



One of the ways to increase the detection efficiency of CZT detectors is to combine several detectors in an assembly.

Using the summation of each CZT detector spectrum from its respective multi-channel-analyzer, creates a sum spectrum with an increased detection efficiency. Combining in this way, the capacity and noise of the detectors will not be added, as it would be in the case with just paralleling the detector crystals. Furthermore, the maximum total count rate increases with the number of detectors.

The difference in charge collection efficiencies of the used detectors can be compensated by the gain adjustment of the MCA.

The energy resolution of the total spectrum is in the interval between the best and worst energy resolution of the component detectors.

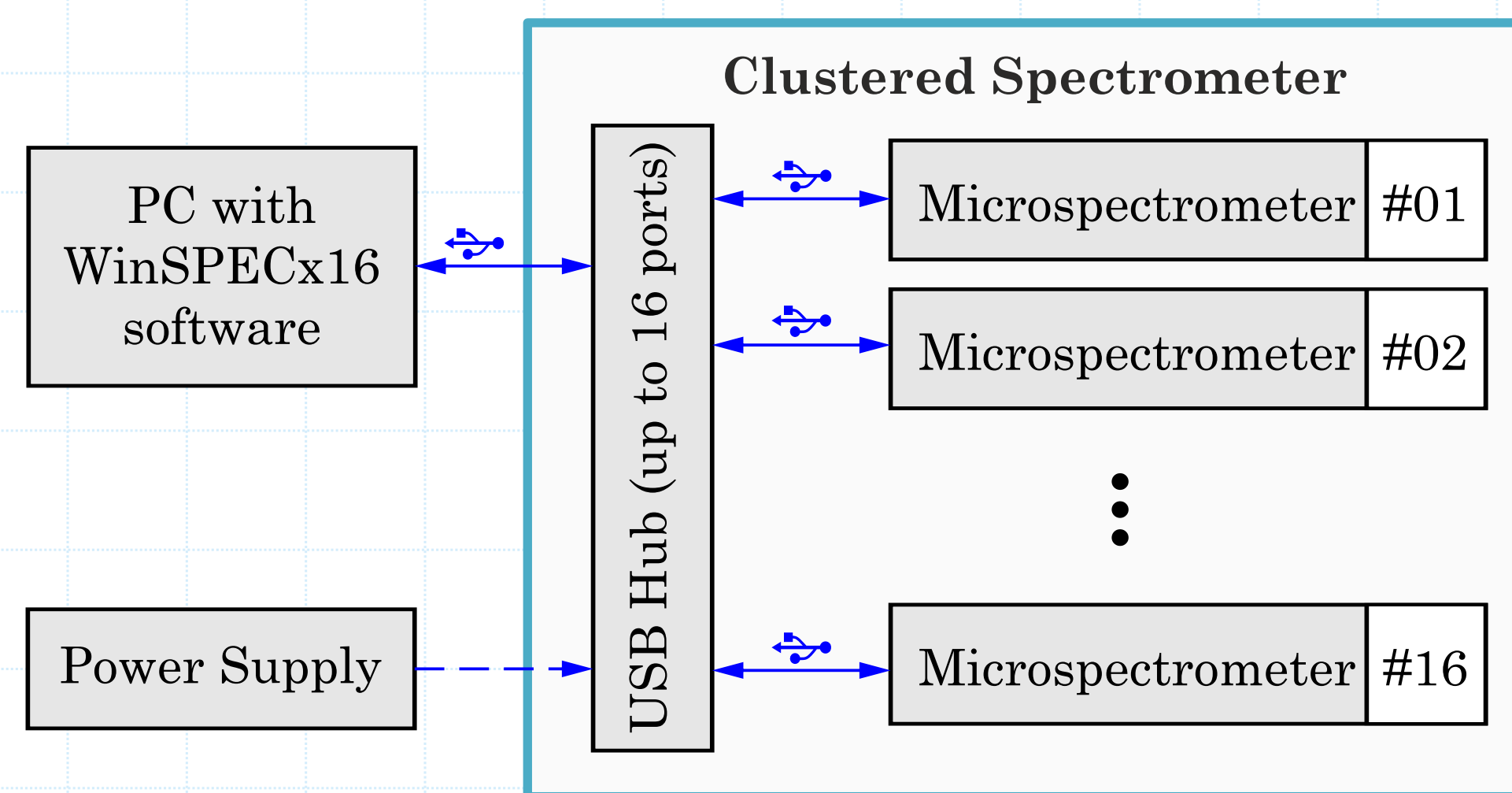
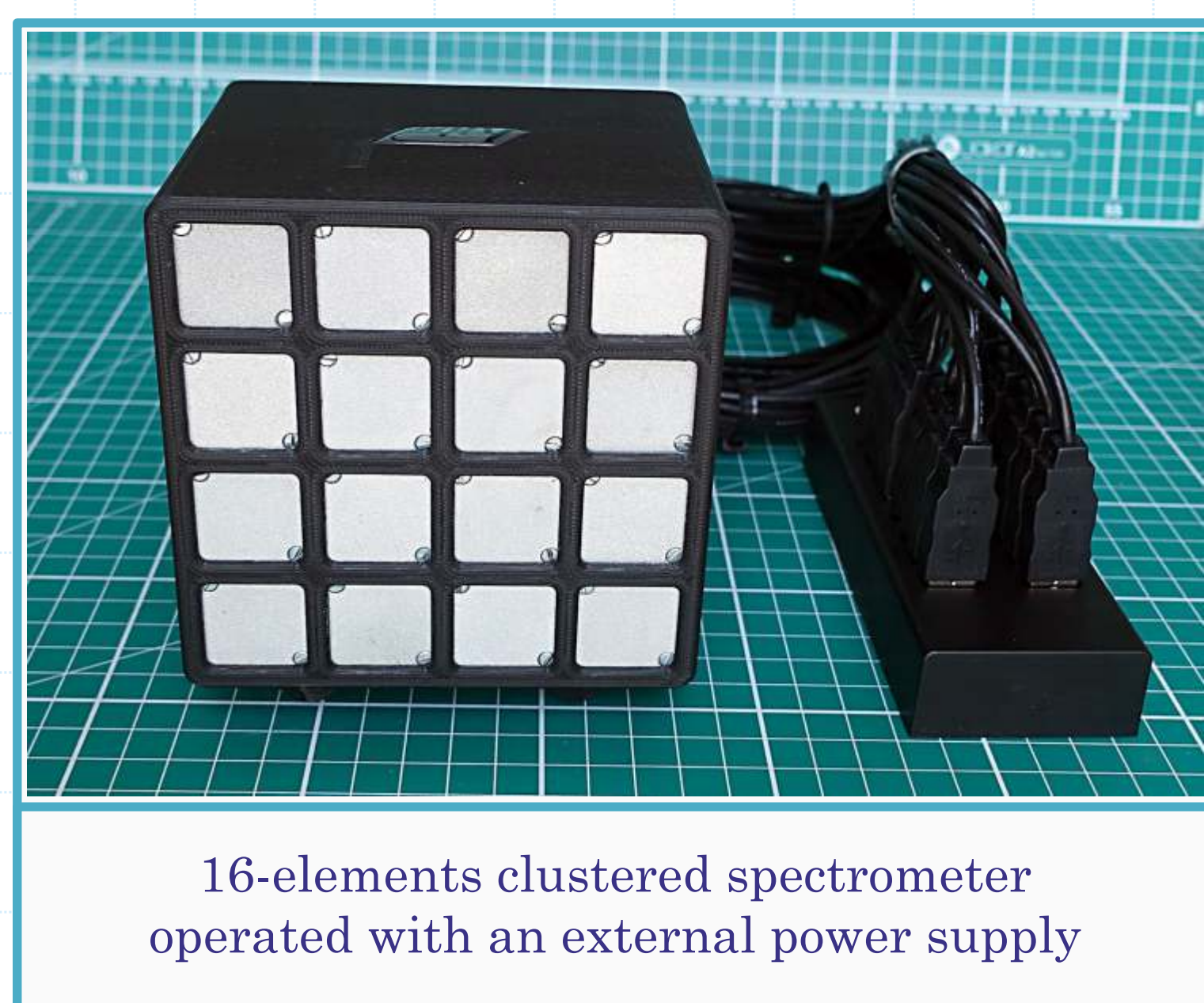
The equipment and a special software that allows combining up to 16

micro-spectrometers in a high efficiency clustered spectrometer were designed, manufactured and tested.

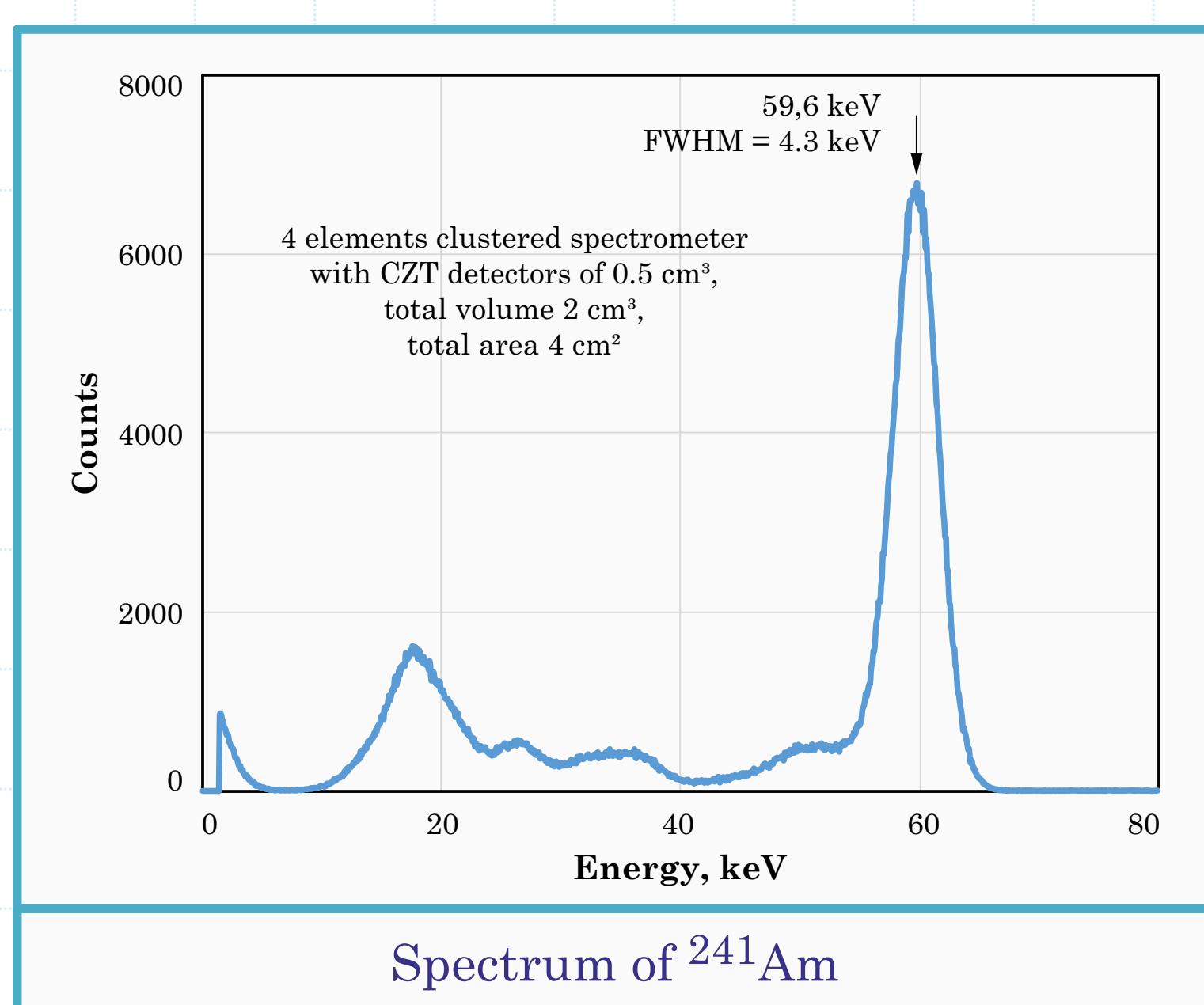
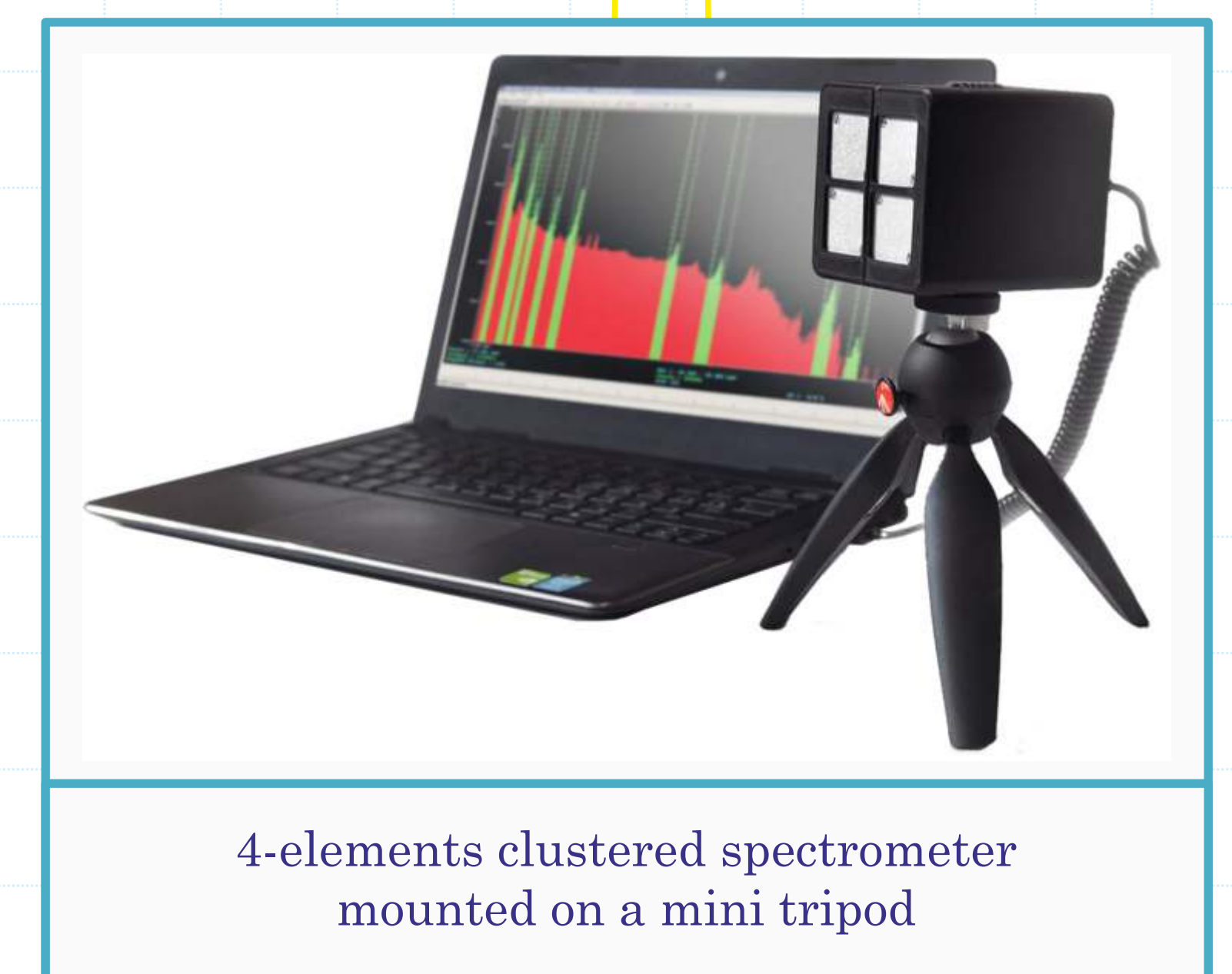
Serial micro-spectrometers CUBE527 [1] or μ SPEC [2] based on the MCA527micro(E) [3] and detector modules with CZT quasi-hemispherical detectors [4] were used.

For spectra collection, gain adjustment and spectra stabilization, the special software WinSPECx16 was developed.

Clustered spectrometers consisting of 4 elements with CZT detectors of 0.5 cm³ and 1.6 cm³ and clustered spectrometer consisting of 16 elements with quasi-hemispherical CZT detectors of 1.6 cm³ were tested. 4-element clustered spectrometer can be powered via USB port. When using more spectrometers in the cluster, an external power supply must be used.

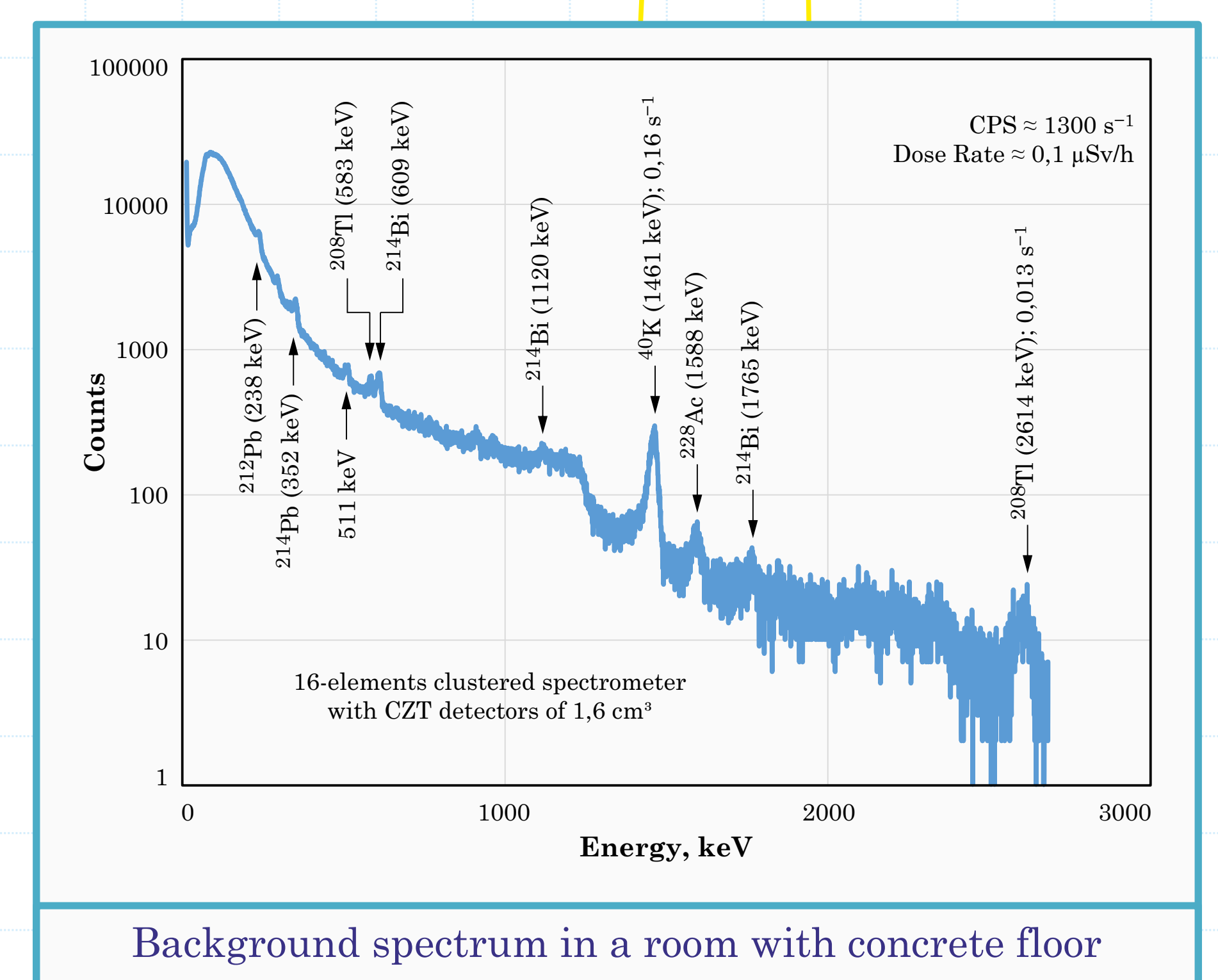
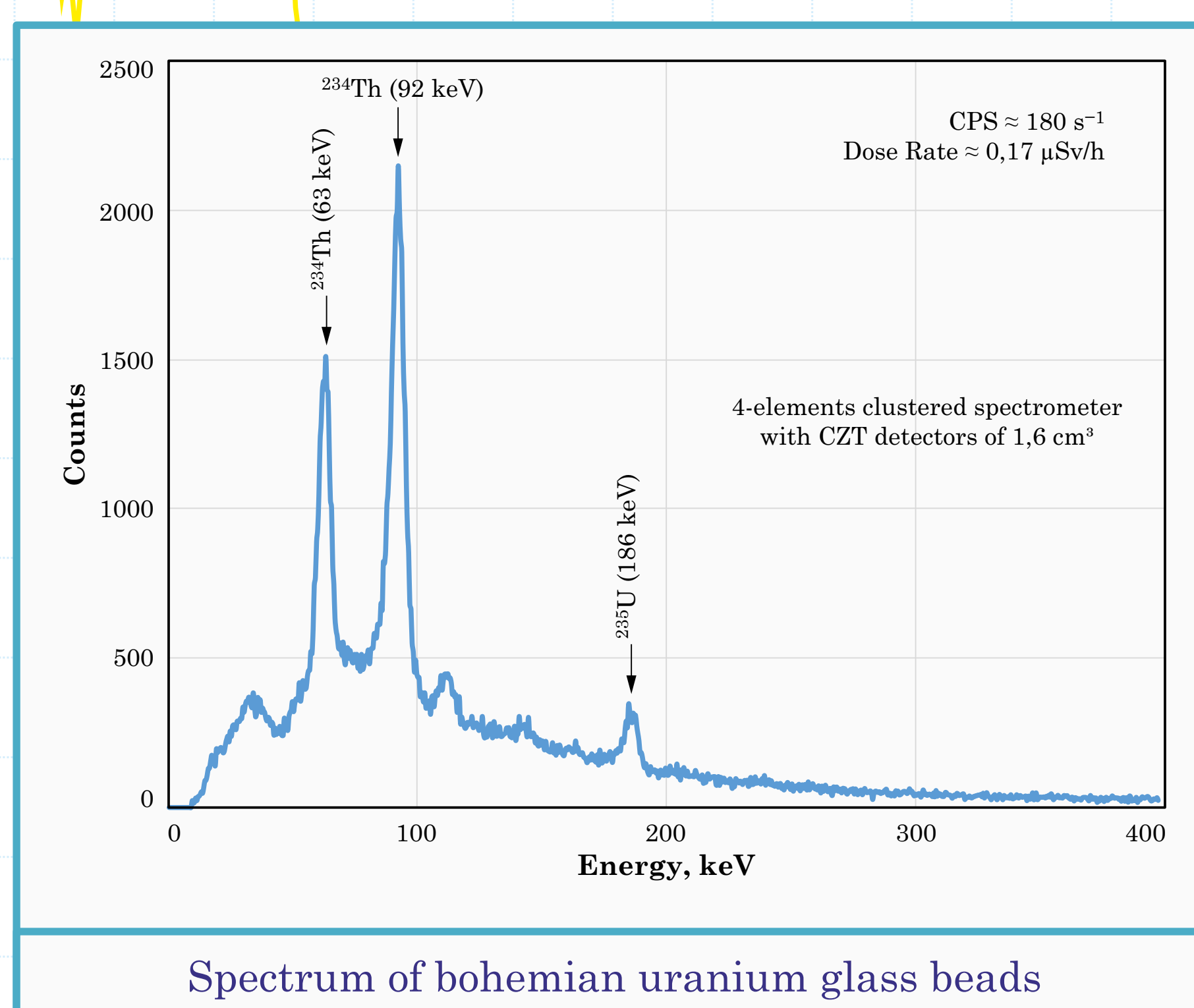
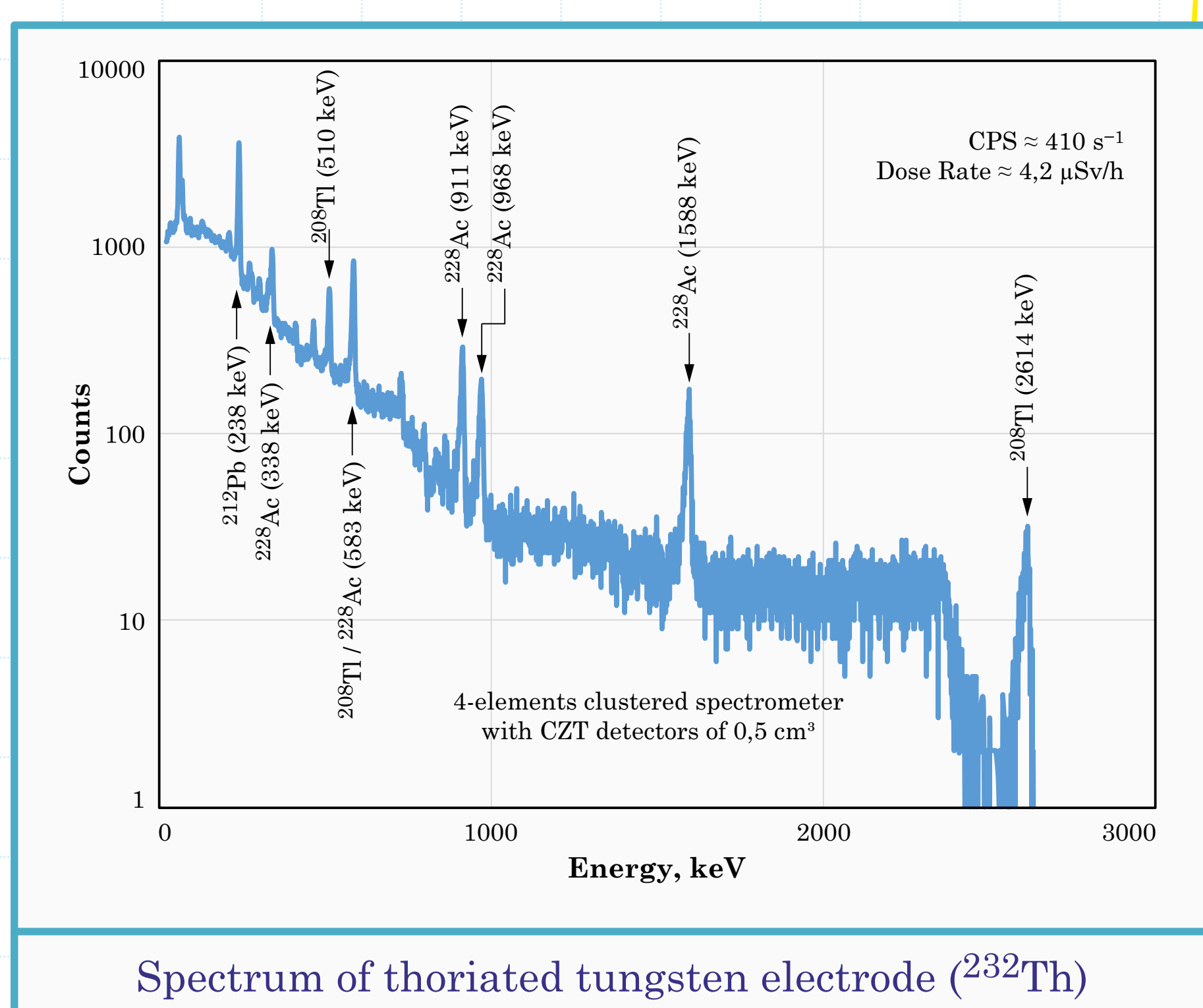
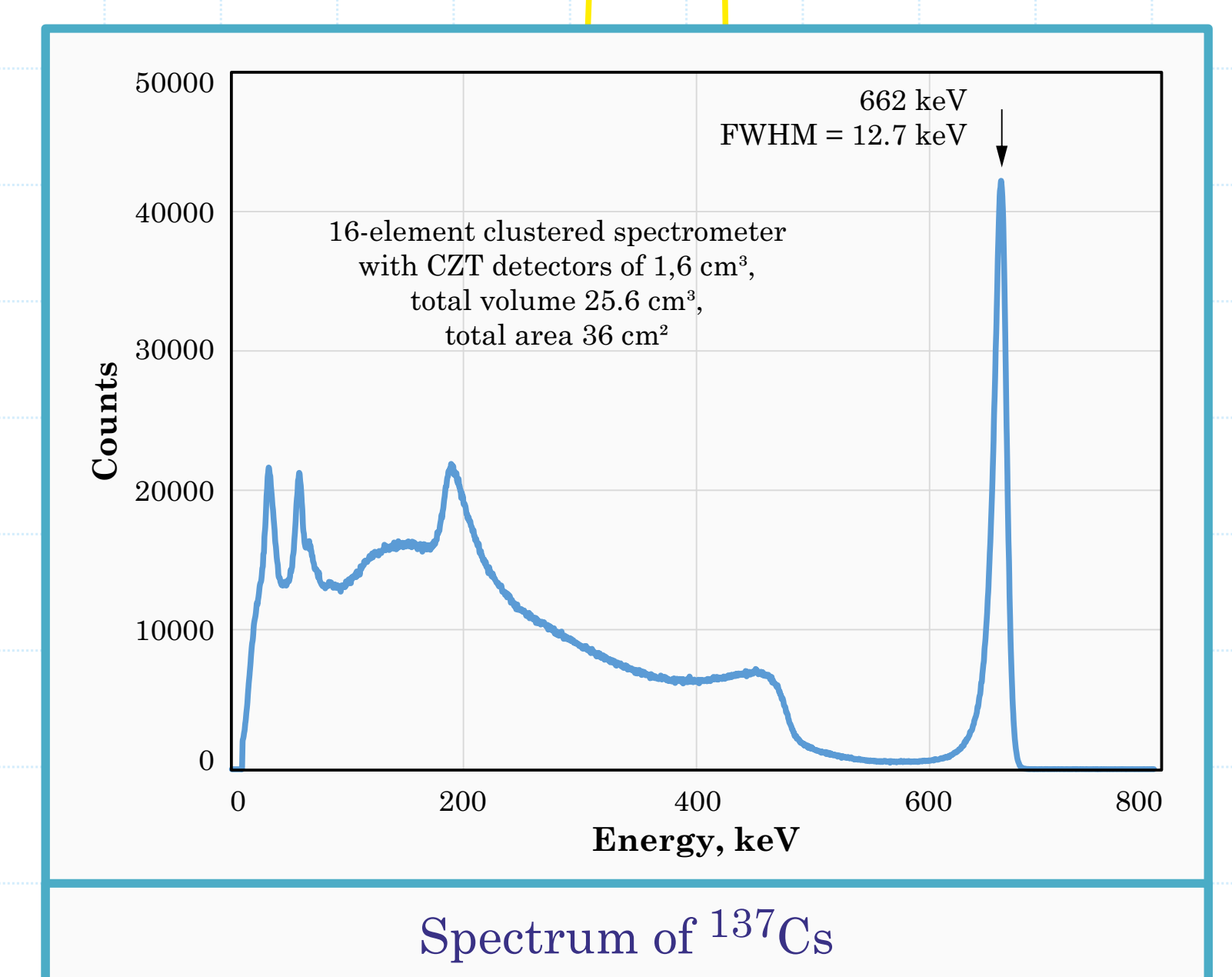


Clustered spectrometer block diagram



Characteristics of the CZT detectors constituting the clustered spectrometers and final energy resolutions of the different clustered spectrometers

#	Number of elements	CZT detector volume, cm ³	Total volume/area of clustered spectrometer, cm ³ /cm ²	Energy resolutions at 662 keV of microspectrometers composing the cluster, %	Spread of peak positions before correction, %	Energy resolutions at 662 keV of clustered spectrometer, %
1	4	0,5	2,0/4,0	1,0; 1,0; 0,9; 1,1	2,7	1,0
2	4	1,6	6,4/9,0	1,7; 1,8; 1,6; 1,9	3,9	1,8
3	16	1,6	25,6/36,0	2,8; 2,0; 1,8; 2,0; 2,8; 1,6; 1,8; 2,2; 2,8; 2,5; 3,0; 2,2; 2,5; 2,2; 2,8; 1,9	4,6	2,2



MAIN RESULTS:

- Clustered spectrometers with different numbers of elements and different volumes of CZT quasi-hemispherical detectors were designed, manufactured and tested.
- Software WinSPECx16 that forms the clustered spectrometer has been developed. It allows the gain and spectrum stabilization of up to 16 spectrometers.
- Possibility of a significant increase in the registration efficiency by combining single serial microspectrometers into a clustered spectrometer was demonstrated.
- Clustered spectrometers were tested for weak and high-flux with a dose rate up to 25 mSv/h gamma-radiation measurements.

REFERENCES:

- Cube527/Digital Multi Channel Analyser, GBS-Elektronik GmbH, Dresden, Germany <http://www.gbs-elektronik.de>
- Microspectrometer μ SPEC, ZRF RITEC SIA, Riga, Latvia, <http://www.ritec.lv>
- MCA527 micro/microE, GBS-Elektronik GmbH, Dresden, Germany
- V.Ivanov, J.Mintcheva, A.Berlizov, A.Lebrun, Performance Evaluation of New Generation CdZnTe Detectors for Safeguards Applications, Symposium on International Safeguards: Linked Strategy, Implementation and People, IAEA-CN-220, IAEA, 2015.