LOW RADIOACTIVITY

MEASURES AND ANALYSIS

STEPS OF ANALYSIS:

- Calibration of spectrum
- Counting of events in the ROI
- Estimation of activity concentration of each radionuclides by using the data of simulation

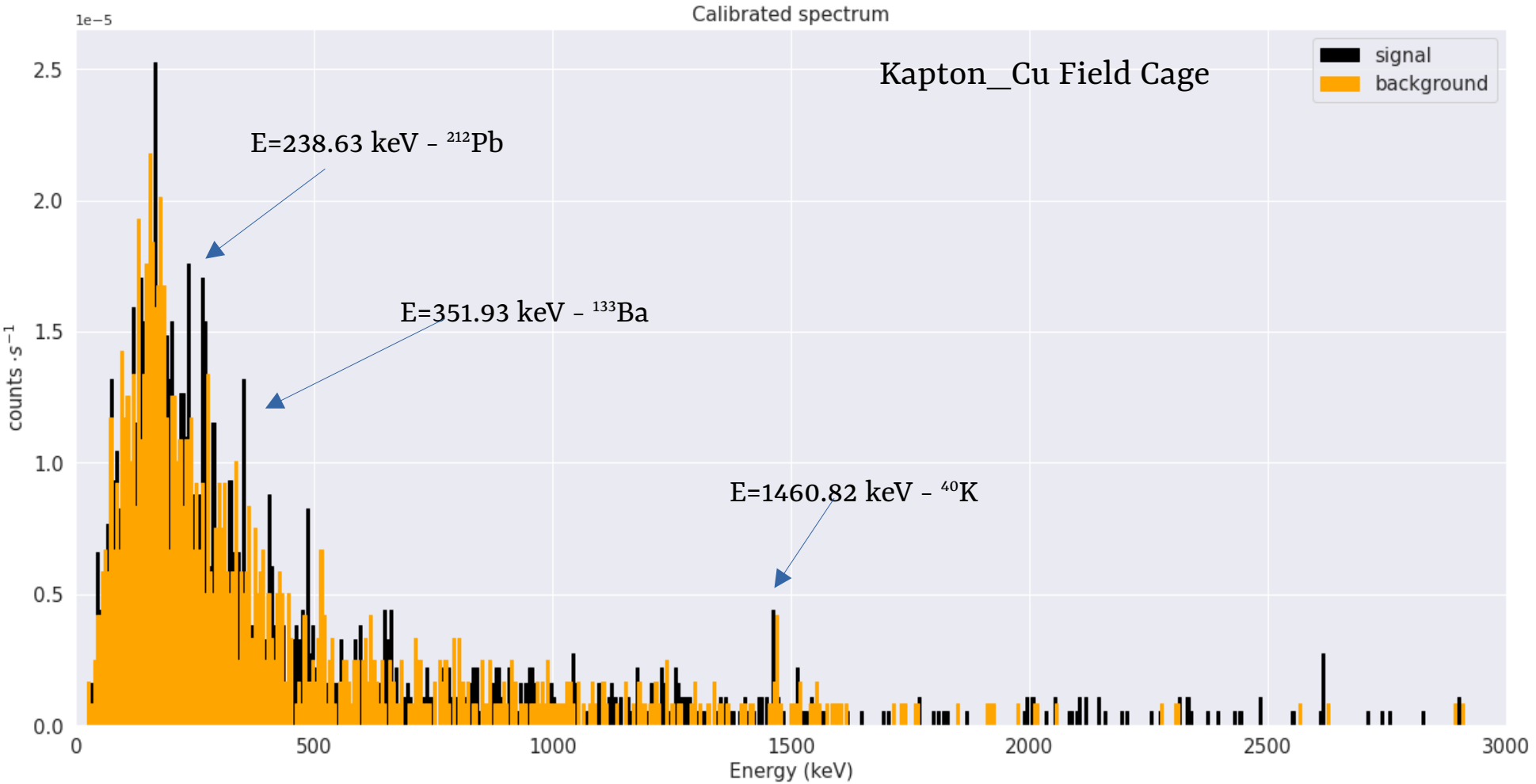
CALIBRATION OF SPECTRUM

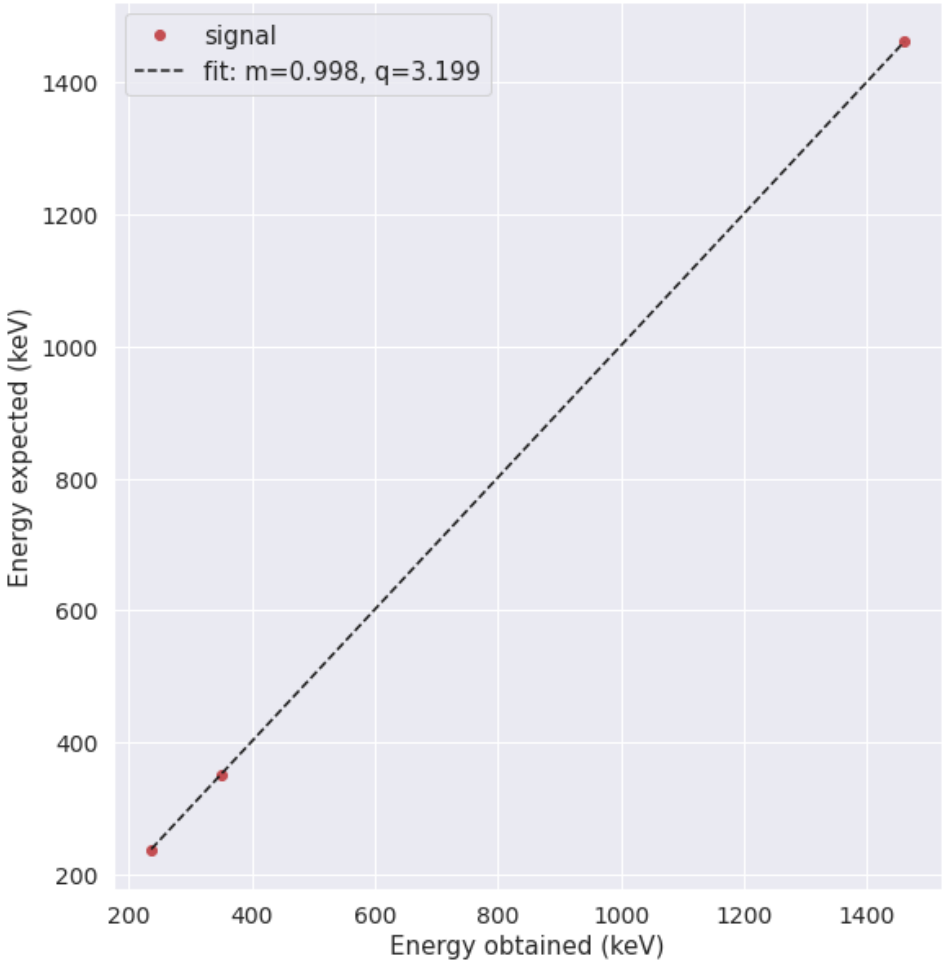
For each sample, the output file contains:

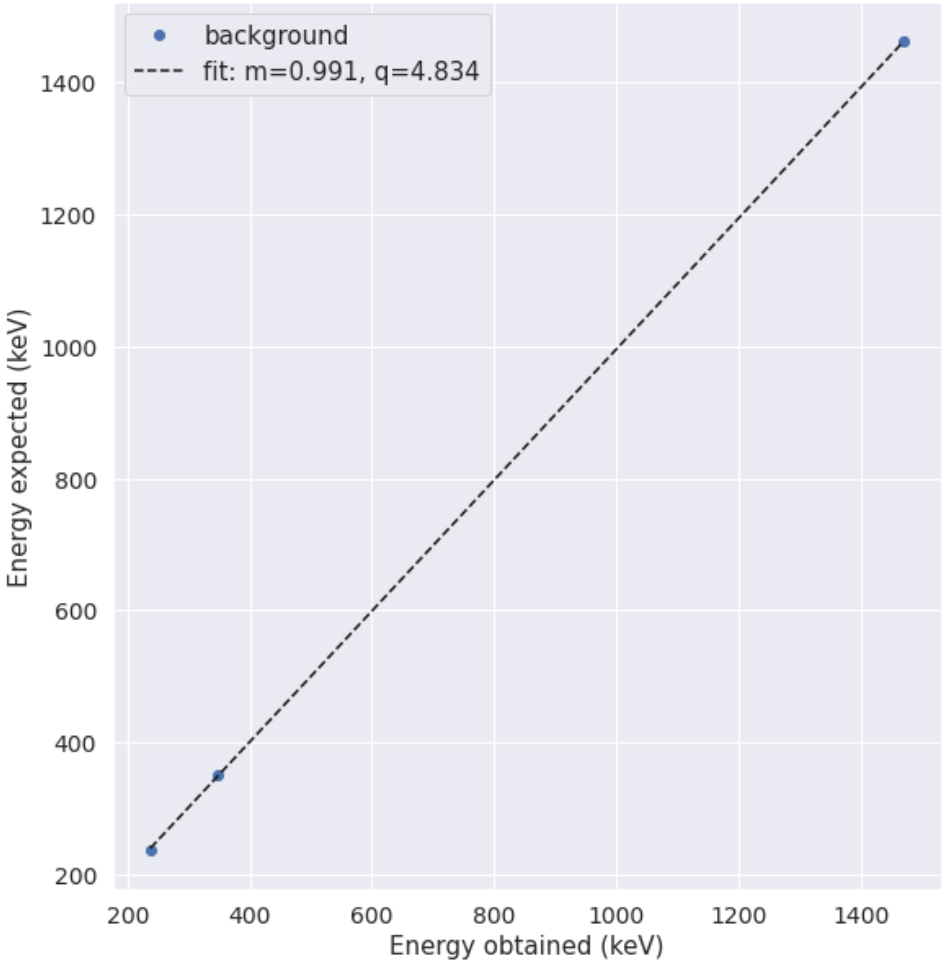
- informations about the sample
- two columns of data: channels and counts
- the coefficients of calibration

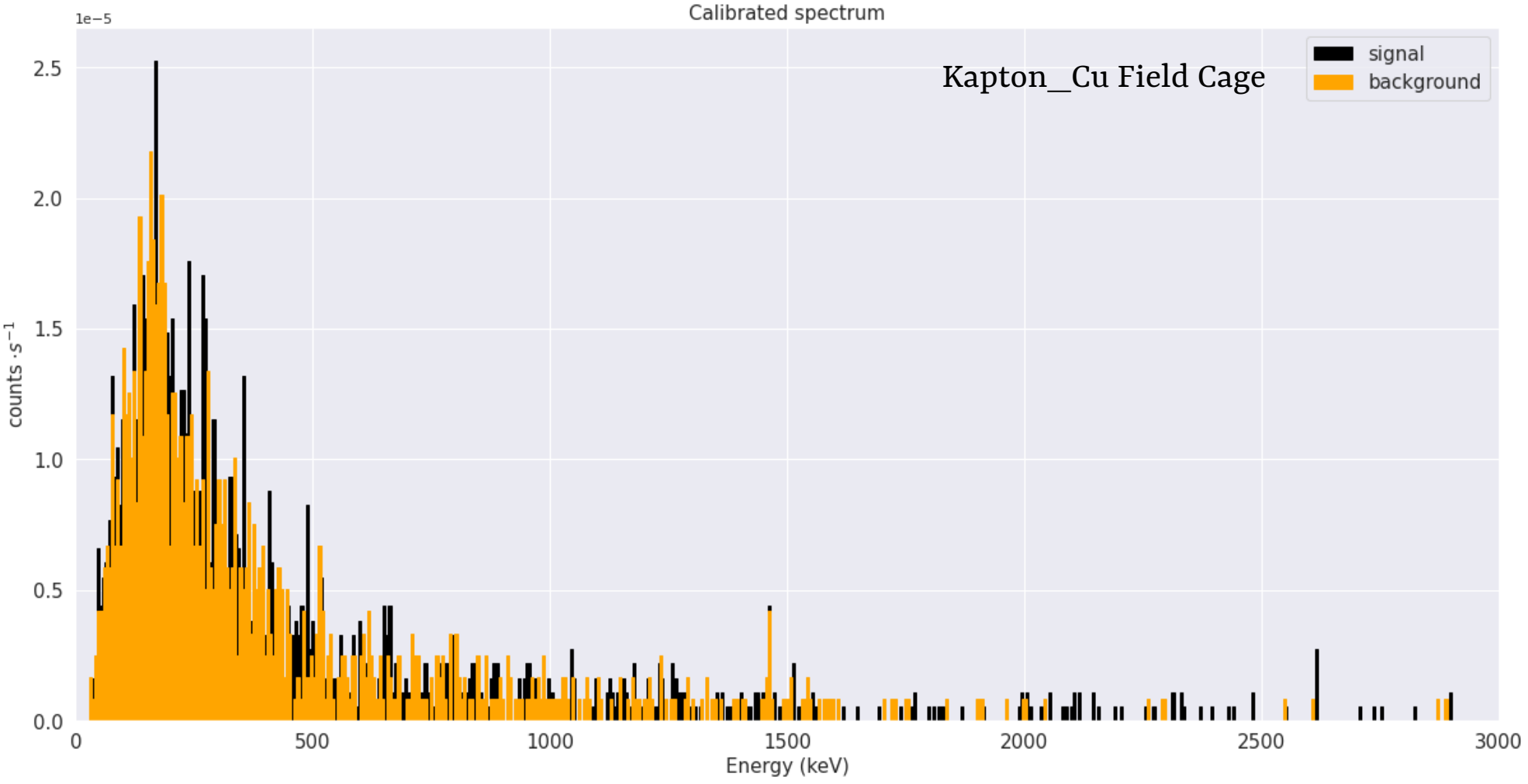
```
$SPEC_ID:
CuKapton foil, CYGNO,(500x250x0.07),inPEbag
$SPEC_REM:
DET# 1
DETDESC#
AP# GammaVision Version 6.08
$DATE_MEA:
04/12/2024 09:00:00
$MEAS_TIM:
1820579 1820579
$DATA:
0 16383
```

```
$MCA_CAL:
3
1.009113E+000 5.771547E-001 1.915398E-007 keV
```


Calibrated spectrum
1e−5
Kapton_Cu Field Cage
signal
background
E=238.63 keV - ^{212}Pb
E=351.93 keV - ^{133}Ba
E=1460.82 keV - ^{40}K
counts ·s^{-1}
Energy (keV)
0.0
0.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000


signal
fit: m=0.998, q=3.199
Energy expected (keV)
Energy obtained (keV)
200
400
600
800
1000
1200
1400


background
fit: m=0.991, q=4.834
Energy expected (keV)
Energy obtained (keV)
200
400
600
800
1000
1200
1400


Calibrated spectrum
1e−5
Kapton_Cu Field Cage
signal
background
counts ·s⁻¹
Energy (keV)
0.0
0.5
1.0
1.5
2.0
2.5
0
500
1000
1500
2000
2500
3000

COUNTING EVENTS IN THE ROI

- To select a region of interest (ROI) I used the following formula

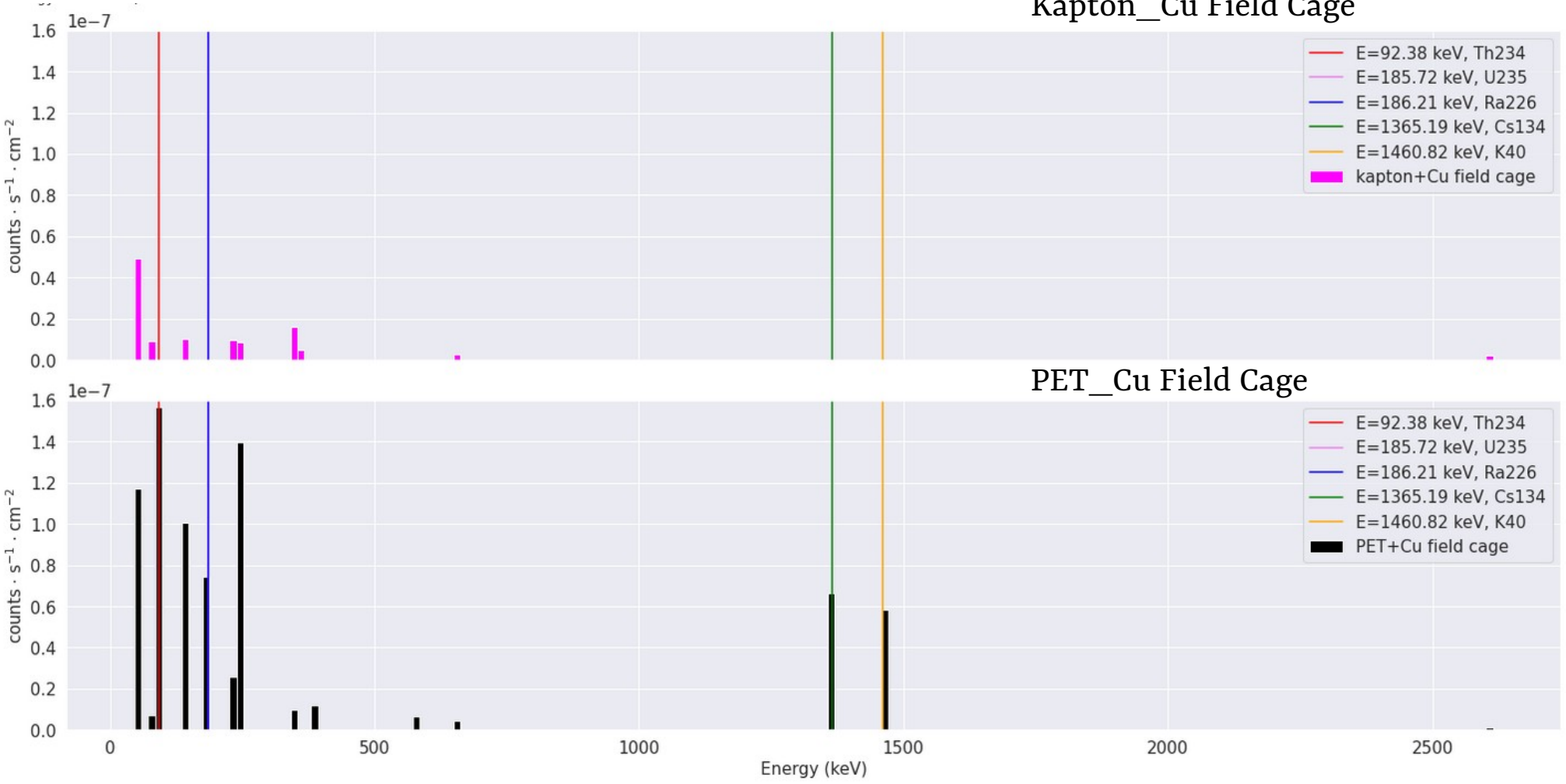
$$ROI = E \pm \Delta E$$

- For each ROI I determined the detection limit (L_D) to select probable signal events

$$L_D = 2.71 + 3.29 \cdot \sqrt{N_B \cdot (1 + \frac{t_S}{t_B})}$$

- $N_S > L_D \rightarrow N_S$ probable signal events

- Then, I obtained the net counts by subtracting the background from the signal


Kapton_Cu Field Cage
1e−7
counts · s⁻¹ · cm⁻²
E=92.38 keV, Th234
E=185.72 keV, U235
E=186.21 keV, Ra226
E=1365.19 keV, Cs134
E=1460.82 keV, K40
kapton+Cu field cage
PET_Cu Field Cage
1e−7
counts · s⁻¹ · cm⁻²
E=92.38 keV, Th234
E=185.72 keV, U235
E=186.21 keV, Ra226
E=1365.19 keV, Cs134
E=1460.82 keV, K40
PET+Cu field cage
0
500
1000
1500
2000
2500
Energy (keV)

- To estimate the activity concentration of each radionuclide I need values of efficiency
- These values outcome from the simulation of the detector used to measure samples
- At the moment I have not yet received the simulation files, so I cannot determine the activity values necessary for the simulation of our detector

CONCLUSIONS AND UPDATES

Results of this first analysis show that:

- Kapton_Cu FC → ^{133}Ba, ^{210}Pb, ^{235}U, ^{214}Pb, ^{137}Cs, ^{208}Tl
- PET_Cu FC → ^{133}Ba, ^{210}Pb, ^{235}U, ^{214}Pb, ^{137}Cs, ^{208}Tl, ^{226}Ra, ^{212}Pb, ^{134}Cs

Update on the status of the samples:

	alias	LNF	LNGS	in measure	measured	analysed
FC-kapton+Cu			x	no	yes	on-going
FC-PET+Cu	PVC		x	no	yes	yes
FC-PET+Cu no glue	PVC no glue		x	no	yes	on-going
FC-PET+Cu+glue	forato	x				
nylon6	PA6		x	no	yes	on-going
Foglio GEM			x	no	no	no
Viti in nylon			x	yes		
Viti per montare le gem			x	yes		
Resistenze SMD			x	yes		
telecamera				no	yes	no

PET+Cu

No rebin

```
[(46.54, 5.0),
 (143.77, 9.0),
 (238.63, 24.0),
 (383.85, 3.0),
 (583.19, 11.0),
 (661.65, 6.0),
 (1460.82, 11.0)]
```

Rebin=5

```
[(46.54, 23.0),
 (92.38, 33.0),
 (143.77, 53.0),
 (165.85, 47.0),
 (185.72, 49.0),
 (186.21, 49.0),
 (238.63, 58.0),
 (242.0, 31.0),
 (302.85, 22.0),
 (351.93, 23.0),
 (661.65, 12.0),
 (1332.49, 5.0),
 (1365.19, 3.0),
 (1460.82, 27.0),
 (2614.51, 3.0)]
```

Rebin=10

```
[(46.54, 35.0),
 (59.54, 33.0),
 (81.0, 49.0),
 (92.38, 65.0),
 (143.77, 111.0),
 (165.85, 87.0),
 (185.72, 83.0),
 (186.21, 83.0),
 (238.63, 89.0),
 (242.0, 75.0),
 (295.22, 39.0),
 (302.85, 41.0),
 (351.93, 38.0),
 (356.01, 34.0),
 (383.85, 32.0),
 (583.19, 28.0),
 (661.65, 16.0),
 (1365.19, 5.0),
 (1460.82, 29.0),
 (2614.51, 3.0)]
```

Rebin=20

```
[(46.54, 77.0),
 (59.54, 64.0),
 (81.0, 100.0),
 (92.38, 116.0),
 (143.77, 213.0),
 (165.85, 162.0),
 (185.72, 163.0),
 (186.21, 163.0),
 (238.63, 140.0),
 (242.0, 140.0),
 (295.22, 80.0),
 (302.85, 86.0),
 (351.93, 72.0),
 (356.01, 72.0),
 (383.85, 54.0),
 (583.19, 37.0),
 (604.72, 24.0),
 (609.31, 24.0),
 (661.65, 23.0),
 (727.33, 18.0),
 (1460.82, 30.0),
 (2614.51, 3.0)]
```

Kapton+Cu

No rebin

```
[(46.54, 4.0),
 (81.0, 7.0),
 (143.77, 12.0),
 (383.85, 3.0),
 (583.19, 3.0),
 (1460.82, 4.0)]
```

Rebin=5

```
[(143.77, 28.0),
 (165.85, 41.0),
 (185.72, 24.0),
 (186.21, 24.0),
 (238.63, 23.0),
 (242.0, 19.0),
 (351.93, 24.0),
 (356.01, 19.0),
 (661.65, 3.0),
 (1460.82, 8.0)]
```

Rebin=10

```
[(46.54, 20.0),
 (59.54, 21.0),
 (81.0, 36.0),
 (92.38, 36.0),
 (143.77, 59.0),
 (165.85, 78.0),
 (185.72, 51.0),
 (186.21, 51.0),
 (238.63, 51.0),
 (242.0, 35.0),
 (295.22, 27.0),
 (302.85, 25.0),
 (351.93, 33.0),
 (356.01, 33.0),
 (583.19, 7.0),
 (661.65, 10.0),
 (1460.82, 9.0),
 (2614.51, 5.0)]
```

Rebin=20

```
[(46.54, 33.0),
 (59.54, 43.0),
 (81.0, 75.0),
 (92.38, 67.0),
 (143.77, 124.0),
 (165.85, 132.0),
 (185.72, 97.0),
 (186.21, 97.0),
 (238.63, 81.0),
 (242.0, 81.0),
 (295.22, 52.0),
 (302.85, 52.0),
 (351.93, 47.0),
 (356.01, 47.0),
 (383.85, 27.0),
 (604.72, 18.0),
 (661.65, 20.0),
 (1460.82, 11.0),
 (2614.51, 5.0)]
```