



Introduction

In recent years there has been increased interest in the usage of a medium resolution semiconductor CdZnTe detector for safeguards applications. However, due to the different mobility and lifetime of electrons and holes in the crystal's sensitive volume, a CdZnTe detector shows an asymmetrical peak. Asymmetry of the peak is characterized by the slope of low-energy tails. One of the parameters that influences the slope of low-energy tails and affects the resolution is the peak's shaping time.

Objectives

This study compares the effect of different shaping time settings on the slope of low-energy tails and resolution obtained on analogue and digital instrumentation coupled with the 500 mm³ CdZnTe detector.

Materials and methods

Analogue electronics

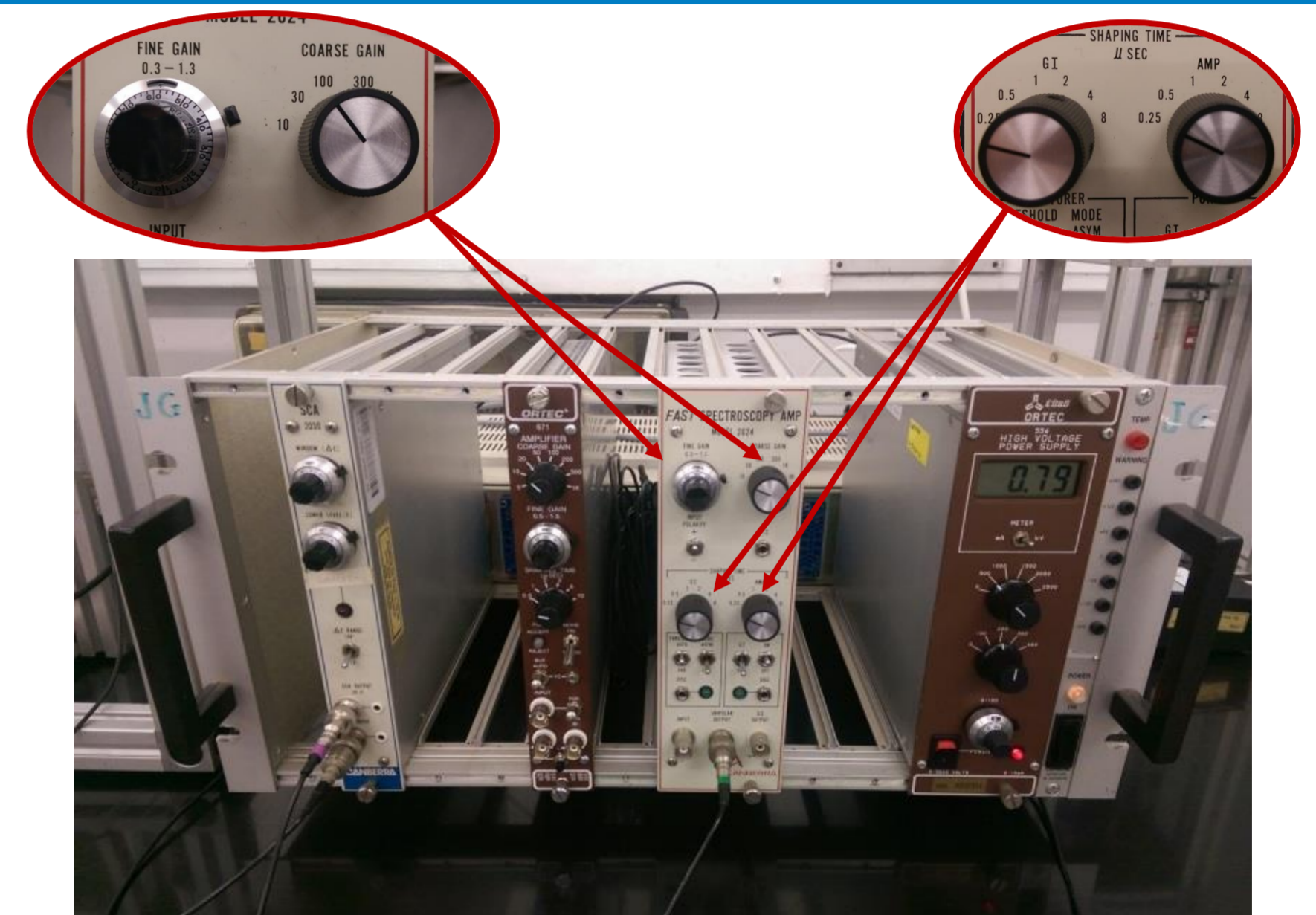
- Preamplifier Canberra model 2005
- Amplifier Canberra "fast spectroscopy AMP" model 2024
- Ortec high-voltage power supply
- ADC Silena
- IRMM data acquisition system
- DAQ-2000 spectra processing software

Digital electronics

- GBS Electronic MCA-527
- WinSpec spectra processing software



Digital MCA-527



Analogue instrumentation

Results

Analogue electronics

Range of shaping time values:

- 0.25; 0.5; 1; 2; 4 and 8 μs

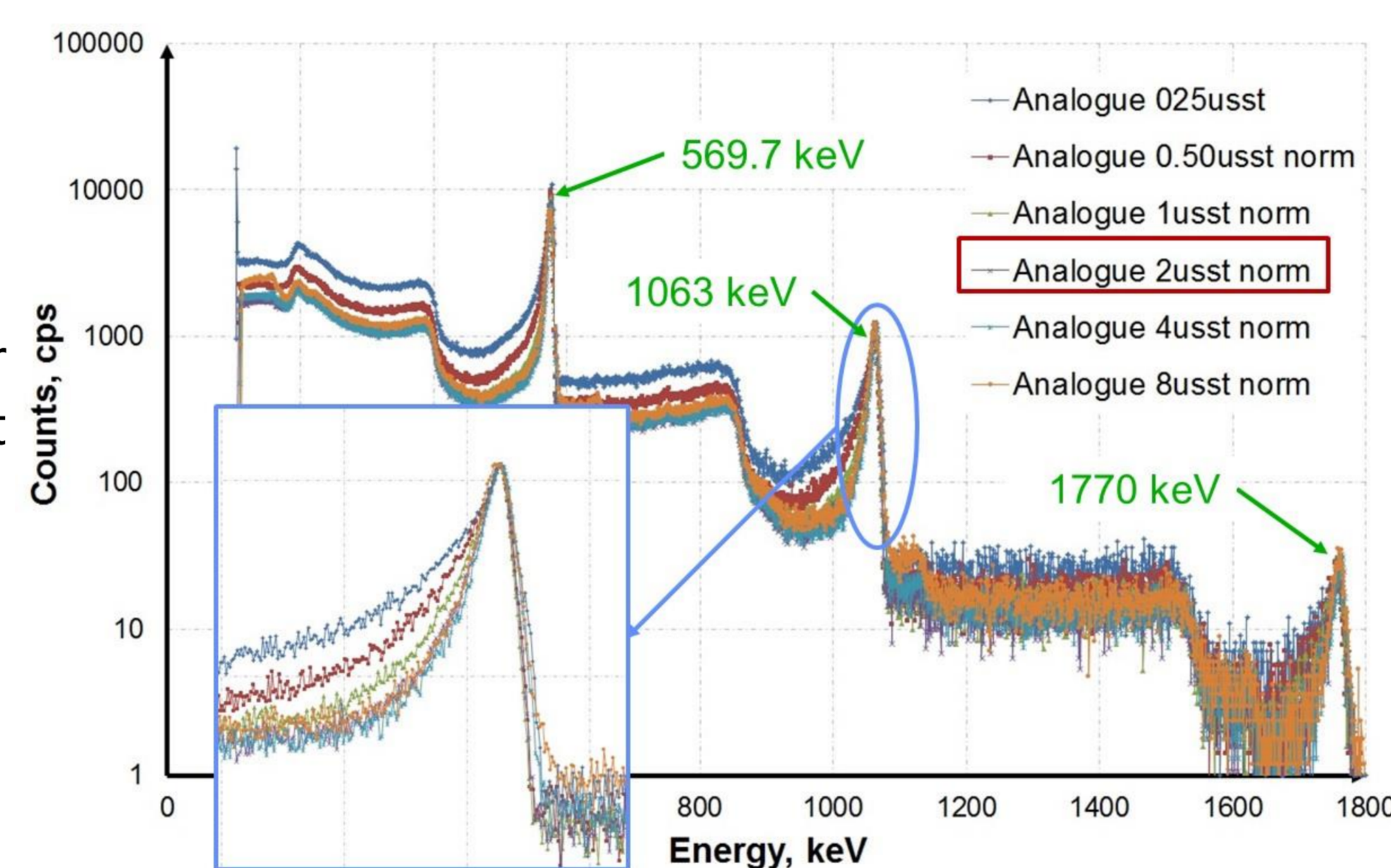
The results show that the best shaping time for analogue electronics is 2 μs, as it has the lowest slope of low-energy tails.

Digital electronics

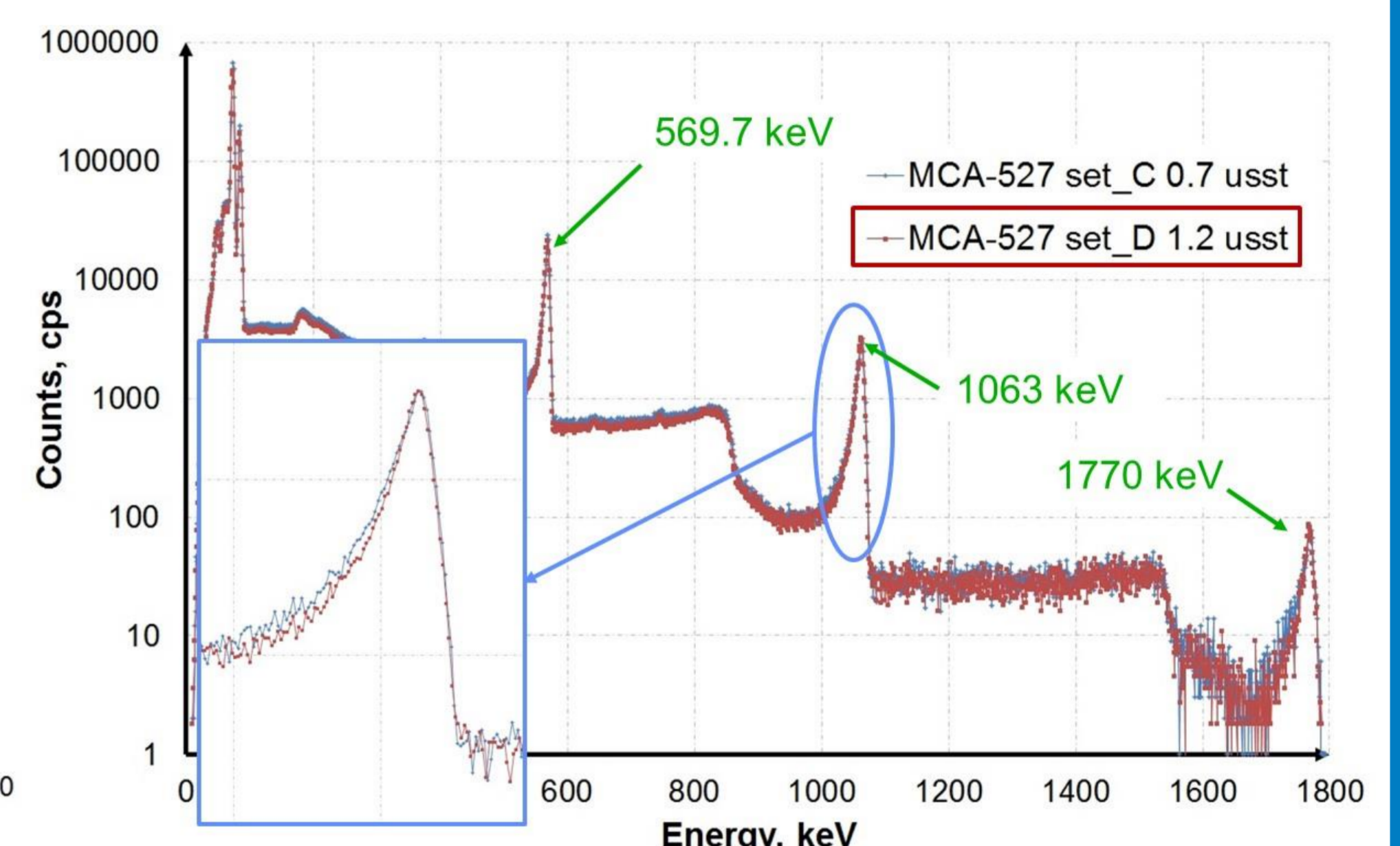
Range of shaping time values:

- 0.7 (sets A and C) and 1.2 (sets B and D) μs

The results show that the lowest slope of low-energy tails was obtained with 1.2 μs shaping time.



500 mm³ CdZnTe detector analogue instrumentation results

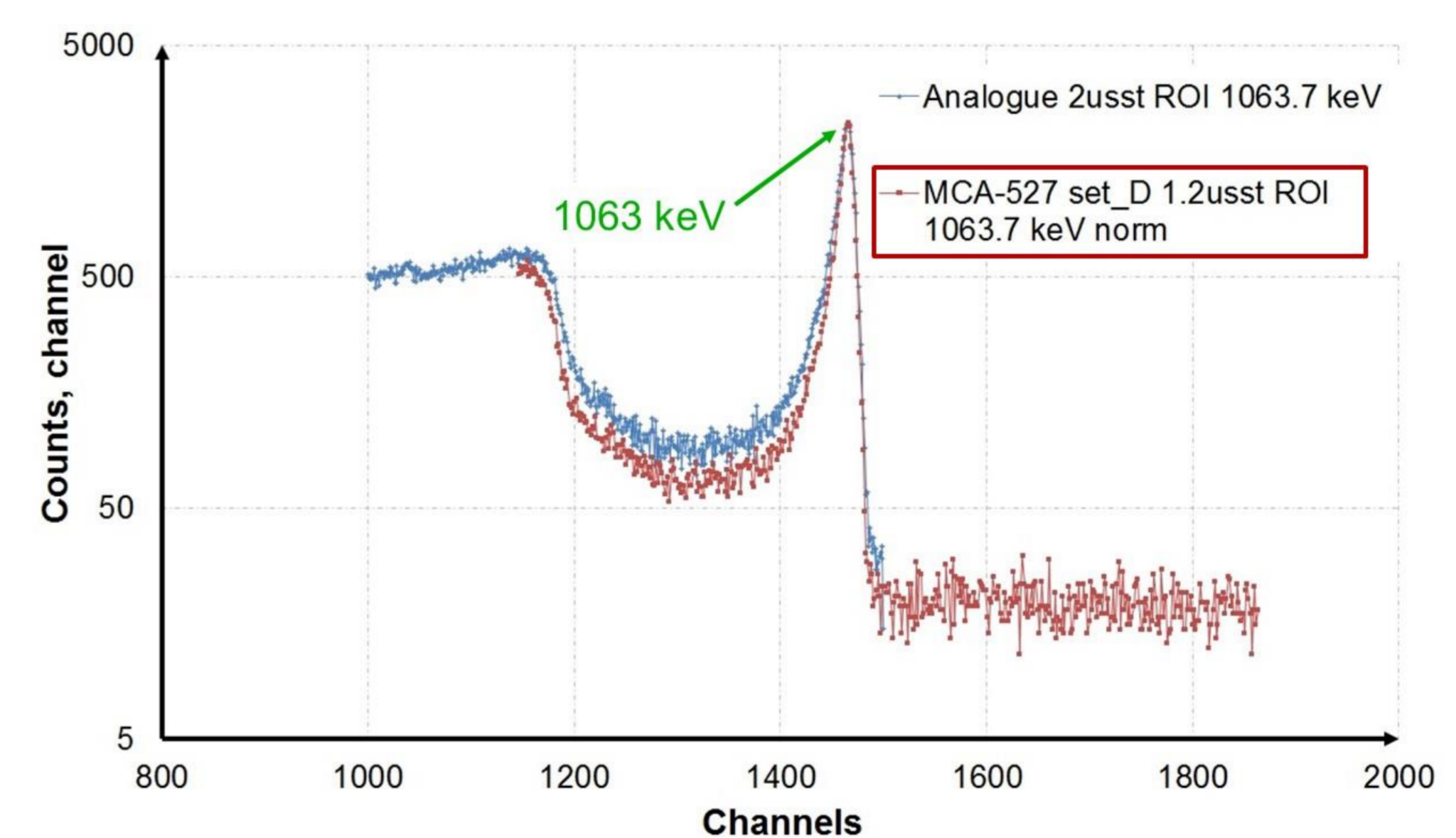


500 mm³ CdZnTe detector digital instrumentation results

Discussion

The comparison of the best results obtained on each of the types of the given instrumentation was made for the 1063 keV peak of ²⁰⁷Bi source.

The results of this comparison suggest the use of the digital MCA-527 instrumentation with 1.2 μs shaping time setting with the 500 mm³ CdZnTe detector. It delivers reasonably small slope of low-energy tails and does not sufficiently broaden the resolution of the peak.



500 mm³ CdZnTe detector results comparison

Conclusion

- Results indicate that the lowest slope of low-energy tails and smallest impact on the resolution is achieved with the digital MCA-527 instrumentation with 1.2 μs shaping time setting.