Application Note

Dependence of HPGe Detector resolution on shaping time

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Problem:
A number of HPGe detectors are specified for shaping times >2µs wheras the standard version of the MCA166 allows only shaping times of 1 and 2µs. Additionally, some larger detectors (>30% efficiency) demand voltages >3000V which the MCA166 cannot deliver. The effects of operating HPGe detector below their specifications are investigated.

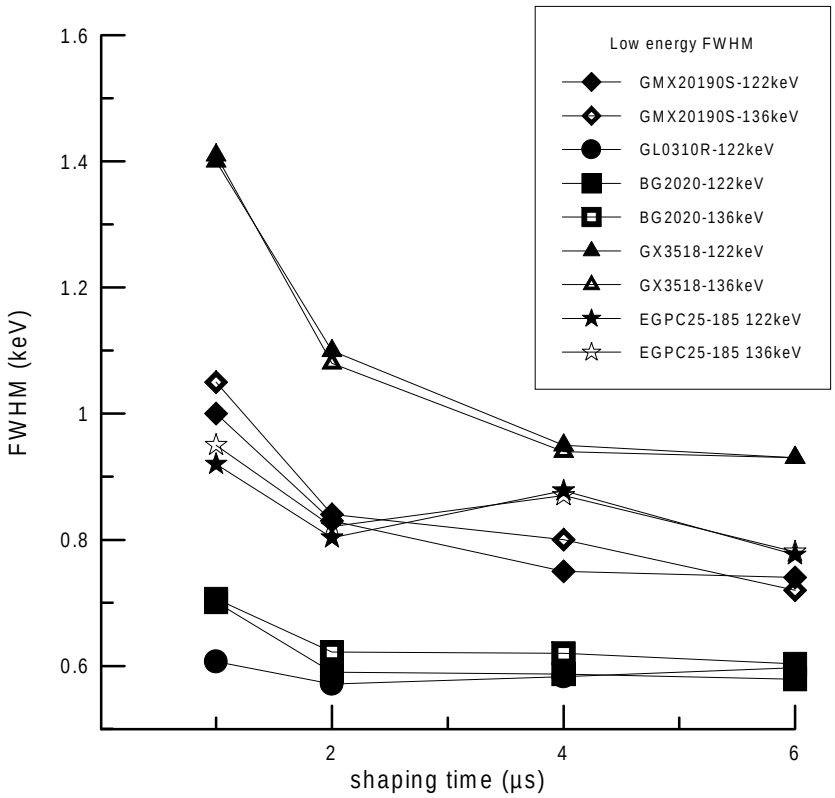
Experiment:
For this report, a MCA 166 was manufactured with a shaping time of 4 and 6 µs (optionally available). This unit was compared in terms of resolution with a conventional unit with 1 and 2 µs.
The following detectors were used for report:

- GL0310R - This is a Canberra planar detector (crystal 300mm², 10mm thick) specified for -2000V and a shaping time of 2µs
- GMX20190S - This is a Ortec coaxial detector (20% relative efficiency) specified for -3000V and a shaping time of 6 µs.
- BG2020 - This is a larger Canberra planar detector (rel. efficiency 9%, crystal 2000mm², 20mm thick) specified for 4µs shaping time and +3000V.
- GX3518 - Canberra coaxial detector, 35% rel. efficiency, specified for 4µs shaping time and +4000V (+3000V applied)
- EGPC25-185R - Silena coaxial detector, 25% rel. efficiency, specified for 6µs shaping time and +2000V

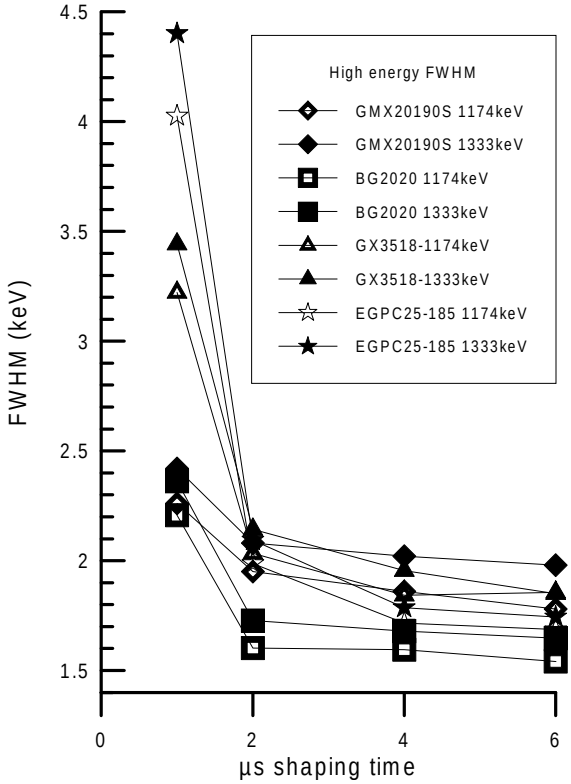
The peaks were adjusted always to the same channels, for each measurement P/Z was adjusted by the automatic option of WinMCA.

Table: Measured resolution for different shaping times.

	shaping time	122 keV	136 keV	1173 keV	1333 keV
GMX20190S	1	1	1.05	2.26	2.42
	2	0.83	0.84	1.95	2.08
	4	0.75	0.8	1.86	2.02
	6	0.74	0.72	1.78	1.98
GL0310R	1GL0310	0.607			
	2	0.571			
	4	0.583			
	6	0.597			
BG2020	1	0.701	0.706	2.207	2.361
	2	0.59	0.622	1.602	1.727
	4	0.587	0.62	1.595	1.679
	6	0.579	0.603	1.541	1.647
GX3518	1	1.4	1.41	3.222	3.442
	2	1.1	1.08	2.033	2.142
	4	0.95	0.94	1.843	1.955
	6	0.93	0.93	1.856	1.85
EGPC25-185	1	0.92	0.95	4.026	4.402
	2	0.803	0.821	1.987	2.093
	4	0.878	0.87	1.716	1.786
	6	0.776	0.781	1.686	1.743



Dependence of FWHM on shaping time at lower photon energies



Dependence of FWHM from shaping time at higher photon energies

As result can be noticed that the deterioration of FWHM with shorter shaping times is most significant with large volume detectors. A difference between 1µs and 2µs can be seen at all detectors. Nevertheless, a shaping time of 1µs may still be useful for high count rate (>30kcps) applications.

The improvement when using 4 or 6 us instead of 2µs is small; for planar detectors the difference is neglible.

So, the special 4/6 µs edition of the MCA166 makes sense in combination with a large volume HPGe and applications, where the demand for best resolution is high and expected count rates are always low. In all other cases the standard version 1/2µs is sufficient.