

# ICN Germanium Detector Commissioning

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for the ICN-UNAM group

Biweekly meeting GCRF , 12 Oct 2018

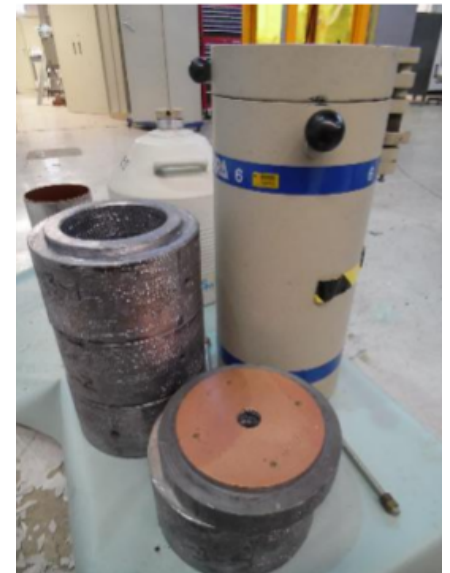
# Germanium Detector at ICN-UNAM

Donated by Fermilab DAMIC group at SiDet.

High Purity Germanium Detector EG&G ORTEC.  
model: CNHDS30-16195 CFG: SV  
S/N: 4034  
Operation voltage: 3200 V negative polarity.  
Fermilab S/N: 123627

Dewar "Union Carbide Corporation".  
Model: LD-31  
S/N: 80DC-5048  
Atmospheric pressure operation  
Fermilab S/N: NT11878

CANBERRA lead + Copper + Steel shield  
Fermilab S/N: 12029



# Germanium Detector at ICN-UNAM

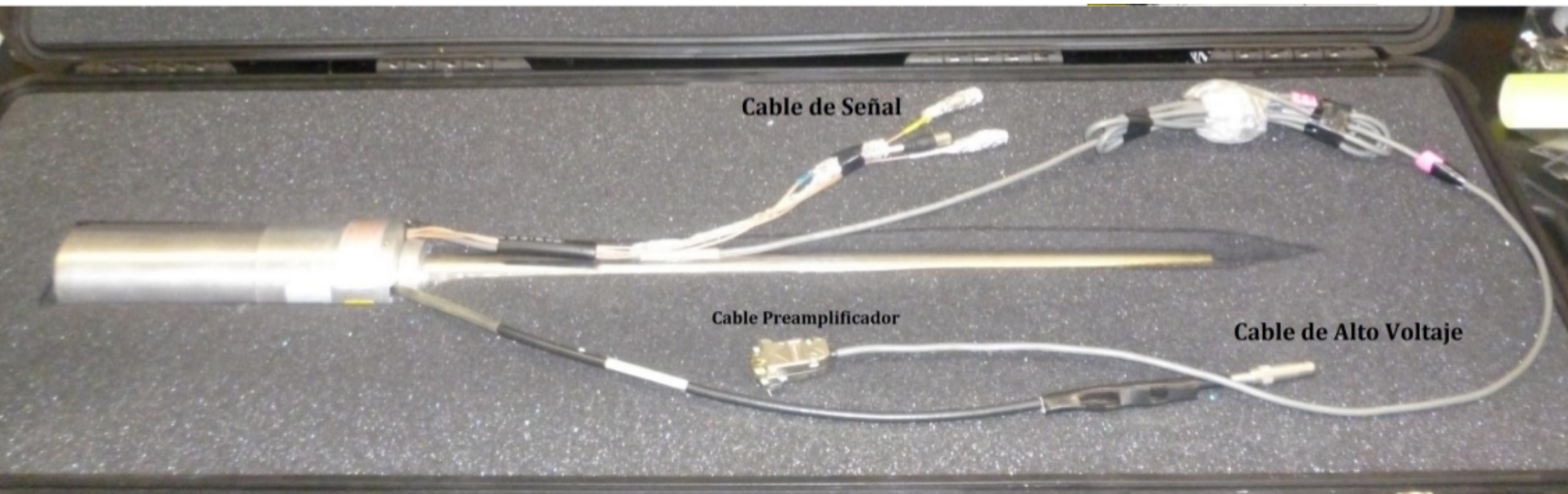
No documentation available. We know:

- Dimensions
- Operation voltage (3200 V negative polarity)
- Preamp voltages: +24 V y -24 V a 10 mA & +12 V y -12 V a 5 mA

## From comparison to current Ortec Models:

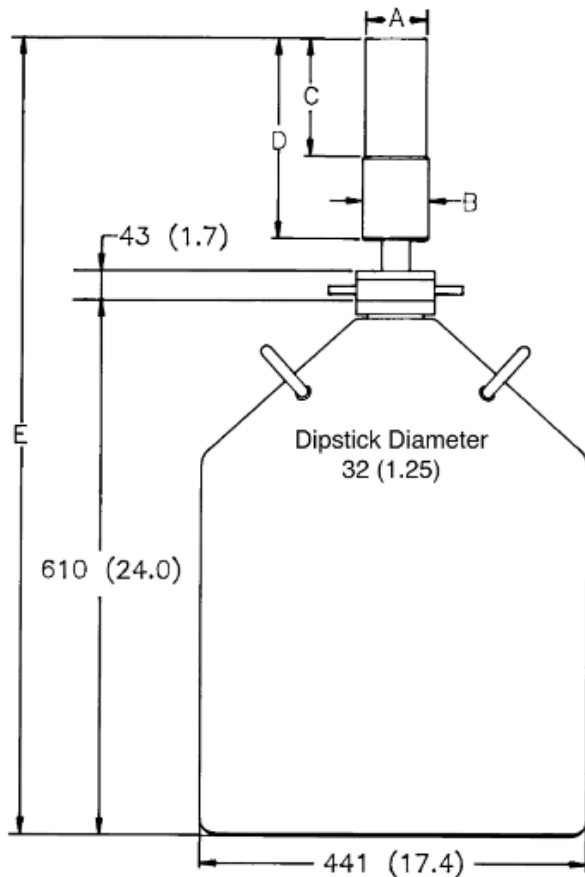
ORTEC HPGe Model GEM30P4, POPTOP CFG-SV DWR-30 is a possible match.

- Coaxial geometry with external diffused Li contact of 700 mm and internal contact by implanted B ions (0.3 mm)
- FWHM of 0.85 keV at low energies (122 keV) and 1.85 keV at high energies (1.33 MeV).



# Possible match ...

ORTEC HPGe Model GEM30P4,  
POPTOP CFG-SV DWR-30.



**CFG-SV, DWR-30**

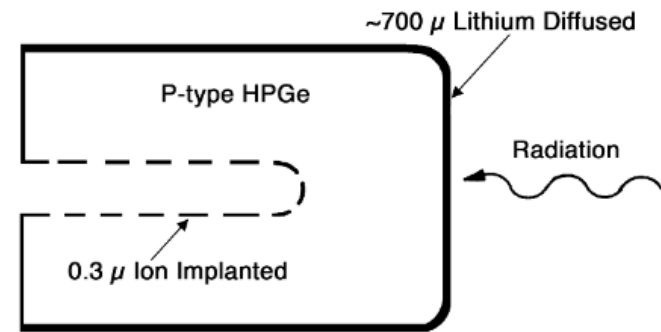


Fig. 1. Configuration of GEM Coaxial Germanium Crystal.

Endcap Model (dia. mm)			-70
% Efficiencies available in this endcap size			0-35
Dim.	Unit	Tol.	
A	mm (in)	0.3 (0.01)	70 (2.75)
B	mm (in)	0.3 (0.01)	75 (2.95)
C	mm (in)	5 (0.2)	134 (5.3)
D	mm (in)	8 (0.3)	250 (9.8)

ORTEC/Ametek GEM Configuration Guide (pages 7 & 11):

<https://www.ortec-online.com/-/media/ametekortec/brochures/gem.pdf>

# Amplifier and MCA

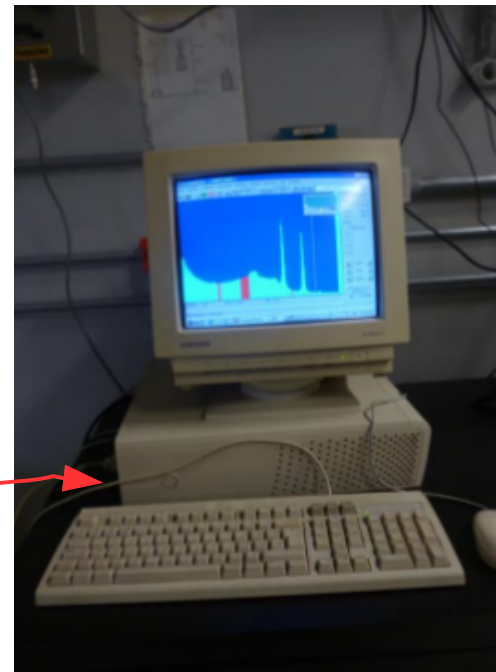
- Currently loan from irradiation unit at ICN
- Ortec 575A re-shaping amplifier.
- MCA: PCI board (ORTEC EG&G 713750 C2ML) and computer running GammaVision<sup>®</sup> software.



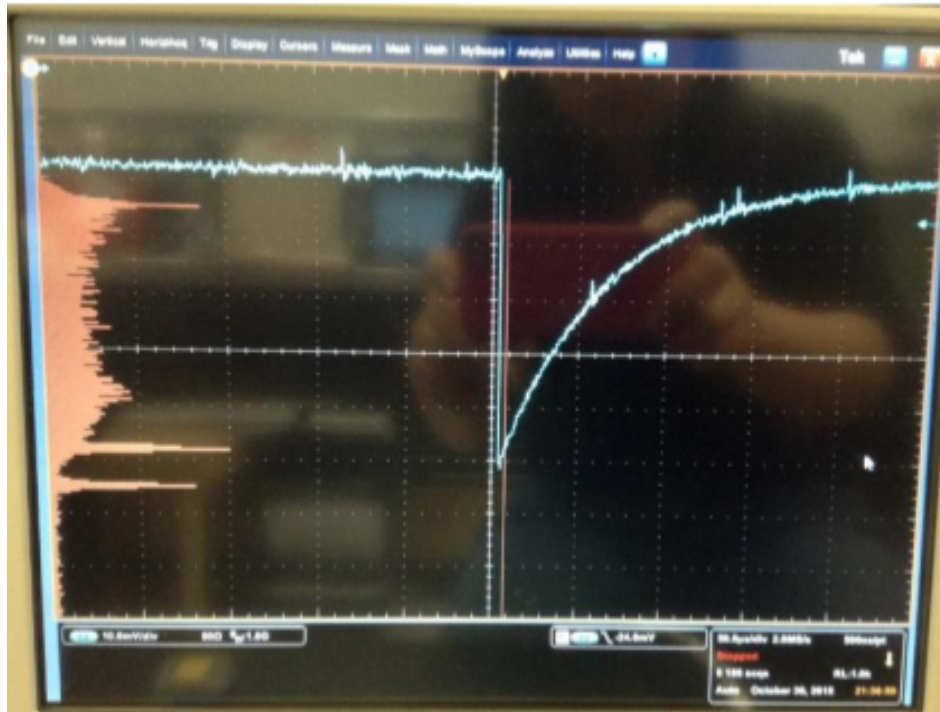
ORTEC EG&G 713750 C2ML



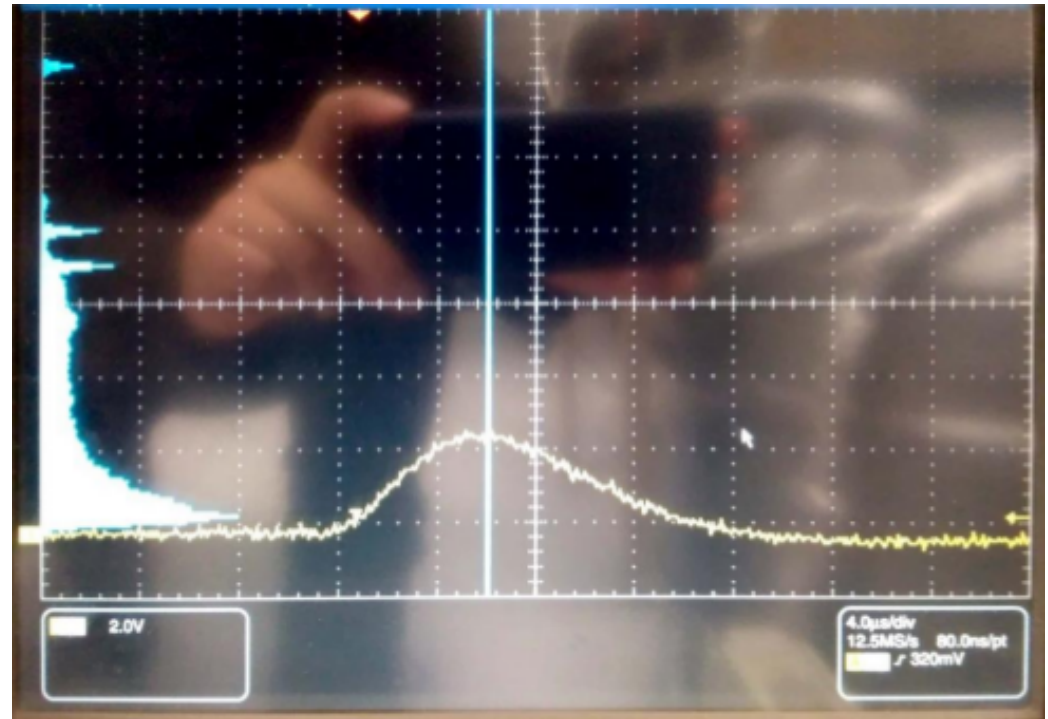
Computer from 90's



# Traces in the oscilloscope

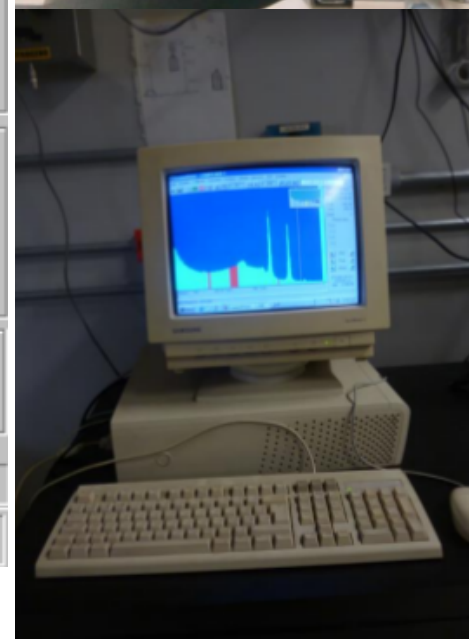
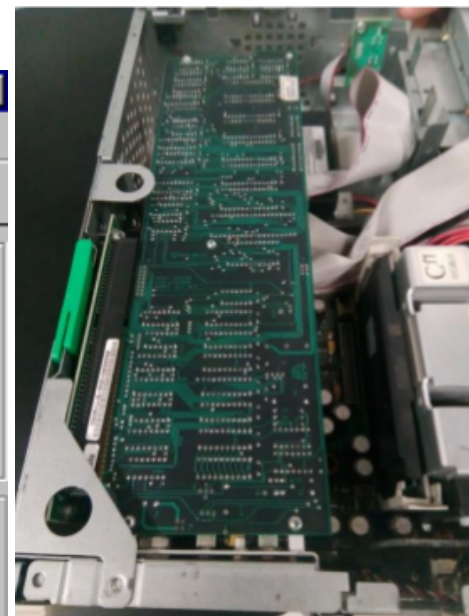
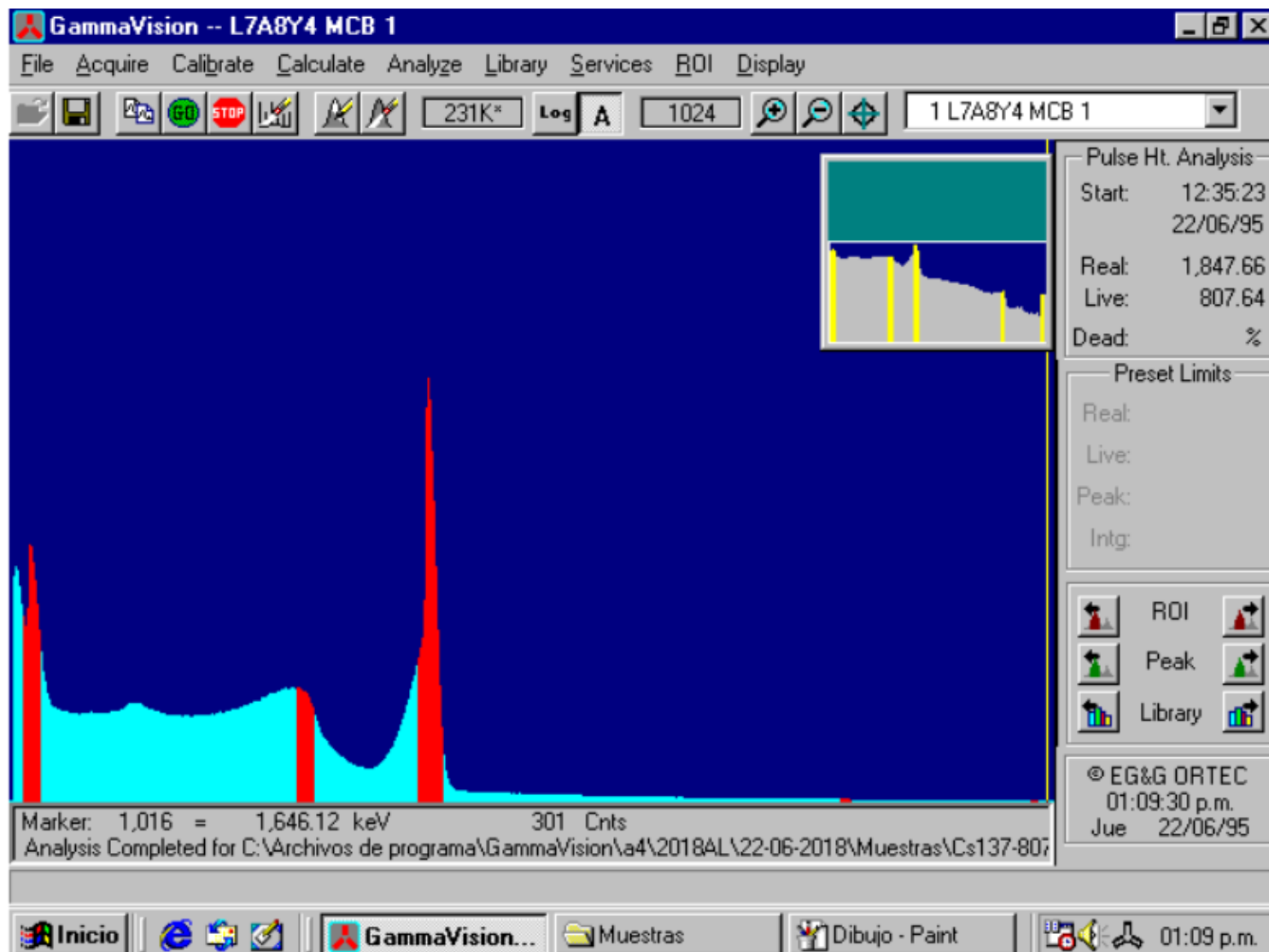


Preamplifier output  
Scope: 50 $\mu$ s/div; 10 mV/div



Re-shaped pulse (Ortec 575A)  
Scope: 4 $\mu$ s/div, 2.0 V/div

# GammaVision Software



# Calibration with radioactive sources





# Photopeak del $^{241}\text{Am}$

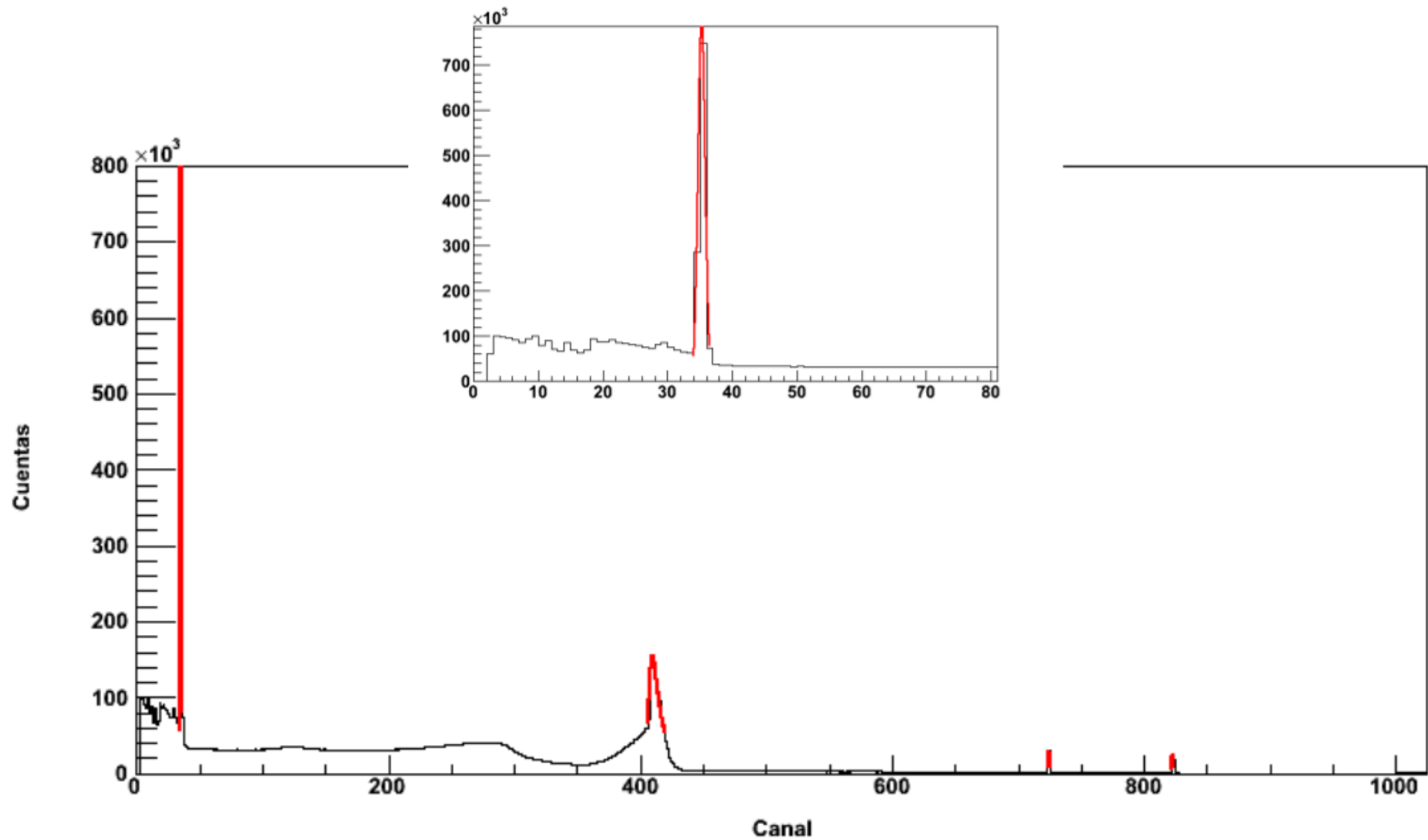


Figura 17. Espectro en canales de las 3 fuentes radiactivas  $^{241}\text{Am}$ ,  $^{137}\text{Cs}$  y  $^{60}\text{Co}$ .

# Photopeak del $^{137}\text{Cs}$

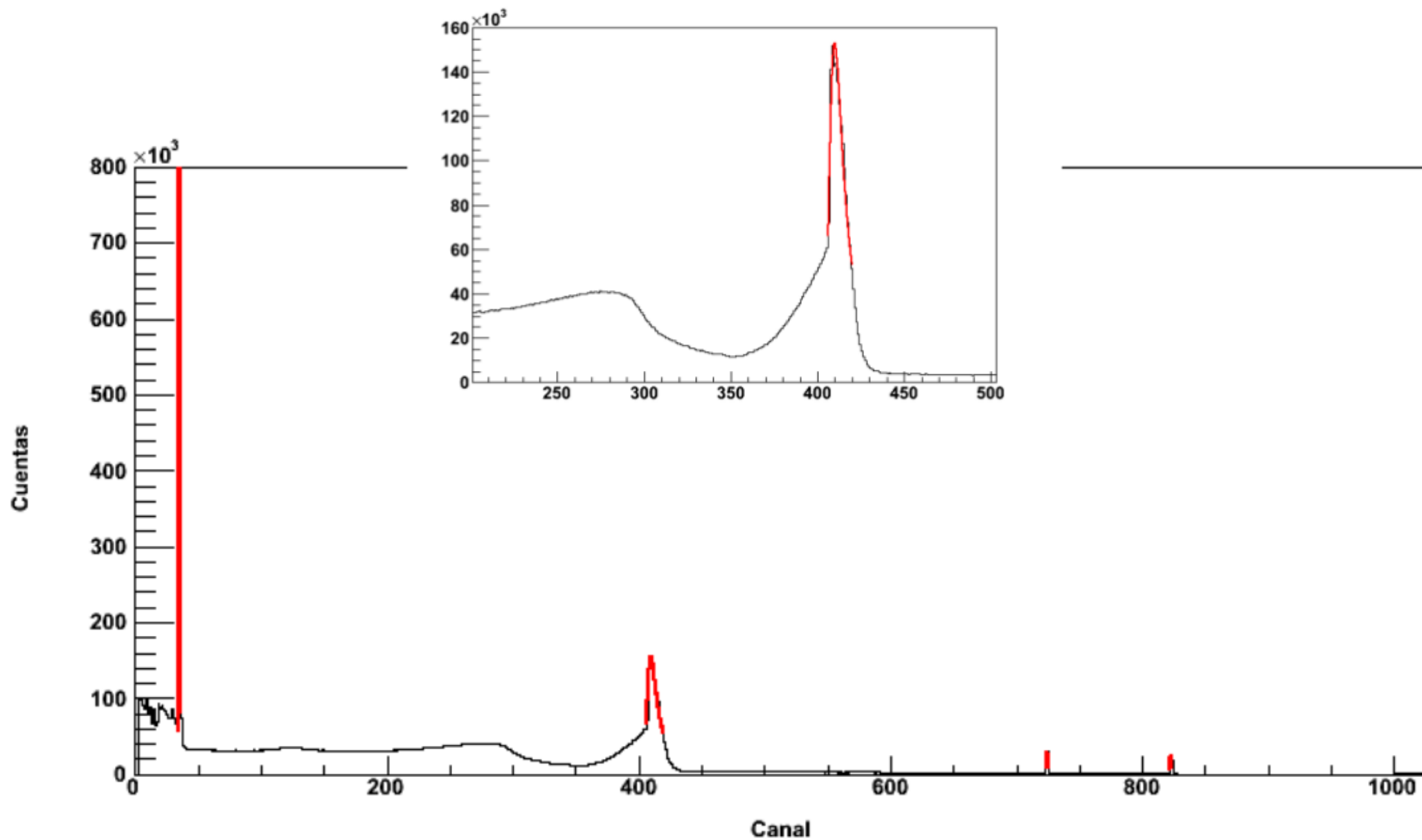


Figura 18. Espectro en canales de las 3 fuentes radiactivas  $^{241}\text{Am}$ ,  $^{137}\text{Cs}$  y  $^{60}\text{Co}$ .

# Photopeaks del $^{60}\text{Co}$

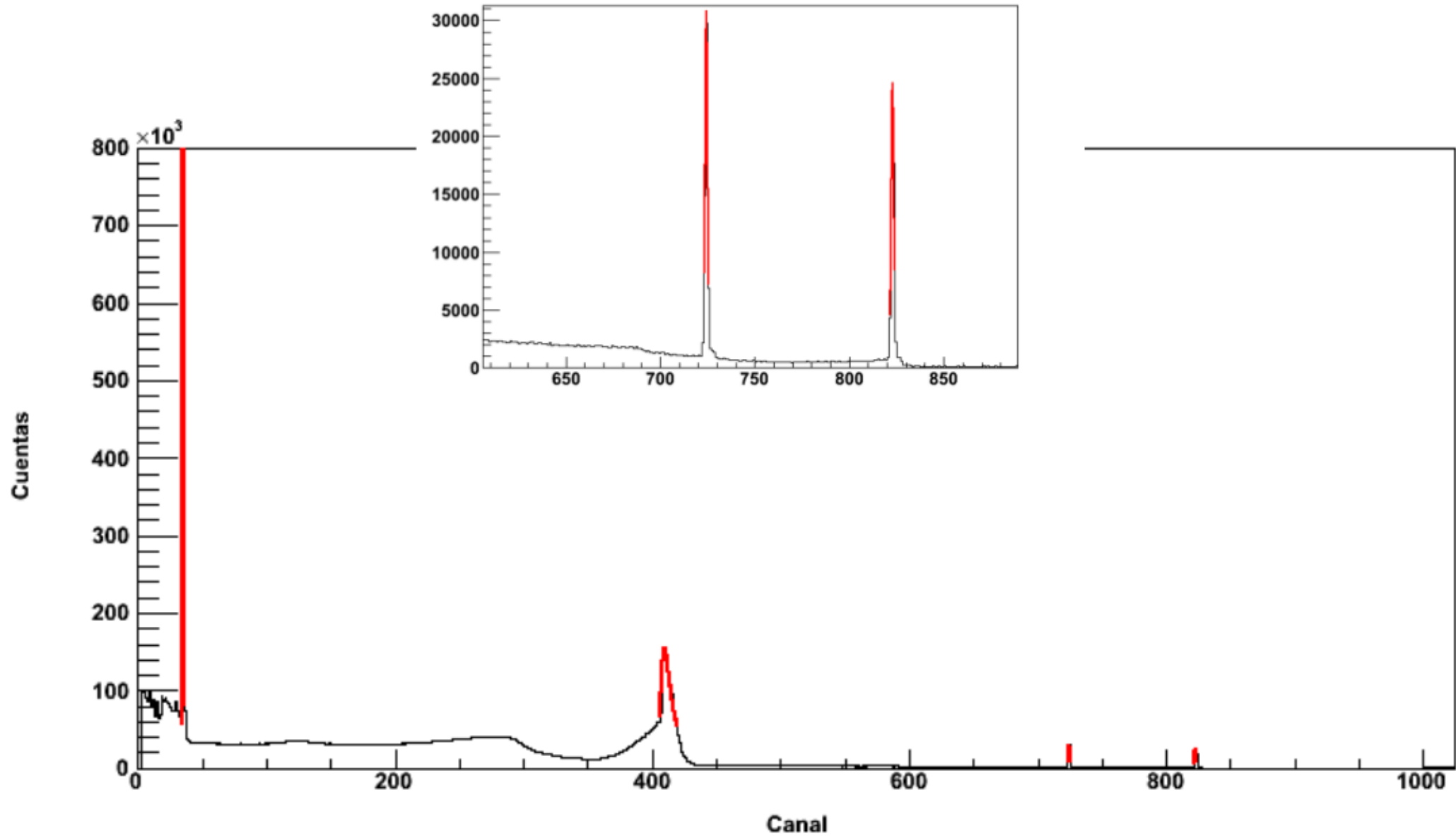


Figura 19. Espectro en canales de las 3 fuentes radiactivas  $^{241}\text{Am}$ ,  $^{137}\text{Cs}$  y  $^{60}\text{Co}$ .

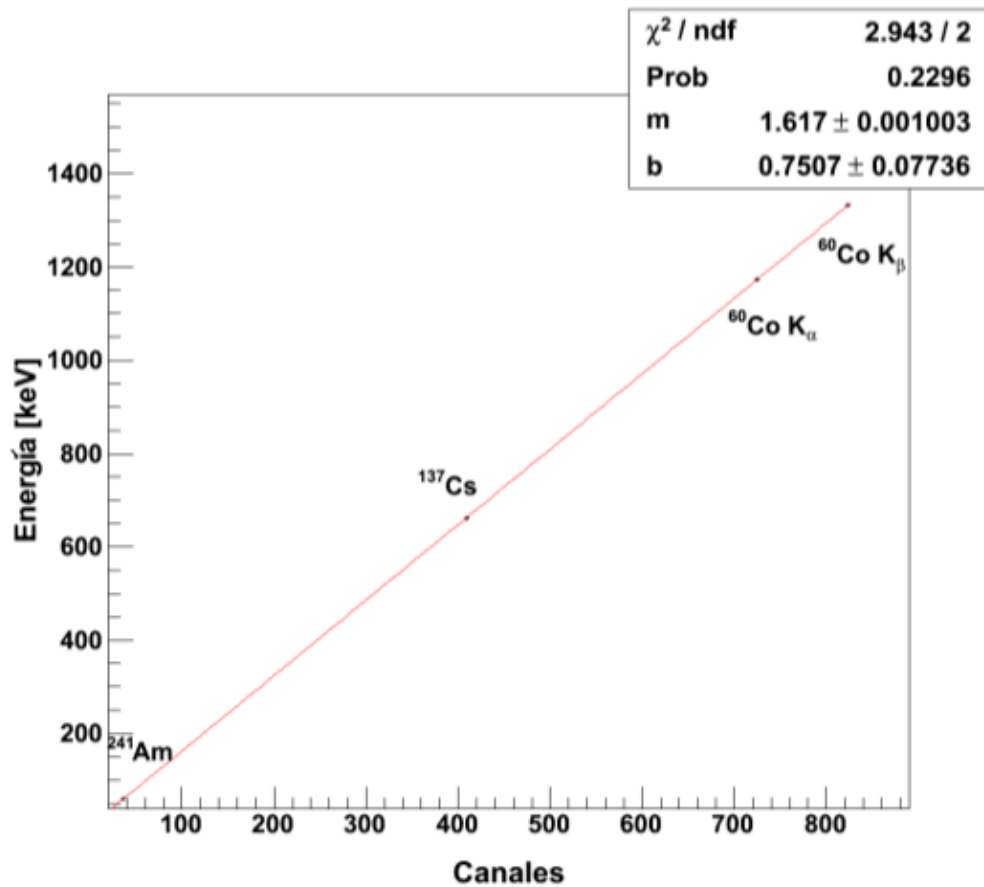


Figura 20. Curva de calibración del montaje GV.

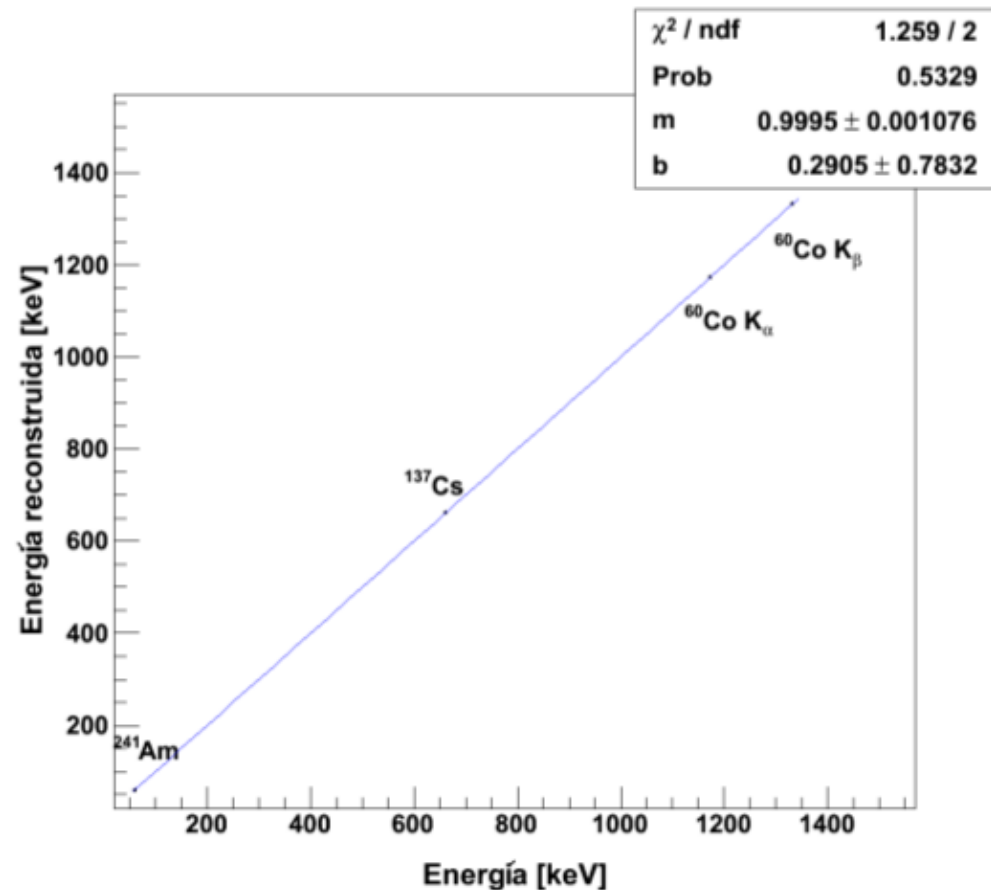


Figura 21. Relación de energía reconstruida y energía reportada en ND.

Fuente	Canal	Energía reconstruida [keV]	Energía ND [keV]
$^{241}\text{Am}$	$36.344 \pm 0.001$	$59.536 \pm 0.774$	$59.541 \pm 0.059$
$^{137}\text{Cs}$	$409.187 \pm 0.002$	$662.597 \pm 0.807$	$661.657 \pm 0.661$
$^{60}\text{Co } K_{\alpha}$	$724.323 \pm 0.003$	$1172.320 \pm 0.753$	$1173.237 \pm 1.173$
$^{60}\text{Co } K_{\beta}$	$822.889 \pm 0.003$	$1331.740 \pm 0.784$	$1332.501 \pm 1.332$

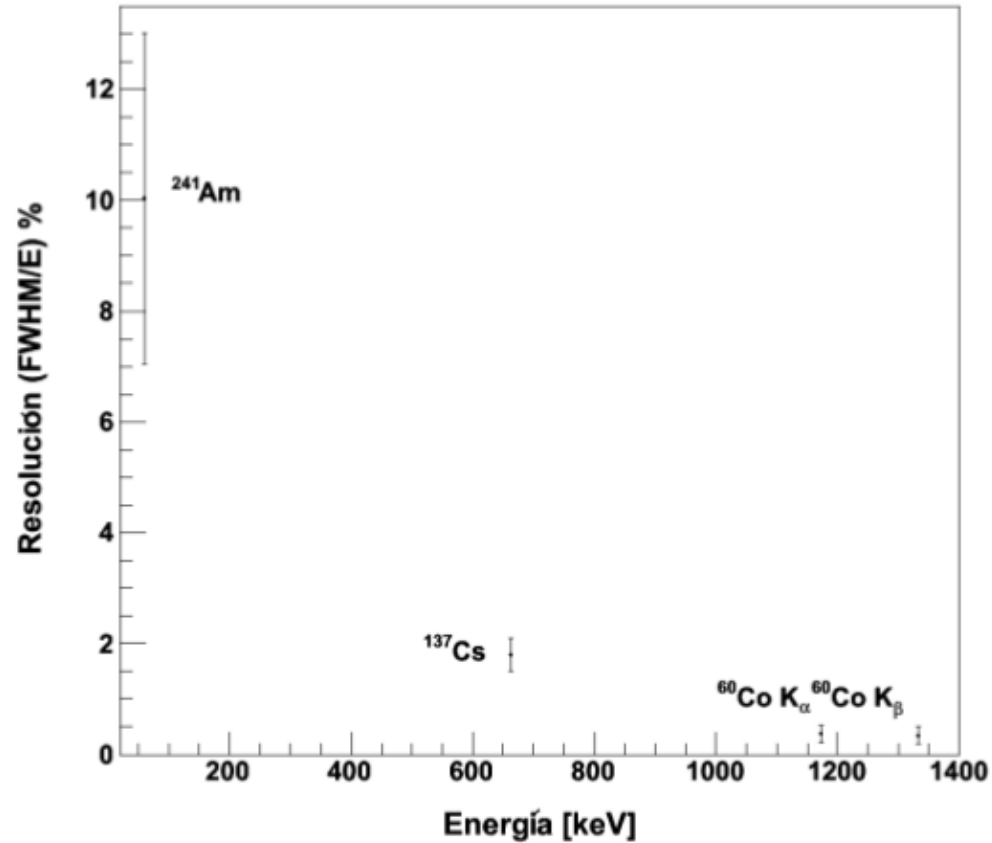


Figura 22. Resolución del detector de Ge usando el amplificador 575A de Ortec.

Fuente	FWHM [keV]	Resolución [%]
$^{241}\text{Am}$	$5.973 \pm 1.802$	$10.032 \pm 2.988$
$^{137}\text{Cs}$	$11.920 \pm 2.003$	$1.799 \pm 0.302$
$^{60}\text{Co } K_{\alpha}$	$4.361 \pm 1.772$	$0.372 \pm 0.151$
$^{60}\text{Co } K_{\beta}$	$4.615 \pm 2.054$	$0.346 \pm 0.154$

•  $^{241}\text{Am}$

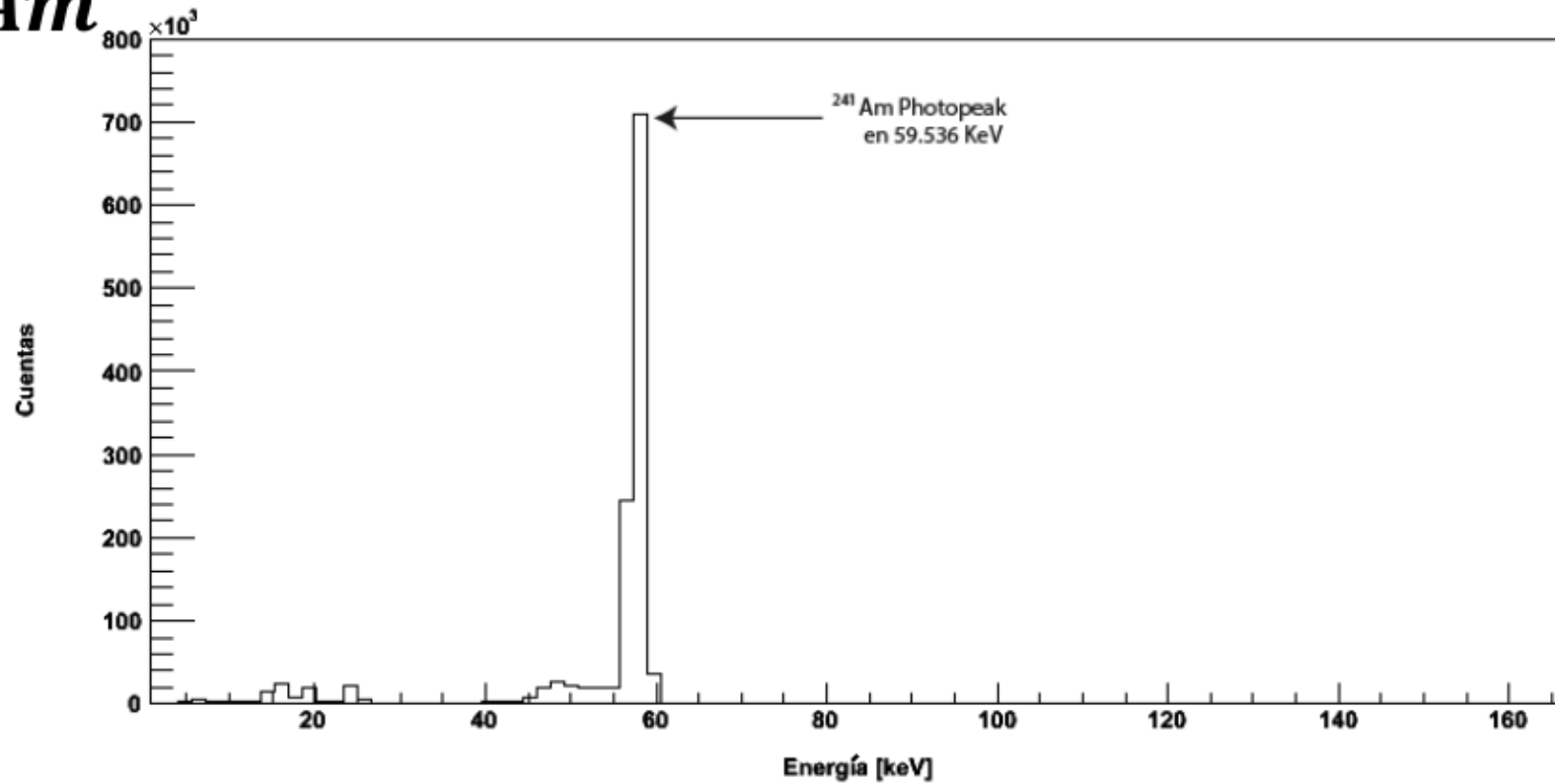


Figura 23. Espectro del  $^{241}\text{Am}$ .

Características del espectro	Energía medida [keV]	Energía esperada [keV]
Compton Edge	---	$11.253 \pm 0.011$
Photopeak	$59.536 \pm 0.774$	$59.541 \pm 0.059$

# $^{137}\text{Cs}$

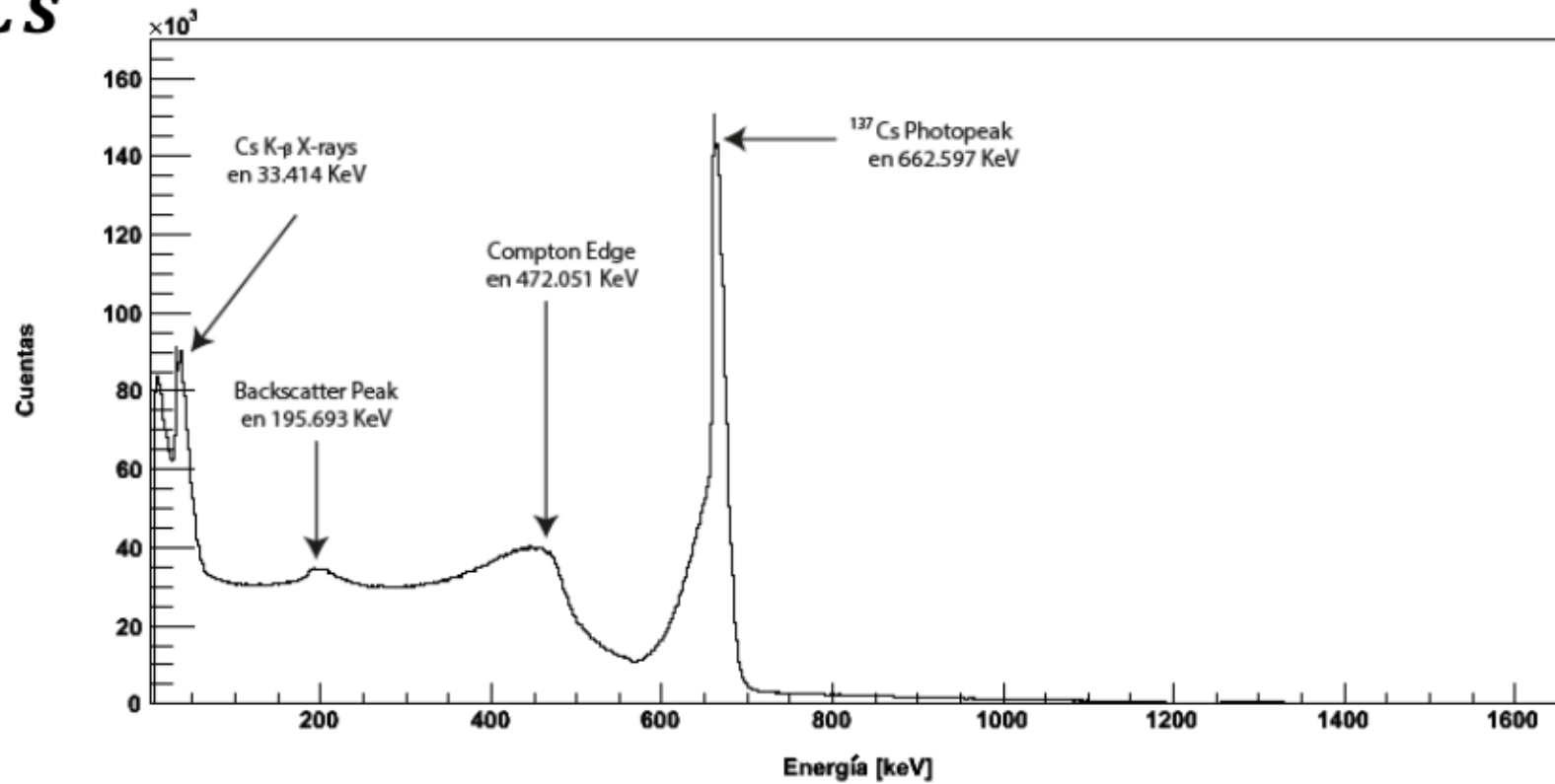
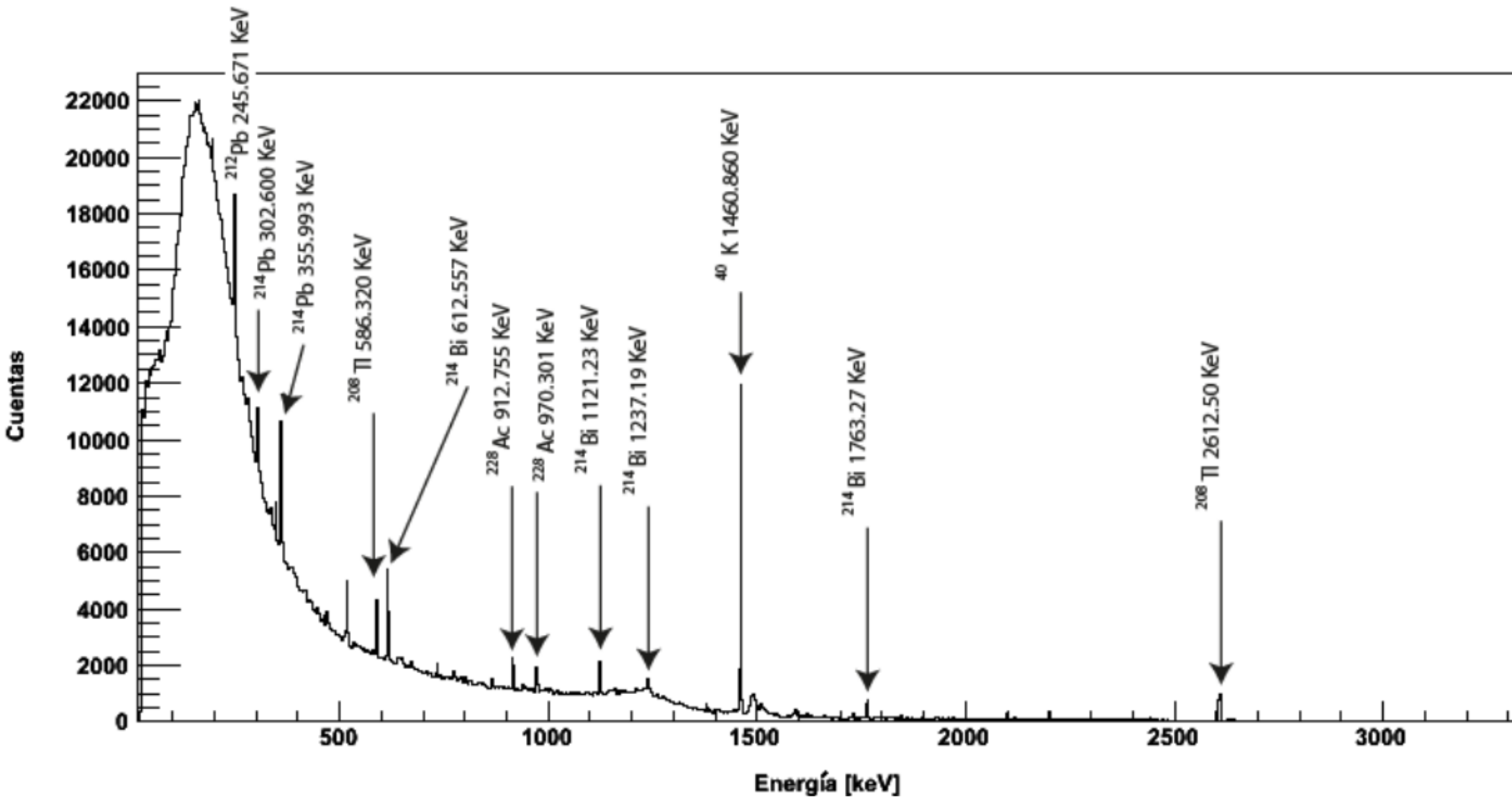


Figura 24. Espectro del  $^{137}\text{Cs}$ .

Características del espectro	Energía medida [keV]	Energía esperada [keV]
$^{137}\text{Cs}$ $K_{\beta}$ X-rays	$33.414 \pm 0.334$	$34.987 \pm 0.034$
Backscatter Peak	$195.693 \pm 1.956$	$184.283 \pm 0.184$
Compton Edge	$472.051 \pm 4.720$	$477.374 \pm 0.477$
Photopeak	$662.597 \pm 0.807$	$661.657 \pm 0.661$

# Natural background





# Samples of materials



Muestras Analizadas	Isótopos encontrados
Barro Negro	$^{235}\text{U}$ , $^{143}\text{Ce}$ , $^{207}\text{Bi}$
Cuarzo	$^{60}\text{Co}$ , $^{139}\text{Ce}$ , $^{214}\text{Pb}$
Electrolitos orales (IMSS)	$^{234}\text{Pa}$ , $^{125}\text{Sb}$ , $^{40}\text{K}$
Piedra Volcánica	$^{40}\text{K}$ , $^{203}\text{Hg}$ , $^{214}\text{Pb}$
Sustituto de Sal "NOVOXAL"	$^{40}\text{K}$ , $^{139}\text{Ce}$

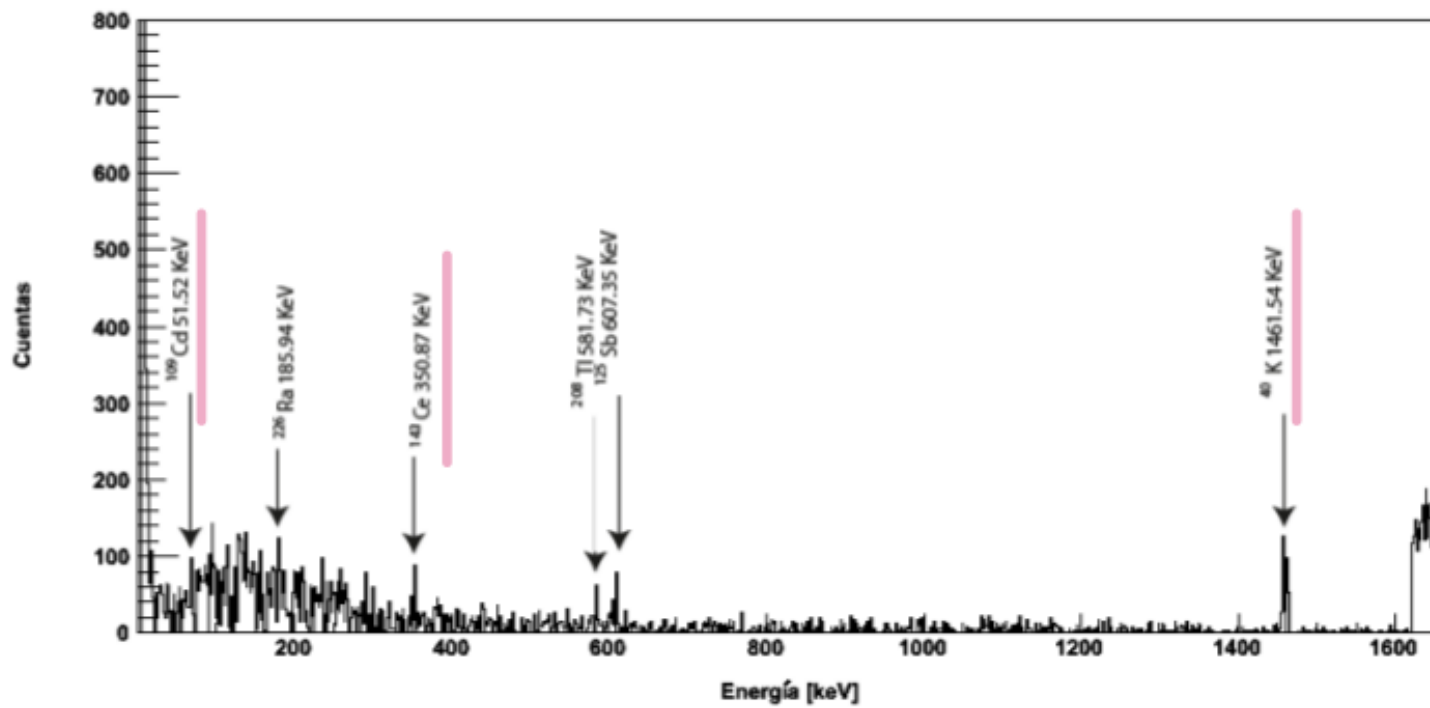
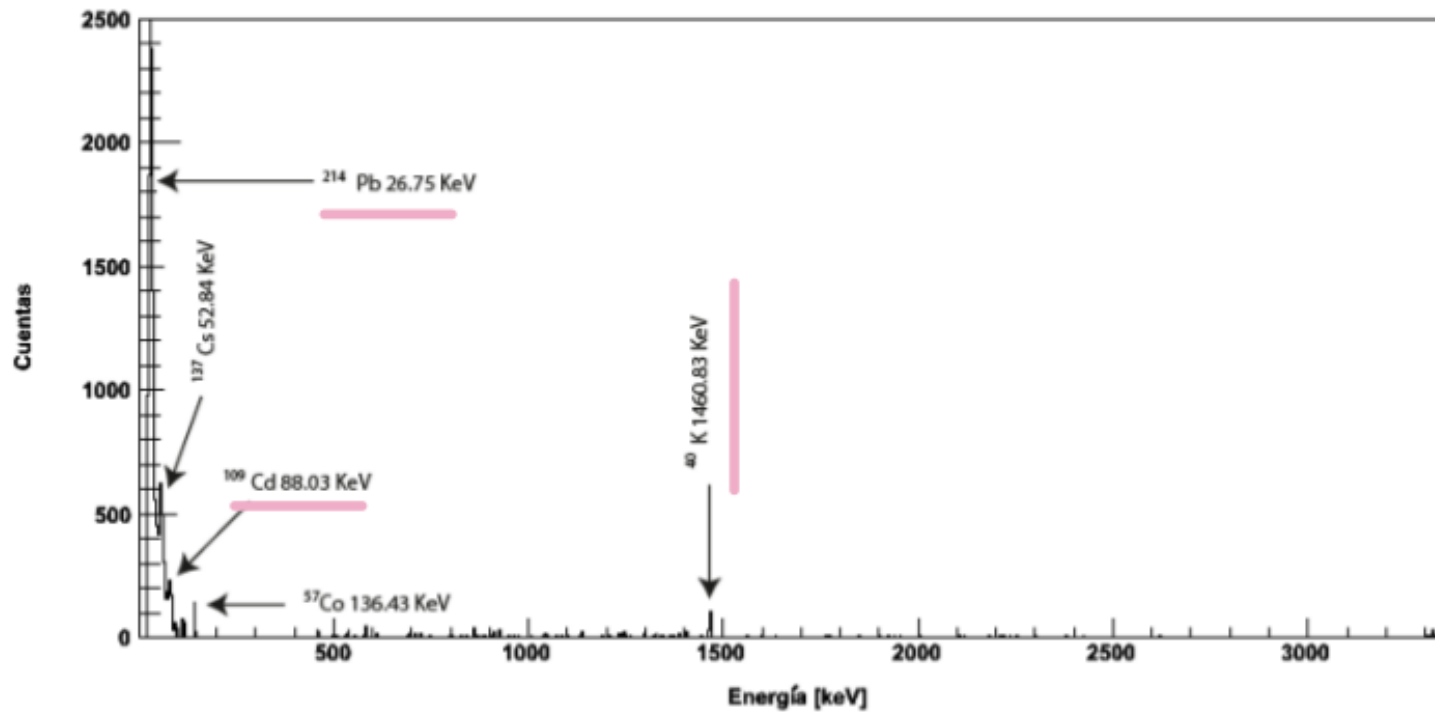


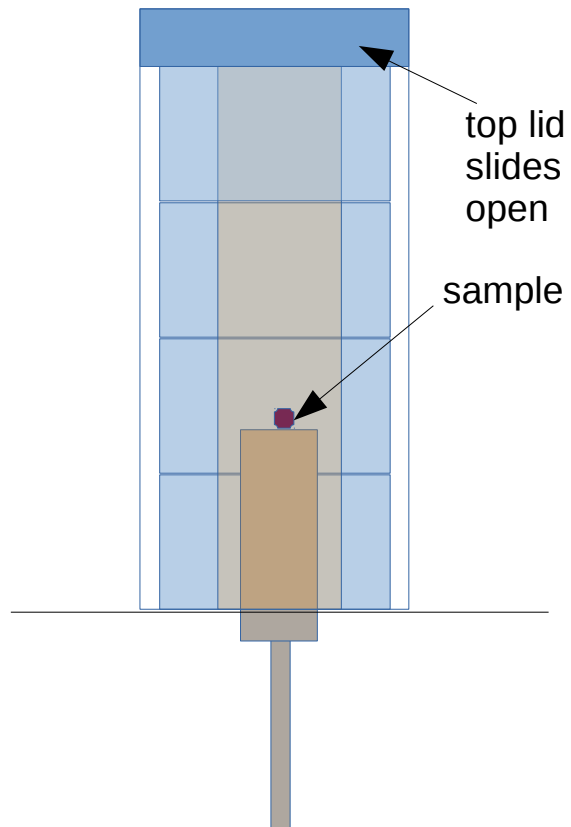
Figura 26. Espectro de café de FC-UNAM



# Current status

Pb + Cu shield:

- 4 Pb cylinders stacked inside steel jacket lined with Copper.



# Current status



# Summary

- Tested the detector at our lab at ICN-UNAM. Detector seems to be working close to specifications (resolution).
- No documentation, but close match to existing ORTEC model based on exterior dimensions.
- No measure of detector efficiency yet.
- Recent tests with full Pb+Cu+steel shield show important reduction of background rate.
- Considering LN2 re-filling option (10 L/ week) with a local vendor.
- Will test detector with ICN from IF-UNAM (Eric)

Thanks to CINVESTAV students (Guadalupe Moreno, Johan Chávez, Karen Meza) and Mauricio Martínez (Technician ICN-UNAM) for helping with the measurements and setup!