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Pu Lx spectroscopy
(in the presence of other radioisotopes)

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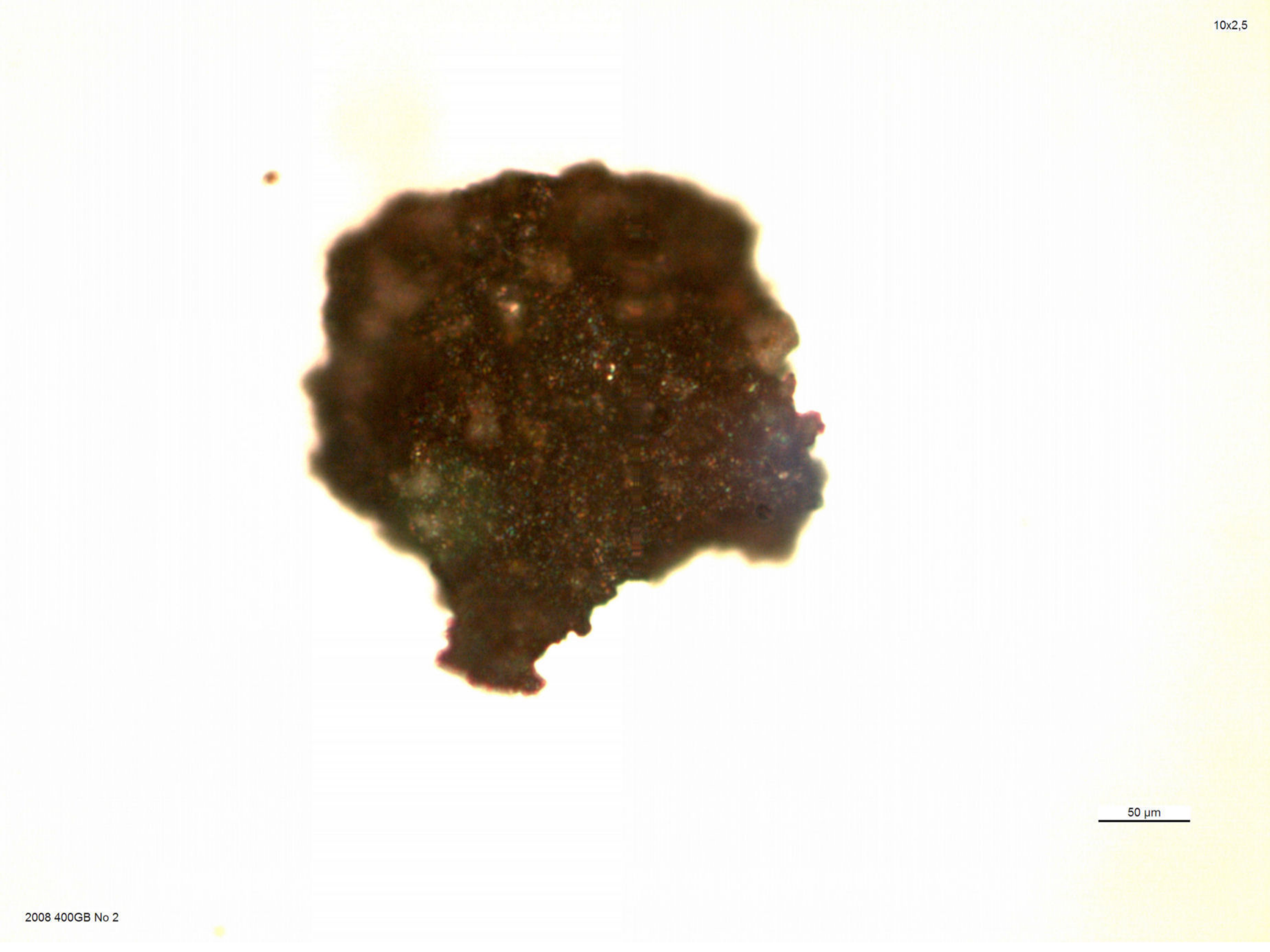
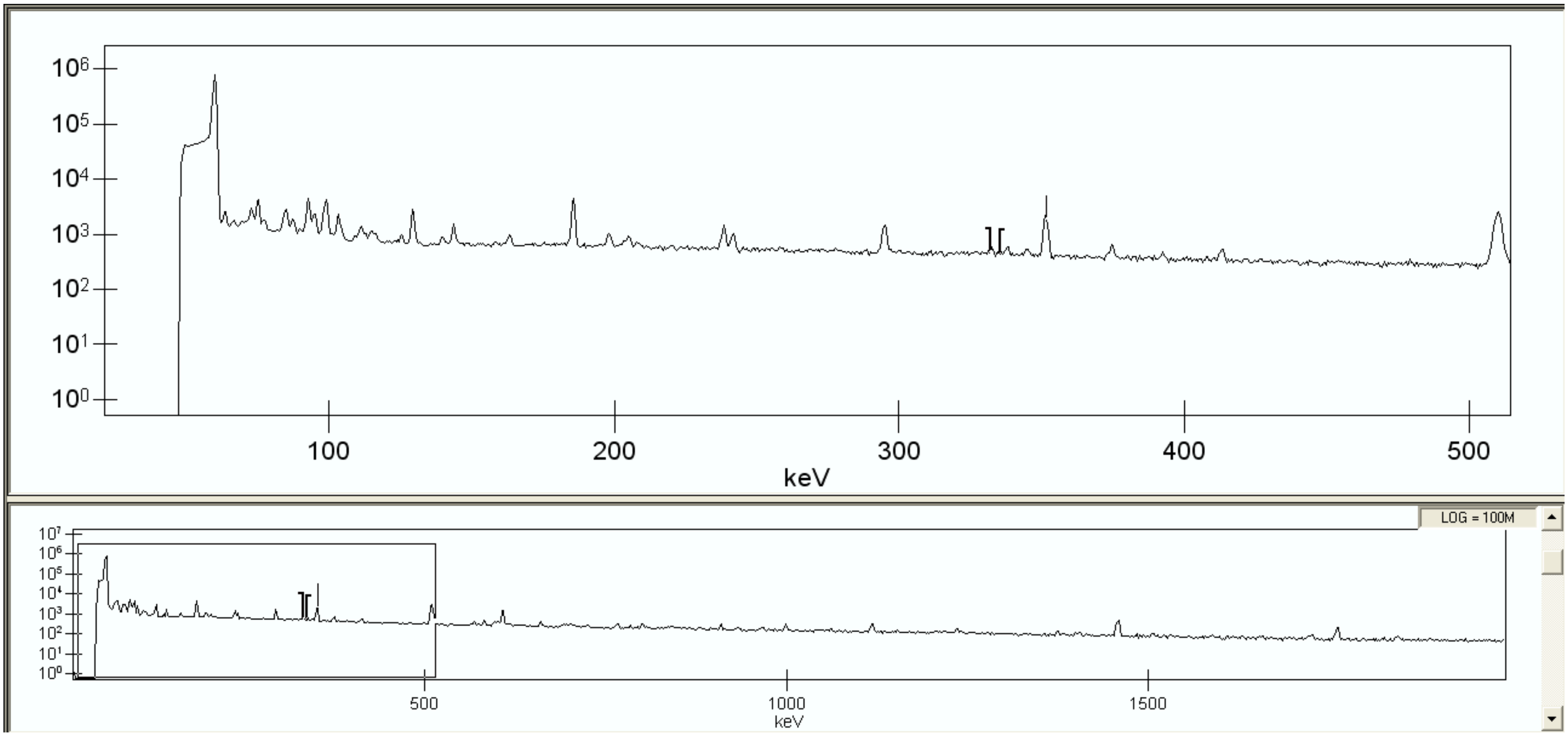
04-nov-08 18:10


10x2,5
50 µm
2008 400GB No 2

60% P-type detector & 5kBq Pu-239 Thule particle



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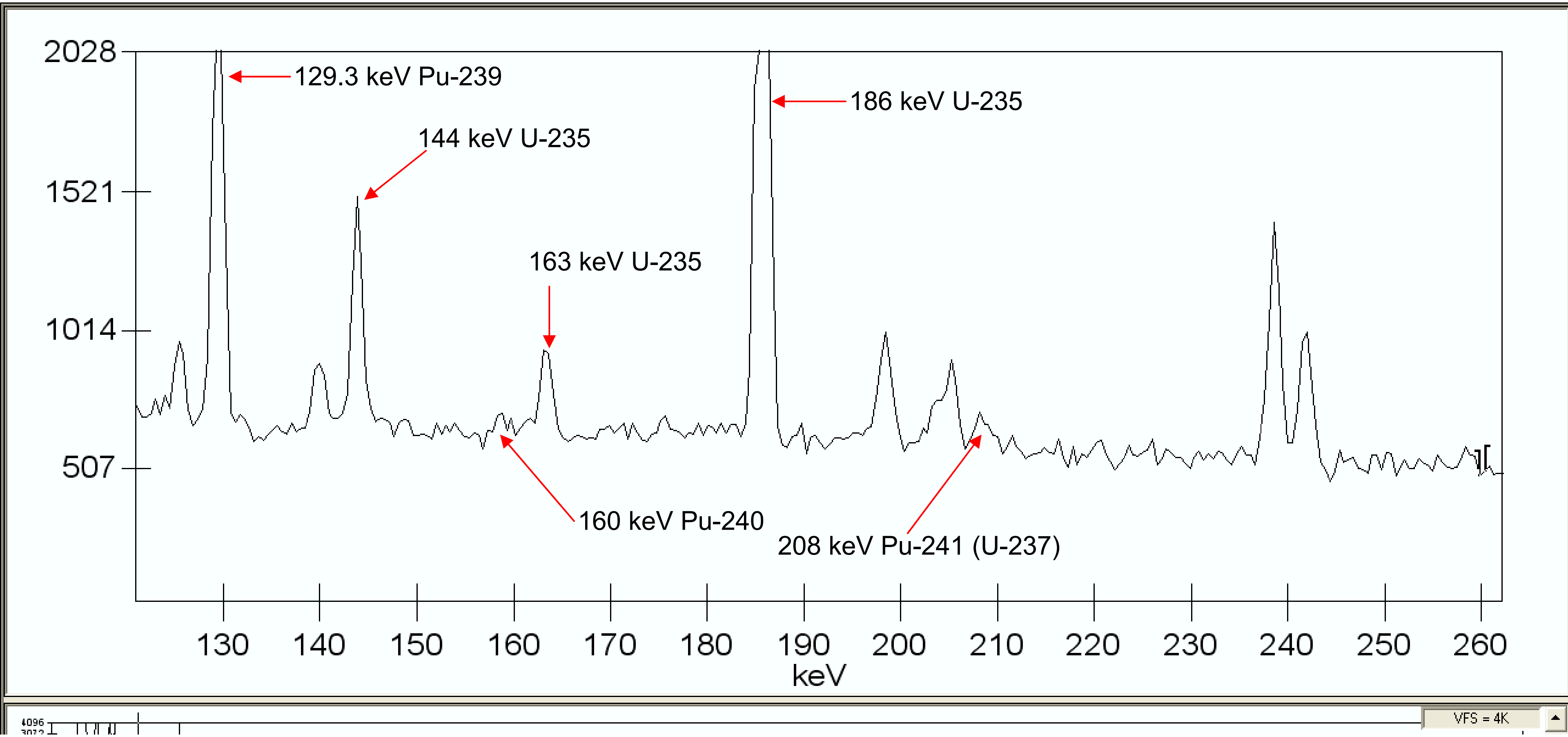
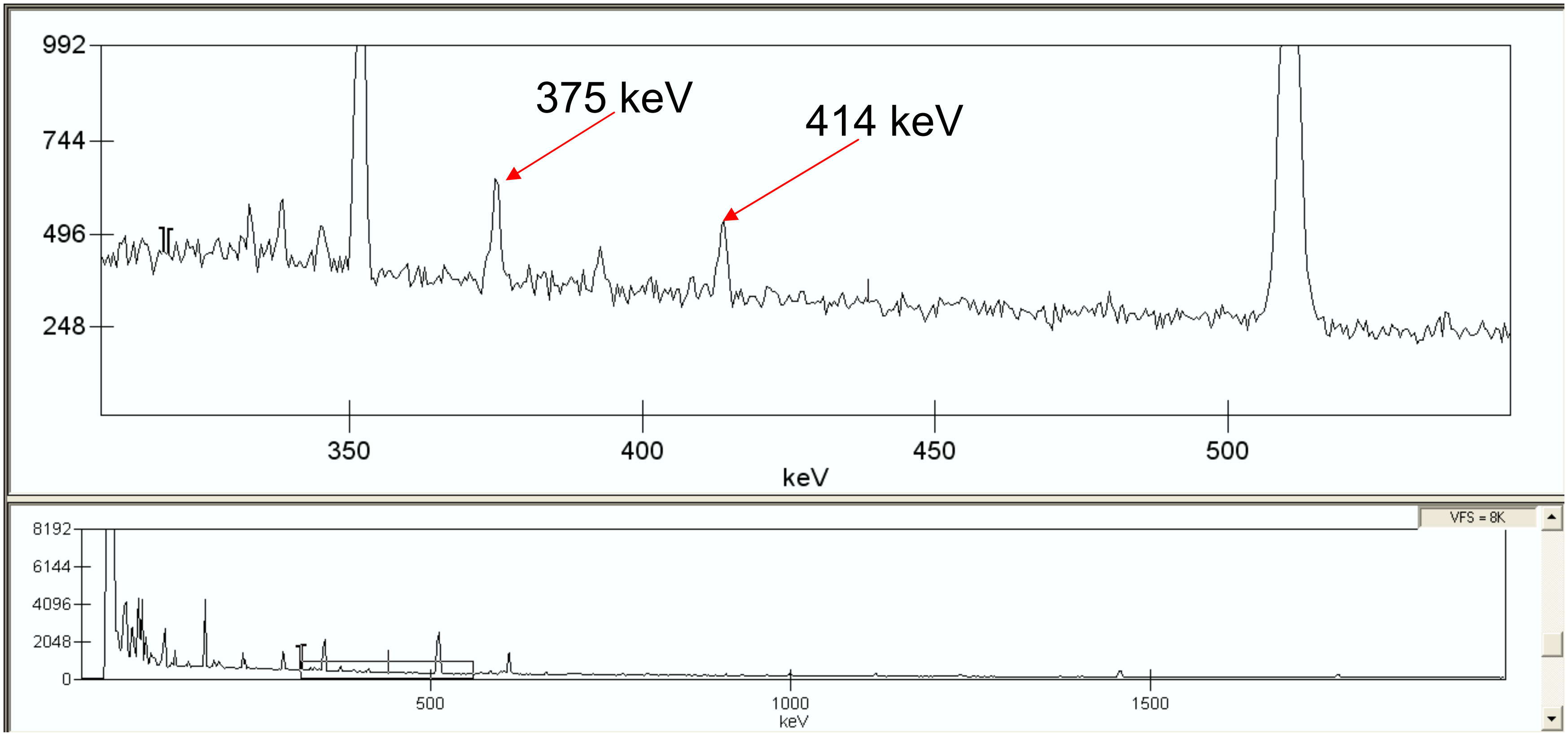
Region with ”strong” lines from Pu-239, 240, 241 & U-235



129.3 keV : 0.0063% [Pu-239]
160.3 keV : 0.000402% [Pu-240]
208 keV : 0.000502% [Pu-241 (U-237)]

375 & 414 keV Pu-239 lines….



375 keV 0.00155%
414 keV 0.00147%

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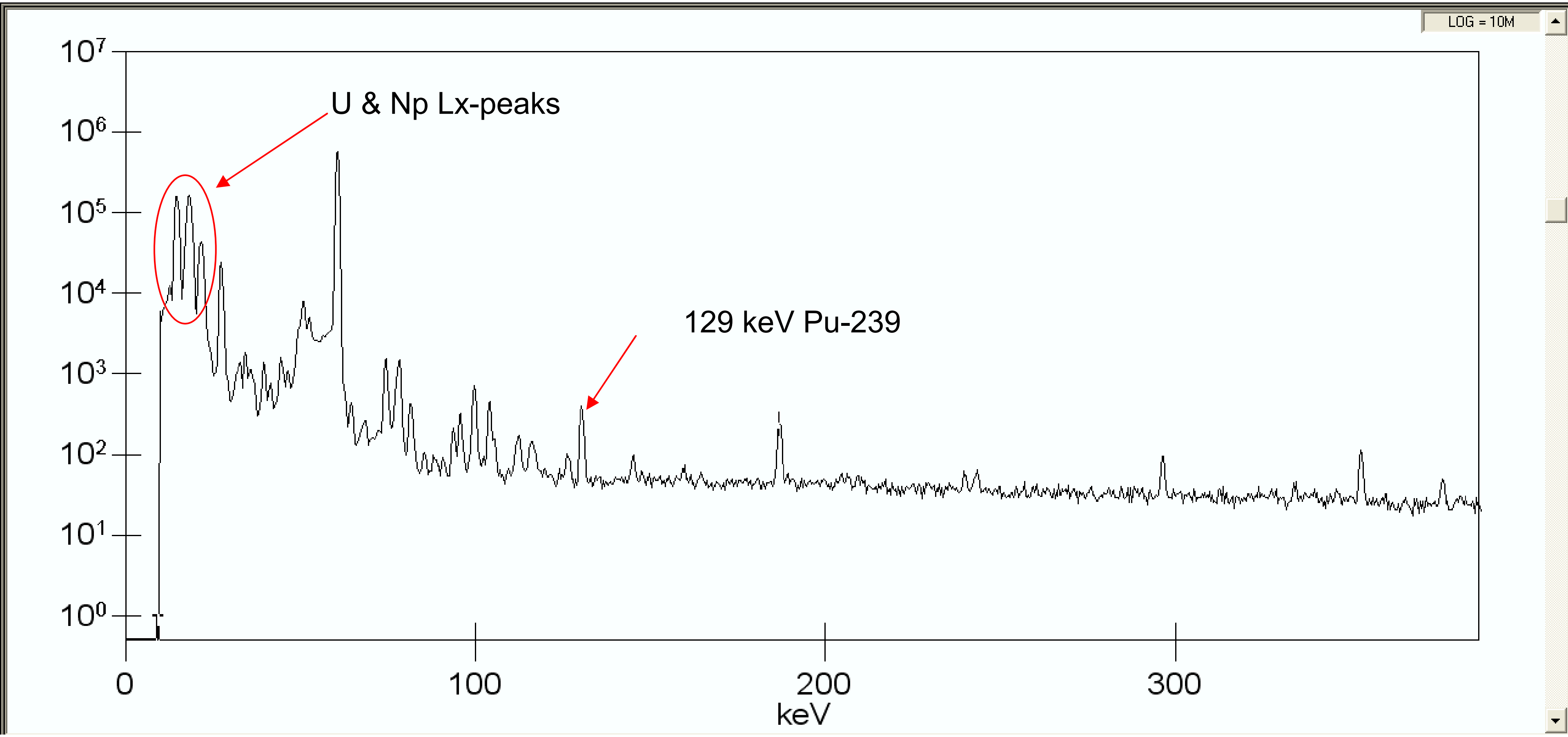
Gamma lines used for elemental/isotopic composition of particles

241Am		**238Pu**		**239Pu**		**240Pu**		**235U**	
[keV]		[keV]		[keV]		[keV]		[keV]	
26.34	2.400%	43.48	0.03958%	38.66	0.0105%	45.24	0.0450%	143.8	10.96%
33.20	0.126%	99.85	0.00736%	51.62	0.0271%	104.2	0.0072%	163.3	5.08%
43.42	0.073%			56.83	0.0010%	160.3	0.0004%	185.7	57.20%
59.54	35.940%			129.3	0.0063%			205.3	5.01%
123.0	0.0010%			203.6	0.00057%				
125.3	0.0041%			332.8	0.00049%				
				345.0	0.00056%				
				375.1	0.00155%				

In spite of a relatively large particle (5 kBq Pu-239) isotopes like Pu-238, 240 & 241 cannot easily be detected even after 3-4 days counting using a 60% detector (P-type).

35% N-type & 5kBq Pu-239 Thule particle



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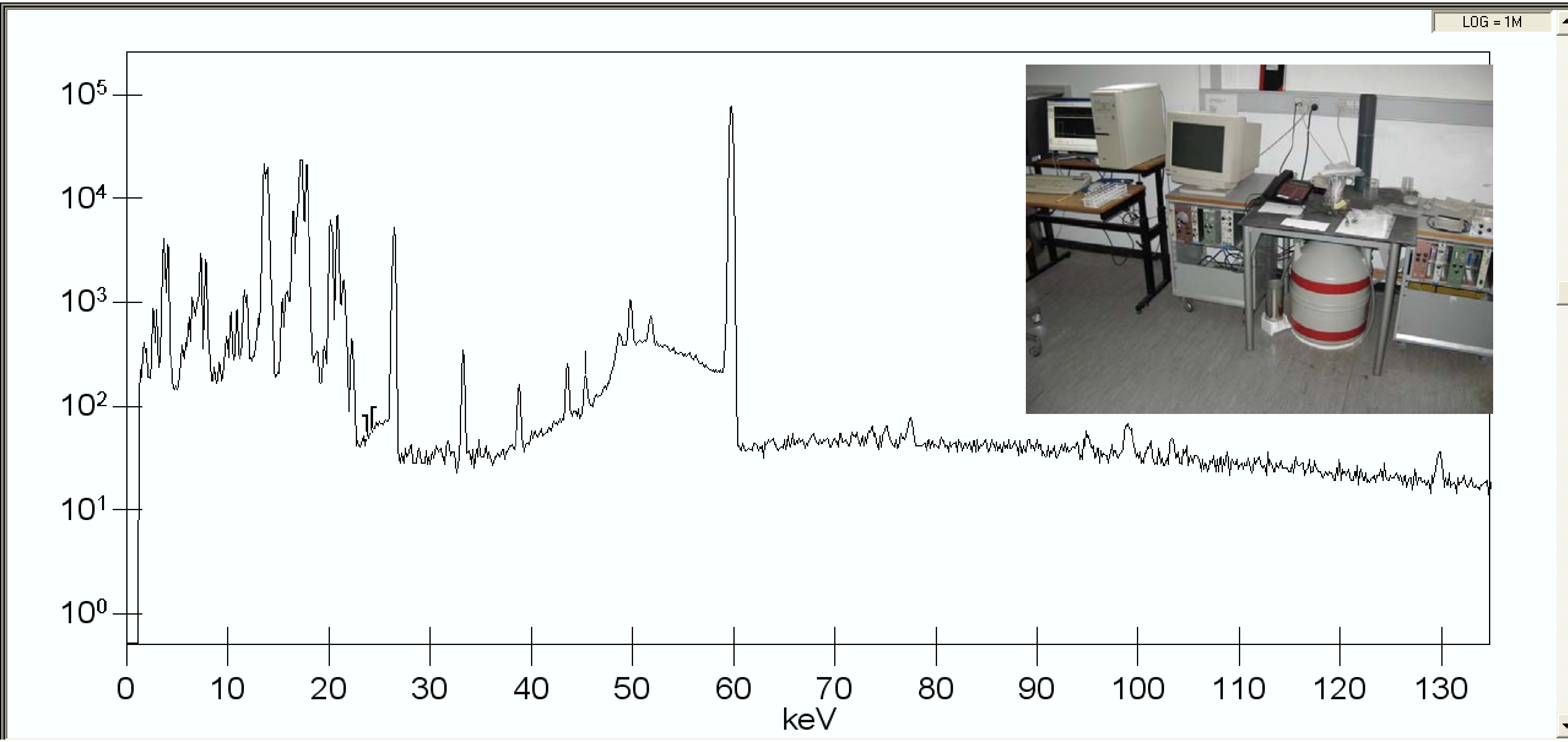
”1%” HPGe & 5kBq Pu-239 Thule particle (230 ksec)



Canberra GL0055P.
50mm^2 active area, 5mm thick.
FWHM 122keV: 0.47 keV
FWHM 5.9 keV: 0.13 keV

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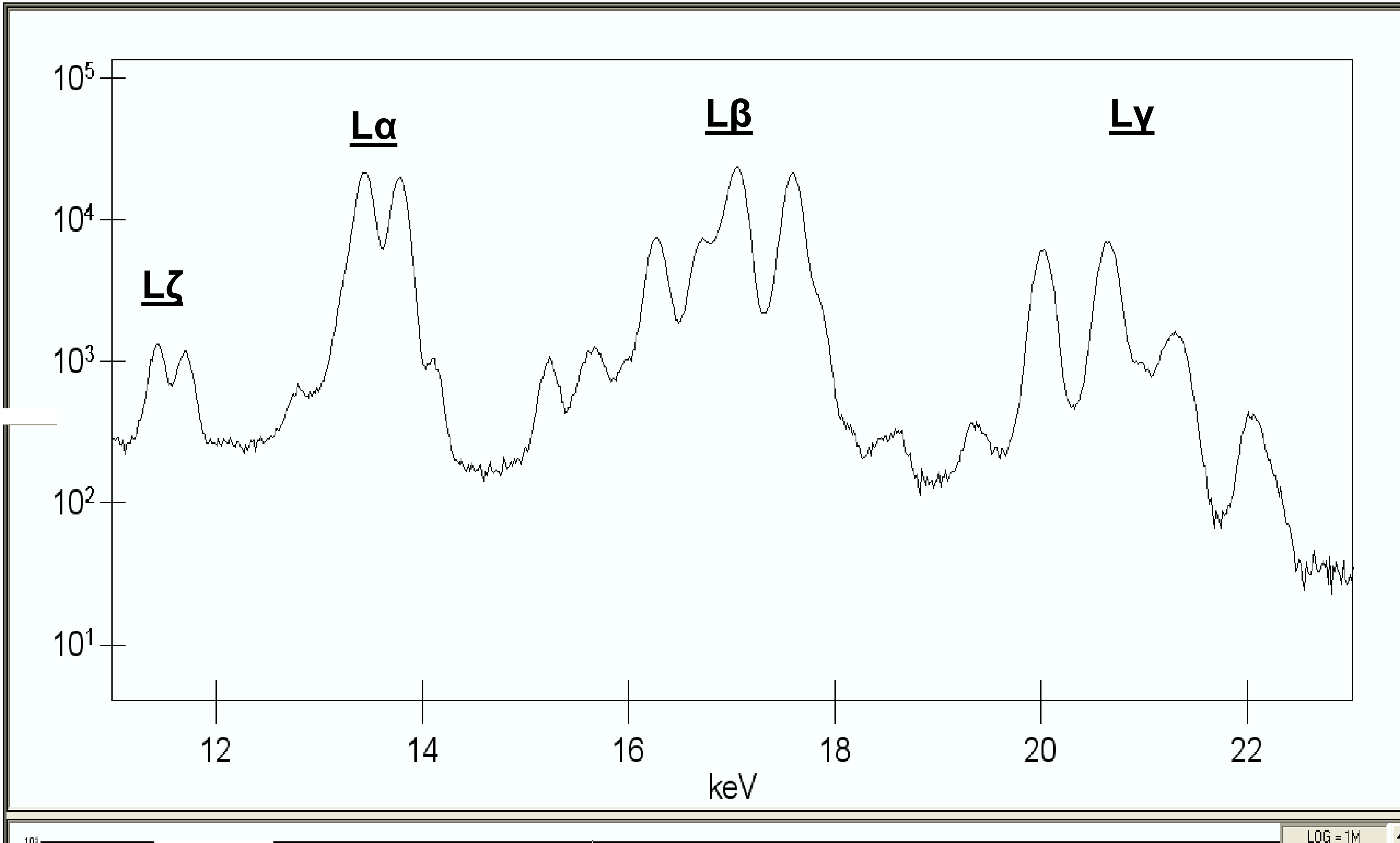
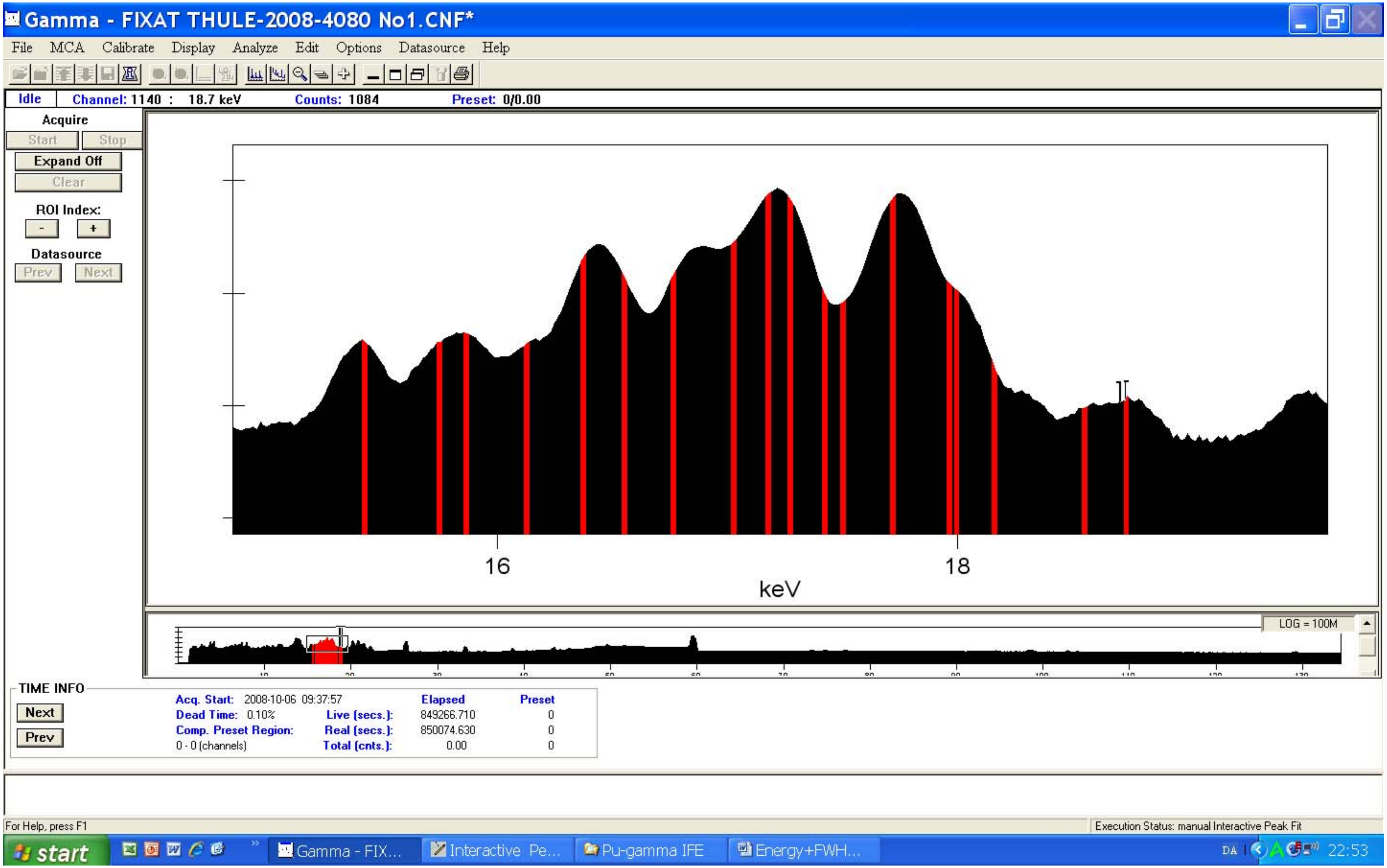
”1%” HPGe & 5kBq Pu-239 Thule particle (230 ksec)



Complexity of the Lx-peak groups (here Lβ in a Thule particle)



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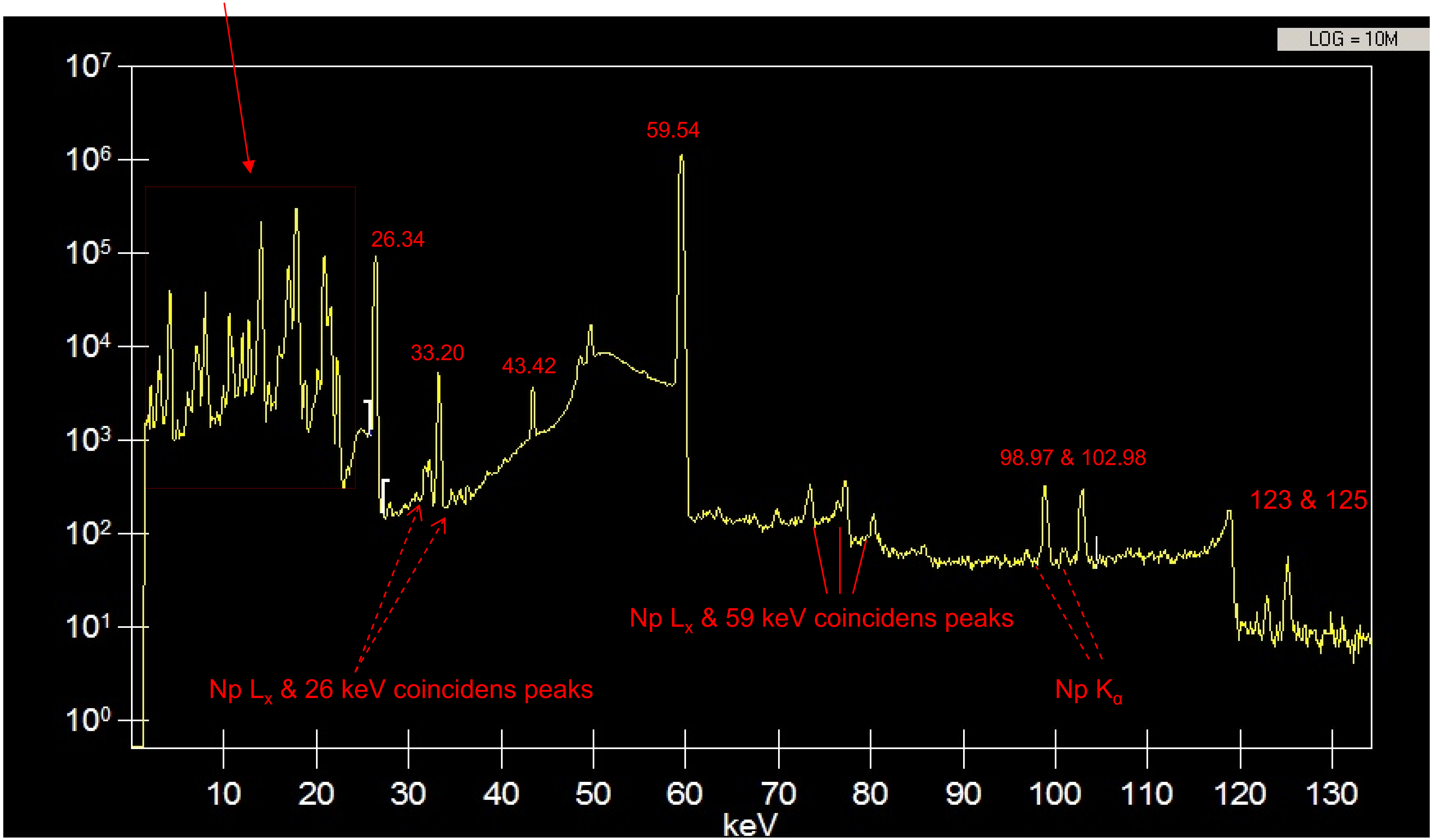
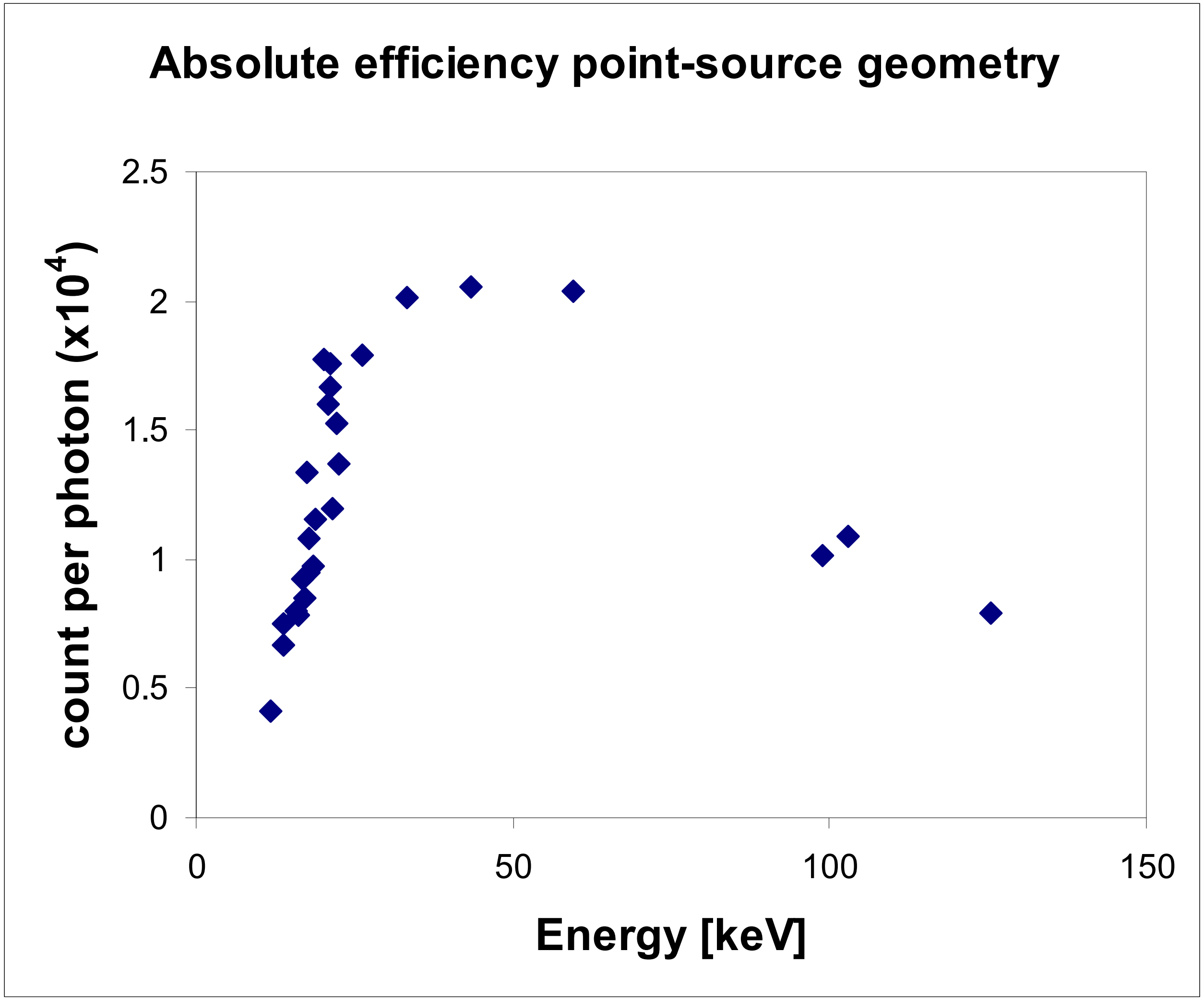
Efficiency calibration

^{241}Am point source in 'particle' geometry

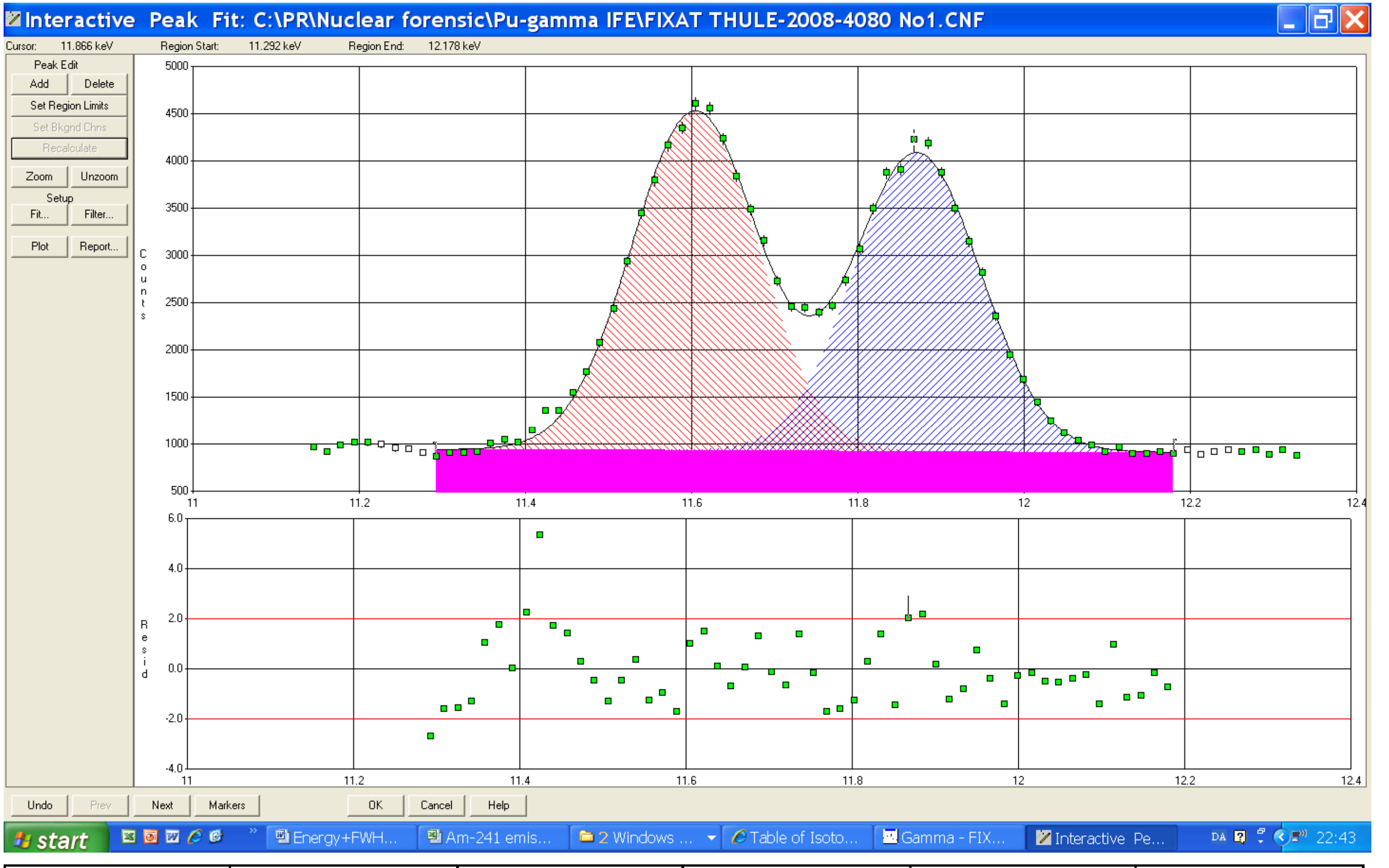
L_x-rays and Ge escape peaks



Efficiency from Am-241 Lx & gamma-rays



Using Genie-2000 interactive peak fit on the Lζ-group



Peak	Energy [keV]	Centroid Ch.	Peak area	Area error %	FWHM [keV]
1	11.603	706.96	41398	0.63	0.178
2	11.87	723.22	36643	0.68	0.179

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Summary Thule-particles (easy case)

- Total Pu activity and/or ^{239}Pu data from 'strong' peaks and the Lx-peaks provide data for $^{240}Pu/^{239}Pu$ ratio calculation even for weaker particles (tens of Bq). Other Pu-isotopes does not contribute to Lx.

- The advantage with the Lx-peaks is the strong emission.

- The disadvantage is the great risk of artefacts (escape peaks, compton peaks, unknown X-ray peaks or escape peaks from other isotopes.)

- More complicated cases are however of importance, eg the presence of other isotopes.

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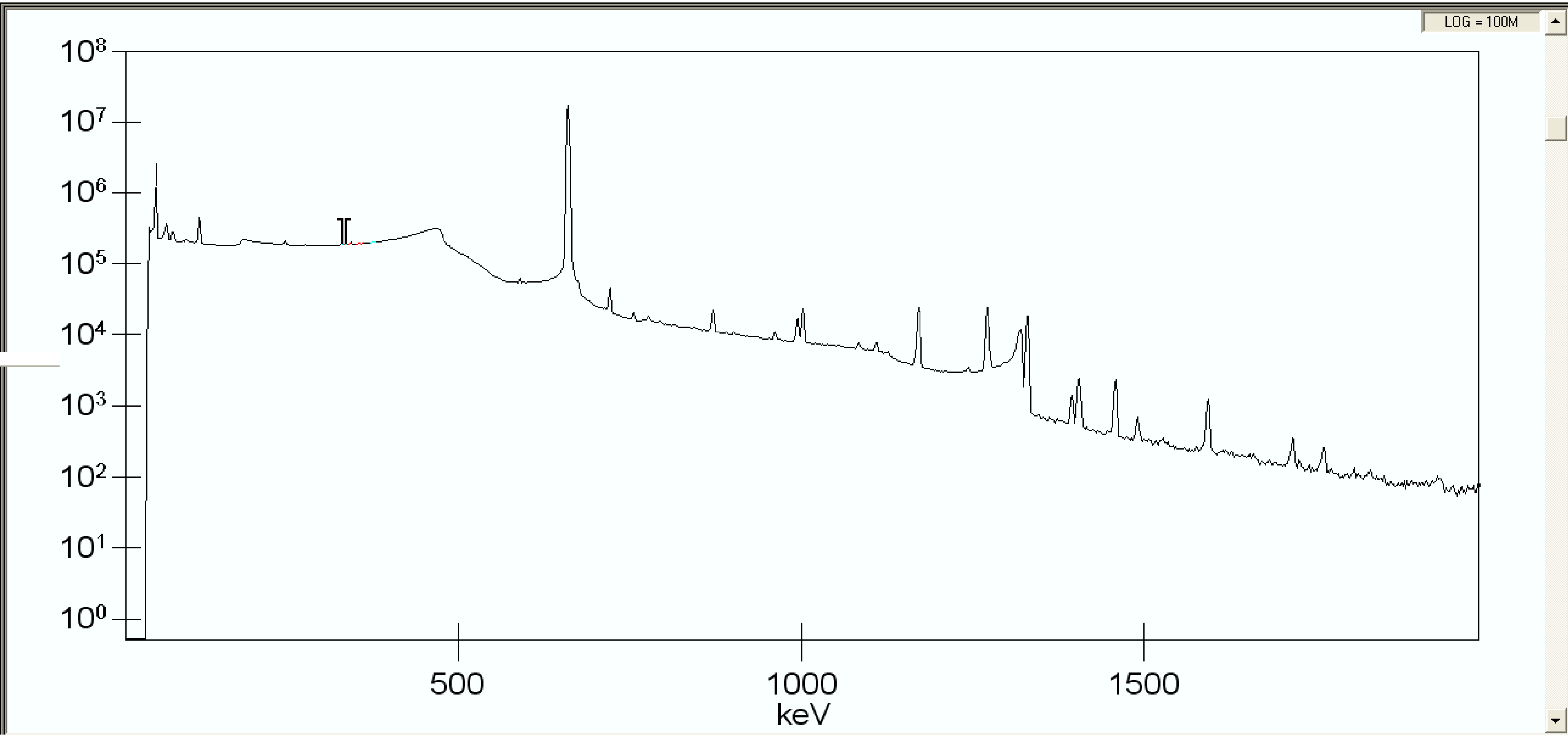
Hot-cell paint (PCB+Lead) – 50kBq/g Pu & 400 kBq/g 241Am



Pu gamma-lines masked by high background even on the ”1%” detector