier drift time in the detector. In this case the timing signal comes late. For energies above ~300keV these tails disappear. The improvement in the relative efficiency is demonstrated in Fig. 1.

The experimenter has a choice between the old mode ("good" timing and low efficiency) or the new mode ("bad" timing and high efficiency) via software control. In the later case, however, the radial signal, recorded simultaneously, can be used to correct the timing of the low energy events off-line, with the same efficiency as the slow rise time rejection circuit.

One of us (M. R. M.) is developing a new CFD, based on a paper by Cho & Chase [3-5], that should overcome these limitations.

Footnotes and References

[1] Yu. K. Akimov, et. al., Nuclear Instruments and Methods 104, 1972, p.581

[2] M. R. Maier & D. A. Landis, Nuclear Instruments and Methods 117, 1974, p.245

[3] R. L. Chase, Reviews of Scientific Instruments 39, 1968, p.1318

[4] Z. H. Cho & R.L.Chase, IEEE Transactions on Nuclear Science, vol. NS-19, (no.1), Feb. 1972, p.451

[5] M. R. Maier & J. A. Becker, contribution to the IEEE Symposium on Nuclear Science, Seattle, WA, Oct. 1999, and to be published

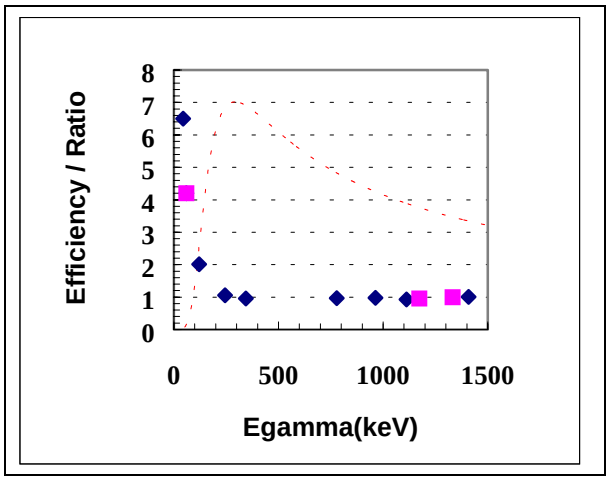

Fig. 1. Relative efficiency for GAMMASPHERE as a function of gamma-ray energy (red curve) and the ratio between the new CFD modification and the standard slow-time rejection circuit (points).