

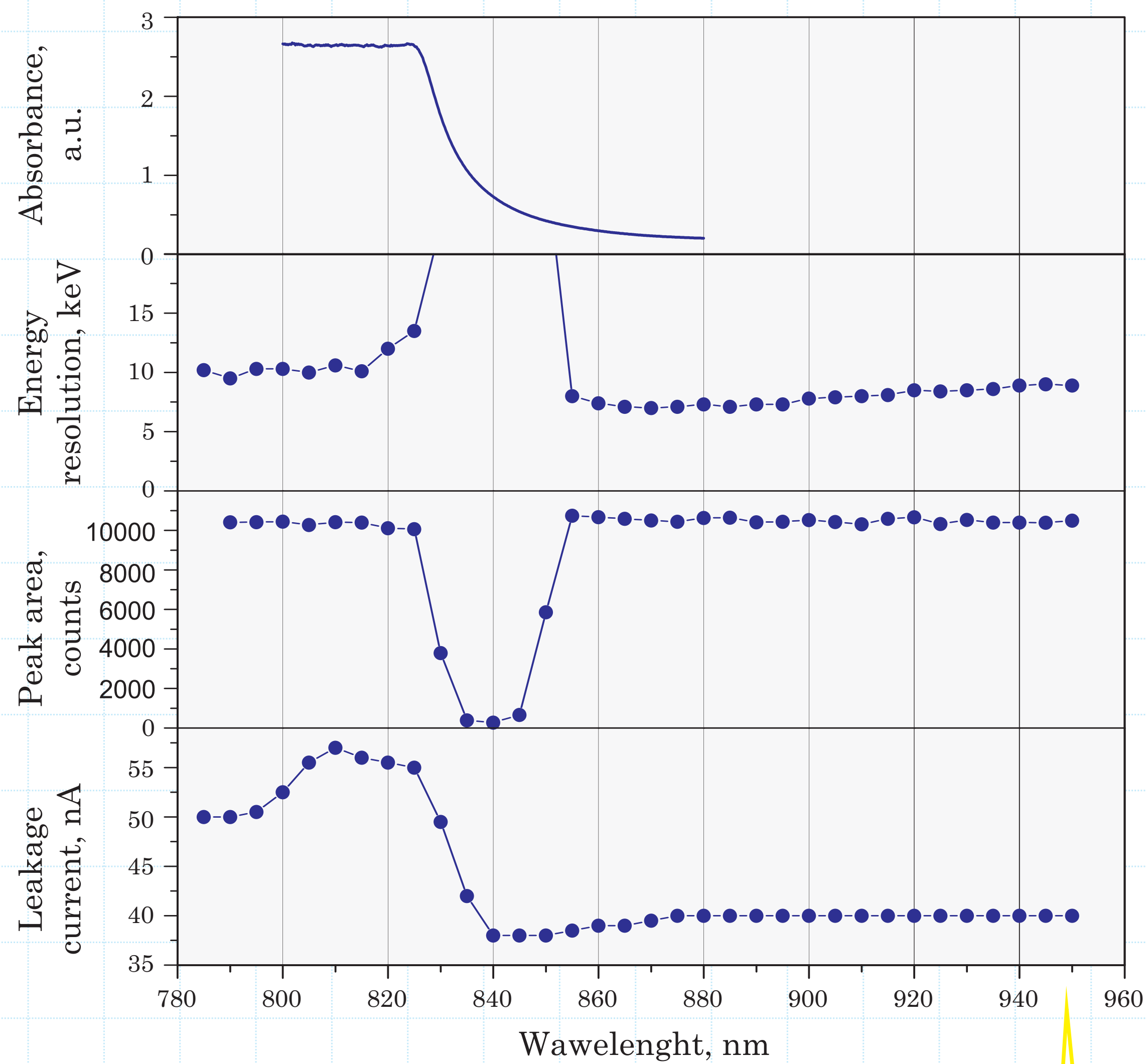
Improving the performance of CdZnTe detectors using infrared stimulation

P. Dorogov¹, V. Ivanov¹, A. Luchanskii¹, L. Grigorjeva², D. Millers²

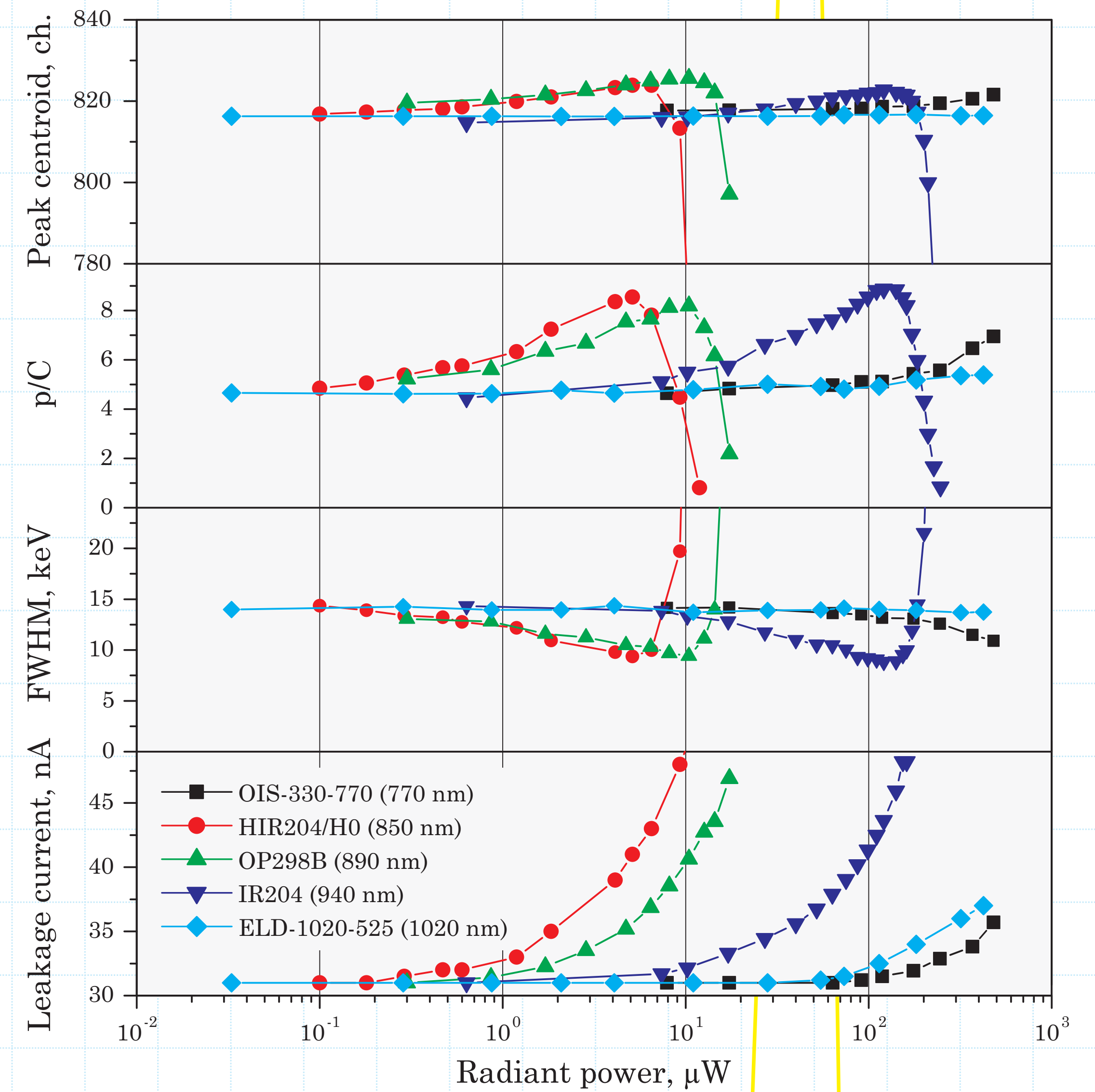
The influence of near IR illumination on spectrometric characteristics of CdZnTe quasi-hemispherical detectors of sizes from 3x3x1.5 mm³ to 10x10x5 mm³ were investigated. IR stimulation was realized by using of tunable monochromator and by commercially available calibrated IR LEDs from the near IR range. At the measurements

the detector was placed on the holder in an electrically shielded, protected from visible light housing having a transparent to IR radiation entrance window done of CdZnTe. At measurements IR radiation penetrated into the detector from the side of a large negative contact through the gold electrode.

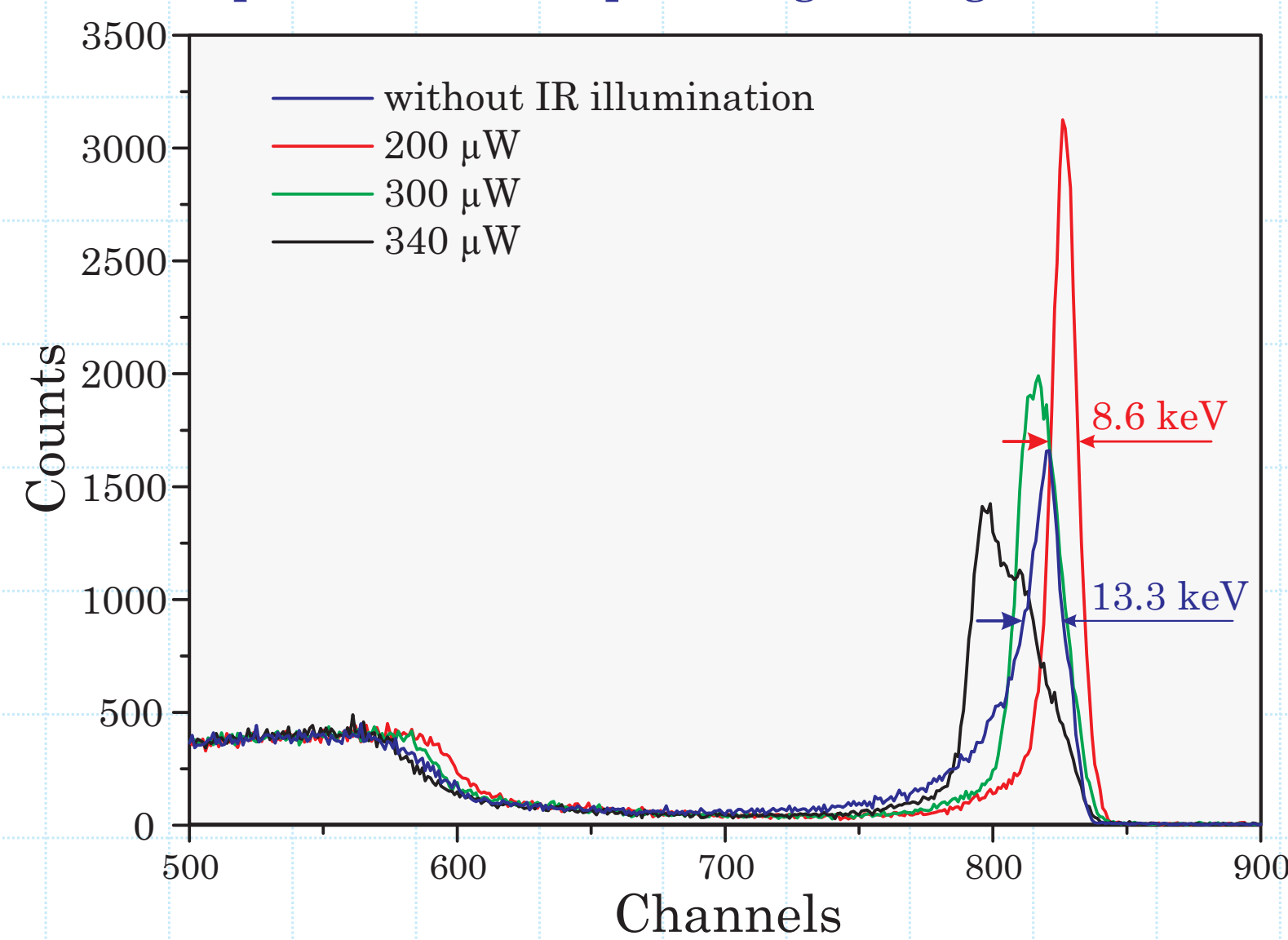
Spectral response of the absorbance of the sample used to the quasi-hemispherical detector fabrication, peak area, energy resolution (FWHM) at 662 keV and leakage current measured with quasi-hemispherical detector of 5x5x2.5 mm using tunable monochromator



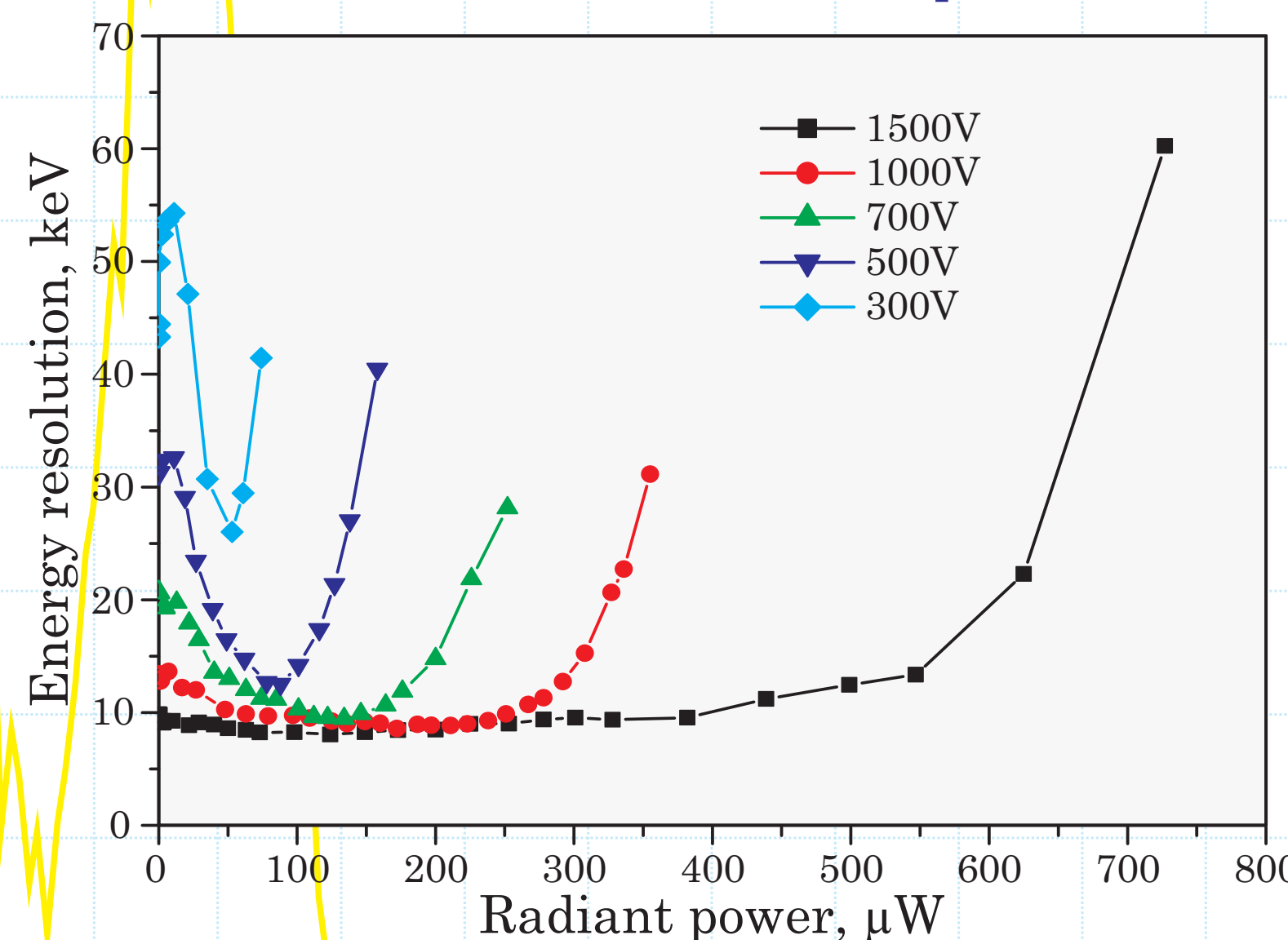
Peak centroid, peak-to-Compton ratio (p/C), energy resolution (FWHM) at 662 keV and leakage current depending on the intensity of IR illumination of different IR LEDs



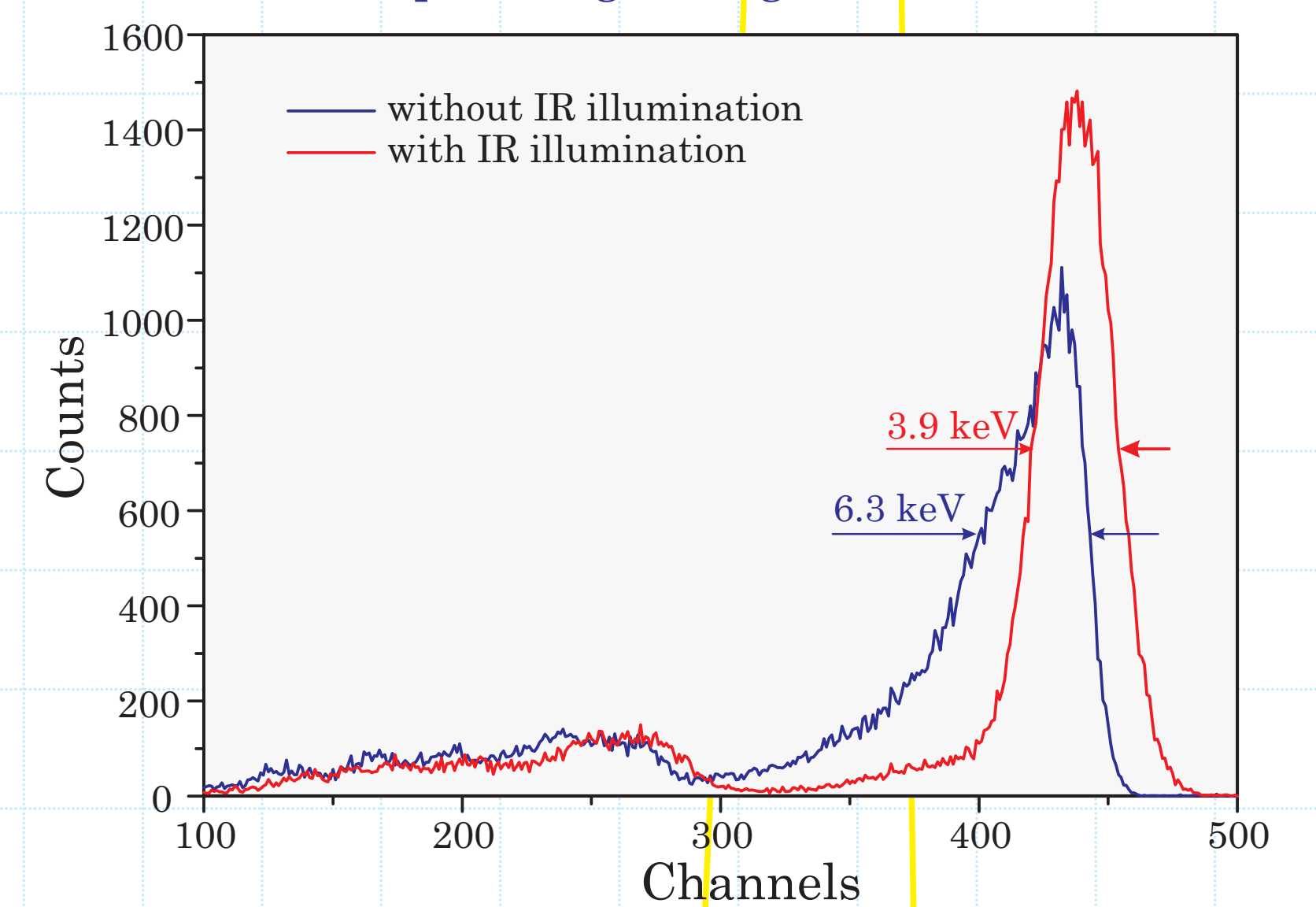
¹³⁷Cs spectra measured at different illumination intensities of IR LED IR204 (940 nm) with quasi-hemispherical detector of 10x10x5 mm³ at room temperature and operating voltage of 1000 V



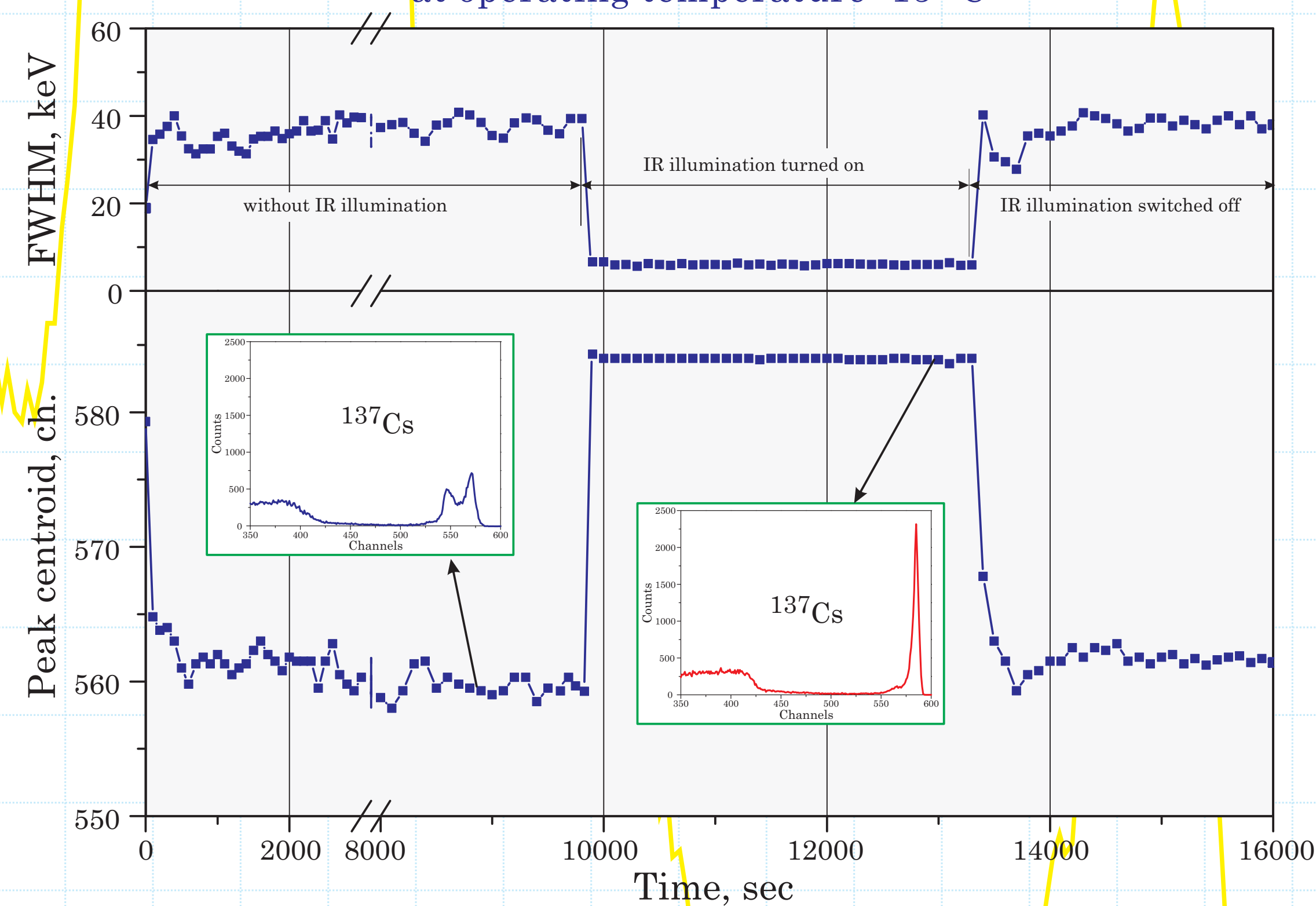
Dependencies of an energy resolution (FWHM) at 662 keV on the IR illumination intensity (940 nm) for different operating voltages measured with quasi-hemispherical detector of 10x10x5 mm³ at room temperature



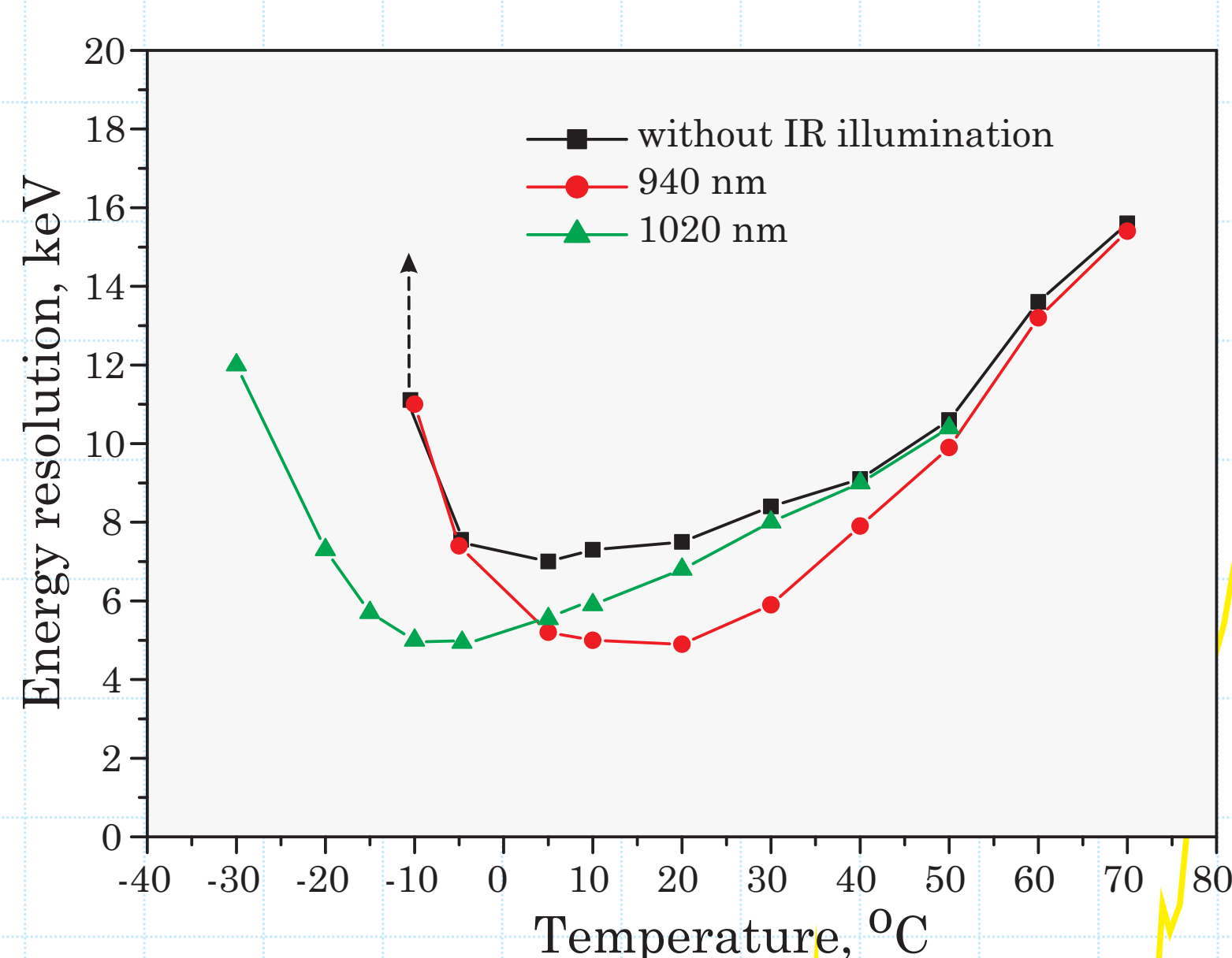
²⁴¹Am spectra obtained with quasi-hemispherical detector of 10x10x5 mm³ with (940 nm) and without IR illumination at room temperature and operating voltage of 400 V



Time dependence of the peak area and energy resolution (FWHM) at 662 keV without and with IR illumination by IR LED ELD-1020 (1020 nm) at operating temperature -15 °C



Temperature dependencies of energy resolution (FWHM) at 662 keV without and with IR illumination measured with quasi-hemispherical detector of 5x5x2.5 mm



Spectrometric characteristics of CdZnTe quasi-hemispherical detectors of different sizes measured without and with IR illumination (940 nm) at room temperature

No	Detector size, mm	Energy resolution (FWHM) at 662 keV, keV		Peak-to-Compton ratio		Energy resolution (FWHM) at 59.5 keV, keV	
		Without illum.	With illum.	Without illum.	With illum.	Without illum.	With illum.
1	10x10x5	20.6	9.6	3.0	7.6		
2	10x10x5	9.8	8.1	7.1	10.0	6.3	3.8
3	7x7x3.5	27.2	13.2	2.5	4.9		
4	7x7x3.5	6.4	5.1	9.4	12.6	5.4	2.8
6	5x5x2.5	24.5	10.8	1.8	5.4		
7	5x5x2.5	7.2	4.7	7.4	10.0	3.3	2.4
8	3x3x1.5	6.9	5.5	5.4	6.3		

Main results:

- ✓ Near IR stimulation by wavelengths close to the wavelength of the CdZnTe absorption edge greatly influences the spectrometric characteristics of CZT detectors.
- ✓ Spectrometric characteristics of quasi-hemispherical detectors can be significantly improved by correctly chosen intensity of IR illumination and wavelength in the range of 870 nm-1000 nm. Degree of improvement depends on a quality of used initial CdZnTe crystal and detectors.
- ✓ Improvement is obtained in a wide gamma-energy range without efficiency decreasing.

- ✓ Improvements of spectrometric capabilities under IR stimulation are obtained without increasing of detectors operating voltages. Good energy resolution can be obtained even at low operating voltages.
- ✓ For the IR stimulation practical realization the usual commercially available IR LEDs can be used.
- ✓ Spectrometric characteristics improvement under IR stimulation is obtained in a wide operating temperatures range. For a stable operation at low temperatures, below -5 °C the IR stimulation by shorter wavelength must be used.