April 27, 2007 Hideyuki Tatsuno

E570 meeting report

Compton tail of calibration peaks

tail ratio TiKa1

Cycle-1   Cycle-2

All cycles   All SDD   All SDD

SDD#

#2 #4 #5   #1 #2 #3 #4 #5 #7 #8

tail ratio NiKa1

tail ratio Kb1/Ka1

Fixed : ratio Kb1/Ka1 = 3.15
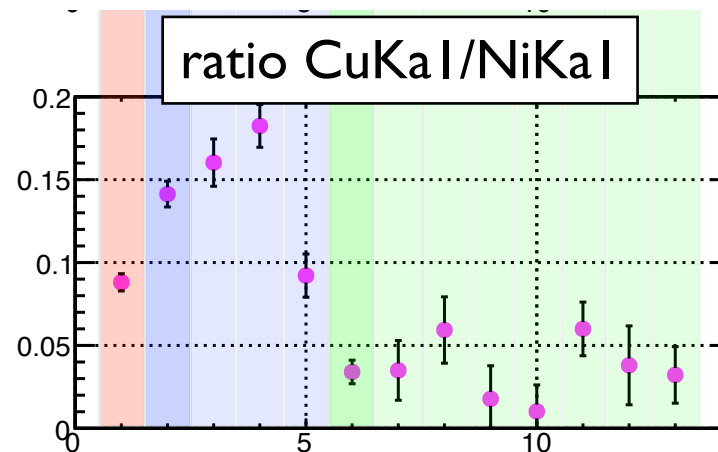
ratio CuKa1/NiKa1

Questions
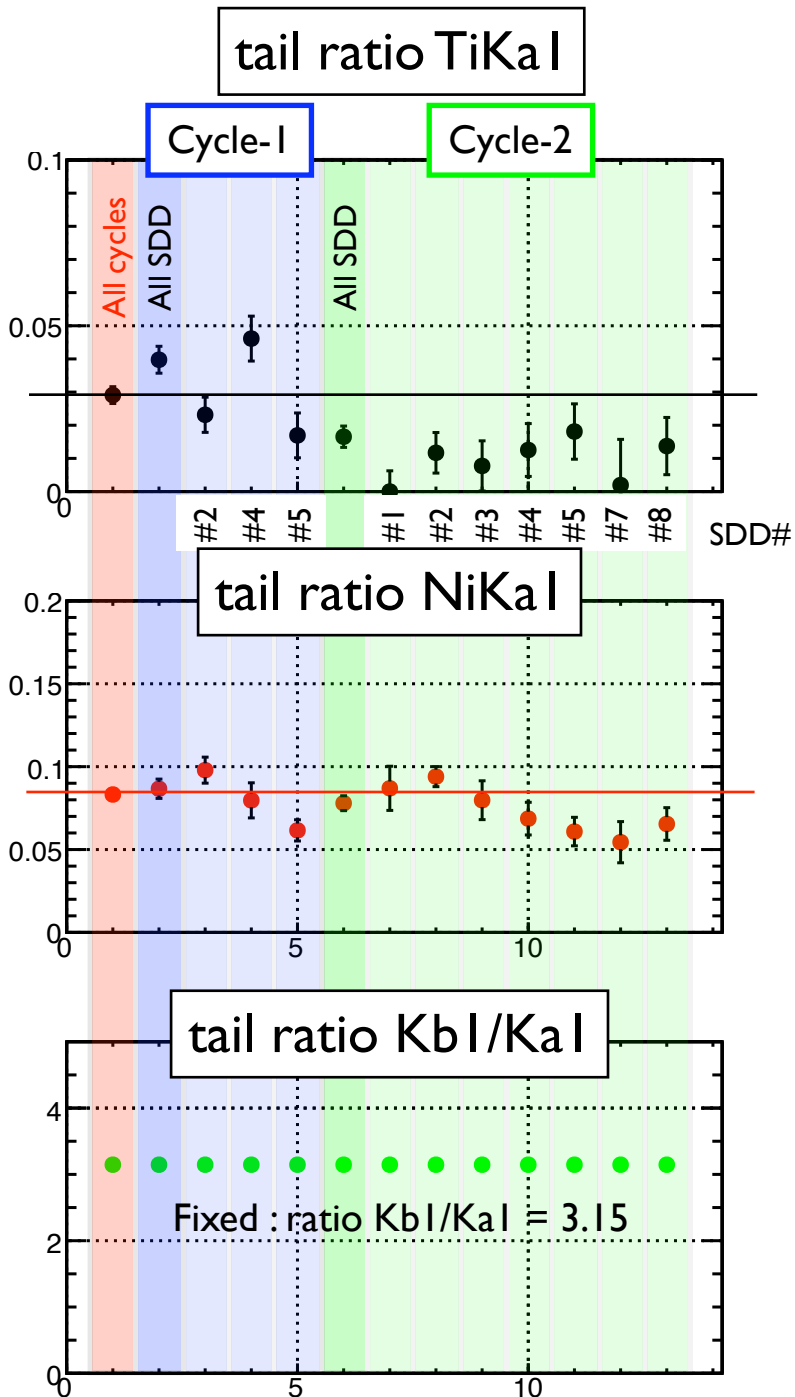
Tail ratio of Ti is twice different between 1st and 2nd cycle while that of Ni is almost same

➡ Is there any energy dependence ?

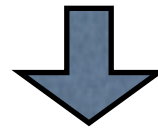Cu contamination of the 2nd cycle is too small

➡ Really Cu exists ?

I'm wondering the "tail" might contains some structure which has energy dependence.

→ Possibility : Compton tail

How much the Compton-tail intensity of calibration peaks ?

Geant4 simulation with the pion distribution of E549 (Preliminary)

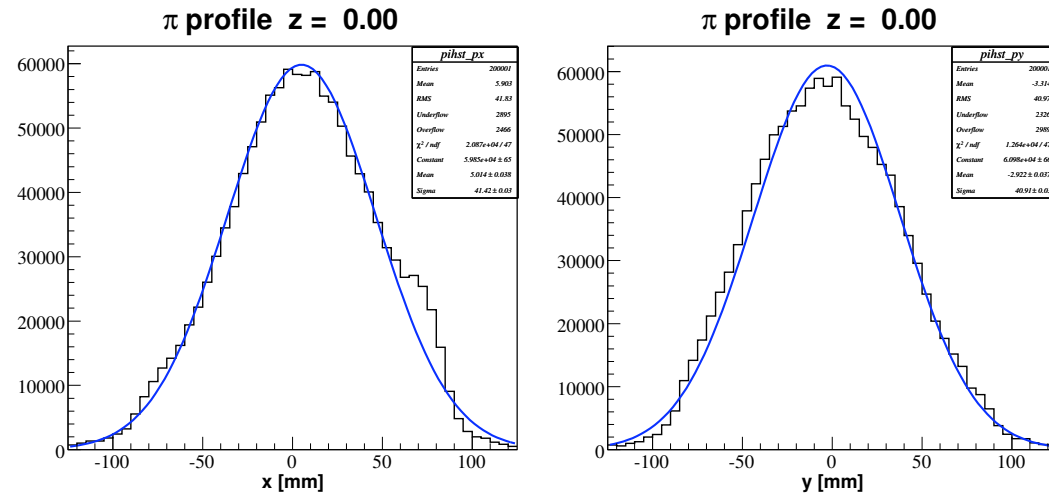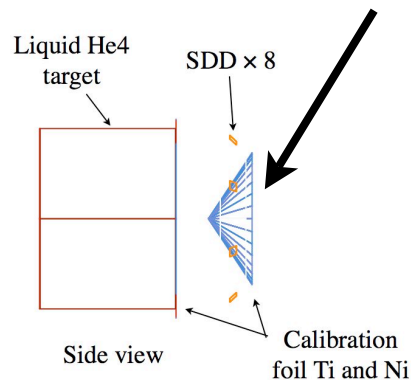X-rays were generated from the pion-hit position on the cone-shape-foil

Figure 2: T Pi-minus profile of E549 ofile of
E549 experiment. The number of π^- is counted per spill (4.0 sec)

Ti Kα1 compton-tail fit cycle 1

Compton fit

χ² / ndf	44.02579 / 44
Prob	0.4705496
G mean [eV]	4482.348 ± 9.258
G sigma [eV]	66.94034 ± 5.26685
Area	6602.782 ± 259.520
Slope	0.8199338 ± 0.2104486

simulation

0.4% Compton

```
[Ti K-alpha1 (4510.84 eV)]
Number of Events
Total    = 157555 +- 396.932
Normal   = 154856
Compton  = 704 +- 26.533
Rayleigh = 1830
Compton other + escaped Rayleigh  = 165


Ratios
Compton/Total = 0.00446828 +- 0.00016878
Compton/(Normal+Rayleigh)  = 0.00449306 +- 0.000169719
```


smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=44.0258 FROM MINOS      STATUS=SUCCESSFUL    276 CALLS         373 TOTAL
                       EDM=3.66174e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC       MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE      POSITIVE
   1  G mean [eV]   4.48235e+03   9.07741e+00  -1.00191e+01   8.49646e+00
   2  G sigma [eV]  6.69403e+01   5.23218e+00  -5.10983e+00   5.42386e+00
   3  Area          6.60278e+03   2.59515e+02  -2.59494e+02   2.59546e+02
   4  Slope         8.19934e-01   2.07337e-01  -2.08967e-01   2.11931e-01
```

Ti Kα1 total fit cycle 1

Total fit (Gauss)

χ² / ndf	80.52127 / 68
Prob	0.1422086
G area	1545157 ± 3939.2
G mean [eV]	4510.866 ± 0.192

simulation

```
[Ti K-alpha1 (4510.84 eV)]
Number of Events
Total    = 157555 +- 396.932
Normal   = 154856
Compton  = 704 +- 26.533
Rayleigh = 1830
Compton other + escaped Rayleigh  = 165


Ratios
Compton/Total = 0.00446828 +- 0.00016878
Compton/(Normal+Rayleigh)  = 0.00449306 +- 0.000169719
```
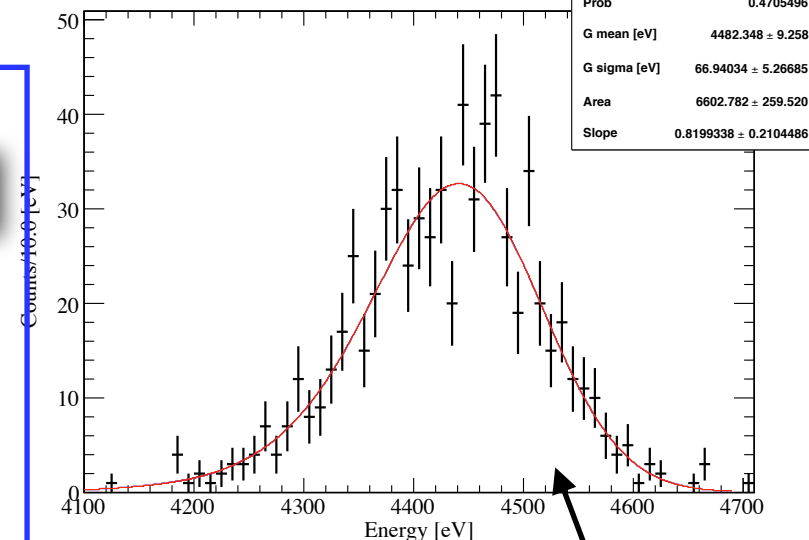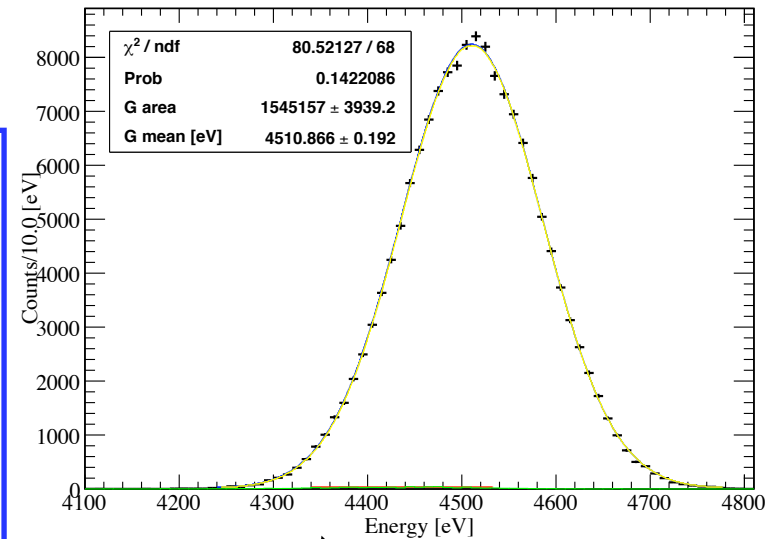
0.4% Compton

fixed Compton tail
Very good fit !

Fit of simulation

```
  FCN=80.5213 FROM MINOS      STATUS=SUCCESSFUL    24 CALLS          64 TOTAL
                    EDM=6.01281e-10    STRATEGY= 1    ERROR MATRIX ACCURATE
  EXT PARAMETER                   PARABOLIC        MINOS ERRORS
  NO.   NAME       VALUE            ERROR      NEGATIVE      POSITIVE
   1  g mean [eV]   4.48235e+03      fixed
   2  g sigma [eV]  6.69403e+01      fixed
   3  t area        6.60278e+03      fixed
   4  t slope       8.19934e-01      fixed
   5  G area        1.54516e+06   3.93917e+03  -3.93916e+03   3.93918e+03
   6  G mean [eV]   4.51087e+03   1.92042e-01  -1.92044e-01   1.92041e-01
   7  G sigma [eV]  7.50889e+01      fixed
```

Ni Kα1 compton-tail fit cycle 1

Compton fit

χ^2 / ndf	60.49867 / 78
Prob	0.9289275
G mean [eV]	7355.177 ± 6.542
G sigma [eV]	98.91032 ± 3.84220
Area	19992.99 ± 448.36
Slope	0.780277 ± 0.096668

smeared with Gaussian
using Noise and Fano inputs

simulation

```
[Ni K-alpha1 (7478.15 eV) ]
Number of Events
Total     = 55792 +- 236.203
Normal    = 52704
Compton   = 2065 +- 45.4423
Rayleigh  = 863
Compton other + escaped Rayleigh  = 160

Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh)  = 0.0385499 +- 0.000864523
```

3.8% Compton

Fit of simulation

```
FCN=60.4987 FROM MINOS       STATUS=SUCCESSFUL    227 CALLS         328 TOTAL
                   EDM=9.31261e-13    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                  PARABOLIC        MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  G mean [eV]   7.35518e+03   6.51121e+00  -6.79478e+00   6.28965e+00
  2  G sigma [eV]  9.89103e+01   3.83804e+00  -3.79207e+00   3.89232e+00
  3  Area          1.99930e+04   4.48353e+02  -4.48356e+02   4.48360e+02
  4  Slope         7.80277e-01   9.63135e-02  -9.68821e-02   9.64546e-02
```

Ni Kα1 total fit cycle 1

Total fit (Gauss)

χ² / ndf	88.04672 / 94
Prob	0.6535048
G area	528689 ± 2327.1
G mean [eV]	7477.798 ± 0.387

simulation

```
[Ni K-alpha1 (7478.15 eV) ]
Number of Events
Total      = 55792 +- 236.203
Normal     = 52704
Compton    = 2065 +- 45.4423
Rayleigh   = 863
Compton other + escaped Rayleigh  = 160


Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh)  = 0.0385499 +- 0.000864523
```
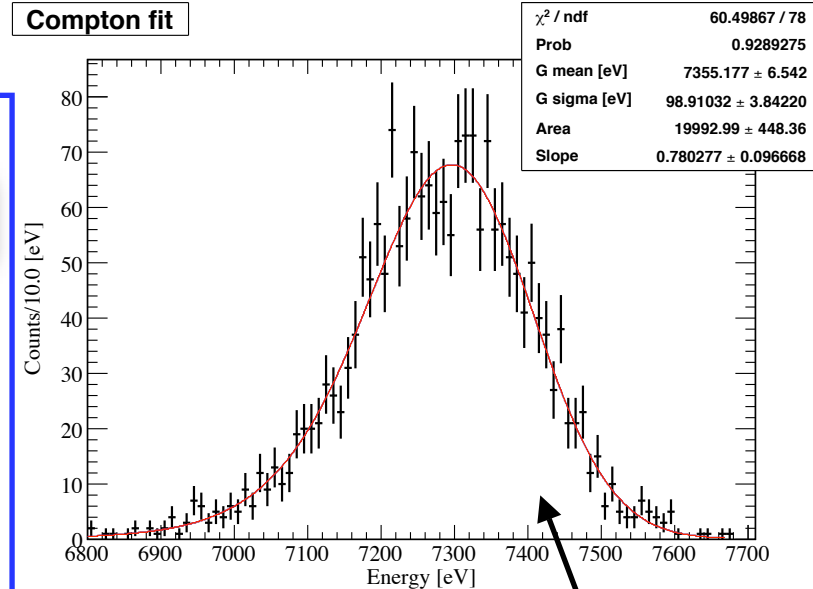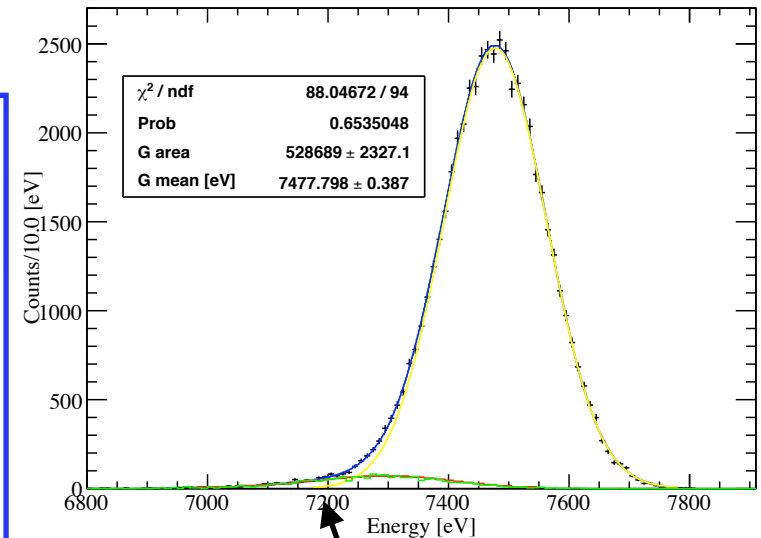
3.8% Compton

fixed Compton tail

Very good fit !

Fit of simulation

```
 FCN=88.0467 FROM MINOS       STATUS=SUCCESSFUL     26 CALLS          67 TOTAL
                  EDM=1.5697e-08     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC          MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
   1  g mean [eV]   7.35518e+03      fixed
   2  g sigma [eV]  9.89103e+01      fixed
   3  t area        1.99930e+04      fixed
   4  t slope       7.80277e-01      fixed
   5  G area        5.28689e+05   2.32713e+03  -2.32711e+03   2.32715e+03
   6  G mean [eV]   7.47780e+03   3.86750e-01  -3.86793e-01   3.86710e-01
   7  G sigma [eV]  8.53091e+01      fixed
```

Okada-san's results

```
cycle 1 ---                                        cycle 2 ---
 1  ConstNoise       5.66728e+01   7.09035e-01      1  ConstNoise       5.55803e+01   6.21989e-01
 2  FANO             1.46123e-01   3.73869e-03      2  FANO             1.27357e-01   3.24398e-03
 9  r Ti Kb1/Ka1     2.27286e-01   2.36560e-03      9  r Ti Kb1/Ka1     2.36748e-01   1.83053e-03
13  r Ni Kb1/Ka1     2.58376e-01   2.92656e-03     13  r Ni Kb1/Ka1     2.60613e-01   2.53222e-03
14  tail ratio TiKa1 3.98269e-02   4.57751e-03     14  tail ratio TiKa1 1.65503e-02   3.19800e-03
15  tail ratio NiKa1 8.67166e-02   5.84379e-03     15  tail ratio NiKa1 7.79778e-02   4.46803e-03
17  tail beta        2.05456e+00   1.91307e-01     17  tail beta        2.40477e+00   2.14368e-01
18  pile area factor 1.06590e-01   2.11381e-03     18  pile area factor 6.21569e-02   1.79397e-03
```

Compton tail contribution for calibration peaks (preliminary)

compton tail ratio TiKa1 0.0045(2)   **comparable in the LE-tail intensity**

compton tail ratio TiKβ 0.0086(2)   The LE-tail ratio of NiKa1 might be ~4% lower

compton tail ratio NiKa1 0.0385(9)   **too small to explain the Cu contamination**

compton tail ratio NiKβ 0.0408(6)   Some components exist at the Cu position

Next

Try to fit the calibration peaks with Compton tails

Get the more reasonable values of the LE-tail intensity

Backup figures

Ti Kα1 compton-tail fit cycle 1

Compton fit

χ² / ndf	44.02579 / 44
Prob	0.4705496
G mean [eV]	4482.348 ± 9.258
G sigma [eV]	66.94034 ± 5.26685
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0.4% Compton

```
[Ti K-alpha1 (4510.84 eV)]
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Compton/Total = 0.00446828 +- 0.00016878
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```

smeared with Gaussian
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Fit of simulation

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  EXT PARAMETER                      PARABOLIC        MINOS ERRORS
  NO.   NAME      VALUE              ERROR      NEGATIVE         POSITIVE
   1  G mean [eV]    4.48235e+03   9.07741e+00  -1.00191e+01    8.49646e+00
   2  G sigma [eV]   6.69403e+01   5.23218e+00  -5.10983e+00    5.42386e+00
   3  Area           6.60278e+03   2.59515e+02  -2.59494e+02    2.59546e+02
   4  Slope          8.19934e-01   2.07337e-01  -2.08967e-01    2.11931e-01
```

Ti Kα1 total fit cycle 1

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```
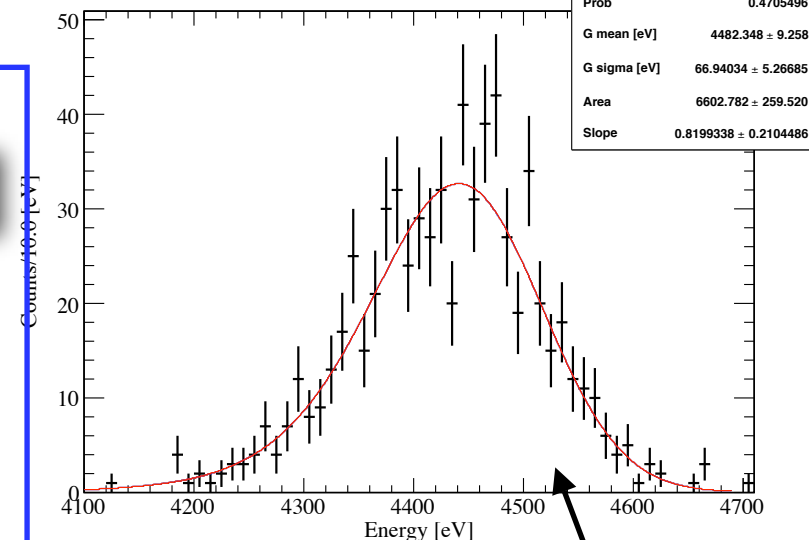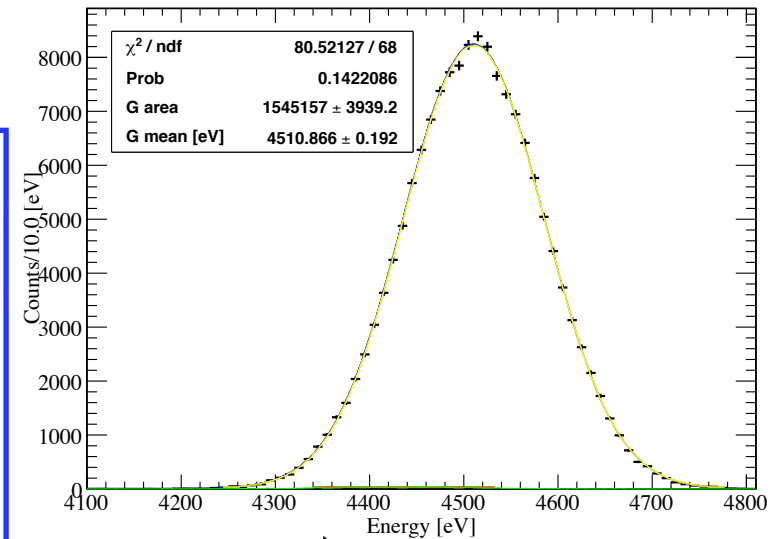
0.4% Compton

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Very good fit !

Fit of simulation

```
 FCN=80.5213 FROM MINOS      STATUS=SUCCESSFUL     24 CALLS        64 TOTAL
                     EDM=6.01281e-10     STRATEGY= 1    ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC        MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE      POSITIVE
   1  g mean [eV]   4.48235e+03      fixed
   2  g sigma [eV]  6.69403e+01      fixed
   3  t area        6.60278e+03      fixed
   4  t slope       8.19934e-01      fixed
   5  G area        1.54516e+06   3.93917e+03  -3.93916e+03   3.93918e+03
   6  G mean [eV]   4.51087e+03   1.92042e-01  -1.92044e-01   1.92041e-01
   7  G sigma [eV]  7.50889e+01      fixed
```

Ti Kα1 compton-tail fit cycle 2

Compton fit

χ² / ndf	39.4601 / 42
Prob	0.583059
G mean [eV]	4473.497 ± 10.511
G sigma [eV]	70.9353 ± 5.6215
Area	6644.088 ± 259.841
Slope	0.6435179 ± 0.2077487

smeared with Gaussian
using Noise and Fano inputs

simulation

0.4% Compton

```
[Ti K-alpha1 (4510.84 eV)]
Number of Events
Total     = 157555 +- 396.932
Normal    = 154856
Compton   = 704 +- 26.533
Rayleigh  = 1830
Compton other + escaped Rayleigh  = 165


Ratios
Compton/Total = 0.00446828 +- 0.00016878
Compton/(Normal+Rayleigh)  = 0.00449306 +- 0.000169719
```

Fit of simulation

```
 FCN=39.4601 FROM MINOS      STATUS=SUCCESSFUL    347 CALLS          443 TOTAL
                  EDM=3.37761e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                 PARABOLIC        MINOS ERRORS
  NO.   NAME        VALUE          ERROR      NEGATIVE      POSITIVE
   1  G mean [eV]   4.47350e+03  9.88850e+00  -1.21145e+01   8.90753e+00
   2  G sigma [eV]  7.09353e+01  5.51764e+00  -5.26572e+00   5.97727e+00
   3  Area          6.64409e+03  2.59835e+02  -2.59828e+02   2.59854e+02
   4  Slope         6.43518e-01  1.99257e-01  -2.21187e-01   1.94310e-01
```

Ti Kα1 total fit cycle 2

simulation

```
[Ti K-alpha1 (4510.84 eV)]
Number of Events
Total    = 157555 +- 396.932
Normal   = 154856
Compton  = 704 +- 26.533
Rayleigh = 1830
Compton other + escaped Rayleigh  = 165


Ratios
Compton/Total = 0.00446828 +- 0.00016878
Compton/(Normal+Rayleigh)  = 0.00449306 +- 0.000169719
```
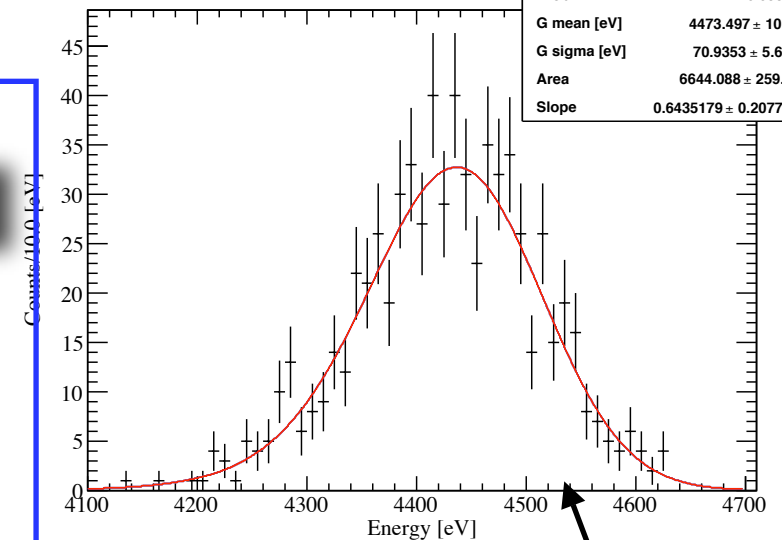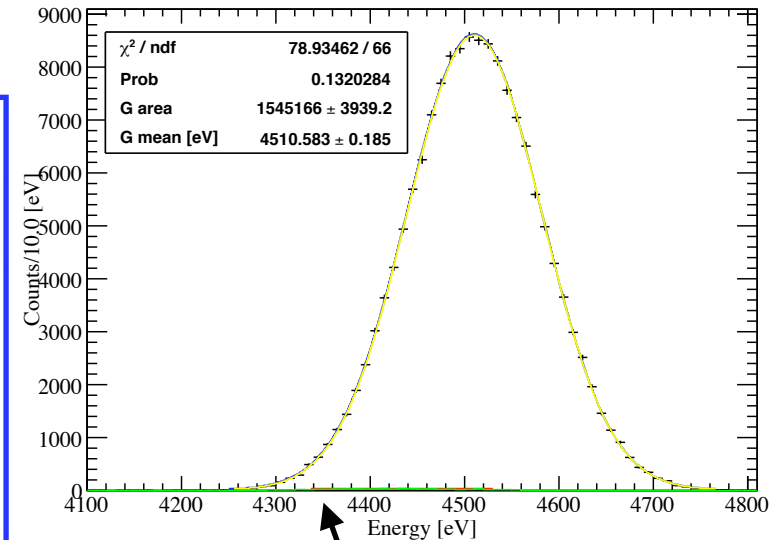
0.4% Compton

fixed Compton tail
Very good fit !

Fit of simulation

```
FCN=78.9346 FROM MINOS        STATUS=SUCCESSFUL     24 CALLS          62 TOTAL
                 EDM=7.97647e-11    STRATEGY= 1     ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC          MINOS ERRORS
 NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
  1  g mean [eV]   4.47350e+03      fixed
  2  g sigma [eV]  7.09353e+01      fixed
  3  t area        6.64409e+03      fixed
  4  t slope       6.43518e-01      fixed
  5  G area        1.54517e+06   3.93920e+03  -3.93920e+03   3.93920e+03
  6  G mean [eV]   4.51058e+03   1.84670e-01  -1.84669e-01   1.84671e-01
  7  G sigma [eV]  7.17842e+01      fixed
```

Ti Kα2 compton-tail fit cycle 1

Compton fit	
χ² / ndf	28.32206 / 39
Prob	0.8968493
G mean [eV]	4488.04 ± 13.590
G sigma [eV]	63.57048 ± 9.64203
Area	2856.311± 174.475
Slope	1.068341 ± 0.418635

smeared with Gaussian
using Noise and Fano inputs

simulation

0.4% Compton

```
[Ti K-alpha2 (4504.86 eV)]
Number of Events
Total    = 76409 +- 276.422
Normal   = 75134
Compton  = 309 +- 17.5784
Rayleigh = 891
Compton other + escaped Rayleigh  = 75


Ratios
Compton/Total = 0.00404403 +- 0.000230521
Compton/(Normal+Rayleigh)  = 0.00406445 +- 0.000231688
```
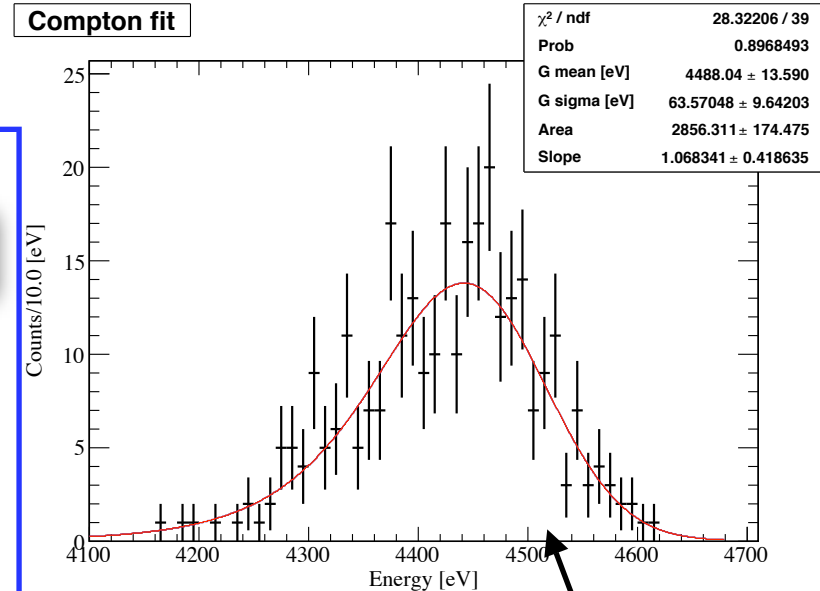
Fit of simulation

```
 FCN=28.3221 FROM MINOS      STATUS=SUCCESSFUL    361 CALLS        455 TOTAL
                   EDM=6.91162e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                     PARABOLIC        MINOS ERRORS
  NO.   NAME       VALUE              ERROR       NEGATIVE       POSITIVE
   1  G mean [eV]   4.48804e+03    1.30326e+01  -1.54124e+01    1.17667e+01
   2  G sigma [eV]  6.35705e+01    9.49784e+00  -9.11330e+00    1.01708e+01
   3  Area          2.85631e+03    1.74468e+02  -1.74309e+02    1.74642e+02
   4  Slope         1.06834e+00    4.07198e-01  -3.97228e-01    4.40041e-01
```

Ti Kα2 total fit cycle 1

simulation

```
[Ti K-alpha2 (4504.86 eV)]
Number of Events
Total    = 76409 +- 276.422
Normal   = 75134
Compton  = 309 +- 17.5784
Rayleigh = 891
Compton other + escaped Rayleigh  = 75


Ratios
Compton/Total = 0.00404403 +- 0.000230521
Compton/(Normal+Rayleigh)  = 0.00406445 +- 0.000231688
```

0.4% Compton

fixed Compton tail

Very good fit !

Fit of simulation

```
 FCN=89.5059 FROM MINOS        STATUS=SUCCESSFUL    24 CALLS          60 TOTAL
                   EDM=1.36157e-10    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                     PARABOLIC         MINOS ERRORS
  NO.   NAME       VALUE              ERROR       NEGATIVE       POSITIVE
   1   g mean [eV]   4.48804e+03      fixed
   2   g sigma [eV]  6.35705e+01      fixed
   3   t area        2.85631e+03      fixed
   4   t slope       1.06834e+00      fixed
   5   G area        7.49777e+05   2.74342e+03  -2.74342e+03   2.74342e+03
   6   G mean [eV]   4.50492e+03   2.74736e-01  -2.74740e-01   2.74733e-01
   7   G sigma [eV]  7.50669e+01      fixed
```

Ti Kα2 compton-tail fit cycle 2

Compton fit

χ² / ndf	25.31819 / 37
Prob	0.9271663
G mean [eV]	4486.842 ± 12.306
G sigma [eV]	59.62672 ± 8.84618
Area	2897.025 ± 176.156
Slope	1.102361 ± 0.417658

simulation

```
[Ti K-alpha2 (4504.86 eV)]
Number of Events
Total    = 76409 +- 276.422
Normal   = 75134
Compton  = 309 +- 17.5784
Rayleigh = 891
Compton other + escaped Rayleigh  = 75


Ratios
Compton/Total = 0.00404403 +- 0.000230521
Compton/(Normal+Rayleigh)  = 0.00406445 +- 0.000231688
```
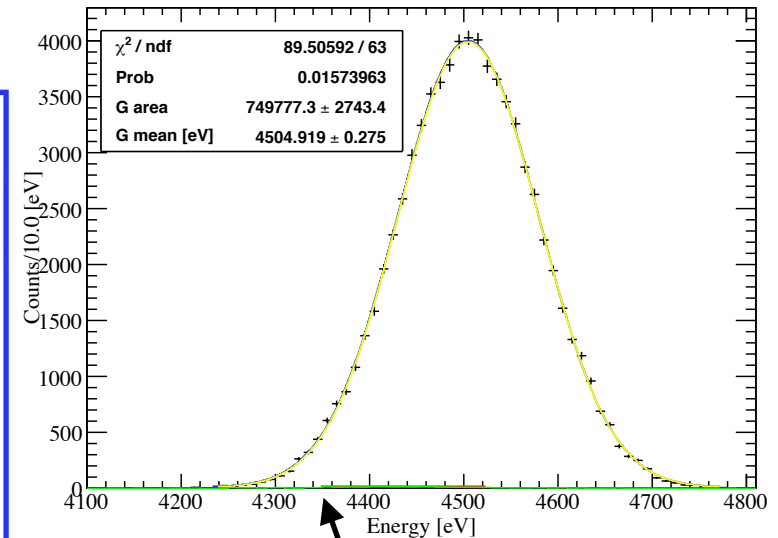
0.4% Compton
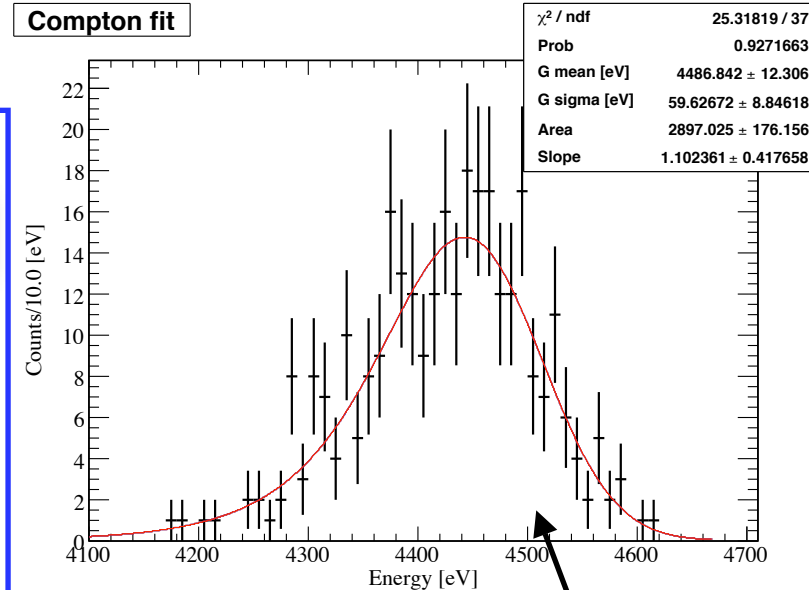
smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=25.3182 FROM MINOS        STATUS=SUCCESSFUL    352 CALLS        449 TOTAL
                    EDM=9.64721e-12    STRATEGY= 1     ERROR MATRIX ACCURATE
  EXT PARAMETER                 PARABOLIC        MINOS ERRORS
  NO.   NAME        VALUE          ERROR      NEGATIVE       POSITIVE
   1  G mean [eV]   4.48684e+03   1.18977e+01  -1.37087e+01   1.09041e+01
   2  G sigma [eV]  5.96267e+01   8.74106e+00  -8.46518e+00   9.22717e+00
   3  Area          2.89703e+03   1.76153e+02  -1.75987e+02   1.76325e+02
   4  Slope         1.10236e+00   4.06629e-01  -3.90951e-01   4.44364e-01
```

Ti Kα2 total fit cycle 2

Total fit (Gauss)

χ²/ndf	68.32176 / 67
Prob	0.4321202
G area	749866.2 ± 2743.5
G mean [eV]	4504.851 ± 0.263

0.4% Compton

simulation

```
[Ti K-alpha2 (4504.86 eV)]
Number of Events
Total    = 76409 +- 276.422
Normal   = 75134
Compton  = 309 +- 17.5784
Rayleigh = 891
Compton other + escaped Rayleigh  = 75


Ratios
Compton/Total = 0.00404403 +- 0.000230521
Compton/(Normal+Rayleigh)  = 0.00406445 +- 0.000231688
```
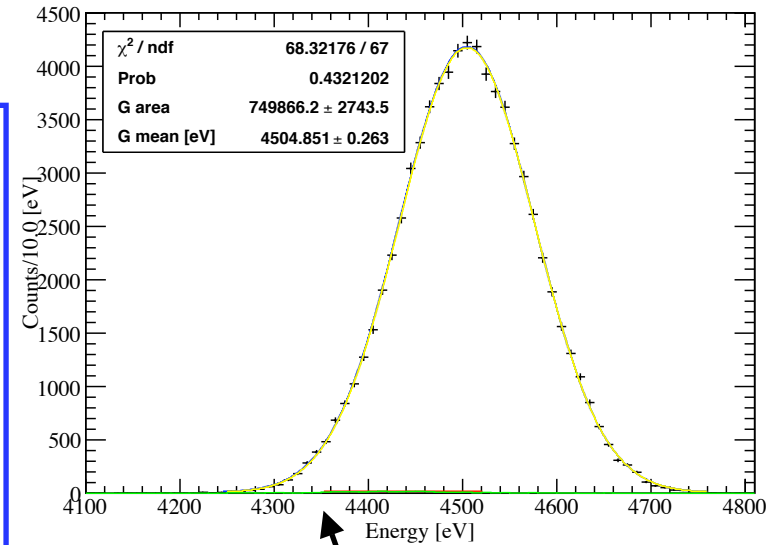
fixed Compton tail
Very good fit !

Fit of simulation

```
 FCN=68.3218 FROM MINOS       STATUS=SUCCESSFUL    24 CALLS         60 TOTAL
                   EDM=5.25934e-10    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC          MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
   1  g mean [eV]   4.48684e+03      fixed
   2  g sigma [eV]  5.96267e+01       fixed
   3  t area        2.89703e+03      fixed
   4  t slope       1.10236e+00      fixed
   5  G area        7.49866e+05   2.74353e+03  -2.74353e+03   2.74353e+03
   6  G mean [eV]   4.50485e+03   2.62616e-01  -2.62625e-01   2.62608e-01
   7  G sigma [eV]  7.17639e+01       fixed
```

Ti Kβ compton-tail fit cycle 1

Compton fit

χ² / ndf	44.62135 / 56
Prob	0.8629997
G mean [eV]	4882.14 ± 6.08
G sigma [eV]	76.02291 ± 3.05010
Area	16917.46 ± 412.03
Slope	0.6309618 ± 0.1031097

simulation

0.9% Compton

```
[Ti K-beta1 (4931.81 eV)]
Number of Events
Total    = 203803 +- 451.445
Normal   = 199031
Compton  = 1739 +- 41.7013
Rayleigh = 2691
Compton other + escaped Rayleigh  = 342


Ratios
Compton/Total = 0.00853275 +- 0.000205487
Compton/(Normal+Rayleigh)  = 0.00862078 +- 0.000207616
```
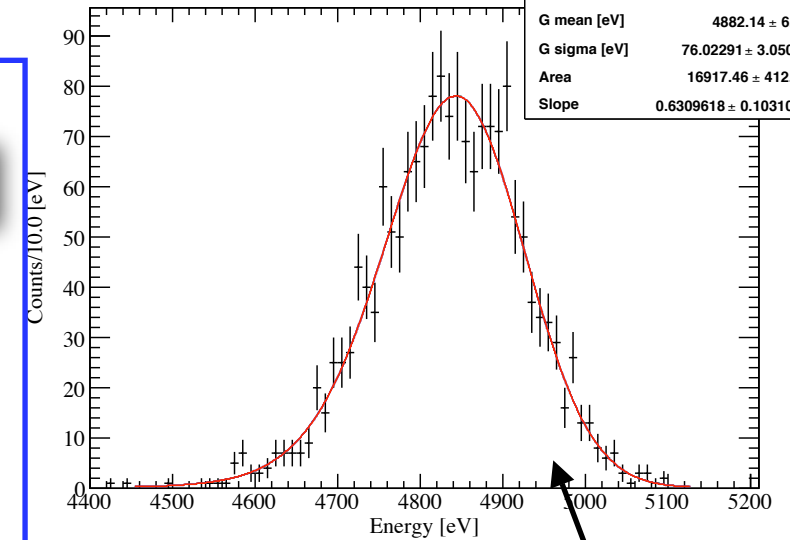
smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
FCN=44.6214 FROM MINOS        STATUS=SUCCESSFUL    281 CALLS        376 TOTAL
                    EDM=1.33651e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                     PARABOLIC        MINOS ERRORS
 NO.   NAME        VALUE              ERROR      NEGATIVE      POSITIVE
  1  G mean [eV]   4.88214e+03   6.01136e+00  -6.49071e+00   5.67614e+00
  2  G sigma [eV]  7.60229e+01   3.04179e+00  -2.98793e+00   3.11227e+00
  3  Area          1.69175e+04   4.12026e+02  -4.12029e+02   4.12031e+02
  4  Slope         6.30962e-01   1.02174e-01  -1.06147e-01   1.00073e-01
```

Ti Kβ total fit cycle 1

simulation

[Ti K-beta1 (4931.81 eV)]
Number of Events
Total   = 203803 +- 451.445
Normal   = 199031
Compton   = 1739 +- 41.7013
Rayleigh = 2691
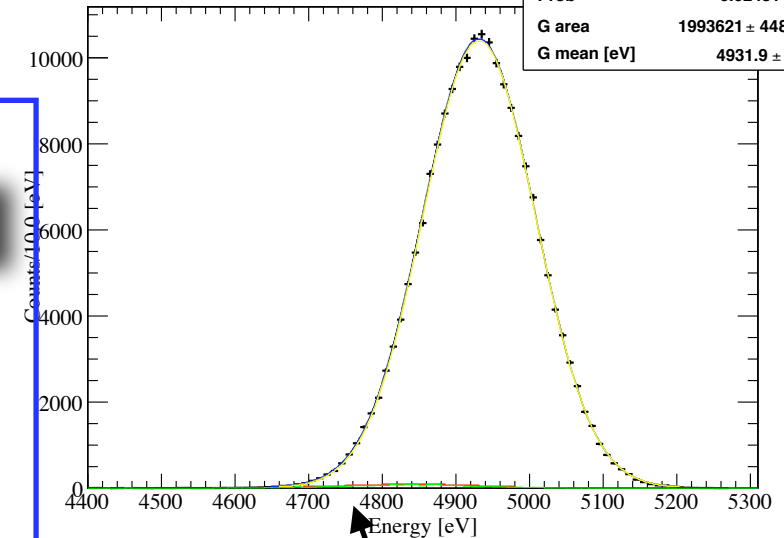Compton other + escaped Rayleigh = 342

Ratios
Compton/Total = 0.00853275 +- 0.000205487
Compton/(Normal+Rayleigh) = 0.00862078 +- 0.000207616

0.9% Compton

Total fit (Gauss)	
χ² / ndf	110.1396 / 83
Prob	0.02481495
G area	1993621 ± 4483.1
G mean [eV]	4931.9 ± 0.2

fixed Compton tail
Very good fit !

Fit of simulation

```
FCN=110.14 FROM MINOS       STATUS=SUCCESSFUL    26 CALLS          67 TOTAL
                EDM=3.42355e-09    STRATEGY= 1     ERROR MATRIX ACCURATE
 EXT PARAMETER                    PARABOLIC         MINOS ERRORS
 NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
  1  g mean [eV]   4.88214e+03      fixed
  2  g sigma [eV]  7.60229e+01      fixed
  3  t area        1.69175e+04      fixed
  4  t slope       6.30962e-01      fixed
  5  G area        1.99362e+06   4.48305e+03  -4.48297e+03   4.48313e+03
  6  G mean [eV]   4.93190e+03   1.73696e-01  -1.73697e-01   1.73696e-01
  7  G sigma [eV]  7.66219e+01      fixed
```

Ti Kβ compton-tail fit cycle 2

Compton fit

χ² / ndf	52.60796 / 54
Prob	0.5282108
G mean [eV]	4864.053 ± 15.981
G sigma [eV]	80.70482 ± 4.31896
Area	16815.1 ± 410.5
Slope	0.3830918 ± 0.2139777

simulation

0.9% Compton

[Ti K-beta1 (4931.81 eV)]
Number of Events
Total   = 203803 +- 451.445
Normal   = 199031
Compton   = 1739 +- 41.7013
Rayleigh = 2691
Compton other + escaped Rayleigh = 342

Ratios
Compton/Total = 0.00853275 +- 0.000205487
Compton/(Normal+Rayleigh) = 0.00862078 +- 0.000207616
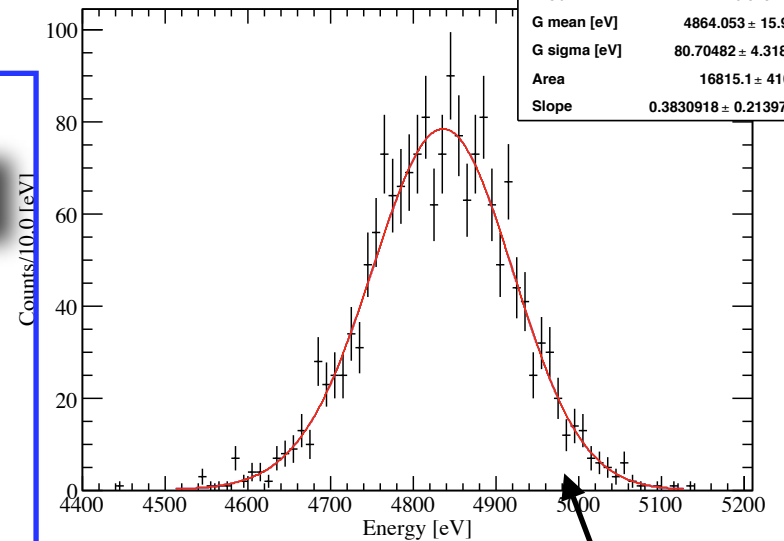
smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=52.608 FROM MINOS      STATUS=SUCCESSFUL   720 CALLS         813 TOTAL
                      EDM=5.69197e-12     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                  PARABOLIC         MINOS ERRORS
  NO.   NAME        VALUE          ERROR      NEGATIVE      POSITIVE
   1  G mean [eV]    4.86405e+03   1.04904e+01  -2.34066e+01    8.55455e+00
   2  G sigma [eV]   8.07048e+01   3.85107e+00  -3.54981e+00    5.08811e+00
   3  Area           1.68151e+04   4.10533e+02  -4.10537e+02    4.10539e+02
   4  Slope          3.83092e-01   1.49447e-01  -3.00269e-01    1.27686e-01
```

Ti Kβ total fit cycle 2

Total fit (Gauss)

χ² / ndf	108.4341 / 85
Prob	0.0441374
G area	1993917 ± 4483.3
G mean [eV]	4931.743 ± 0.167

simulation

```
[Ti K-beta1 (4931.81 eV)]
Number of Events
Total    = 203803 +- 451.445
Normal   = 199031
Compton  = 1739 +- 41.7013
Rayleigh = 2691
Compton other + escaped Rayleigh  = 342

Ratios
Compton/Total = 0.00853275 +- 0.000205487
Compton/(Normal+Rayleigh)  = 0.00862078 +- 0.000207616
```
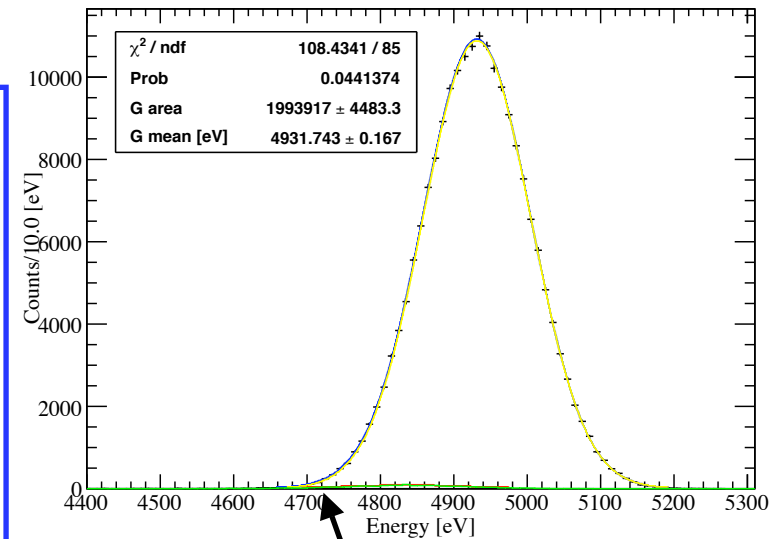
0.9% Compton

fixed Compton tail
Very good fit !

Fit of simulation

```
 FCN=108.434 FROM MINOS        STATUS=SUCCESSFUL      26 CALLS         68 TOTAL
                    EDM=1.36073e-09     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                   PARABOLIC         MINOS ERRORS
  NO.   NAME         VALUE           ERROR       NEGATIVE       POSITIVE
   1  g mean [eV]   4.86405e+03     fixed
   2  g sigma [eV]  8.07048e+01     fixed
   3  t area        1.68151e+04     fixed
   4  t slope       3.83092e-01     fixed
   5  G area        1.99392e+06   4.48327e+03  -4.48320e+03   4.48333e+03
   6  G mean [eV]   4.93174e+03   1.66680e-01  -1.66680e-01   1.66681e-01
   7  G sigma [eV]  7.32002e+01     fixed
```

Ni Kα1 compton-tail fit cycle 1

Compton fit

χ² / ndf	60.49867 / 78
Prob	0.9289275
G mean [eV]	7355.177 ± 6.542
G sigma [eV]	98.91032 ± 3.84220
Area	19992.99 ± 448.36
Slope	0.780277 ± 0.096668

simulation

[Ni K-alpha1 (7478.15 eV)]
Number of Events
Total   = 55792 +- 236.203
Normal   = 52704
Compton   = 2065 +- 45.4423
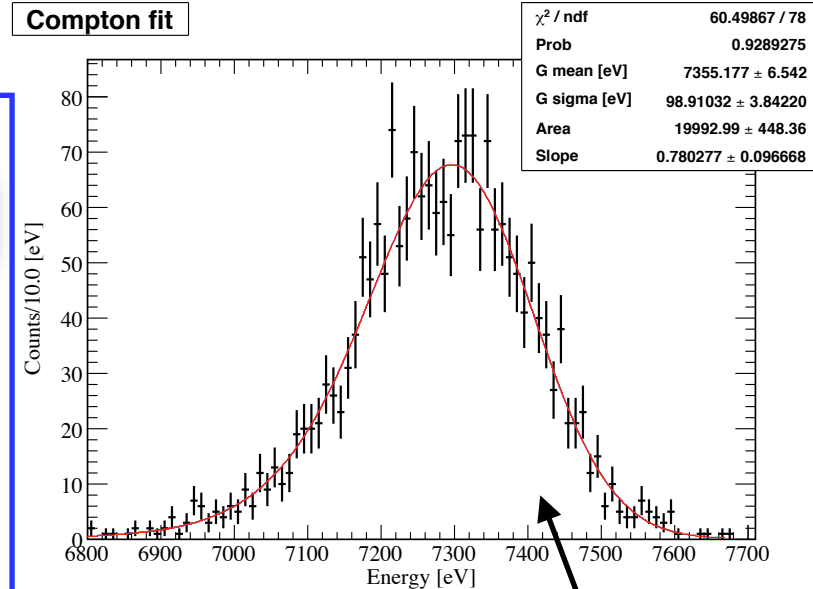Rayleigh = 863
Compton other + escaped Rayleigh = 160

Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh) = 0.0385499 +- 0.000864523

3.8% Compton

smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
FCN=60.4987 FROM MINOS        STATUS=SUCCESSFUL    227 CALLS          328 TOTAL
                    EDM=9.31261e-13     STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                    PARABOLIC         MINOS ERRORS
 NO.   NAME        VALUE            ERROR      NEGATIVE        POSITIVE
  1  G mean [eV]   7.35518e+03   6.51121e+00  -6.79478e+00    6.28965e+00
  2  G sigma [eV]  9.89103e+01   3.83804e+00  -3.79207e+00    3.89232e+00
  3  Area          1.99930e+04   4.48353e+02  -4.48356e+02    4.48360e+02
  4  Slope         7.80277e-01   9.63135e-02  -9.68821e-02    9.64546e-02
```

Ni Kα1 total fit cycle 1

Total fit (Gauss)

χ² / ndf   88.04672 / 94
Prob   0.6535048
G area   528689 ± 2327.1
G mean [eV]   7477.798 ± 0.387

simulation

```
[Ni K-alpha1 (7478.15 eV) ]
Number of Events
Total    = 55792 +- 236.203
Normal   = 52704
Compton  = 2065 +- 45.4423
Rayleigh = 863
Compton other + escaped Rayleigh  = 160


Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh)  = 0.0385499 +- 0.000864523
```
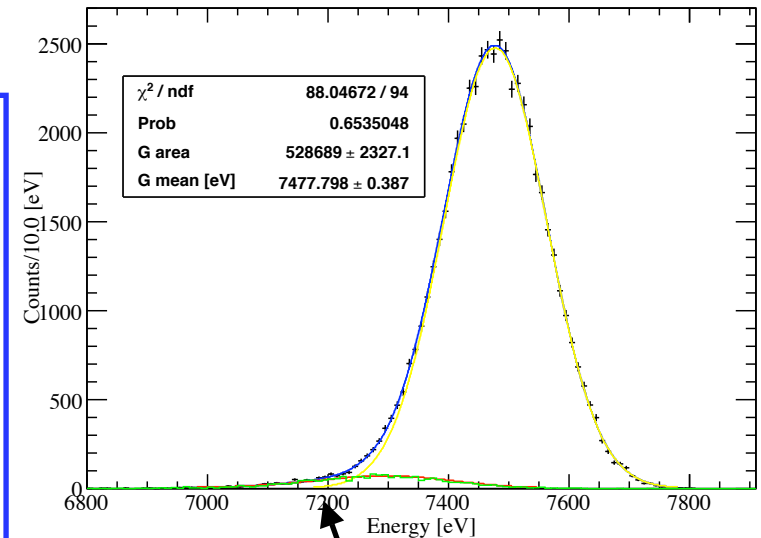
3.8% Compton

fixed Compton tail

Very good fit !

Fit of simulation

```
 FCN=88.0467 FROM MINOS        STATUS=SUCCESSFUL     26 CALLS            67 TOTAL
                    EDM=1.5697e-08     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                   PARABOLIC         MINOS ERRORS
  NO.   NAME        VALUE           ERROR       NEGATIVE       POSITIVE
   1  g mean [eV]   7.35518e+03      fixed
   2  g sigma [eV]   9.89103e+01      fixed
   3  t area        1.99930e+04      fixed
   4  t slope       7.80277e-01      fixed
   5  G area        5.28689e+05   2.32713e+03  -2.32711e+03   2.32715e+03
   6  G mean [eV]   7.47780e+03   3.86750e-01  -3.86793e-01   3.86710e-01
   7  G sigma [eV]   8.53091e+01      fixed
```

Ni Kα1 compton-tail fit cycle 2

Compton fit

χ^2 / ndf	74.34886 / 75
Prob	0.4995263
G mean [eV]	7351.966 ± 6.792
G sigma [eV]	96.56419 ± 3.83303
Area	19841.03 ± 446.62
Slope	0.73728 ± 0.10090

simulation

```
[Ni K-alpha1 (7478.15 eV) ]
Number of Events
Total     = 55792 +- 236.203
Normal    = 52704
Compton   = 2065 +- 45.4423
Rayleigh = 863
Compton other + escaped Rayleigh  = 160


Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh)  = 0.0385499 +- 0.000864523
```
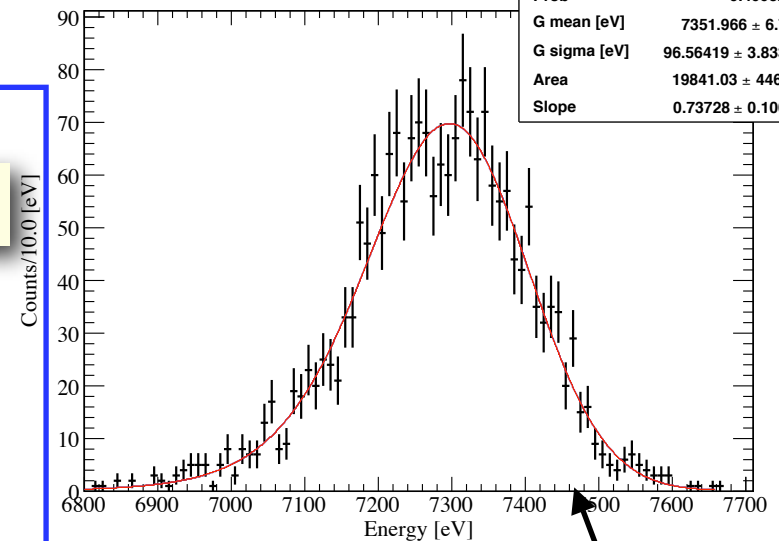
3.8% Compton

smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=74.3489 FROM MINOS      STATUS=SUCCESSFUL    252 CALLS          351 TOTAL
                    EDM=1.53573e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                   PARABOLIC         MINOS ERRORS
  NO.   NAME       VALUE            ERROR       NEGATIVE        POSITIVE
   1  G mean [eV]    7.35197e+03   6.75348e+00  -7.11568e+00    6.46789e+00
   2  G sigma [eV]   9.65642e+01   3.83038e+00  -3.76703e+00    3.89903e+00
   3  Area           1.98410e+04   4.46617e+02  -4.46620e+02    4.46625e+02
   4  Slope          7.37280e-01   1.00527e-01  -1.01830e-01    9.99695e-02
```

Ni Kα1 total fit cycle 2

Total fit (Gauss)

χ² / ndf	88.04672 / 94
Prob	0.6535048
G area	528689 ± 2327.1
G mean [eV]	7477.798 ± 0.387

simulation

```
[Ni K-alpha1 (7478.15 eV) ]
Number of Events
Total    = 55792 +- 236.203
Normal   = 52704
Compton  = 2065 +- 45.4423
Rayleigh = 863
Compton other + escaped Rayleigh  = 160


Ratios
Compton/Total = 0.0370125 +- 0.000829431
Compton/(Normal+Rayleigh)  = 0.0385499 +- 0.000864523
```
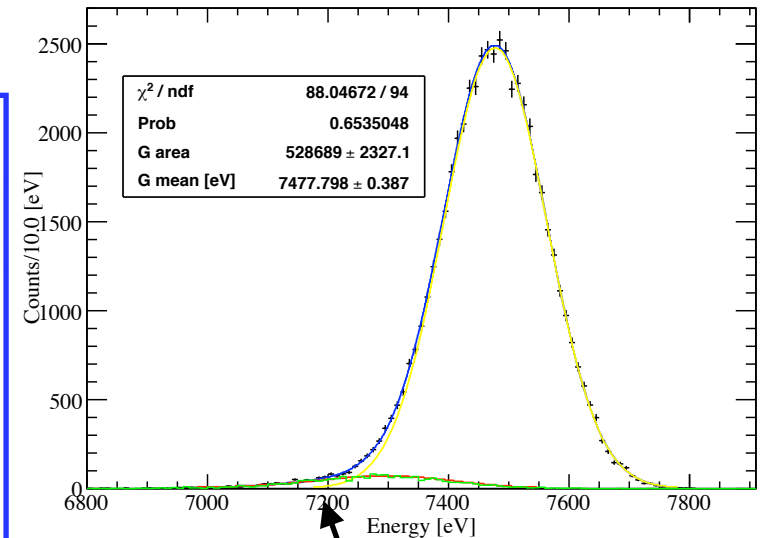
3.8% Compton

fixed Compton tail

Very good fit !

Fit of simulation

```
 FCN=89.4008 FROM MINOS       STATUS=SUCCESSFUL    26 CALLS          67 TOTAL
                   EDM=1.99895e-08    STRATEGY= 1     ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC         MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
   1  g mean [eV]   7.35197e+03      fixed
   2  g sigma [eV]  9.65642e+01      fixed
   3  t area        1.98410e+04      fixed
   4  t slope       7.37280e-01      fixed
   5  G area        5.28578e+05   2.32559e+03  -2.32557e+03   2.32560e+03
   6  G mean [eV]   7.47782e+03   3.68317e-01  -3.68357e-01   3.68281e-01
   7  G sigma [eV]  8.12408e+01      fixed
```

Ni Kα2 compton-tail fit cycle 1

χ² / ndf	54.26382 / 67
Prob	0.8687029
G mean [eV]	7341.396 ± 10.020
G sigma [eV]	96.62775 ± 5.64570
Area	10642.39 ± 328.68
Slope	0.7871169 ± 0.153120

simulation

```
[Ni K-alpha2 (7460.89 eV) ]
Number of Events
Total     = 32840 +- 181.218
Normal    = 31110
Compton   = 1117 +- 33.4215
Rayleigh  = 505
Compton other + escaped Rayleigh  = 108


Ratios
Compton/Total = 0.0340134 +- 0.00103487
Compton/(Normal+Rayleigh)  = 0.0353313 +- 0.00107566
```
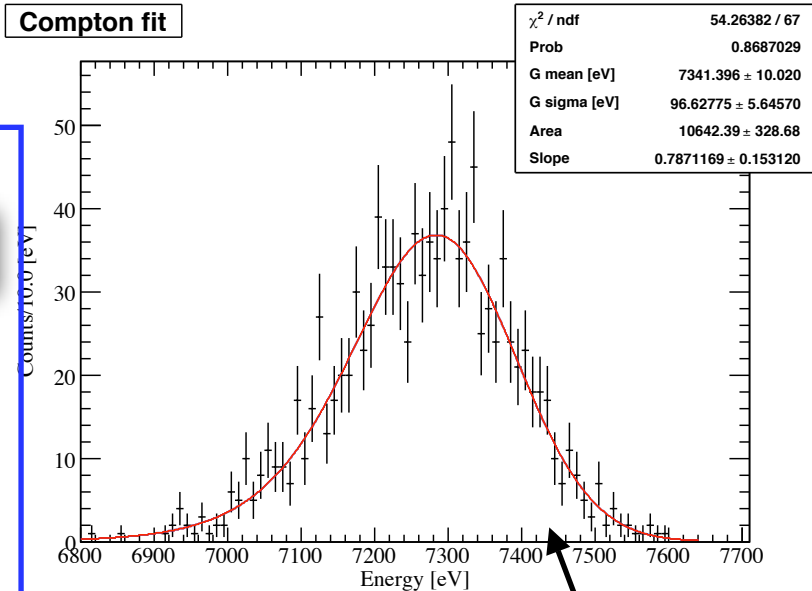
3.5% Compton

smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
FCN=54.2638 FROM MINOS      STATUS=SUCCESSFUL    270 CALLS           368 TOTAL
                     EDM=7.6226e-12      STRATEGY= 1        ERROR MATRIX ACCURATE
 EXT PARAMETER                    PARABOLIC         MINOS ERRORS
 NO.   NAME        VALUE            ERROR      NEGATIVE       POSITIVE
  1  G mean [eV]   7.34140e+03   9.89942e+00  -1.06727e+01   9.36767e+00
  2  G sigma [eV]  9.66278e+01   5.62261e+00  -5.51947e+00   5.77193e+00
  3  Area          1.06424e+04   3.28673e+02  -3.28663e+02   3.28701e+02
  4  Slope         7.87117e-01   1.51751e-01  -1.53109e-01   1.53132e-01
```

Ni Kα2 total fit cycle 1

Total fit (Gauss)

χ² / ndf	88.04672 / 94
Prob	0.6535048
G area	528689 ± 2327.1
G mean [eV]	7477.798 ± 0.387

simulation

```
[Ni K-alpha2 (7460.89 eV) ]
Number of Events
Total    = 32840 +- 181.218
Normal   = 31110
Compton  = 1117 +- 33.4215
Rayleigh = 505
Compton other + escaped Rayleigh  = 108

Ratios
Compton/Total = 0.0340134 +- 0.00103487
Compton/(Normal+Rayleigh)  = 0.0353313 +- 0.00107566
```
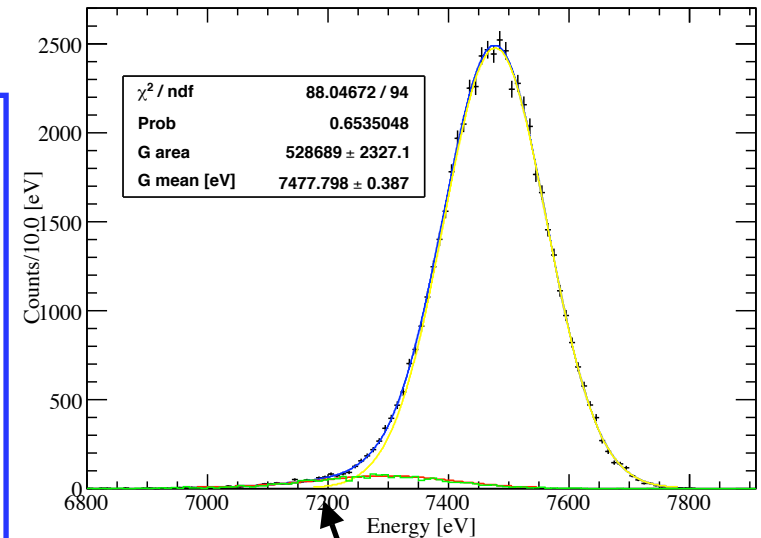
3.5% Compton

fixed Compton tail

Very good fit !

Fit of simulation

```
FCN=67.6979 FROM MINOS       STATUS=SUCCESSFUL     26 CALLS          66 TOTAL
                  EDM=8.91861e-09    STRATEGY= 1     ERROR MATRIX ACCURATE
 EXT PARAMETER                  PARABOLIC         MINOS ERRORS
 NO.   NAME        VALUE           ERROR      NEGATIVE        POSITIVE
  1  g mean [eV]   7.34140e+03     fixed
  2  g sigma [eV]  9.66278e+01     fixed
  3  t area        1.06424e+04     fixed
  4  t slope       7.87117e-01     fixed
  5  G area        3.12231e+05  1.78707e+03  -1.78707e+03   1.78707e+03
  6  G mean [eV]   7.46095e+03  4.95885e-01  -4.95972e-01   4.95806e-01
  7  G sigma [eV]  8.52532e+01     fixed
```

Ni Kα2 compton-tail fit cycle 2

Compton fit

χ² / ndf	64.62745 / 65
Prob	0.489707
G mean [eV]	7332.928 ± 9.623
G sigma [eV]	97.12296 ± 6.00172
Area	10597.8 ± 329.0
Slope	0.7500308 ± 0.1549997

simulation

```
[Ni K-alpha2 (7460.89 eV) ]
Number of Events
Total     = 32840 +- 181.218
Normal    = 31110
Compton   = 1117 +- 33.4215
Rayleigh = 505
Compton other + escaped Rayleigh  = 108


Ratios
Compton/Total = 0.0340134 +- 0.00103487
Compton/(Normal+Rayleigh)  = 0.0353313 +- 0.00107566
```
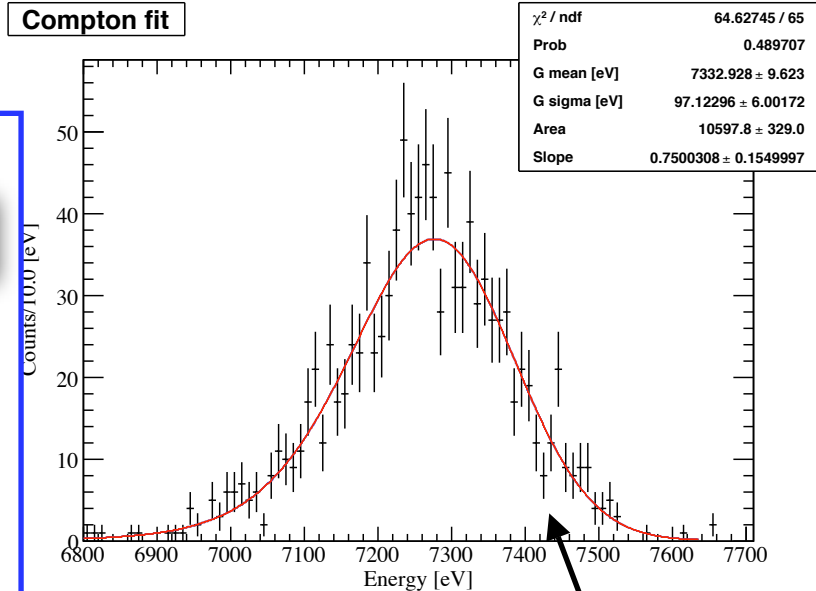
3.5% Compton

smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=64.6275 FROM MINOS        STATUS=SUCCESSFUL     266 CALLS          366 TOTAL
                      EDM=2.7474e-11     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT  PARAMETER                    PARABOLIC         MINOS ERRORS
  NO.   NAME        VALUE            ERROR      NEGATIVE        POSITIVE
   1   G mean [eV]   7.33293e+03   9.41680e+00  -1.04088e+01    8.83736e+00
   2   G sigma [eV]  9.71230e+01   5.95458e+00  -5.80265e+00    6.20080e+00
   3   Area          1.05978e+04   3.28969e+02  -3.28962e+02    3.28990e+02
   4   Slope         7.50031e-01   1.52620e-01  -1.58046e-01    1.51953e-01
```

Ni Kα2 total fit cycle 2

simulation

[Ni K-alpha2 (7460.89 eV)]
Number of Events
Total   = 32840 +- 181.218
Normal   = 31110
Compton   = 1117 +- 33.4215
Rayleigh = 505
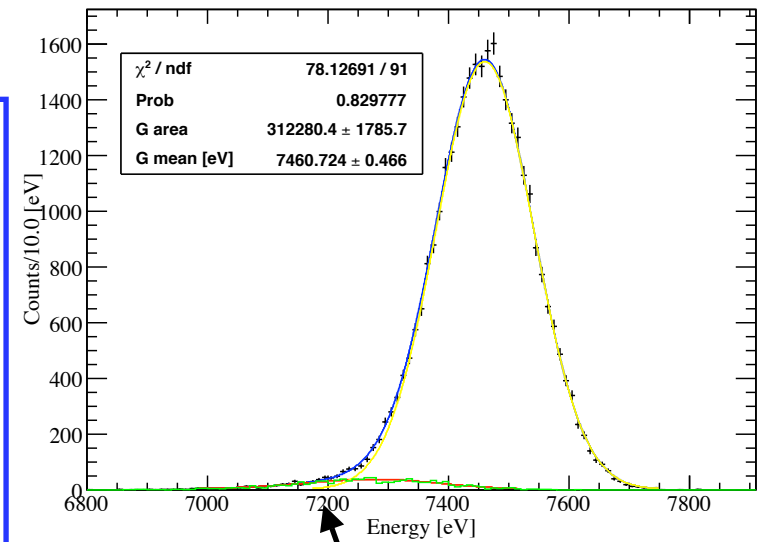Compton other + escaped Rayleigh = 108

Ratios
Compton/Total = 0.0340134 +- 0.00103487
Compton/(Normal+Rayleigh) = 0.0353313 +- 0.00107566

3.5% Compton

Total fit (Gauss)

χ² / ndf	78.12691 / 91
Prob	0.829777
G area	312280.4 ± 1785.7
G mean [eV]	7460.724 ± 0.466

fixed Compton tail
Very good fit !

Fit of simulation

```
FCN=78.1269 FROM MINOS        STATUS=SUCCESSFUL      24 CALLS           62 TOTAL
                   EDM=1.78181e-08     STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                      PARABOLIC          MINOS ERRORS
 NO.   NAME        VALUE              ERROR        NEGATIVE        POSITIVE
  1  g mean [eV]   7.33293e+03       fixed
  2  g sigma [eV]  9.71230e+01       fixed
  3  t area        1.05978e+04       fixed
  4  t slope       7.50031e-01       fixed
  5  G area        3.12280e+05    1.78572e+03   -1.78573e+03    1.78572e+03
  6  G mean [eV]   7.46072e+03    4.66268e-01   -4.66386e-01    4.66157e-01
  7  G sigma [eV]  8.11890e+01       fixed
```

Ni Kβ compton-tail fit cycle 1

Compton fit

χ² / ndf	79.28355 / 83
Prob	0.5951856
G mean [eV]	8102.18 ± 4.65
G sigma [eV]	109.483 ± 2.704
Area	47003.2 ± 686.9
Slope	0.6934289 ± 0.058724

4.1% Compton

simulation

```
[Ni K-beta (8264.66 eV) ]
Number of Events
Total     = 122417 +- 349.881
Normal    = 115399
Compton   = 4782 +- 69.152
Rayleigh = 1825
Compton other + escaped Rayleigh  = 411


Ratios
Compton/Total = 0.0390632 +- 0.000575816
Compton/(Normal+Rayleigh)  = 0.0407937 +- 0.000601825
```
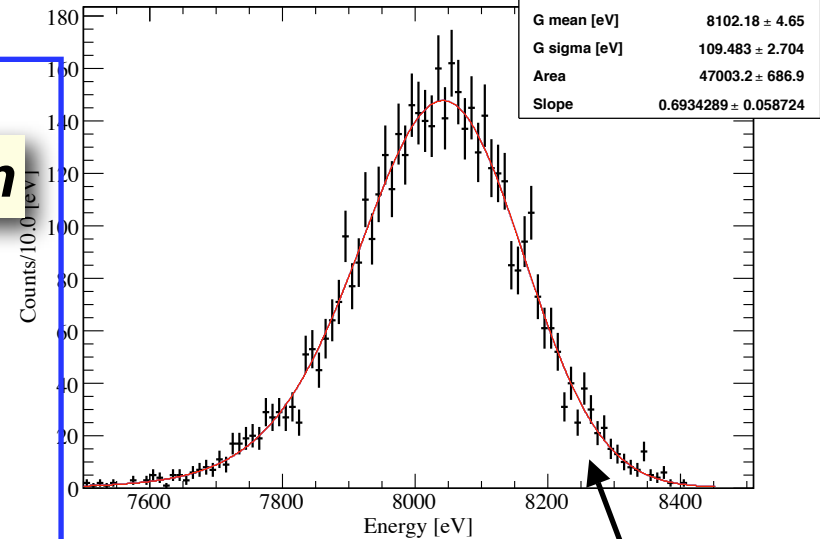
smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
FCN=79.2836 FROM MINOS       STATUS=SUCCESSFUL    239 CALLS          334 TOTAL
                    EDM=4.56873e-13     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                    PARABOLIC        MINOS ERRORS
  NO.   NAME       VALUE             ERROR      NEGATIVE      POSITIVE
   1  G mean [eV]    8.10218e+03    4.63529e+00  -4.79160e+00    4.50276e+00
   2  G sigma [eV]   1.09483e+02    2.70374e+00  -2.67896e+00    2.72972e+00
   3  Area           4.70032e+04    6.86922e+02  -6.86925e+02    6.86927e+02
   4  Slope          6.93429e-01    5.86214e-02  -5.92614e-02    5.81856e-02
```

Ni Kβ total fit cycle 1

Total fit (Gauss)

χ² / ndf	126.9092 / 110
Prob	0.1290789
G area	1158869 ± 3440.9
G mean [eV]	8264.323 ± 0.270

simulation

[Ni K-beta (8264.66 eV)]
Number of Events
Total   = 122417 +- 349.881
Normal   = 115399
Compton   = 4782 +- 69.152
Rayleigh = 1825
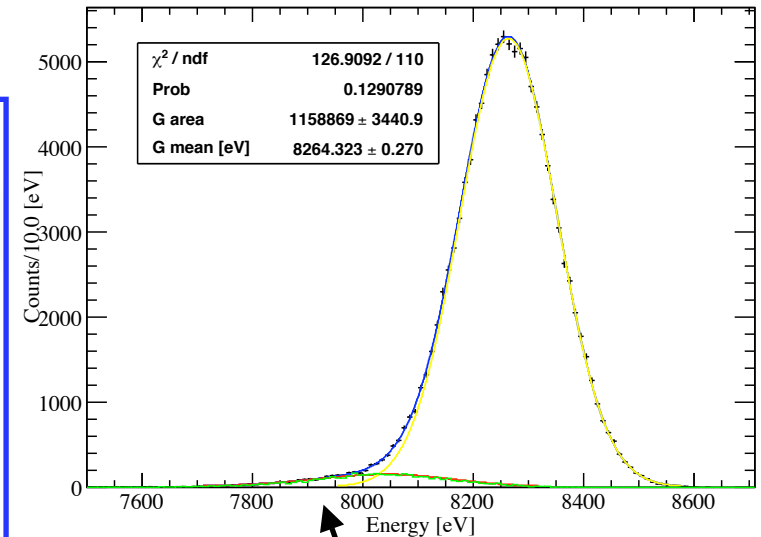Compton other + escaped Rayleigh = 411

Ratios
Compton/Total = 0.0390632 +- 0.000575816
Compton/(Normal+Rayleigh) = 0.0407937 +- 0.000601825

4.1% Compton

fixed Compton tail
Very good fit !

Fit of simulation

```
FCN=126.909 FROM MINOS        STATUS=SUCCESSFUL     26 CALLS          67 TOTAL
                    EDM=4.46534e-08     STRATEGY= 1     ERROR MATRIX ACCURATE
 EXT PARAMETER                      PARABOLIC           MINOS ERRORS
 NO.   NAME        VALUE            ERROR       NEGATIVE       POSITIVE
  1  g mean [eV]   8.10218e+03      fixed
  2  g sigma [eV]  1.09483e+02      fixed
  3  t area        4.70032e+04      fixed
  4  t slope       6.93429e-01      fixed
  5  G area        1.15887e+06   3.44090e+03  -3.44086e+03   3.44092e+03
  6  G mean [eV]   8.26432e+03   2.69891e-01  -2.69882e-01   2.69900e-01
  7  G sigma [eV]  8.78188e+01      fixed
```

Ni Kβ compton-tail fit cycle 2

Compton fit

χ² / ndf	71.41993 / 86
Prob	0.8707582
G mean [eV]	8101.582 ± 4.302
G sigma [eV]	106.5682 ± 2.5026
Area	47036.55 ± 686.60
Slope	0.7017537 ± 0.0548672

simulation

```
[Ni K-beta (8264.66 eV) ]
Number of Events
Total    = 122417 +- 349.881
Normal   = 115399
Compton  = 4782 +- 69.152
Rayleigh = 1825
Compton other + escaped Rayleigh  = 411


Ratios
Compton/Total = 0.0390632 +- 0.000575816
Compton/(Normal+Rayleigh)  = 0.0407937 +- 0.000601825
```
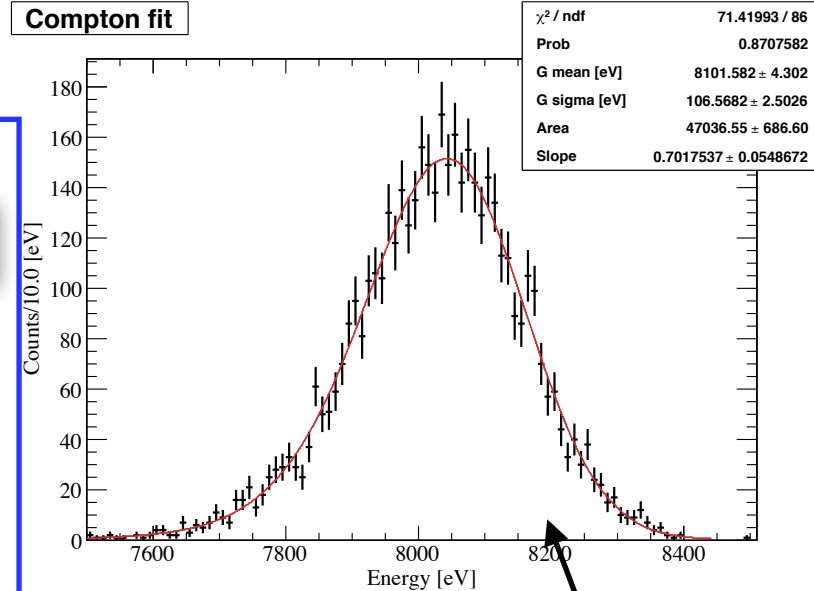
4.1% Compton

smeared with Gaussian
using Noise and Fano inputs

Fit of simulation

```
 FCN=71.4199 FROM MINOS       STATUS=SUCCESSFUL    238 CALLS          335 TOTAL
                     EDM=2.48229e-12     STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                   PARABOLIC         MINOS ERRORS
  NO.   NAME       VALUE            ERROR      NEGATIVE       POSITIVE
   1  G mean [eV]   8.10158e+03    4.29039e+00  -4.42026e+00    4.18410e+00
   2  G sigma [eV]  1.06568e+02    2.50038e+00  -2.48548e+00    2.51967e+00
   3  Area          4.70366e+04    6.86601e+02  -6.86604e+02    6.86604e+02
   4  Slope         7.01754e-01    5.47398e-02  -5.53092e-02    5.44252e-02
```

Ni Kβ total fit cycle 2

Total fit (Gauss)

χ^2 / ndf	130.0394 / 109
Prob	0.08273854
G area	1158469 ± 3437.9
G mean [eV]	8264.537 ± 0.255

simulation

[Ni K-beta (8264.66 eV)]
Number of Events
Total   = 122417 +- 349.881
Normal   = 115399
Compton   = 4782 +- 69.152
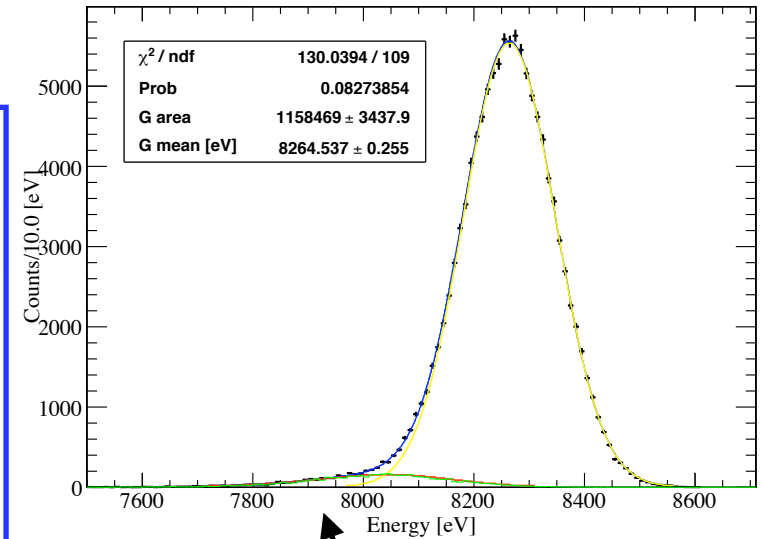Rayleigh = 1825
Compton other + escaped Rayleigh = 411

Ratios
Compton/Total = 0.0390632 +- 0.000575816
Compton/(Normal+Rayleigh) = 0.0407937 +- 0.000601825

4.1% Compton

fixed Compton tail
Very good fit !

Fit of simulation

```
 FCN=130.039 FROM MINOS       STATUS=SUCCESSFUL    26 CALLS          67 TOTAL
                   EDM=7.4612e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                      PARABOLIC           MINOS ERRORS
  NO.   NAME        VALUE             ERROR        NEGATIVE      POSITIVE
   1  g mean [eV]   8.10158e+03      fixed
   2  g sigma [eV]  1.06568e+02      fixed
   3  t area        4.70366e+04      fixed
   4  t slope       7.01754e-01      fixed
   5  G area        1.15847e+06   3.43789e+03  -3.43787e+03   3.43791e+03
   6  G mean [eV]   8.26454e+03   2.54783e-01  -2.54772e-01   2.54794e-01
   7  G sigma [eV]  8.35681e+01      fixed
```