

9/21/24

# Lab #1: Abundances data and Results

- 1.) • Co-60, Bar-133,  
Cs-137 will be  
use to calibrate
- Eu-152 will be used  
for energy-dependent detector  
efficiency.
- Use Residuals to test  
how good Calibration detector

efficiency is .

- Know how much  $N$  needed for each spectrum; also precision; How long they took; the data files taken / source ; amplifier settings

- Barium :

- Peak # 1 :
  - $N_S = 662.938$
  - $N_0 = 180$
  - $N_T = 842.938$
  - Mean = 1563.71 channel
  - Energy = 276.400 keV
  - Std-err = 0.122
  - Energy-err = 0.001

- Peak #2 :  $N_s = 1755.43$ 
  - mean = 1700.76 channel
  - Energy = 302.851 keV
  - std-err = 0.069
  - Energy-err = 0.001
- Peak #3 :  $N_s = 4563.47$ 
  - mean = 1976.12 channel
  - Energy = 356.013 keV
  - std-err = 0.0422
  - channel-err = 0.001

Peak #4 :  $N_s = 612.644$

- mean = 2120.32 channel
- Energy = 383.848 keV
- std-err = 0.122
- energy-err = 0.001

Peak #5 : .  $N = 1445.62$

- Mean = 6202.74 channel
- energy = 1173.237 keV
- std-err = 0.123
- energy-err = 0.004

Peak #6 : .  $N = 1184.28$

- Mean = 7025.74 channel
- energy = 1332.501 keV
- std-err = 0.48
- energy-err = 0.005

Peak #7: •  $N = 2262.2$

- channel = 3556.72 channel
- Energy = 661.657 keV
- std-err = 0.077
- Energy-err = 0.003

## Energy Calibration :

- $a(\text{slope}) = 0.193356 \pm 4.046 \times 10^{-6}$
- $b(\text{Intercept}) = -26.0566 \pm 0.011713$
- $E = 0.193356 \times \text{channel}$   
- 26.0566

# • Barium Residuals :

- $E_1(Lit) = 276.400 \text{ keV}$
- $E_2(Lit) = 302.851 \text{ keV}$
- $E_3(Lit) = 356.013 \text{ keV}$
- $E_4(Lit) = 383.848 \text{ keV}$

- $E_1(Fit) = 276.296 \text{ keV}$
- $E_2(Fit) = 302.796 \text{ keV}$
- $E_3(Fit) = 356.038 \text{ keV}$
- $E_4(Fit) = 383.92 \text{ keV}$

$$\cdot J_{1(Fit)} = 0.006922$$

$$\cdot J_{2(Fit)} = 0.006621$$

- $\sigma_3(\text{fit}) = 0.006122$
- $\sigma_4(\text{fit}) = 0.005927$
- $\text{Cor}(a,b) = -4.18 \times 10^{-8}$
- $\sigma_a = 4.01461 \times 10^{-6}$
- $\sigma_b = 0.0117173$

$$R_1 = -0.104$$

$$R_2 = -0.055$$

$$R_3 = 0.025$$

$$R_4 = 0.072$$

## • Cesium Residuals :

- $E_1(\text{fit}) = 661.6566$
- $E_1(\text{Lit}) = 661.657$

- $\text{Cov}(a, b) = -4.11 \times 10^{-8}$
- $\sigma_A = 4.01461 \times 10^{-6}$
- $\sigma_B = 0.0117173$
- $\sigma_{CE} = 0.00694621$
- $R = -4 \times 10^{-4} = -0.0004$

## Cobalt - 60 Residuals:

- $E_1^{(Lit)} = 1173.237 \text{ keV}$
- $E_2^{(Lit)} = 1332.501 \text{ keV}$
- $E_1^{(Fit)} = 1173.28 \text{ keV}$
- $E_2^{(Fit)} = 1332.412 \text{ keV}$
- $\text{Cov}(a, b) = -4.11 \times 10^{-8}$
- $\sigma_A = 4.01461 \times 10^{-6}$

$$\cdot \sigma_B = 0.0117173$$

$$\cdot \sigma_{CE_1} = 0.0157012$$

$$\cdot \sigma_{CE_2} = 0.0188205$$

$$\cdot R_1 = 0.043$$

$$\cdot R_2 = -0.089$$

## • Europium •

• Peak # / :

• Range = 745-775

•  $N_T = 20758.1$

•  $N_S = 19458.1$

•  $N_b = 1300$

•  $\sigma_{\text{counting}} = 148.52$

•  $\sigma_{\text{stdev}} = 0.0181816$

- $E_{fit} = 120.37$
- $E_{L,t} = 121.78$
- $R = -1.412$
- $\sigma_{En} = 0.001$
- $\sigma_{cal} = 0.00918$
- $B_{funkt} = 10.0$
- $B_{Rage} = 751 - 764$
- $\bar{X} = 757.292$

(Calibration formula:

$$\sigma_{cal} = \sqrt{\chi^2 \sigma_A^2 + \sigma_B^2 + 2 \times \text{Cov}(A, B)}$$

- Peak # 2 :
- Range = 1385 - 1410
- NT = 3477.63

- $N_s = 2877.63$
- $N_B = 600$
- $\sigma_{\text{rel}} = 5.38 \times 10^{-5}$
- $\sigma_{E_n} = 0.001$
- $\sigma_{\text{count}} = 63.86$
- $E_{\text{fit}} = 244.49 \text{ keV}$
- $\bar{E}_{L;+} = 244.697 \text{ keV}$
- $\sigma_{\text{Stdev}} = 0.0562581$
- $\bar{X} = 1399.21$
- $B_{\text{func}} = 40$
- $B_{\text{Range}} = 1392-1407$
- $R = -0.207$

next 2 Peaks :

$$\text{Range}_3 = 1900-1930$$

Range 4 = 4140 - 4190

# Lab #1 Data Collection (9/23)

## Day #4

(2:24 - 3:04)

- $E_{\nu r} \rightarrow 40 \text{ min}$  (1) (2) (3)  
• Precision = .46, 1.14, 0.785
- tag4000 -  $E_{\nu}$  1.8, 2.41
- dat2xy tag3001.dat (6) (7)

command to  
convert to XY

$V_r$  (3:15 - 3:55) 40 min

- Prec = 0.294, 1.14, 0.294  
 $\downarrow$  (Low) (High) (Low)
- tag 4001 -  $V_r$

(9/23)

# Europium ;

Peak #3 :

$$\bullet N_b = 360$$

$$\bullet N_T = 7179.08$$

$$\bullet N_S = 6819.08$$

$$\bullet \sigma_{std} = 0.05703$$

$$\bullet \sigma_{En} = 0.001$$

$$\bullet \sigma_{cal} = 0.0062$$

$$\bullet \sigma_{cont} = 86.8$$

$$\bullet \beta_{Rang} = 1906-1924$$

$$\bullet Range = 1900-1940$$

$$\bullet R = 0.081$$

$$\bullet B_{funt} = 20$$

$$\bar{X} = 1915.57$$

$$E_{S1f} = 344.36 \text{ kJ}$$

$$E_{L1f} = 344.27 \text{ J}$$

- Lab (Gain Settings):

1.) Fine gain : 11.95 (1.195)

Course gain : 20

Shaping : 3 ms

Total = CG • FG

- Lab (connection (ords)):

1.) OutPut1 - Scope 4

OutPut2 - Amp

Red/Green - high volt / Bias

Gev (Pulse-  
Preamp) - Amp / Shutdown  
Green - Shutdown - Back  
Interlock / high  
high voltage  
section.

## Europium

Peak #4:

- $\bar{X} = 2431.59$
- $N_S = 468.167$
- $N_b = 374$
- $N_T = 842.167$
- $E_{fit} = 444.106 \text{ keV}$
- $E_{L fit} = 443.965 \text{ keV}$

- $\sigma_{\text{cal}} = 0.00572$
- $\sigma_E = 0.003$
- $\sigma_{\text{Stdev}} = 0.249915$
- Range = 2420-2445
- Bin Space = 25
- $\sigma_{\text{count}} = 34.87$
- Bin Sidewidths =  
2395-2420 ; 2445-2470
- $R = 0.141$

Peak #5 :

- $N_T = 1434.21$
- $N_B = 374$
- $N_s = 839.713$
- $\sigma_{\text{count}} = 42.52$

- Range = 4140 - 4200
- Siderwidths = 4080 - 4140; 4200 - 4260
- BinSpace = 60
- $\sigma_E = 0.002$
- $\sigma_{\text{std-err}} = 0.164962$
- $E_{\text{Fit}} = 778.821 \text{ keV}$
- $E_{\text{L fit}} = 778.904 \text{ keV}$
- $X = 4162.67$
- $R = -0.083$
- $\sigma_{\text{cal}} = 0.00863$

## Europium Data #1 Intensities:

(Ref)

Peak 1:  $I = 100$   $\sigma_I = 0.12$

Peak 2:  $I = 27.9$   $\sigma_I = 0.03$

Peak 3:  $I = 97.9$   $\sigma_I = 1.5$

Peak 4:  $I = 11.40$   $\sigma_I = 0.027$

Peak 5:  $I = 480$   $\sigma_I = 0.09$

## Run #1 Efficiencies:

$$\epsilon_{eff1} = 1.0 \pm 0.001$$

$$\epsilon_{eff2} = 0.5301 \pm 0.0127$$

$$\epsilon_{eff3} = 0.358 \pm 0.00765$$

$$\Sigma_{\text{ff}} = 0.211 \pm 0.0158$$

$$\Sigma_{\text{ff}} = 0.0899 \pm 0.0046$$

$$a = 2.22 \times 10^{-6}$$

$$\sigma_A = 2.32 \times 10^{-7}$$

$$b = -0.0031$$

$$\sigma_b = 0.000254$$

$$c = 1.16$$

$$\sigma_c = 0.0585$$

$$\chi^2 = 0.563$$

$$\text{ndf} = 1$$

function :  $a x^2 + b x + c$

## Fair settings :

$$FG = 1.195$$

$$CG = 20$$

$$\text{Sharpening} = 3\mu s$$

$$\text{Total Gain} = CG \times FG = 23.9$$