Iterative fitting

with low-energy tail and Cu contamination

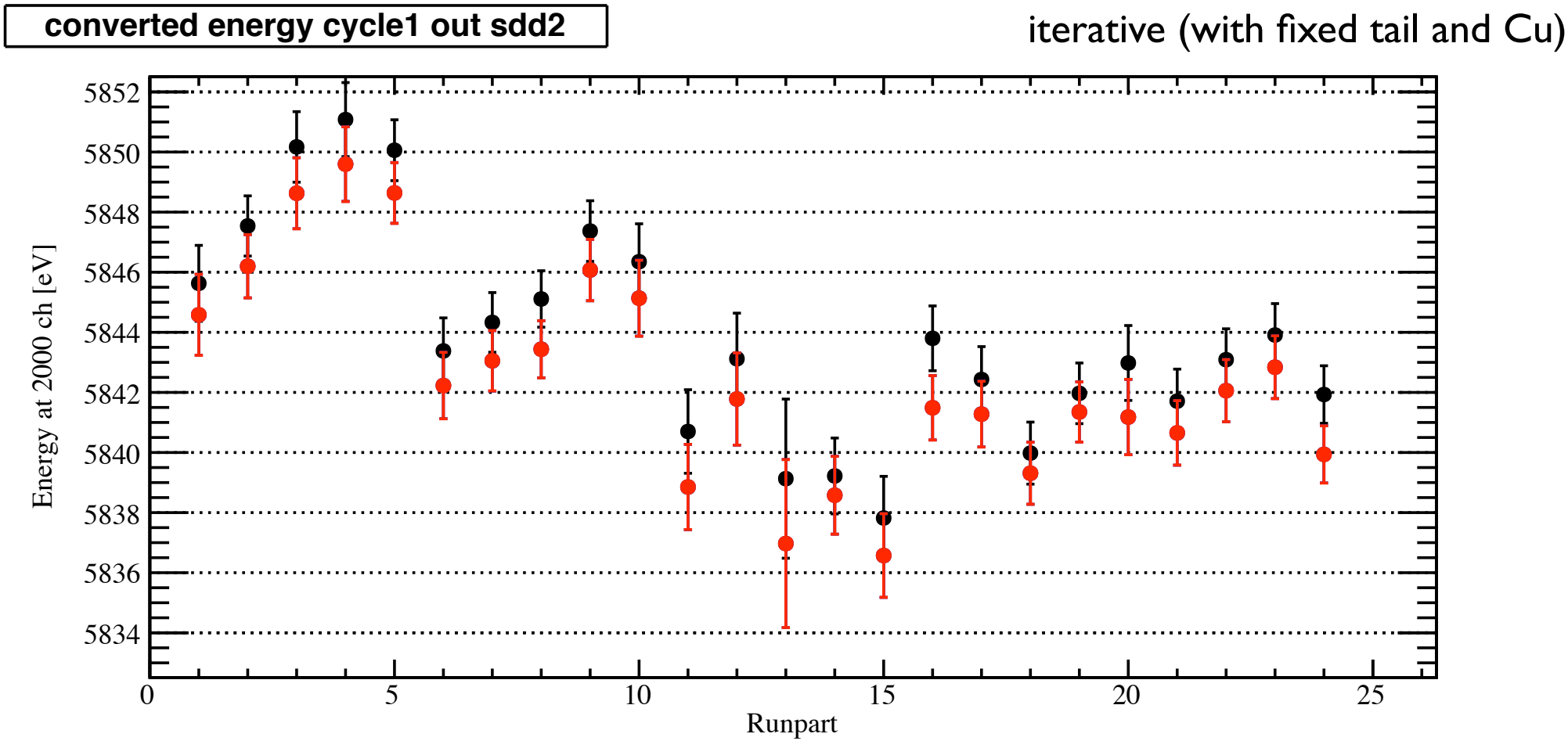
Calibration
- time dependence of gain drift -

--> obtained opposite sign !!
(~2eV lower than upper-rate cut)

--> influence the KHeX shift

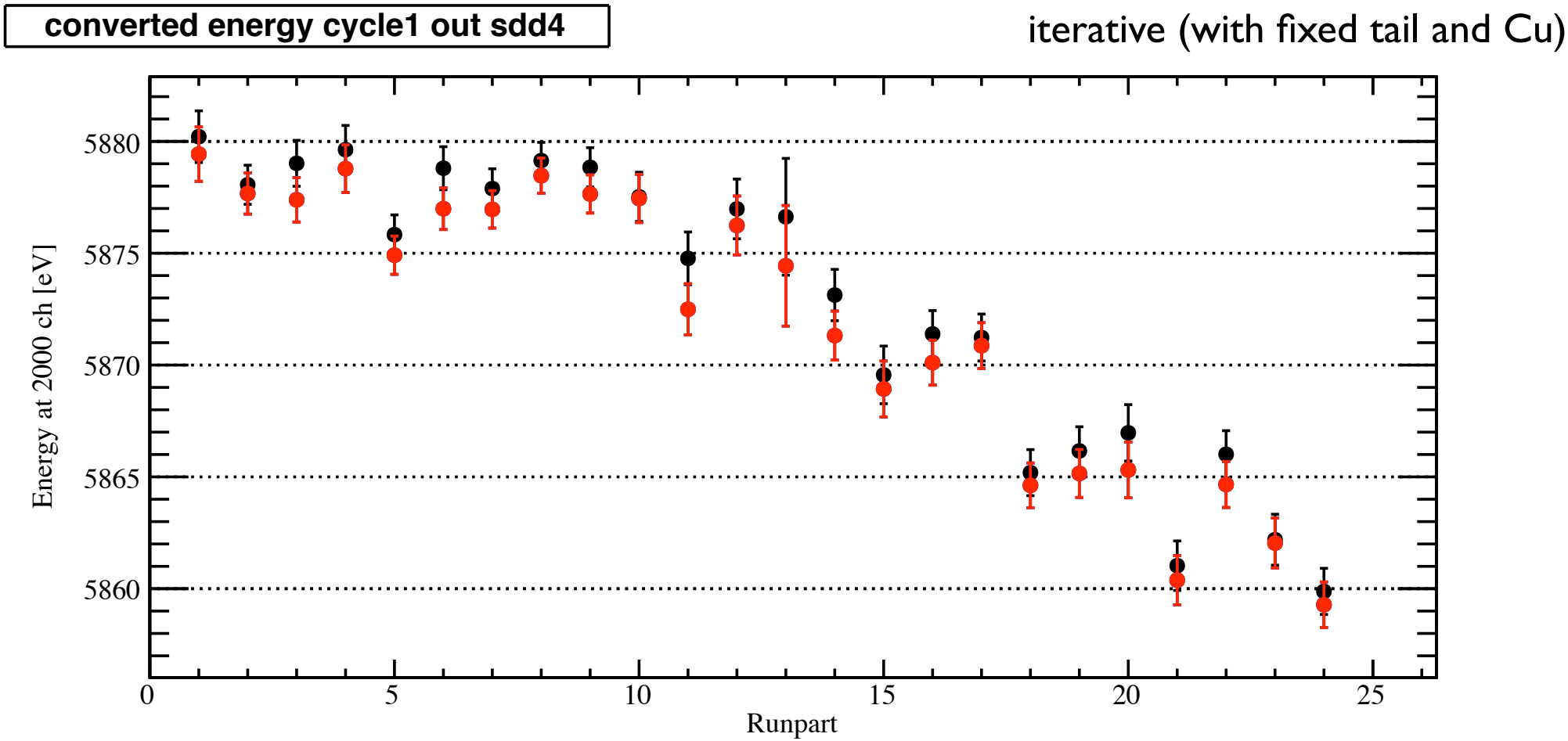
red : with pileup Gaussian + fixed tails

black : upper-rate cut



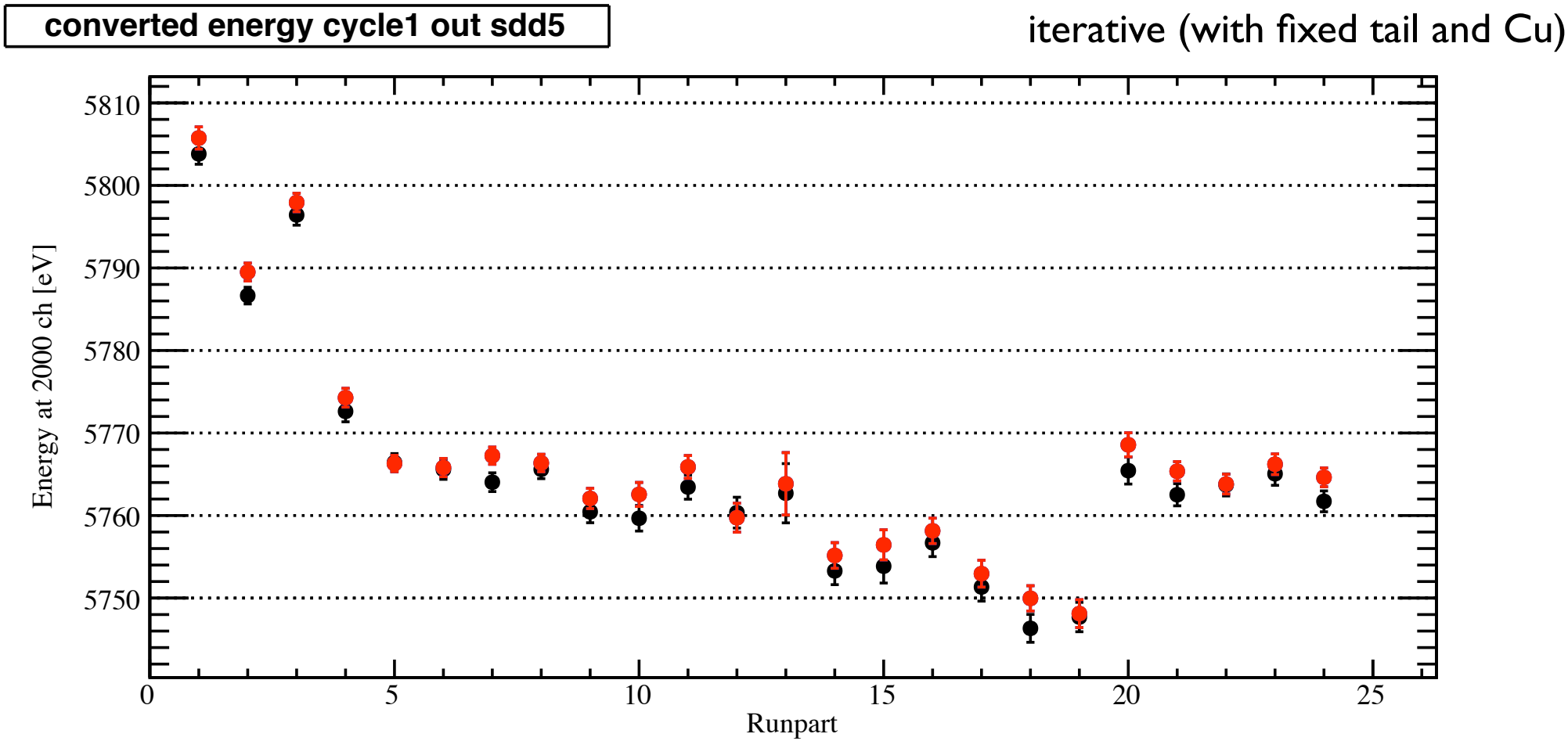
red : with pileup Gaussian + fixed tails

black : upper-rate cut



red : with pileup Gaussian + fixed tails

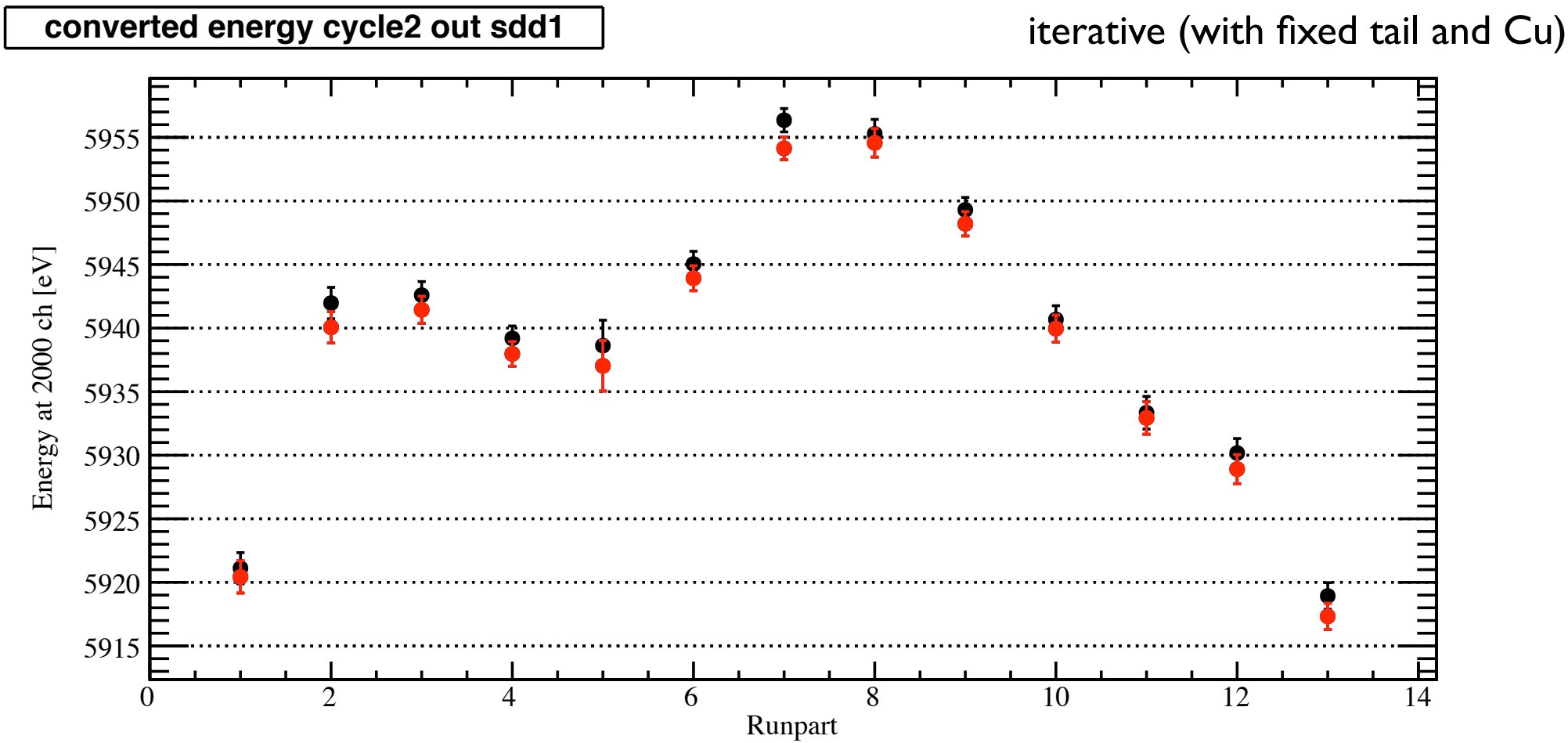
black : upper-rate cut



inverse sign only for SDD5

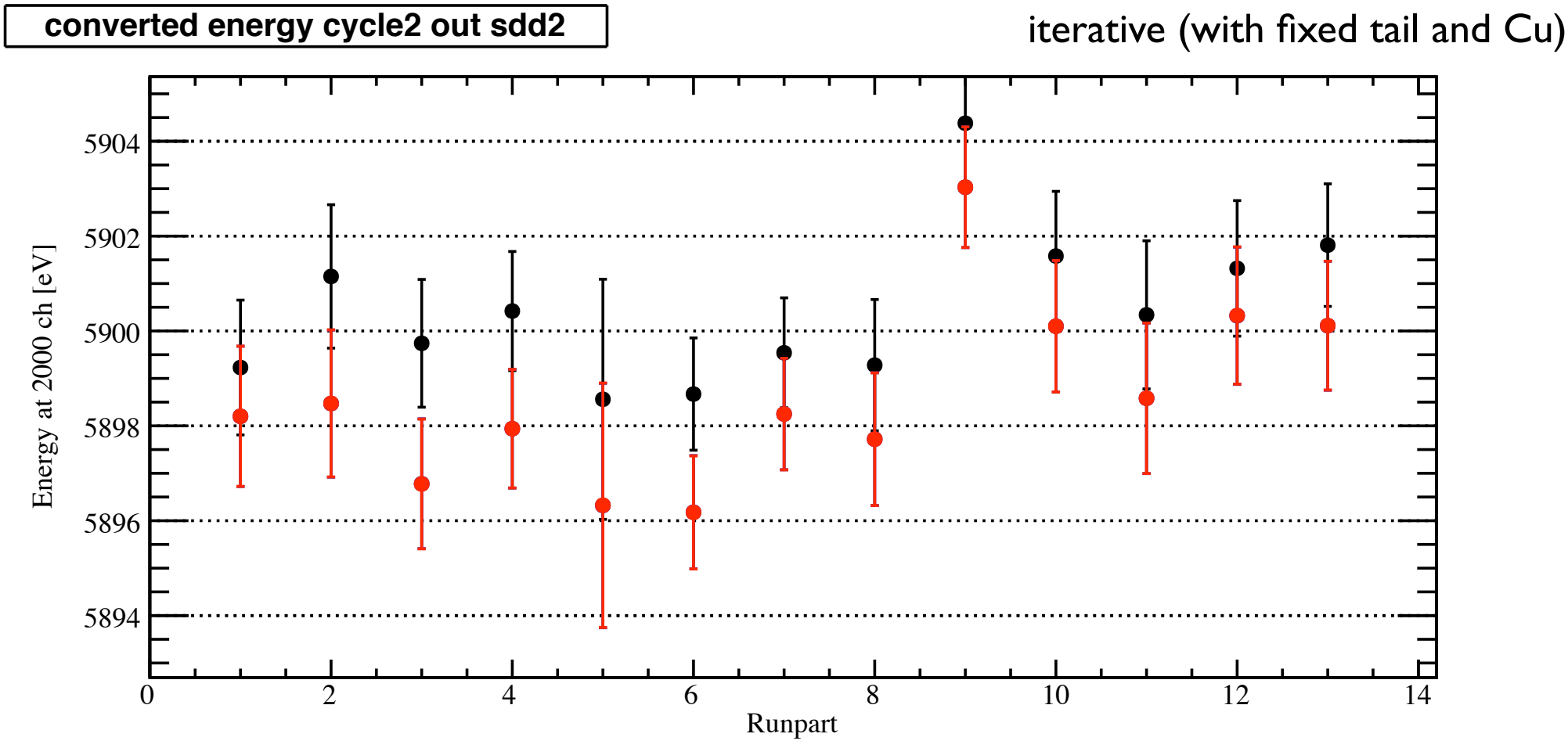
red : with pileup Gaussian + fixed tails

black : upper-rate cut



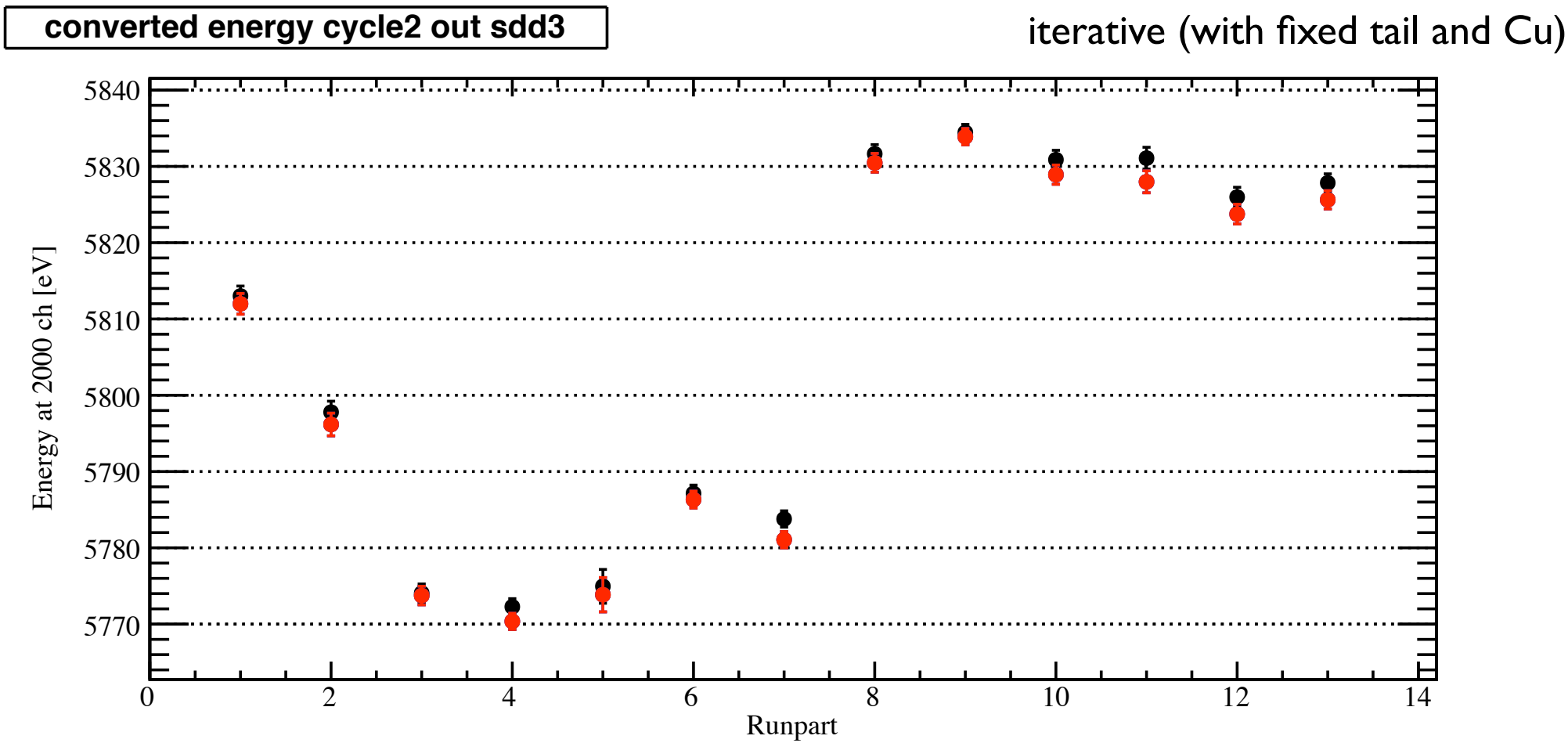
red : with pileup Gaussian + fixed tails

black : upper-rate cut



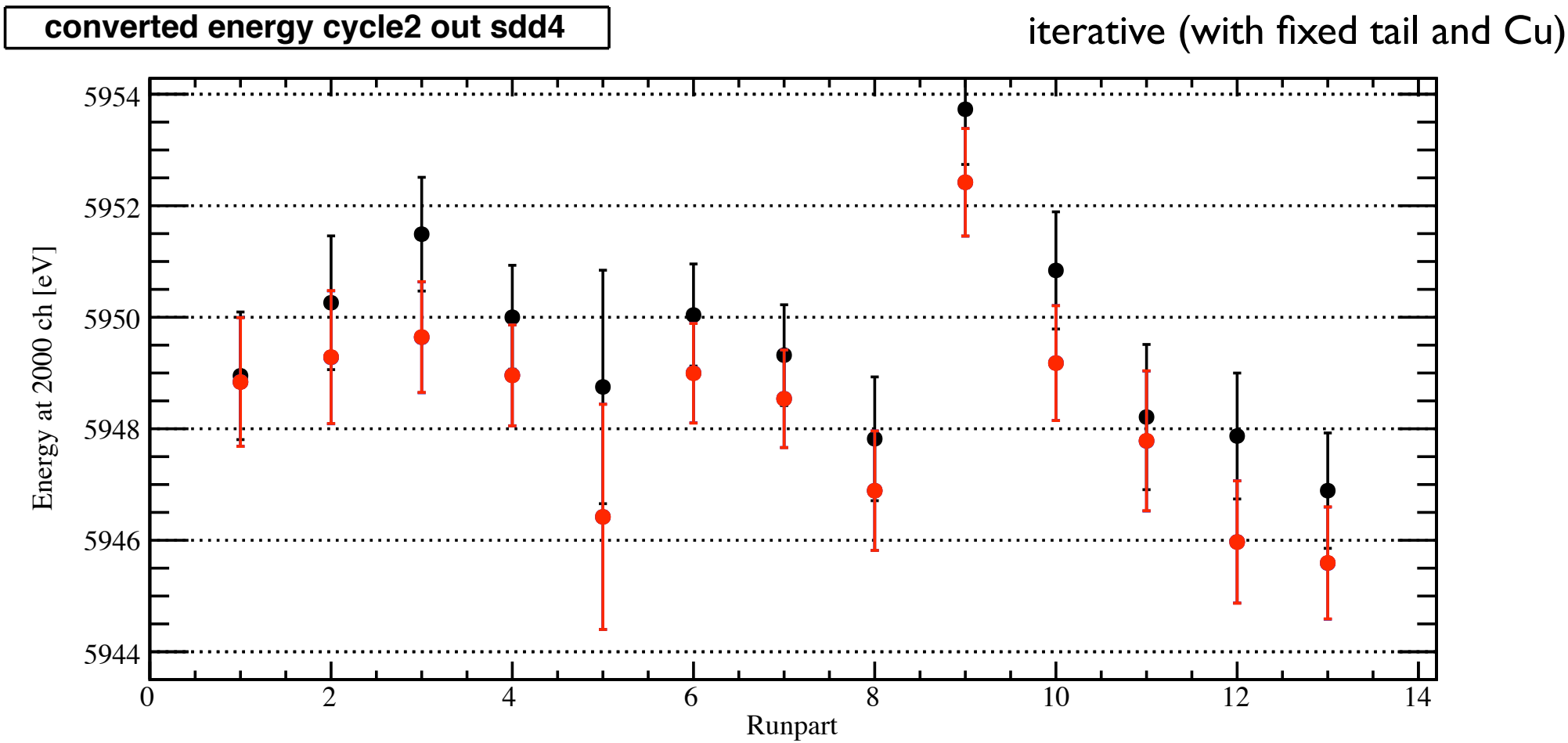
red : with pileup Gaussian + fixed tails

black : upper-rate cut



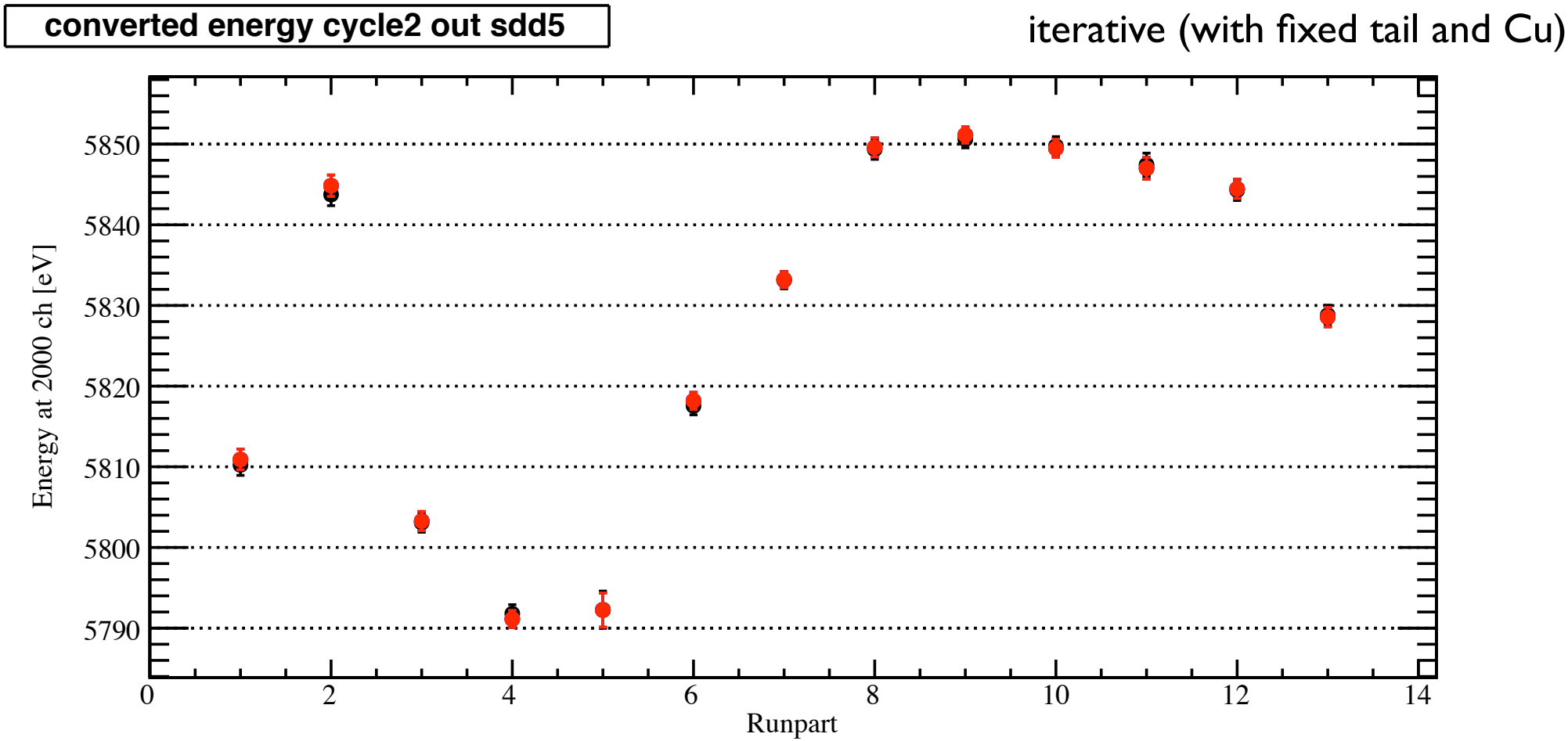
red : with pileup Gaussian + fixed tails

black : upper-rate cut



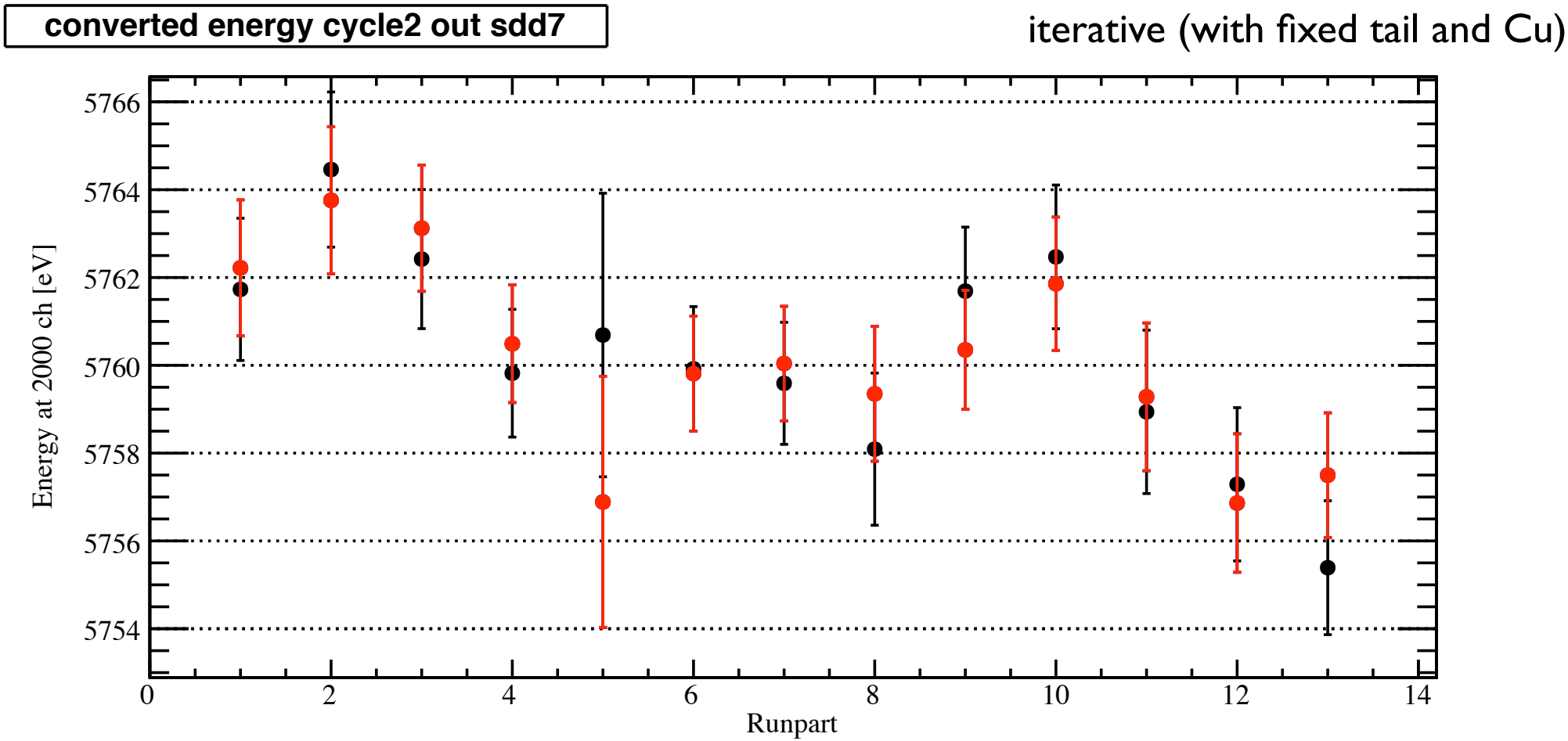
red : with pileup Gaussian + fixed tails

black : upper-rate cut



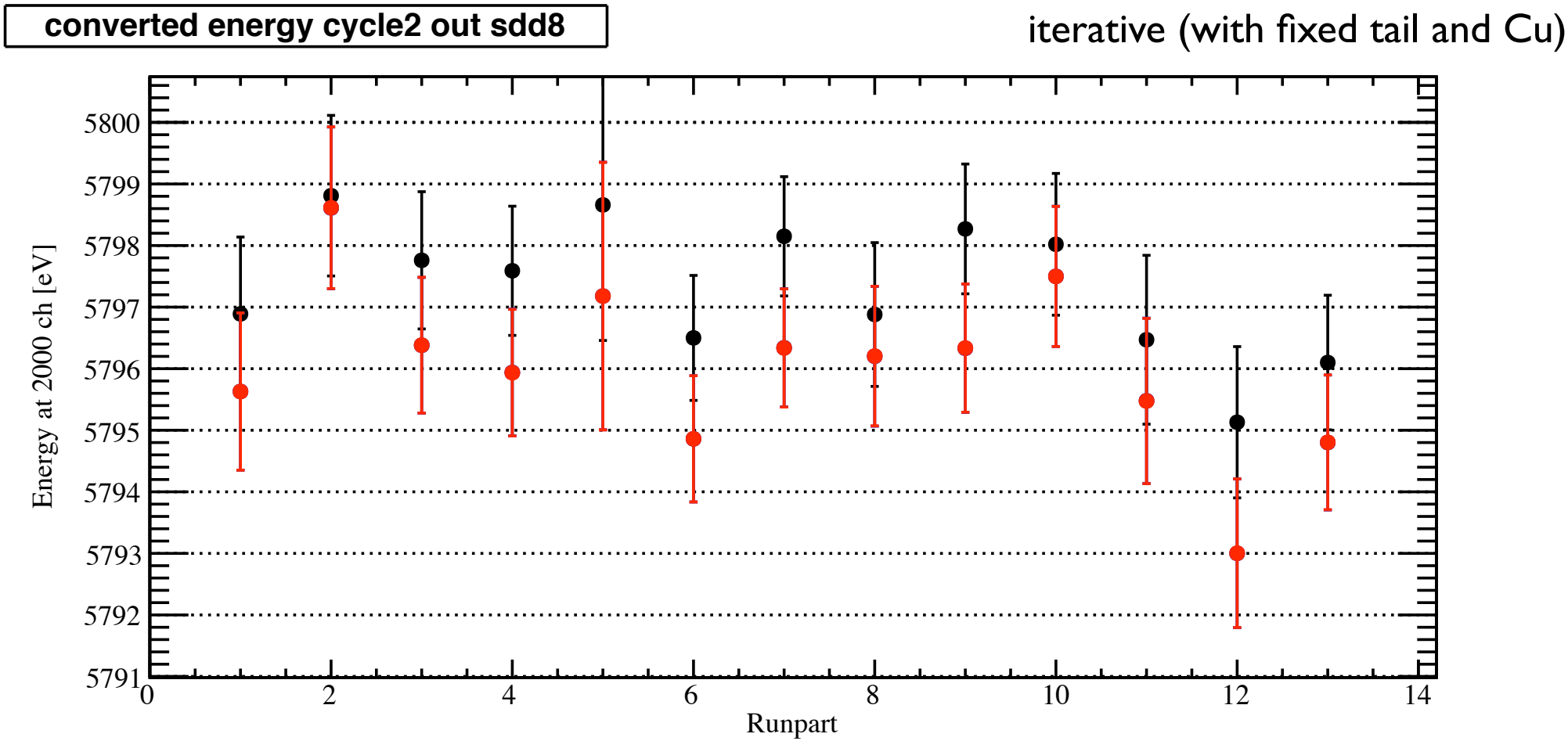
red : with pileup Gaussian + fixed tails

black : upper-rate cut



red : with pileup Gaussian + fixed tails

black : upper-rate cut

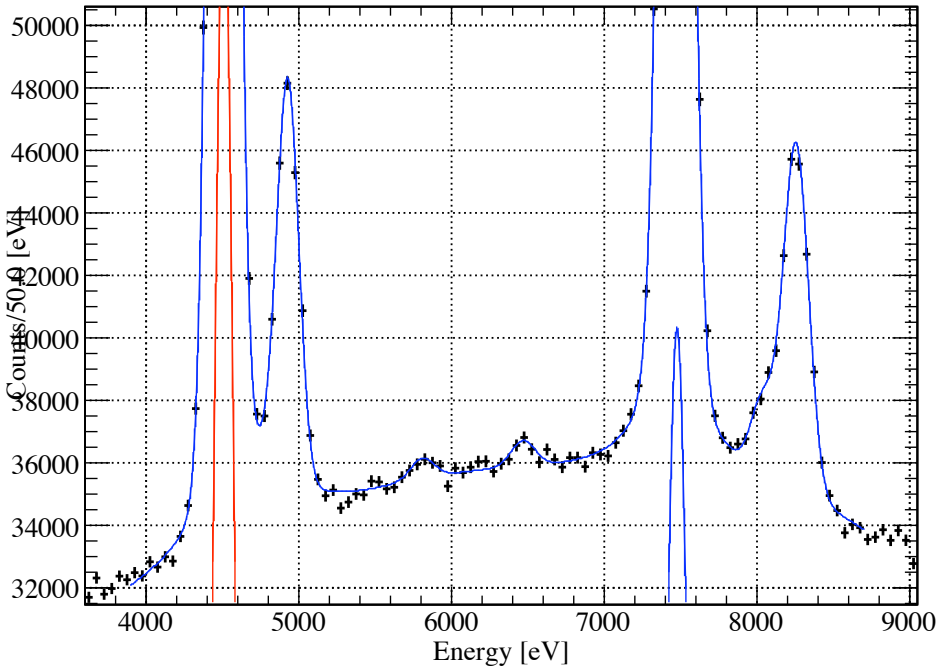


SDD-by-SDD
summed up calibrated histograms
(iterative)

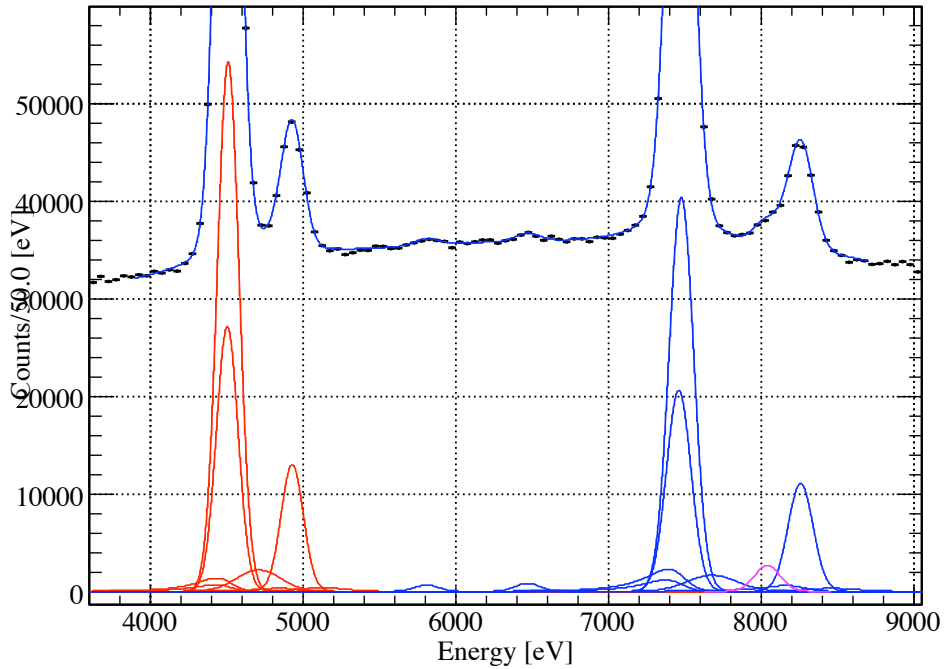
-> Ka-lines agreement is better
than before iterative fitting !

-> The difference is ~±1 eV

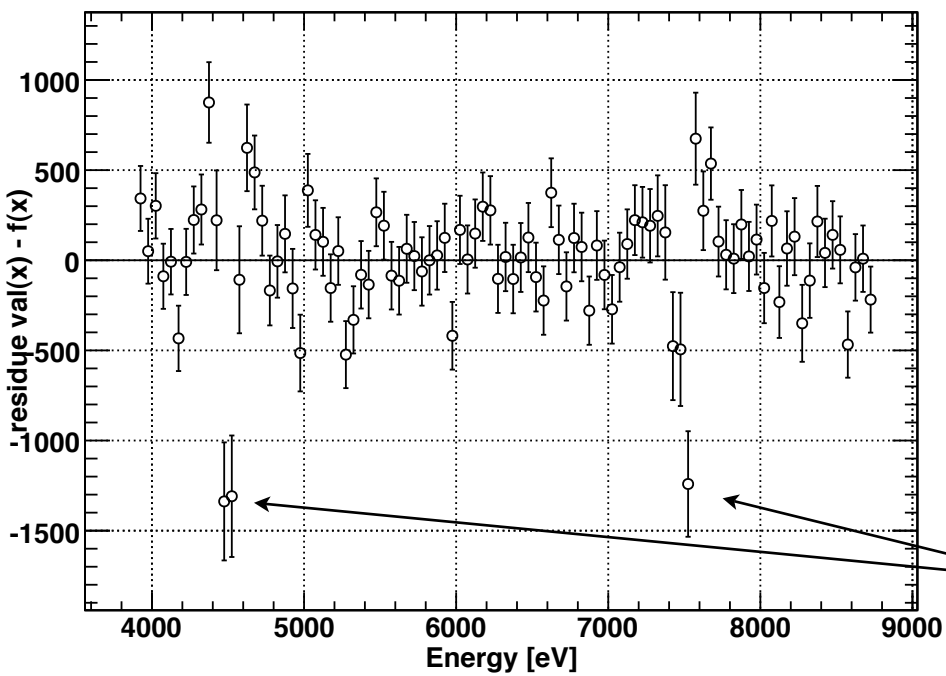
self total 1st mean and noise free fit



self total 1st mean and noise free fit



fit residue

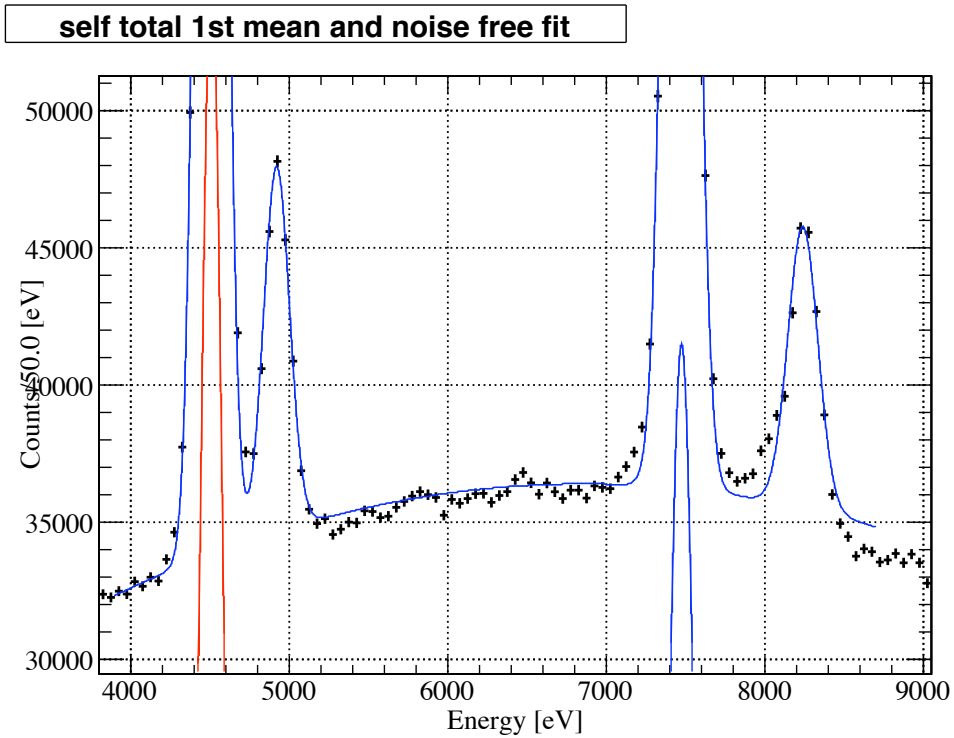


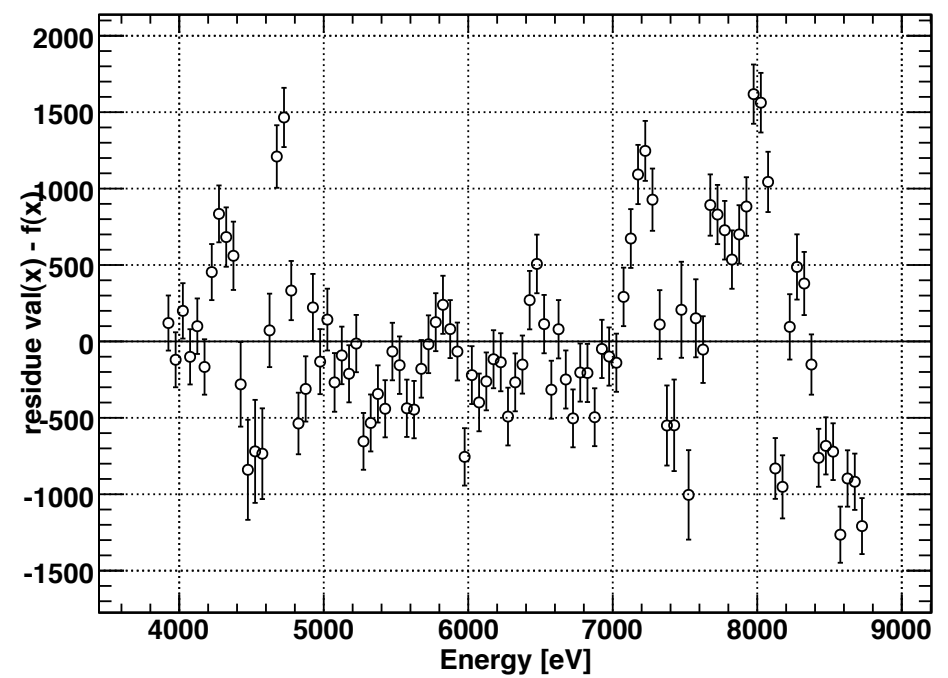
Chisqr has no difference ... between before and after the iterative calib.

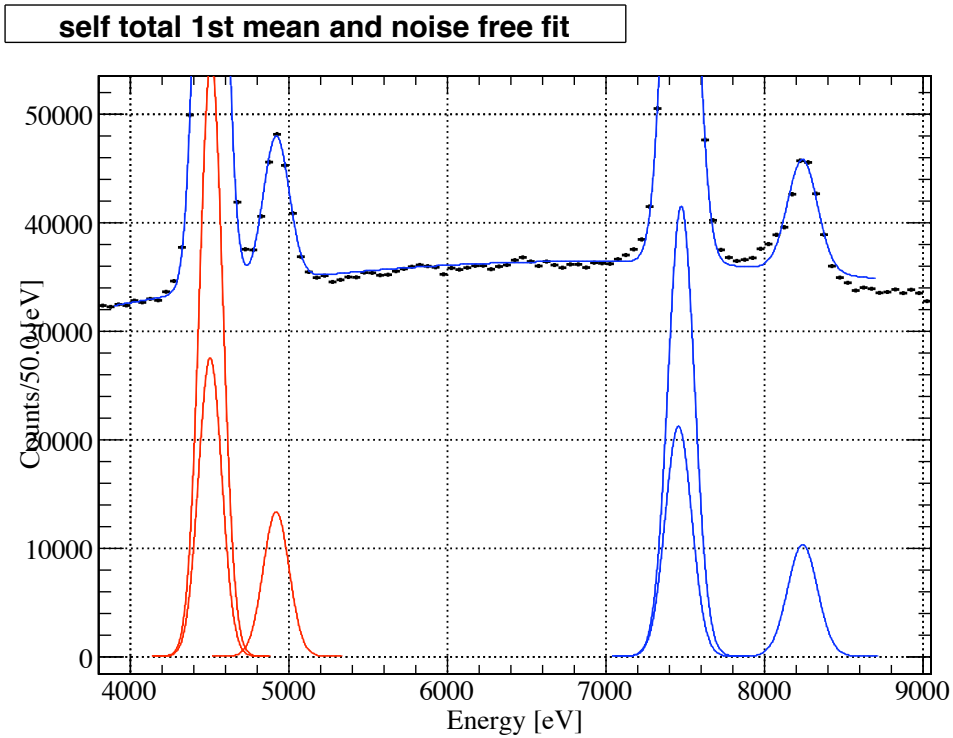
This large negative miss-mach exists always ...

Compare three types of fitting

1. no pileup, tail and contaminations
2. with pileup
3. with pileup, tail and contaminations







1. no pileup, tail and contaminations

1. no pileup, tail and contaminations

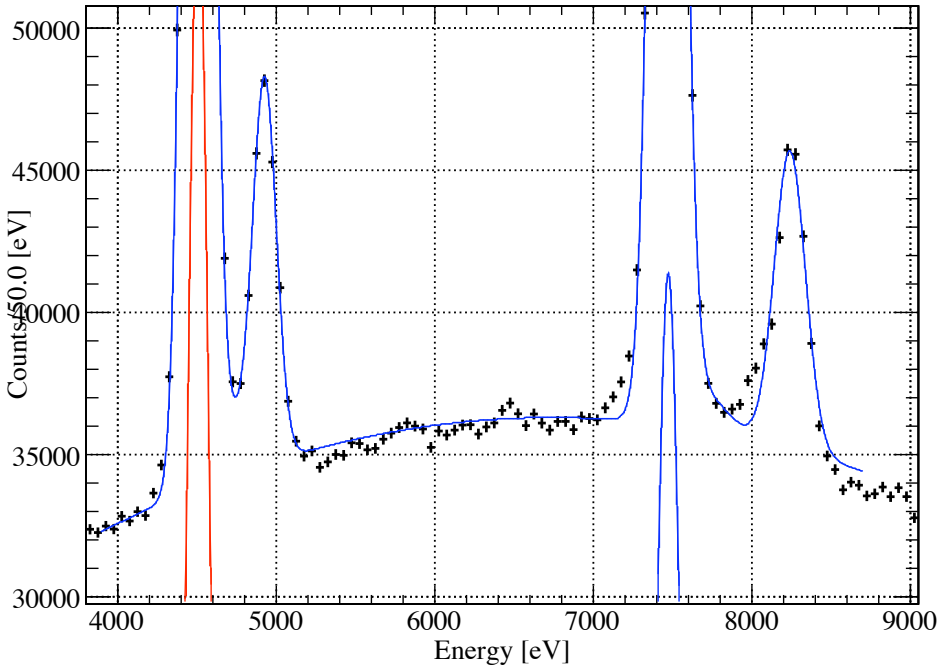
```
FCN=1977.22 FROM MINOS     STATUS=SUCCESSFUL   7034 CALLS        7563 TOTAL
                     EDM=0.420669    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.44787e+04   4.65245e+02  -7.72028e+02   3.07662e+02
  2  BGb          6.38320e+00   1.52541e-01  -1.00562e-01   2.53837e-01
  3  BGc         -4.65229e-04   1.22522e-05  -2.03106e-05   8.14119e-06
  4  Const Noise [eV]   5.40221e+01   1.03443e+00  -1.11385e+00   1.18911e+00
  5  Fano         1.44912e-01   5.29081e-03  -6.06140e-03   5.72272e-03
  6  Ti Kb/Ka1 ratio   2.68877e-01   3.36174e-03  -3.68985e-03   3.76864e-03
  7  Ni Kb/Ka1 ratio   2.77685e-01   5.18172e-03  -4.90446e-03   6.69790e-03
  8  TiKa1 Height   5.50140e+04   1.66833e+02  -1.81533e+02   1.88716e+02
  9  NiKa1 Height   4.15076e+04   1.44898e+02  -1.62178e+02   1.59487e+02
 10  TiKa1 Mean [eV]   4.51059e+03   2.17580e-01  -2.47626e-01   2.35164e-01
 11  NiKa1 Mean [eV]   7.47610e+03   2.91922e-01  -3.17955e-01   3.29784e-01
 12  TiKb1 Mean [eV]   4.92098e+03   1.07318e+00  -1.21831e+00   1.16350e+00
 13  NiKb1 Mean [eV]   8.24134e+03   1.54325e+00  -1.72180e+00   1.70504e+00
 14  TiKb1 Sigma [eV]   8.17070e+01   1.17068e+00  -1.26807e+00   1.32989e+00
 15  NiKb1 Sigma [eV]   9.42298e+01   1.92250e+00  -1.89680e+00   2.39539e+00
```

```
TiKa1 Mean   = 4510.590 +-  0.241
TiKb1 Mean   = 4920.984 +-  1.191
NiKa1 Mean   = 7476.101 +-  0.324
NiKb1 Mean   = 8241.340 +-  1.713
Const Noise  = 54.022 +-  1.151
Fano         =  0.145 +-  0.006
TiKb1 Noise  = 81.707 +-  1.299
NiKb1 Noise  = 94.230 +-  2.146
Chisq/NDF    = 778.447/81
```

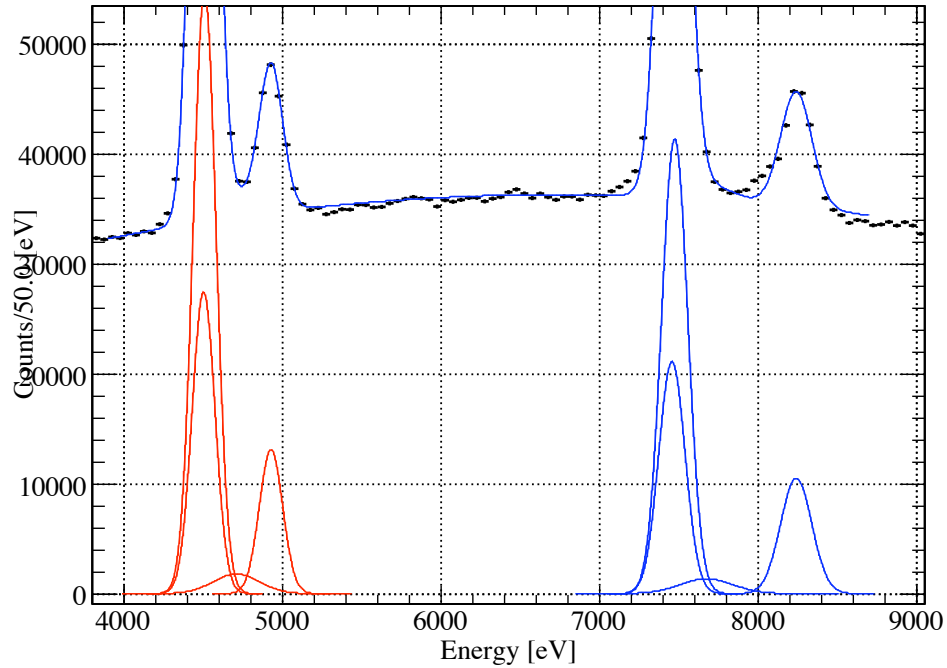
K beta means are lower due to pileup

K alpha is good agreement

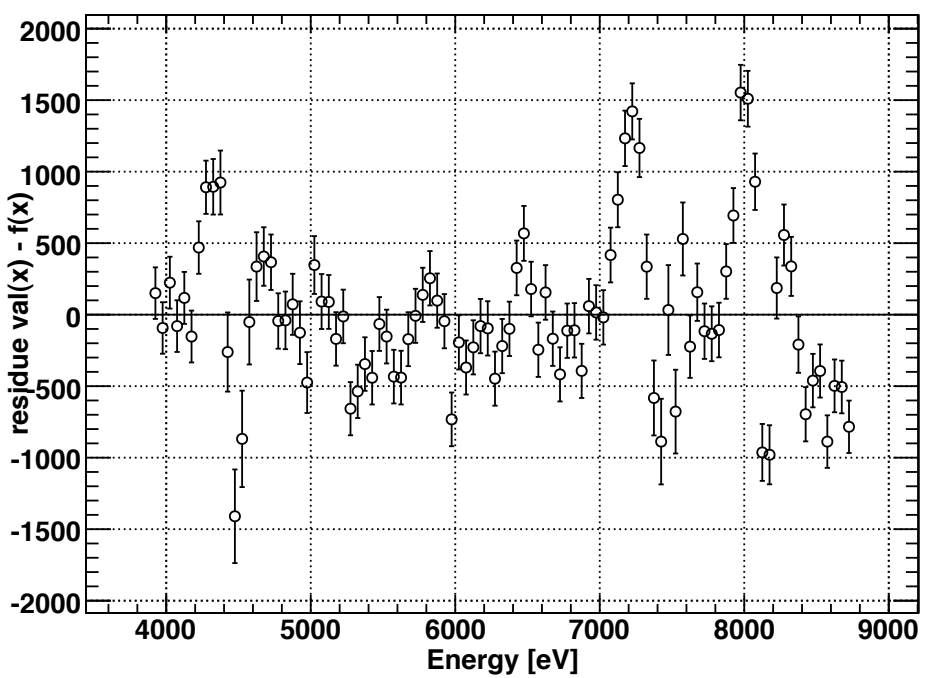
self total 1st mean and noise free fit



self total 1st mean and noise free fit



fit residue



2. with pileup

2. with pileup

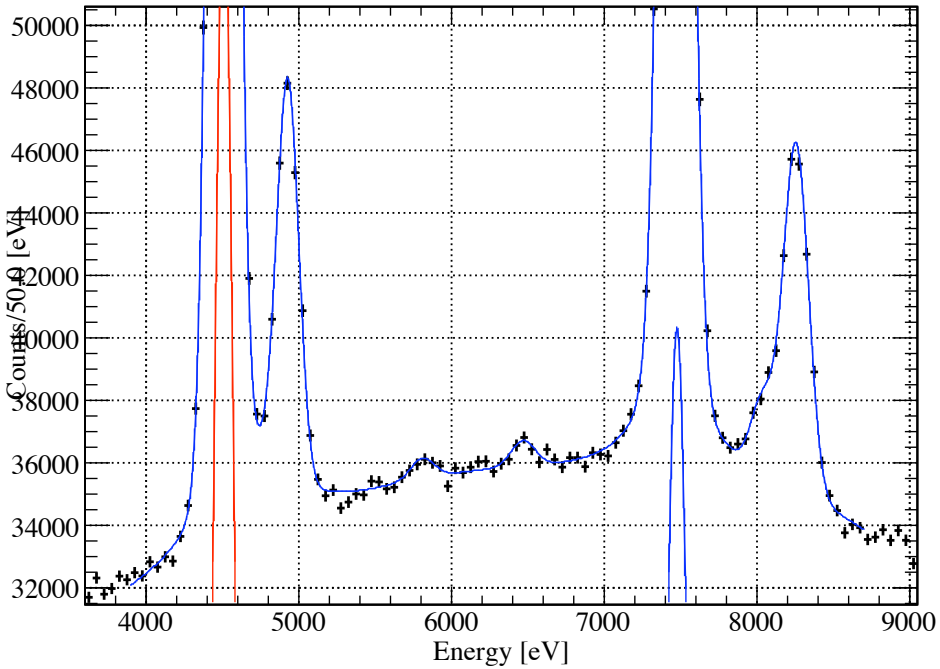
```
FCN=1789.52 FROM MINOS     STATUS=SUCCESSFUL   3547 CALLS        4254 TOTAL
                     EDM=0.00264524    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.37061e+04   4.66591e+02  -5.05812e+02   4.72821e+02
  2  BGb          6.69435e+00   1.53666e-01  -1.55863e-01   1.66795e-01
  3  BGc         -4.96314e-04   1.24211e-05  -1.34716e-05   1.25930e-05
  4  Const Noise [eV]   5.22187e+01   1.05572e+00  -1.05918e+00   1.05941e+00
  5  Fano         1.45032e-01   5.19240e-03  -5.25036e-03   5.16892e-03
  6  Ti Kb/Ka1 ratio   2.43335e-01   3.52147e-03  -3.51844e-03   3.53080e-03
  7  Ni Kb/Ka1 ratio   3.00478e-01   5.69360e-03  -5.62470e-03   5.85972e-03
  8  TiKa1 Height   5.48561e+04   1.69612e+02  -1.69384e+02   1.70171e+02
  9  NiKa1 Height   4.13677e+04   1.47068e+02  -1.45970e+02   1.48513e+02
 10  TiKa1 Mean [eV]   4.50932e+03   2.35327e-01  -2.37357e-01   2.33782e-01
 11  NiKa1 Mean [eV]   7.47470e+03   3.08696e-01  -3.10849e-01   3.06935e-01
 12  TiKb1 Mean [eV]   4.92843e+03   1.13874e+00  -1.13466e+00   1.14482e+00
 13  NiKb1 Mean [eV]   8.24149e+03   1.52302e+00  -1.52338e+00   1.52633e+00
 14  TiKb1 Sigma [eV]   7.37619e+01   1.17446e+00  -1.16962e+00   1.18123e+00
 15  NiKb1 Sigma [eV]   9.82097e+01   1.96188e+00  -1.93324e+00   2.01120e+00
 16  Pile area scale   3.23303e-02   2.28330e-03  -2.26743e-03   2.30337e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma scale   2.00000e+00     fixed
```

```
Ti EVENT
KA1+KA2     = 297995
Pileup      = 12845.7
Pile/All = 0.0413257
Ni EVENT
KA1+KA2     = 259315
Pileup      = 11104.3
Pile/All = 0.0410632
TiKa1 Mean   = 4509.324 +-  0.236
TiKb1 Mean   = 4928.425 +-  1.140
NiKa1 Mean   = 7474.700 +-  0.309
NiKb1 Mean   = 8241.485 +-  1.525
Const Noise  = 52.219 +-  1.059
Fano         =  0.145 +-  0.005
TiKb1 Noise  = 73.762 +-  1.175
NiKb1 Noise  = 98.210 +-  1.972
Chisq/NDF    = 590.313/80
```

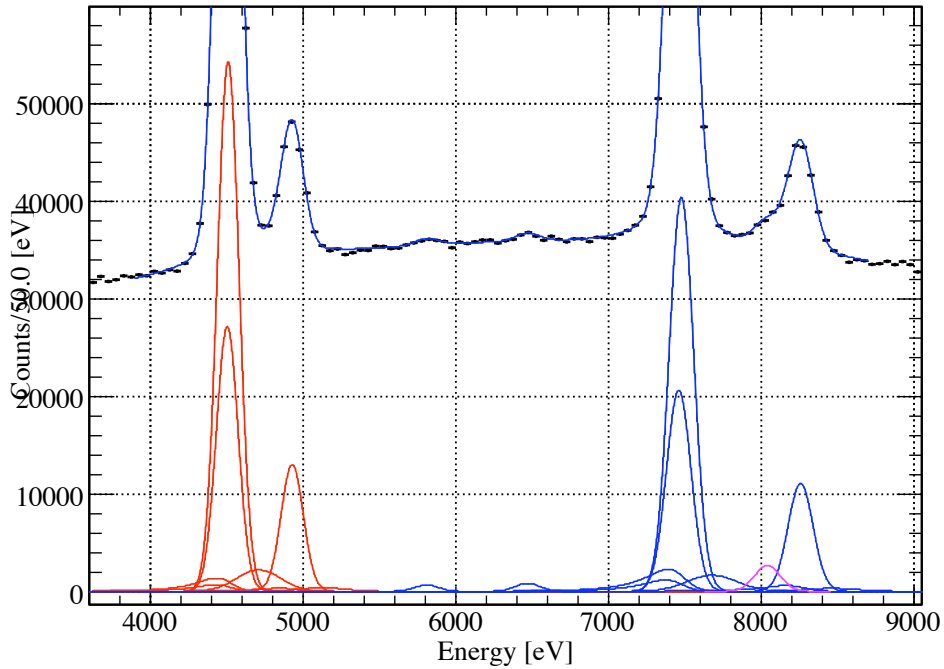
Peak centroids are pulled to the low-energy side !

--> low-energy tail has to be considered !

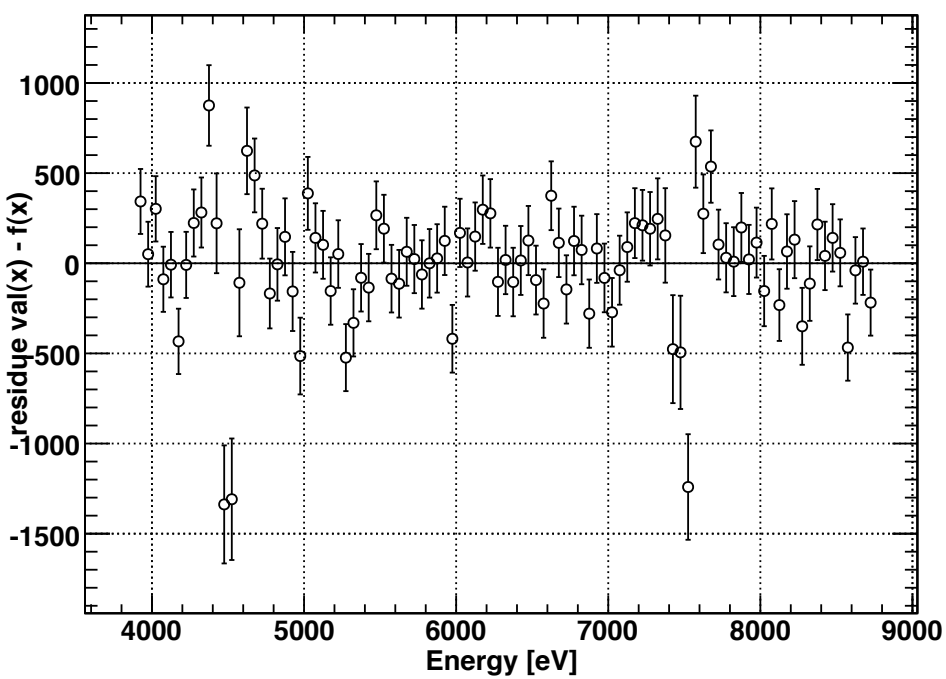
self total 1st mean and noise free fit



self total 1st mean and noise free fit



fit residue



3. with pileup, tail and contaminations

```
FCN=1291.98 FROM MINOS     STATUS=SUCCESSFUL  10488 CALLS       12225 TOTAL
                     EDM=0.000227617    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.30713e+04   6.14168e+02  -6.56477e+02   6.51838e+02
  2  BGb          6.83466e+00   1.94188e-01  -2.06808e-01   2.07211e-01
  3  BGc         -5.12517e-04   1.50667e-05  -1.60469e-05   1.60406e-05
  4  Const Noise [eV]   5.38795e+01   1.14236e+00  -1.15837e+00   1.13907e+00
  5  Fano         1.24952e-01   6.05187e-03  -6.09022e-03   6.07061e-03
  6  Ti Kb/Ka1 ratio   2.44438e-01   3.95291e-03  -3.92464e-03   3.99244e-03
  7  Ni Kb/Ka1 ratio   2.77919e-01   5.44620e-03  -5.41376e-03   5.50545e-03
  8  TiKa1 Height   5.42301e+04   2.23330e+02  -2.29325e+02   2.19448e+02
  9  NiKa1 Height   4.03223e+04   2.71549e+02  -2.86344e+02   2.59401e+02
 10  TiKa1 Mean [eV]   4.51059e+03   3.38920e-01  -3.36838e-01   3.44303e-01
 11  NiKa1 Mean [eV]   7.47835e+03   5.47242e-01  -5.36405e-01   5.60581e-01
 12  TiKb1 Mean [eV]   4.92995e+03   1.11440e+00  -1.11545e+00   1.11400e+00
 13  NiKb1 Mean [eV]   8.25869e+03   1.40386e+00  -1.40962e+00   1.40085e+00
 14  TiKb1 Sigma [eV]   7.25666e+01   1.22155e+00  -1.20786e+00   1.23619e+00
 15  NiKb1 Sigma [eV]   8.16202e+01   1.54666e+00  -1.53003e+00   1.56984e+00
 16  Pile area factor   5.36396e-02   3.44329e-03  -3.45585e-03   3.44079e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   4.60111e-02   6.92663e-03  -7.00047e-03   7.07998e-03
 20  Tail area factor NiKa   1.02507e-01   9.22382e-03  -8.90000e-03   9.67022e-03
 21  Tail slope factor Ka   2.39827e+00   3.05498e-01  -2.81129e-01   3.34800e-01
 22  Tail area factor TiKb   4.50000e-02     fixed
 23  Tail area factor NiKb   1.00000e-01     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   9.71909e-03   2.05071e-03  -2.04942e-03   2.06016e-03
 26  Escape mean NiKa [eV]   5.81079e+03   1.93058e+01  -1.96569e+01   1.93430e+01
 27  FeKa Height factor   1.93028e-02   3.12296e-03  -3.13367e-03   3.13794e-03
 28  FeKa mean [eV]   6.47014e+03   1.57977e+01  -1.57891e+01   1.60371e+01
 29  CuKa Height factor   6.58245e-02   3.93028e-03  -3.94059e-03   3.92095e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

3. with pileup, tail and contaminations

```
Ti EVENT
KA1+KA2     = 289809
Pileup      = 15545.3
Pile/All = 0.0509089
Ni EVENT
KA1+KA2     = 245395
Pileup      = 13162.9
Pile/All = 0.0509089
TiKa1 Mean   = 4510.589 +-  0.341
TiKb1 Mean   = 4929.951 +-  1.115
NiKa1 Mean   = 7478.354 +-  0.548
NiKb1 Mean   = 8258.694 +-  1.405
Const Noise  = 53.880 +-  1.149
Fano         =  0.125 +-  0.006
TiKb1 Noise  = 72.567 +-  1.222
NiKb1 Noise  = 81.620 +-  1.550
Chisq/NDF    = 97.441/72
```

best fitting

fit results
SDD-by-SDD

```
FCN=1291.98 FROM MINOS     STATUS=SUCCESSFUL  10488 CALLS       12225 TOTAL
                     EDM=0.000227617    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.30713e+04   6.14168e+02  -6.56477e+02   6.51838e+02
  2  BGb          6.83466e+00   1.94188e-01  -2.06808e-01   2.07211e-01
  3  BGc         -5.12517e-04   1.50667e-05  -1.60469e-05   1.60406e-05
  4  Const Noise [eV]   5.38795e+01   1.14236e+00  -1.15837e+00   1.13907e+00
  5  Fano         1.24952e-01   6.05187e-03  -6.09022e-03   6.07061e-03
  6  Ti Kb/Ka1 ratio   2.44438e-01   3.95291e-03  -3.92464e-03   3.99244e-03
  7  Ni Kb/Ka1 ratio   2.77919e-01   5.44620e-03  -5.41376e-03   5.50545e-03
  8  TiKa1 Height   5.42301e+04   2.23330e+02  -2.29325e+02   2.19448e+02
  9  NiKa1 Height   4.03223e+04   2.71549e+02  -2.86344e+02   2.59401e+02
 10  TiKa1 Mean [eV]   4.51059e+03   3.38920e-01  -3.36838e-01   3.44303e-01
 11  NiKa1 Mean [eV]   7.47835e+03   5.47242e-01  -5.36405e-01   5.60581e-01
 12  TiKb1 Mean [eV]   4.92995e+03   1.11440e+00  -1.11545e+00   1.11400e+00
 13  NiKb1 Mean [eV]   8.25869e+03   1.40386e+00  -1.40962e+00   1.40085e+00
 14  TiKb1 Sigma [eV]   7.25666e+01   1.22155e+00  -1.20786e+00   1.23619e+00
 15  NiKb1 Sigma [eV]   8.16202e+01   1.54666e+00  -1.53003e+00   1.56984e+00
 16  Pile area factor   5.36396e-02   3.44329e-03  -3.45585e-03   3.44079e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   4.60111e-02   6.92663e-03  -7.00047e-03   7.07998e-03
 20  Tail area factor NiKa   1.02507e-01   9.22382e-03  -8.90000e-03   9.67022e-03
 21  Tail slope factor Ka   2.39827e+00   3.05498e-01  -2.81129e-01   3.34800e-01
 22  Tail area factor TiKb   4.50000e-02     fixed
 23  Tail area factor NiKb   1.00000e-01     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   9.71909e-03   2.05071e-03  -2.04942e-03   2.06016e-03
 26  Escape mean NiKa [eV]   5.81079e+03   1.93058e+01  -1.96569e+01   1.93430e+01
 27  FeKa Height factor   1.93028e-02   3.12296e-03  -3.13367e-03   3.13794e-03
 28  FeKa mean [eV]   6.47014e+03   1.57977e+01  -1.57891e+01   1.60371e+01
 29  CuKa Height factor   6.58245e-02   3.93028e-03  -3.94059e-03   3.92095e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle1 sdd2

iterative calibration

```
Ti EVENT
KA1+KA2     = 289809
Pileup      = 15545.3
Pile/All = 0.0509089
Ni EVENT
KA1+KA2     = 245395
Pileup      = 13162.9
Pile/All = 0.0509089
TiKa1 Mean   = 4510.589 +-  0.341
TiKb1 Mean   = 4929.951 +-  1.115
NiKa1 Mean   = 7478.354 +-  0.548
NiKb1 Mean   = 8258.694 +-  1.405
Const Noise  = 53.880 +-  1.149
Fano         =  0.125 +-  0.006
TiKb1 Noise  = 72.567 +-  1.222
NiKb1 Noise  = 81.620 +-  1.550
Chisq/NDF    = 97.441/72
```

```
FCN=1320.09 FROM MINOS     STATUS=SUCCESSFUL  25441 CALLS       26845 TOTAL
                     EDM=0.426249    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          2.27935e+04   6.30163e+02  -4.28529e+02   1.08552e+03
  2  BGb          6.59374e+00   1.98828e-01  -3.45823e-01   1.34177e-01
  3  BGc         -5.35743e-04   1.55116e-05  -1.04992e-05   2.69848e-05
  4  Const Noise [eV]   5.17505e+01   1.15880e+00  -1.22940e+00   1.38593e+00
  5  Fano         1.30349e-01   5.86800e-03  -7.17929e-03   6.05744e-03
  6  Ti Kb/Ka1 ratio   2.40872e-01   3.83368e-03  -4.39664e-03   4.22459e-03
  7  Ni Kb/Ka1 ratio   2.77078e-01   5.46795e-03  -6.14784e-03   6.18441e-03
  8  TiKa1 Height   6.11355e+04   3.92915e+02  -4.98200e+02   3.95735e+02
  9  NiKa1 Height   4.95484e+04   4.64696e+02  -6.68184e+02   4.09369e+02
 10  TiKa1 Mean [eV]   4.51043e+03   3.99619e-01  -4.48090e-01   4.55775e-01
 11  NiKa1 Mean [eV]   7.47799e+03   6.41088e-01  -5.89180e-01   8.63632e-01
 12  TiKb1 Mean [eV]   4.93023e+03   1.04024e+00  -1.16163e+00   1.16634e+00
 13  NiKb1 Mean [eV]   8.25912e+03   1.24738e+00  -1.46070e+00   1.33280e+00
 14  TiKb1 Sigma [eV]   6.93182e+01   1.14158e+00  -1.29227e+00   1.25727e+00
 15  NiKb1 Sigma [eV]   8.13200e+01   1.37302e+00  -1.65590e+00   1.41879e+00
 16  Pile area factor   8.40837e-02   3.25619e-03  -3.83536e-03   3.46459e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   6.19636e-02   8.80681e-03  -1.03544e-02   1.00024e-02
 20  Tail area factor NiKa   8.52250e-02   1.33072e-02  -1.17071e-02   1.90705e-02
 21  Tail slope factor Ka   1.68366e+00   2.40160e-01  -2.67981e-01   2.54457e-01
 22  Tail area factor TiKb   6.10000e-02     fixed
 23  Tail area factor NiKb   8.60000e-02     fixed
 24  Tail slope factor Kb   2.00000e+00     fixed
 25  Escape area factor NiKa   2.24706e-03   1.79091e-03  -1.89677e-03   2.11379e-03
 26  Escape mean NiKa [eV]   5.70800e+03   6.10310e+01  -9.42977e+01   9.89891e+01
 27  FeKa Height factor   8.53869e-03   2.77897e-03  -2.74975e-03   3.49748e-03
 28  FeKa mean [eV]   6.67668e+03   4.89488e+01  -6.30080e+01   5.03300e+01
 29  CuKa Height factor   6.72448e-02   3.55454e-03  -3.95160e-03   4.00926e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle1 sdd4

iterative calibration

```
Ti EVENT
KA1+KA2     = 322407
Pileup      = 27109.2
Pile/All = 0.077562
Ni EVENT
KA1+KA2     = 299876
Pileup      = 25214.7
Pile/All = 0.077562
TiKa1 Mean   = 4510.430 +-  0.452
TiKb1 Mean   = 4930.231 +-  1.164
NiKa1 Mean   = 7477.985 +-  0.726
NiKb1 Mean   = 8259.121 +-  1.397
Const Noise  = 51.751 +-  1.308
Fano         =  0.130 +-  0.007
TiKb1 Noise  = 69.318 +-  1.275
NiKb1 Noise  = 81.320 +-  1.537
Chisq/NDF    = 107.628/72
```

cycle1 sdd5

iterative calibration

too large ?

```
FCN=1372.69 FROM MINOS     STATUS=SUCCESSFUL  10797 CALLS       11865 TOTAL
                     EDM=0.000106442    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          3.92210e+04   1.28803e+03  -1.49392e+03   1.47473e+03
  2  BGb          4.69113e+00   3.88787e-01  -4.46219e-01   4.51427e-01
  3  BGc         -4.19152e-04   2.84764e-05  -3.30085e-05   3.26676e-05
  4  Const Noise [eV]   7.04197e+01   1.12484e+00  -1.13754e+00   1.12203e+00
  5  Fano         1.50410e-01   7.02413e-03  -7.04871e-03   7.05632e-03
  6  Ti Kb/Ka1 ratio   2.32104e-01   5.55736e-03  -5.59118e-03   5.81452e-03
  7  Ni Kb/Ka1 ratio   2.90280e-01   5.31649e-03  -5.27410e-03   5.38059e-03
  8  TiKa1 Height   5.38870e+04   1.76458e+02  -1.76830e+02   1.76472e+02
  9  NiKa1 Height   5.37237e+04   1.67693e+02  -1.67476e+02   1.68051e+02
 10  TiKa1 Mean [eV]   4.51026e+03   4.07182e-01  -4.18987e-01   4.24645e-01
 11  NiKa1 Mean [eV]   7.47737e+03   3.60008e-01  -3.63506e-01   3.62413e-01
 12  TiKb1 Mean [eV]   4.93116e+03   1.60765e+00  -1.61743e+00   1.60729e+00
 13  NiKb1 Mean [eV]   8.25805e+03   1.58225e+00  -1.59477e+00   1.57209e+00
 14  TiKb1 Sigma [eV]   8.58467e+01   1.98031e+00  -1.97530e+00   2.03712e+00
 15  NiKb1 Sigma [eV]   9.92379e+01   1.75114e+00  -1.72953e+00   1.78368e+00
 16  Pile area factor   1.55843e-01   5.17473e-03  -5.19634e-03   5.15456e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   2.90241e-02   1.22609e-02  -1.33190e-02   1.35612e-02
 20  Tail area factor NiKa   7.48024e-02   8.02574e-03  -8.30427e-03   8.29091e-03
 21  Tail slope factor Ka   6.00000e+00     fixed
 22  Tail area factor TiKb   2.80000e-02     fixed
 23  Tail area factor NiKb   7.40000e-02     fixed
 24  Tail slope factor Kb   6.00000e+00     fixed
 25  Escape area factor NiKa   6.57716e-03   1.79634e-03  -1.79537e-03   1.80263e-03
 26  Escape mean NiKa [eV]   5.73442e+03   2.36913e+01  -2.42026e+01   2.39760e+01
 27  FeKa Height factor   5.86643e-03   2.63547e-03  -2.66393e-03   2.66181e-03
 28  FeKa mean [eV]   6.53020e+03   7.34033e+01  -1.40128e+02   6.26664e+01
 29  CuKa Height factor   4.45429e-02   4.17624e-03  -4.23140e-03   4.15328e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

```
Ti EVENT
KA1+KA2     = 351952
Pileup      = 54849.5
Pile/All = 0.134831
Ni EVENT
KA1+KA2     = 391013
Pileup      = 60936.7
Pile/All = 0.134831
TiKa1 Mean   = 4510.263 +-  0.422
TiKb1 Mean   = 4931.164 +-  1.612
NiKa1 Mean   = 7477.368 +-  0.363
NiKb1 Mean   = 8258.055 +-  1.583
Const Noise  = 70.420 +-  1.130
Fano         =  0.150 +-  0.007
TiKb1 Noise  = 85.847 +-  2.006
NiKb1 Noise  = 99.238 +-  1.757
Chisq/NDF    = 140.094/73
```

fixed to converge...
2nd cycle SDD5 params.
were used

```
FCN=1189.15 FROM MINOS     STATUS=SUCCESSFUL  17101 CALLS       19485 TOTAL
                     EDM=6.05247e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          3.18691e+03   3.05929e+02  -3.43302e+02   3.41094e+02
  2  BGb          2.89433e+00   9.83710e-02  -1.10778e-01   1.10659e-01
  3  BGc         -2.14119e-04   7.72458e-06  -8.67983e-06   8.70910e-06
  4  Const Noise [eV]   4.59156e+01   1.77719e+00  -1.80144e+00   1.75777e+00
  5  Fano         1.14414e-01   7.92137e-03  -7.98901e-03   7.87749e-03
  6  Ti Kb/Ka1 ratio   2.55772e-01   5.74586e-03  -5.67654e-03   5.79680e-03
  7  Ni Kb/Ka1 ratio   2.79086e-01   7.53682e-03  -7.41313e-03   7.80352e-03
  8  TiKa1 Height   2.22203e+04   1.32092e+02  -1.33840e+02   1.28317e+02
  9  NiKa1 Height   1.90280e+04   2.22919e+02  -2.49148e+02   2.03929e+02
 10  TiKa1 Mean [eV]   4.51073e+03   4.53737e-01  -4.07433e-01   4.60683e-01
 11  NiKa1 Mean [eV]   7.47808e+03   7.78208e-01  -7.45481e-01   8.18566e-01
 12  TiKb1 Mean [eV]   4.92801e+03   1.47466e+00  -1.47576e+00   1.47490e+00
 13  NiKb1 Mean [eV]   8.25899e+03   1.76969e+00  -1.77912e+00   1.76397e+00
 14  TiKb1 Sigma [eV]   6.57975e+01   1.51446e+00  -1.49791e+00   1.53164e+00
 15  NiKb1 Sigma [eV]   7.72262e+01   1.84849e+00  -1.82639e+00   1.88016e+00
 16  Pile area factor   3.67241e-02   4.11790e-03  -4.13134e-03   4.13003e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.94923e-03   9.77011e-03   at limit      1.01432e-02
 20  Tail area factor NiKa   9.13092e-02   1.57657e-02  -1.43678e-02   1.76263e-02
 21  Tail slope factor Ka   1.92032e+00   3.70058e-01  -3.26722e-01   4.34705e-01
 22  Tail area factor TiKb   3.00000e-03     fixed
 23  Tail area factor NiKb   9.00000e-02     fixed
 24  Tail slope factor Kb   2.00000e+00     fixed
 25  Escape area factor NiKa   4.49084e-03   2.61411e-03  -2.62645e-03   2.63049e-03
 26  Escape mean NiKa [eV]   5.83263e+03   4.85267e+01  -5.80202e+01   5.17606e+01
 27  FeKa Height factor   8.71514e-03   4.11721e-03  -4.12792e-03   4.14282e-03
 28  FeKa mean [eV]   6.74917e+03   3.49693e+01  -3.86492e+01   3.54806e+01
 29  CuKa Height factor   2.35665e-02   4.92599e-03  -4.93557e-03   4.92012e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd1

iterative calibration

```
Ti EVENT
KA1+KA2     = 106660
Pileup      = 3916.98
Pile/All = 0.0354232
Ni EVENT
KA1+KA2     = 105536
Pileup      = 3875.7
Pile/All = 0.0354232
TiKa1 Mean   = 4510.725 +-  0.434
TiKb1 Mean   = 4928.015 +-  1.475
NiKa1 Mean   = 7478.081 +-  0.782
NiKb1 Mean   = 8258.988 +-  1.772
Const Noise  = 45.916 +-  1.780
Fano         =  0.114 +-  0.008
TiKb1 Noise  = 65.798 +-  1.515
NiKb1 Noise  = 77.226 +-  1.853
Chisq/NDF    = 92.808/72
```

```
FCN=1213.94 FROM MINOS     STATUS=SUCCESSFUL  29860 CALLS       31472 TOTAL
                     EDM=0.594017    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          4.90108e+03   3.83635e+02  -2.48392e+02   7.19779e+02
  2  BGb          2.39743e+00   1.18527e-01  -2.26764e-01   7.51783e-02
  3  BGc         -1.82748e-04   9.08888e-06  -5.74502e-06   1.74655e-05
  4  Const Noise [eV]   6.05351e+01   1.83159e+00  -1.92709e+00   2.38731e+00
  5  Fano         1.14509e-01   1.11678e-02  -1.46119e-02   1.16843e-02
  6  Ti Kb/Ka1 ratio   2.40622e-01   6.38769e-03  -7.95107e-03   6.92230e-03
  7  Ni Kb/Ka1 ratio   2.86959e-01   9.37948e-03  -1.15430e-02   1.04403e-02
  8  TiKa1 Height   2.03400e+04   1.26787e+02  -1.44934e+02   1.54941e+02
  9  NiKa1 Height   1.46202e+04   1.71923e+02  -2.64064e+02   1.60612e+02
 10  TiKa1 Mean [eV]   4.51077e+03   5.33539e-01  -7.14711e-01   5.55773e-01
 11  NiKa1 Mean [eV]   7.47805e+03   1.01023e+00  -9.61216e-01   1.42177e+00
 12  TiKb1 Mean [eV]   4.93010e+03   1.82716e+00  -2.15754e+00   2.11217e+00
 13  NiKb1 Mean [eV]   8.25850e+03   2.42892e+00  -3.00494e+00   2.67715e+00
 14  TiKb1 Sigma [eV]   7.46543e+01   1.95945e+00  -2.29729e+00   2.25600e+00
 15  NiKb1 Sigma [eV]   8.66567e+01   2.60462e+00  -3.24876e+00   2.83254e+00
 16  Pile area factor   3.57555e-02   5.92284e-03  -7.61614e-03   6.22204e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.84646e-02   1.08829e-02  -1.66656e-02   9.24040e-
 20  Tail area factor NiKa   8.53678e-02   1.62401e-02  -1.47559e-02   2.50449e-
 21  Tail slope factor Ka   2.42435e+00   6.58676e-01  -6.73625e-01   8.48751e-0
 22  Tail area factor TiKb   4.40000e-02     fixed
 23  Tail area factor NiKb   8.00000e-02     fixed
 24  Tail slope factor Kb   3.30000e+00     fixed
 25  Escape area factor NiKa   8.97056e-03   3.39105e-03  -3.70503e-03   4.21709
 26  Escape mean NiKa [eV]   5.74314e+03   7.09167e+01  -5.86531e+01   8.83183e+
 27  FeKa Height factor   1.55461e-02   5.08498e-03  -5.12269e-03   6.84230e-03
 28  FeKa mean [eV]   6.43242e+03   3.21119e+01  -3.89875e+01   3.65296e+01
 29  CuKa Height factor   3.53644e-02   6.50333e-03  -7.71690e-03   7.47583e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd2

iterative calibration

```
Ti EVENT
KA1+KA2     = 114792
Pileup      = 4104.43
Pile/All = 0.0345212
Ni EVENT
KA1+KA2     = 92113.4
Pileup      = 3293.56
Pile/All = 0.0345212
TiKa1 Mean   = 4510.765 +-  0.635
TiKb1 Mean   = 4930.102 +-  2.135
NiKa1 Mean   = 7478.051 +-  1.191
NiKb1 Mean   = 8258.499 +-  2.841
Const Noise  = 60.535 +-  2.157
Fano         =  0.115 +-  0.013
TiKb1 Noise  = 74.654 +-  2.277
NiKb1 Noise  = 86.657 +-  3.041
Chisq/NDF    = 117.938/72
```

```
FCN=1185.21 FROM MINOS     STATUS=SUCCESSFUL  15978 CALLS       17338 TOTAL
                     EDM=0.00810469    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          3.18077e+03   3.44139e+02  -3.55386e+02   4.08743e+02
  2  BGb          2.84007e+00   1.09687e-01  -1.30682e-01   1.13345e-01
  3  BGc         -2.12974e-04   8.55330e-06  -8.85767e-06   1.01271e-05
  4  Const Noise [eV]   5.51301e+01   1.87000e+00  -1.87607e+00   1.89112e+00
  5  Fano         1.37937e-01   1.02596e-02  -1.04615e-02   1.01774e-02
  6  Ti Kb/Ka1 ratio   2.44452e-01   6.07495e-03  -6.14738e-03   6.03674e-03
  7  Ni Kb/Ka1 ratio   2.80242e-01   7.94509e-03  -7.88557e-03   8.13437e-03
  8  TiKa1 Height   2.14260e+04   1.26833e+02  -1.29453e+02   1.27266e+02
  9  NiKa1 Height   1.76831e+04   2.21057e+02  -2.50541e+02   1.98017e+02
 10  TiKa1 Mean [eV]   4.51065e+03   5.10675e-01  -5.26025e-01   5.06348e-01
 11  NiKa1 Mean [eV]   7.47842e+03   9.68134e-01  -9.20105e-01   1.02080e+00
 12  TiKb1 Mean [eV]   4.92698e+03   1.68590e+00  -1.69192e+00   1.68959e+00
 13  NiKb1 Mean [eV]   8.25706e+03   2.00231e+00  -2.01814e+00   2.00005e+00
 14  TiKb1 Sigma [eV]   7.36630e+01   1.84734e+00  -1.83709e+00   1.86585e+00
 15  NiKb1 Sigma [eV]   8.46300e+01   2.13149e+00  -2.12217e+00   2.16131e+00
 16  Pile area factor   3.59178e-02   5.18745e-03  -5.26320e-03   5.14943e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   2.34095e-02   1.00244e-02  -1.06754e-02   9.86238e-03
 20  Tail area factor NiKa   8.54372e-02   1.56078e-02  -1.37077e-02   1.81245e-02
 21  Tail slope factor Ka   2.17540e+00   6.03980e-01  -4.86186e-01   7.98319e-01
 22  Tail area factor TiKb   2.30000e-02     fixed
 23  Tail area factor NiKb   8.20000e-02     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   1.09913e-02   2.77828e-03  -2.76383e-03   2.82802e-03
 26  Escape mean NiKa [eV]   5.75254e+03   2.53972e+01  -2.47247e+01   2.71320e+01
 27  FeKa Height factor   1.49759e-02   4.19928e-03  -4.16955e-03   4.30601e-03
 28  FeKa mean [eV]   6.27869e+03   2.91946e+01  -2.96125e+01   3.00963e+01
 29  CuKa Height factor   2.47486e-02   5.39409e-03  -5.38222e-03   5.42904e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd3

iterative calibration

```
Ti EVENT
KA1+KA2     = 118507
Pileup      = 4256.51
Pile/All = 0.0346724
Ni EVENT
KA1+KA2     = 111752
Pileup      = 4013.89
Pile/All = 0.0346724
TiKa1 Mean   = 4510.651 +-  0.516
TiKb1 Mean   = 4926.980 +-  1.691
NiKa1 Mean   = 7478.416 +-  0.970
NiKb1 Mean   = 8257.064 +-  2.009
Const Noise  = 55.130 +-  1.884
Fano         =  0.138 +-  0.010
TiKb1 Noise  = 73.663 +-  1.851
NiKb1 Noise  = 84.630 +-  2.142
Chisq/NDF    = 89.277/72
```

```
FCN=1188.53 FROM MINOS     STATUS=SUCCESSFUL  17829 CALLS       19139 TOTAL
                     EDM=0.142637    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          8.13631e+03   3.92234e+02  -3.20770e+02   5.68543e+02
  2  BGb          2.36226e+00   1.23828e-01  -1.80393e-01   1.01071e-01
  3  BGc         -1.90569e-04   9.59328e-06  -7.85186e-06   1.39220e-05
  4  Const Noise [eV]   4.39272e+01   1.61574e+00  -1.66308e+00   1.71742e+00
  5  Fano         1.25779e-01   6.59625e-03  -7.07306e-03   6.73029e-03
  6  Ti Kb/Ka1 ratio   2.37857e-01   5.77508e-03  -6.27260e-03   5.76139e-03
  7  Ni Kb/Ka1 ratio   2.85206e-01   6.22989e-03  -6.82188e-03   6.19529e-03
  8  TiKa1 Height   2.36793e+04   1.34937e+02  -1.35093e+02   1.46746e+02
  9  NiKa1 Height   2.32205e+04   1.54558e+02  -1.72212e+02   1.53191e+02
 10  TiKa1 Mean [eV]   4.51068e+03   4.37605e-01  -4.96217e-01   4.23454e-01
 11  NiKa1 Mean [eV]   7.47793e+03   5.55176e-01  -5.44962e-01   6.13839e-01
 12  TiKb1 Mean [eV]   4.93136e+03   1.56772e+00  -1.63164e+00   1.63513e+00
 13  NiKb1 Mean [eV]   8.25817e+03   1.57663e+00  -1.68792e+00   1.59884e+00
 14  TiKb1 Sigma [eV]   6.42939e+01   1.69770e+00  -1.77029e+00   1.76376e+00
 15  NiKb1 Sigma [eV]   7.85327e+01   1.71423e+00  -1.83059e+00   1.74435e+00
 16  Pile area factor   5.95730e-02   4.05238e-03  -4.41529e-03   4.03450e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.75805e-02   1.00480e-02  -1.23244e-02   9.04915e-03
 20  Tail area factor NiKa   7.64521e-02   8.86692e-03  -8.54401e-03   1.00152e-02
 21  Tail slope factor Ka   2.94455e+00   5.68139e-01  -5.27115e-01   6.83953e-01
 22  Tail area factor TiKb   3.50000e-02     fixed
 23  Tail area factor NiKb   7.60000e-02     fixed
 24  Tail slope factor Kb   3.00000e+00     fixed
 25  Escape area factor NiKa   7.10138e-03   2.39148e-03  -2.41882e-03   2.56523e-03
 26  Escape mean NiKa [eV]   5.57980e+03   2.58032e+01  -2.74190e+01   2.78541e+01
 27  FeKa Height factor   1.09826e-02   3.62285e-03  -3.53423e-03   4.04626e-03
 28  FeKa mean [eV]   6.40343e+03   2.87962e+01  -3.16153e+01   2.99201e+01
 29  CuKa Height factor   1.74782e-02   4.36803e-03  -4.60524e-03   4.49371e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd4

iterative calibration

```
Ti EVENT
KA1+KA2     = 113895
Pileup      = 6785.1
Pile/All = 0.0562236
Ni EVENT
KA1+KA2     = 130517
Pileup      = 7775.32
Pile/All = 0.0562236
TiKa1 Mean   = 4510.683 +-  0.460
TiKb1 Mean   = 4931.358 +-  1.633
NiKa1 Mean   = 7477.932 +-  0.579
NiKb1 Mean   = 8258.166 +-  1.643
Const Noise  = 43.927 +-  1.690
Fano         =  0.126 +-  0.007
TiKb1 Noise  = 64.294 +-  1.767
NiKb1 Noise  = 78.533 +-  1.787
Chisq/NDF    = 73.884/72
```

```
FCN=1204.43 FROM MINOS     STATUS=SUCCESSFUL  28420 CALLS       29429 TOTAL
                     EDM=0.325655    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.43421e+04   7.13526e+02  -1.26403e+03   5.88330e+02
  2  BGb          1.62000e+00   2.28905e-01  -1.90631e-01   4.00848e-01
  3  BGc         -1.49741e-04   1.72863e-05  -3.01710e-05   1.44283e-05
  4  Const Noise [eV]   5.78509e+01   1.51302e+00  -1.69870e+00   1.69766e+00
  5  Fano         1.48353e-01   8.13676e-03  -9.60141e-03   8.65366e-03
  6  Ti Kb/Ka1 ratio   2.40254e-01   6.20613e-03  -6.23656e-03   7.86694e-03
  7  Ni Kb/Ka1 ratio   2.86971e-01   6.34797e-03  -6.48504e-03   7.84950e-03
  8  TiKa1 Height   2.62072e+04   1.20123e+02  -1.49557e+02   1.23856e+02
  9  NiKa1 Height   2.44066e+04   1.20582e+02  -1.54418e+02   1.21292e+02
 10  TiKa1 Mean [eV]   4.51044e+03   4.62664e-01  -4.22270e-01   6.64249e-01
 11  NiKa1 Mean [eV]   7.47804e+03   5.09409e-01  -5.54369e-01   6.07404e-01
 12  TiKb1 Mean [eV]   4.92922e+03   1.78025e+00  -2.10634e+00   1.87810e+00
 13  NiKb1 Mean [eV]   8.26150e+03   1.78597e+00  -1.99230e+00   2.01235e+00
 14  TiKb1 Sigma [eV]   7.62093e+01   2.01610e+00  -2.11290e+00   2.42608e+00
 15  NiKb1 Sigma [eV]   8.86723e+01   1.95764e+00  -2.05085e+00   2.35481e+00
 16  Pile area factor   8.45245e-02   5.61047e-03  -6.37910e-03   5.97243e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   2.20368e-02   1.35387e-02  -1.13492e-02   2.05437e-02
 20  Tail area factor NiKa   8.04862e-02   1.65018e-02  -1.88598e-02   1.80273e-02
 21  Tail slope factor Ka   5.95276e+00   1.99062e+00  -2.09920e+00   2.26015e+00
 22  Tail area factor TiKb   2.60000e-02     fixed
 23  Tail area factor NiKb   8.30000e-02     fixed
 24  Tail slope factor Kb   6.00000e+00     fixed
 25  Escape area factor NiKa   7.24809e-03   2.46587e-03  -3.13124e-03   2.46812e-03
 26  Escape mean NiKa [eV]   5.76440e+03   3.27214e+01  -3.92139e+01   3.79317e+01
 27  FeKa Height factor   6.00760e-03   3.69582e-03  -4.41777e-03   3.85189e-03
 28  FeKa mean [eV]   6.23809e+03   7.70511e+01  -1.09214e+02   1.13407e+02
 29  CuKa Height factor   3.74175e-02   4.93034e-03  -6.05602e-03   4.95121e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd5

iterative calibration

```
Ti EVENT
KA1+KA2     = 151327
Pileup      = 12790.8
Pile/All = 0.077937
Ni EVENT
KA1+KA2     = 160787
Pileup      = 13590.5
Pile/All = 0.077937
TiKa1 Mean   = 4510.444 +-  0.543
TiKb1 Mean   = 4929.215 +-  1.992
NiKa1 Mean   = 7478.038 +-  0.581
NiKb1 Mean   = 8261.496 +-  2.002
Const Noise  = 57.851 +-  1.698
Fano         =  0.148 +-  0.009
TiKb1 Noise  = 76.209 +-  2.269
NiKb1 Noise  = 88.672 +-  2.203
Chisq/NDF    = 69.811/72
```

```
FCN=1222.72 FROM MINOS     STATUS=SUCCESSFUL  26732 CALLS       27784 TOTAL
                     EDM=0.272026    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.38073e+04   5.39915e+02  -4.09238e+02   8.62016e+02
  2  BGb          2.21354e+00   1.65926e-01  -2.68928e-01   1.24568e-01
  3  BGc         -1.94674e-04   1.26447e-05  -9.48824e-06   2.05031e-05
  4  Const Noise [eV]   6.42041e+01   1.92539e+00  -1.95512e+00   2.23858e+00
  5  Fano         1.52425e-01   1.16009e-02  -1.36216e-02   1.16785e-02
  6  Ti Kb/Ka1 ratio   2.37890e-01   7.96462e-03  -9.19417e-03   7.92883e-03
  7  Ni Kb/Ka1 ratio   2.88530e-01   9.34520e-03  -1.06726e-02   9.51585e-03
  8  TiKa1 Height   2.16469e+04   1.42416e+02  -1.54376e+02   1.58239e+02
  9  NiKa1 Height   1.92763e+04   1.59032e+02  -2.11511e+02   1.51137e+02
 10  TiKa1 Mean [eV]   4.51054e+03   6.50207e-01  -7.95365e-01   6.38818e-01
 11  NiKa1 Mean [eV]   7.47794e+03   8.26470e-01  -7.73242e-01   1.04420e+00
 12  TiKb1 Mean [eV]   4.93436e+03   2.40808e+00  -2.58549e+00   2.61598e+00
 13  NiKb1 Mean [eV]   8.25628e+03   2.77493e+00  -3.09073e+00   2.89962e+00
 14  TiKb1 Sigma [eV]   8.46222e+01   2.73963e+00  -3.02580e+00   2.85118e+00
 15  NiKb1 Sigma [eV]   9.82858e+01   3.06022e+00  -3.46471e+00   3.13773e+00
 16  Pile area factor   1.09829e-01   7.36356e-03  -8.37625e-03   7.50084e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.98081e-02   1.32386e-02  -1.80629e-02   1.12720e-02
 20  Tail area factor NiKa   5.80502e-02   1.19933e-02  -1.11415e-02   1.55062e-02
 21  Tail slope factor Ka   2.71262e+00   8.58602e-01  -8.54001e-01   1.16349e+00
 22  Tail area factor TiKb   3.90000e-02     fixed
 23  Tail area factor NiKb   5.80000e-02     fixed
 24  Tail slope factor Kb   2.60000e+00     fixed
 25  Escape area factor NiKa   7.69979e-03   3.16689e-03  -3.31742e-03   3.52195e-03
 26  Escape mean NiKa [eV]   5.66128e+03   3.63364e+01  -4.04111e+01   4.12091e+01
 27  FeKa Height factor   6.79511e-03   4.67441e-03  -4.55565e-03   5.60247e-03
 28  FeKa mean [eV]   6.40981e+03   1.07813e+02  -1.23430e+02   2.07650e+02
 29  CuKa Height factor   2.24708e-02   7.14510e-03  -7.62276e-03   7.77333e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 sdd7

iterative calibration

```
Ti EVENT
KA1+KA2     = 133656
Pileup      = 14679.3
Pile/All = 0.0989604
Ni EVENT
KA1+KA2     = 134255
Pileup      = 14745.1
Pile/All = 0.0989604
TiKa1 Mean   = 4510.542 +-  0.717
TiKb1 Mean   = 4934.357 +-  2.601
NiKa1 Mean   = 7477.939 +-  0.909
NiKb1 Mean   = 8256.276 +-  2.995
Const Noise  = 64.204 +-  2.097
Fano         =  0.152 +-  0.013
TiKb1 Noise  = 84.622 +-  2.938
NiKb1 Noise  = 98.286 +-  3.301
Chisq/NDF    = 83.450/72
```

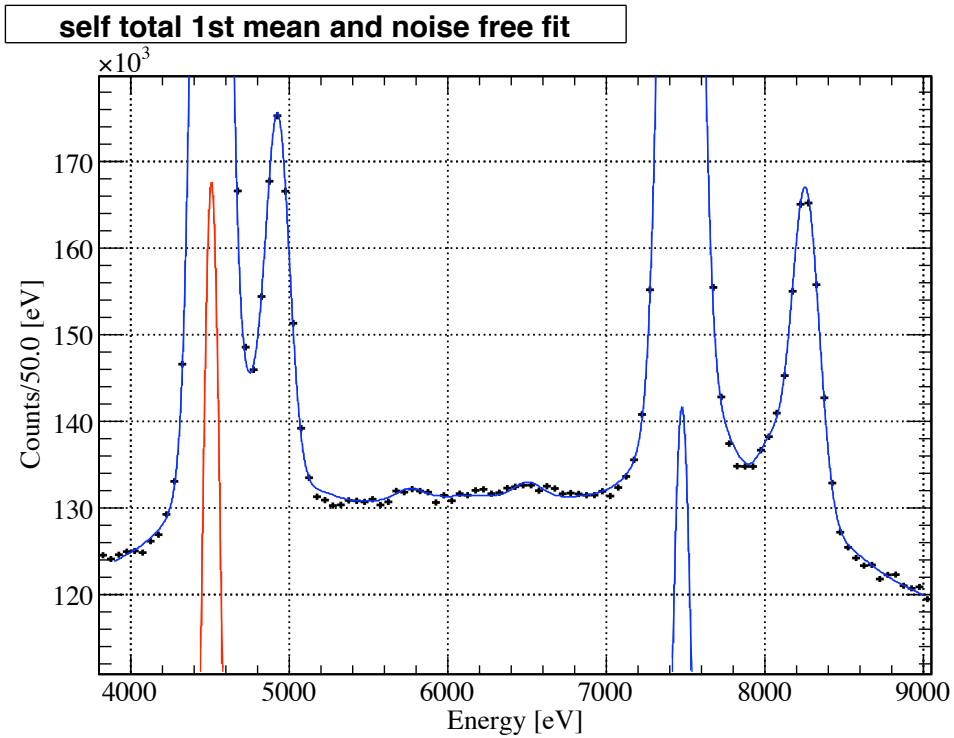
```
FCN=1182.09 FROM MINOS     STATUS=SUCCESSFUL  13500 CALLS       15191 TOTAL
                     EDM=2.12665e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          3.62265e+03   3.50397e+02  -3.78191e+02   3.80894e+02
  2  BGb          3.08609e+00   1.12441e-01  -1.22481e-01   1.21435e-01
  3  BGc         -2.29841e-04   8.82655e-06  -9.52824e-06   9.59438e-06
  4  Const Noise [eV]   5.01701e+01   1.75701e+00  -1.79431e+00   1.74393e+00
  5  Fano         1.34905e-01   8.07631e-03  -8.16450e-03   8.07483e-03
  6  Ti Kb/Ka1 ratio   2.49946e-01   6.44926e-03  -6.37825e-03   6.53768e-03
  7  Ni Kb/Ka1 ratio   2.73135e-01   6.95675e-03  -6.86653e-03   7.12121e-03
  8  TiKa1 Height   2.09707e+04   1.49278e+02  -1.61797e+02   1.42263e+02
  9  NiKa1 Height   2.11031e+04   1.97838e+02  -2.23873e+02   1.79577e+02
 10  TiKa1 Mean [eV]   4.51044e+03   5.66155e-01  -5.53764e-01   5.88822e-01
 11  NiKa1 Mean [eV]   7.47813e+03   7.08608e-01  -6.74473e-01   7.49777e-01
 12  TiKb1 Mean [eV]   4.93037e+03   1.76069e+00  -1.76188e+00   1.76172e+00
 13  NiKb1 Mean [eV]   8.25698e+03   1.81526e+00  -1.82521e+00   1.80967e+00
 14  TiKb1 Sigma [eV]   7.28507e+01   1.93694e+00  -1.90887e+00   1.96680e+00
 15  NiKb1 Sigma [eV]   8.33168e+01   2.01459e+00  -1.98951e+00   2.05112e+00
 16  Pile area factor   4.89810e-02   4.59439e-03  -4.60950e-03   4.59200e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.56849e-02   1.18199e-02  -1.16312e-02   1.25466e-02
 20  Tail area factor NiKa   7.24628e-02   1.24926e-02  -1.14956e-02   1.39593e-02
 21  Tail slope factor Ka   2.03278e+00   4.23147e-01  -3.79603e-01   4.76884e-01
 22  Tail area factor TiKb   3.60000e-02     fixed
 23  Tail area factor NiKb   6.90000e-02     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   9.41954e-03   2.41139e-03  -2.41434e-03   2.42186e-03
 26  Escape mean NiKa [eV]   5.73915e+03   2.44069e+01  -2.42406e+01   2.54471e+01
 27  FeKa Height factor   9.25335e-03   3.70745e-03  -3.72177e-03   3.73043e-03
 28  FeKa mean [eV]   6.43001e+03   3.51125e+01  -3.34095e+01   4.27390e+01
 29  CuKa Height factor   2.20924e-02   4.71650e-03  -4.73310e-03   4.70010e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

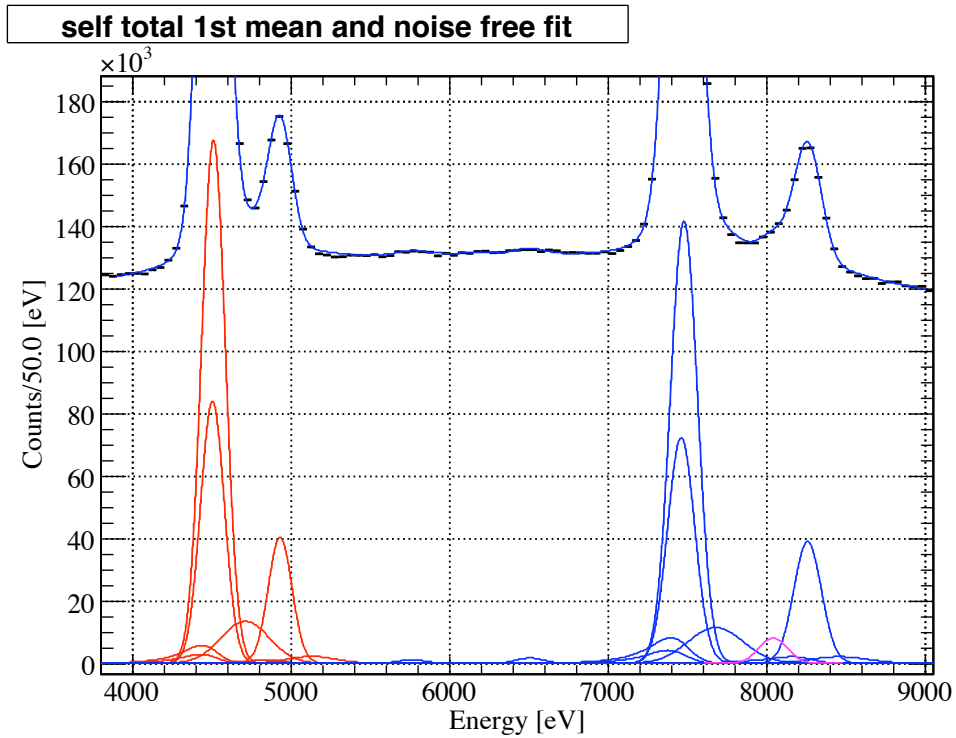
cycle2 sdd8

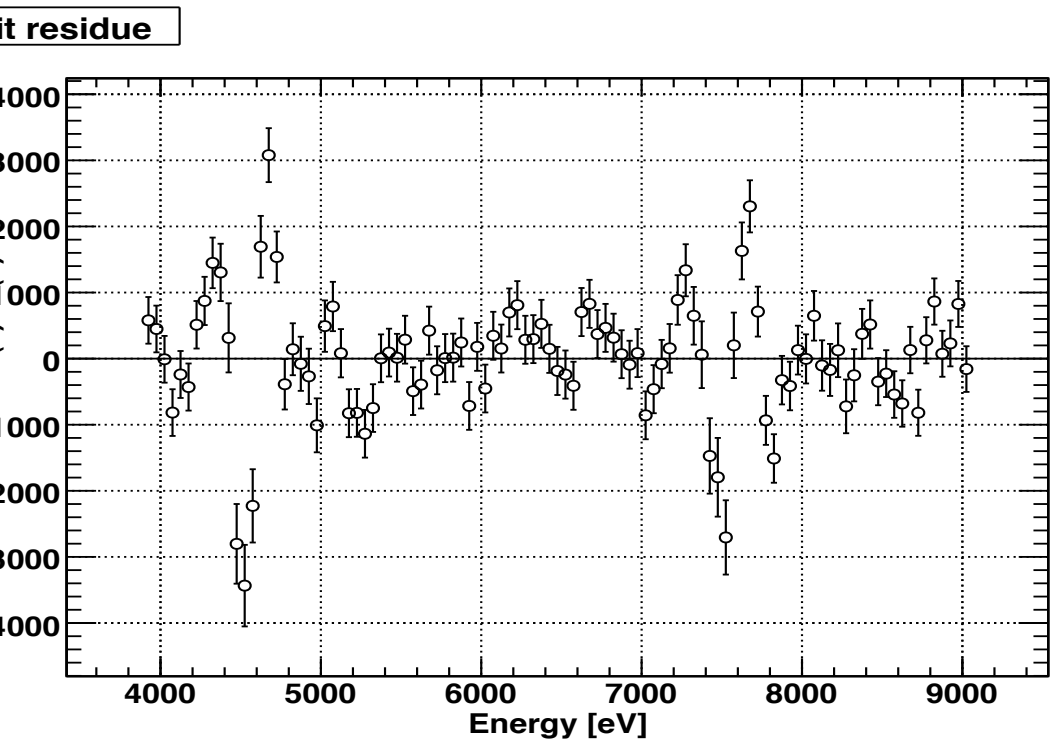
iterative calibration

```
Ti EVENT
KA1+KA2     = 109657
Pileup      = 5371.13
Pile/All = 0.0466939
Ni EVENT
KA1+KA2     = 127408
Pileup      = 6240.57
Pile/All = 0.0466939
TiKa1 Mean   = 4510.442 +-  0.571
TiKb1 Mean   = 4930.369 +-  1.762
NiKa1 Mean   = 7478.132 +-  0.712
NiKb1 Mean   = 8256.984 +-  1.817
Const Noise  = 50.170 +-  1.769
Fano         =  0.135 +-  0.008
TiKb1 Noise  = 72.851 +-  1.938
NiKb1 Noise  = 83.317 +-  2.020
Chisq/NDF    = 77.338/72
```

total fit
1st and 2nd cycles







cycle1 total

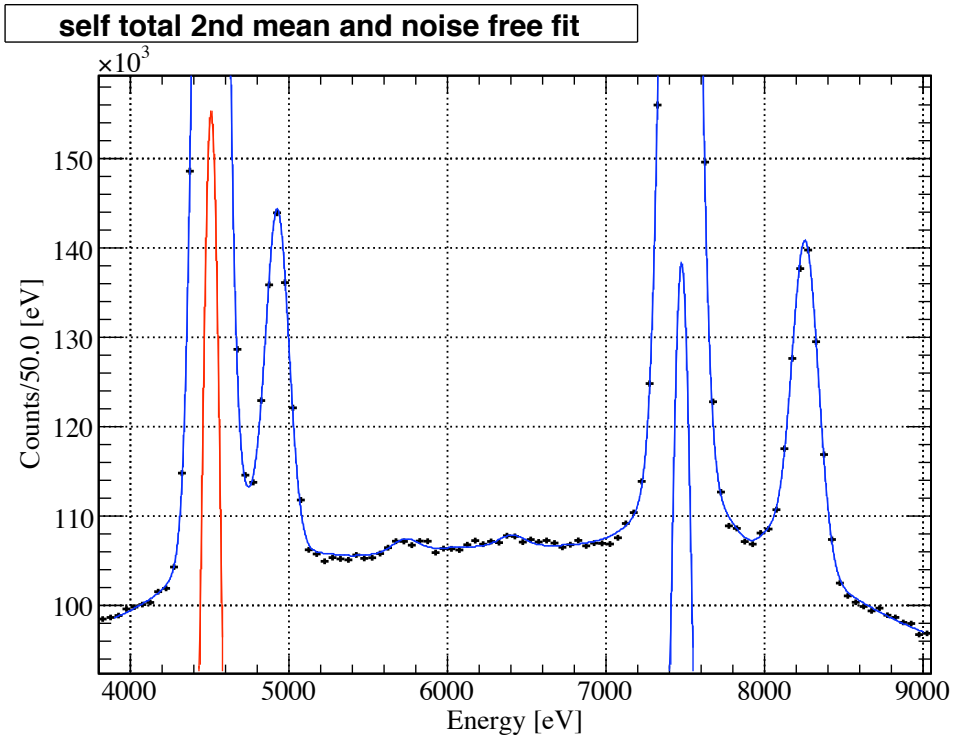
iterative calibration

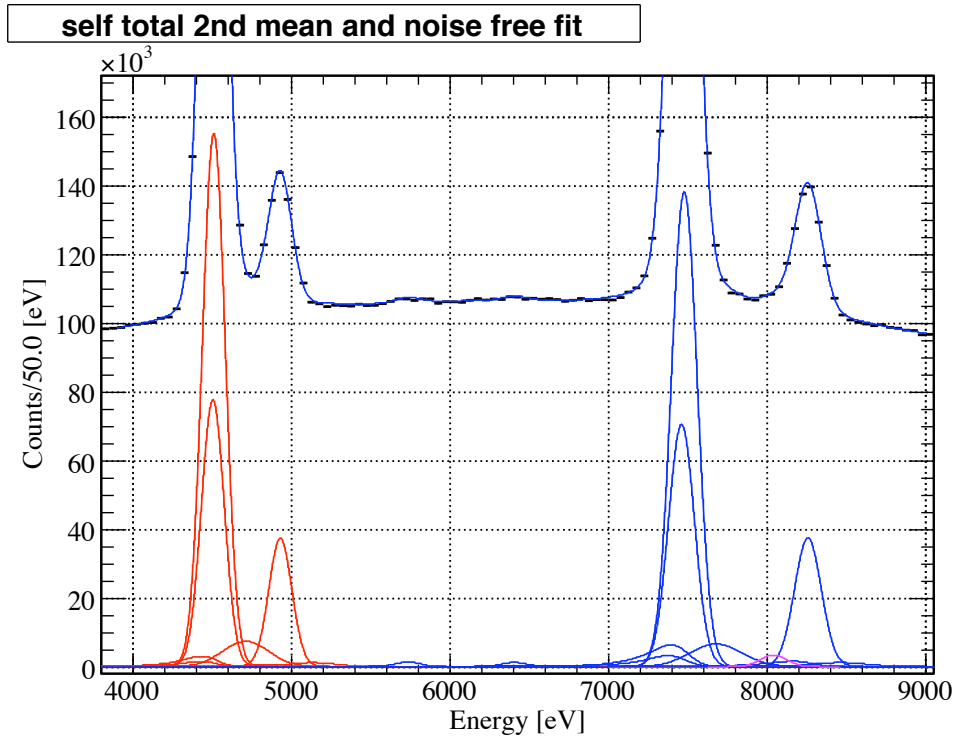
```
FCN=1617.93 FROM MINOS     STATUS=SUCCESSFUL  13819 CALLS       14887 TOTAL
                     EDM=0.0565561    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          7.44316e+04   1.07677e+03  -9.57081e+02   1.25606e+03
  2  BGb          1.83241e+01   3.29058e-01  -3.80245e-01   2.96762e-01
  3  BGc         -1.47538e-03   2.43686e-05  -2.22818e-05   2.78626e-05
  4  Const Noise [eV]   5.61846e+01   7.12168e-01  -7.12038e-01   7.35651e-01
  5  Fano         1.44940e-01   3.87268e-03  -4.04046e-03   3.82798e-03
  6  Ti Kb/Ka1 ratio   2.35734e-01   2.39016e-03  -2.57102e-03   2.28041e-03
  7  Ni Kb/Ka1 ratio   2.77180e-01   2.95877e-03  -2.85865e-03   3.14679e-03
  8  TiKa1 Height   1.67552e+05   5.49956e+02  -5.78613e+02   5.39097e+02
  9  NiKa1 Height   1.41690e+05   6.97084e+02  -7.77506e+02   6.42468e+02
 10  TiKa1 Mean [eV]   4.51062e+03   2.45194e-01  -2.59511e-01   2.39144e-01
 11  NiKa1 Mean [eV]   7.47850e+03   3.72732e-01  -3.52036e-01   4.04104e-01
 12  TiKb1 Mean [eV]   4.93188e+03   6.98986e-01  -7.02445e-01   7.15557e-01
 13  NiKb1 Mean [eV]   8.25890e+03   8.02608e-01  -8.16741e-01   8.11260e-01
 14  TiKb1 Sigma [eV]   7.39492e+01   7.87174e-01  -8.22448e-01   7.72966e-01
 15  NiKb1 Sigma [eV]   8.64737e+01   8.67317e-01  -8.78150e-01   8.81258e-01
 16  Pile area factor   1.07228e-01   2.12651e-03  -2.12475e-03   2.18606e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   5.65872e-02   4.97502e-03  -5.34962e-03   4.81004e-03
 20  Tail area factor NiKa   9.24735e-02   6.84392e-03  -6.28049e-03   7.66096e-03
 21  Tail slope factor Ka   1.89240e+00   1.56603e-01  -1.55785e-01   1.60037e-01
 22  Tail area factor TiKb   5.50000e-02     fixed
 23  Tail area factor NiKb   9.30000e-02     fixed
 24  Tail slope factor Kb   2.00000e+00     fixed
 25  Escape area factor NiKa   4.95301e-03   1.09046e-03  -1.12296e-03   1.08931e-03
 26  Escape mean NiKa [eV]   5.76161e+03   1.97966e+01  -2.01590e+01   2.04993e+01
 27  FeKa Height factor   1.11119e-02   1.66143e-03  -1.65256e-03   1.72313e-03
 28  FeKa mean [eV]   6.50678e+03   2.57323e+01  -2.51919e+01   2.74187e+01
 29  CuKa Height factor   5.81208e-02   2.19220e-03  -2.16177e-03   2.28643e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

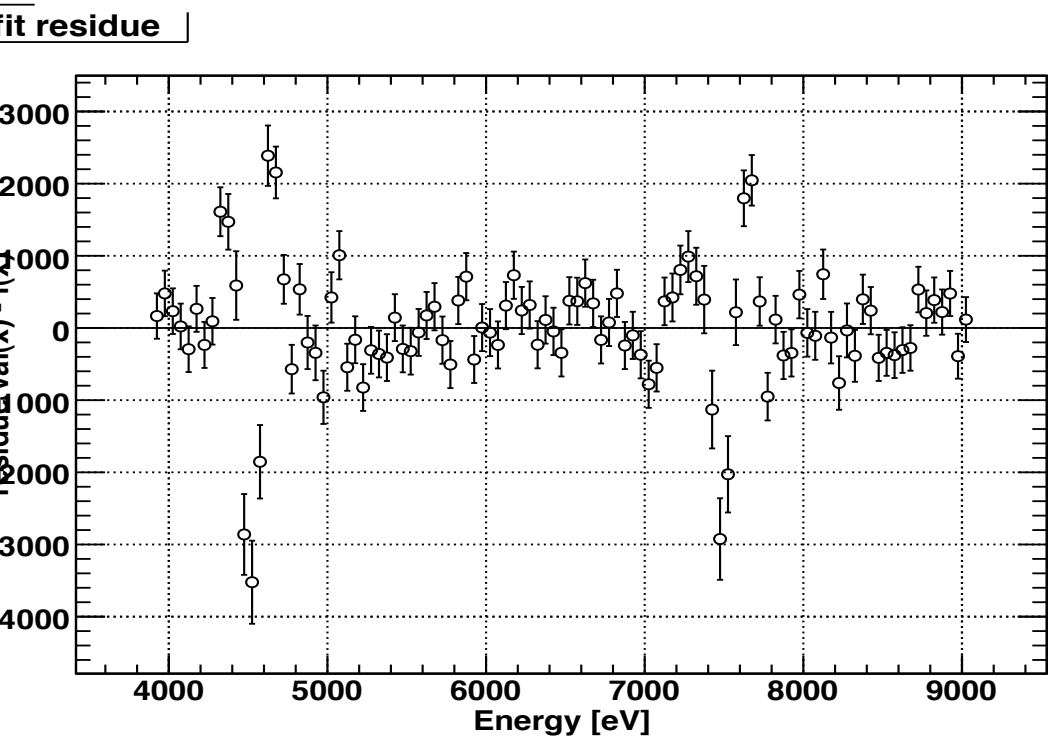
cycle1 total

iterative calibration

```
Ti EVENT
KA1+KA2     = 946872
Pileup      = 101531
Pile/All = 0.0968437
Ni EVENT
KA1+KA2     = 915576
Pileup      = 98175.5
Pile/All = 0.0968437
TiKa1 Mean   = 4510.617 +-  0.249
TiKb1 Mean   = 4931.879 +-  0.709
NiKa1 Mean   = 7478.503 +-  0.378
NiKb1 Mean   = 8258.898 +-  0.814
Const Noise  = 56.185 +-  0.724
Fano         =  0.145 +-  0.004
TiKb1 Noise  = 73.949 +-  0.798
NiKb1 Noise  = 86.474 +-  0.880
Chisq/NDF    = 216.511/78
```







cycle2 total

iterative calibration

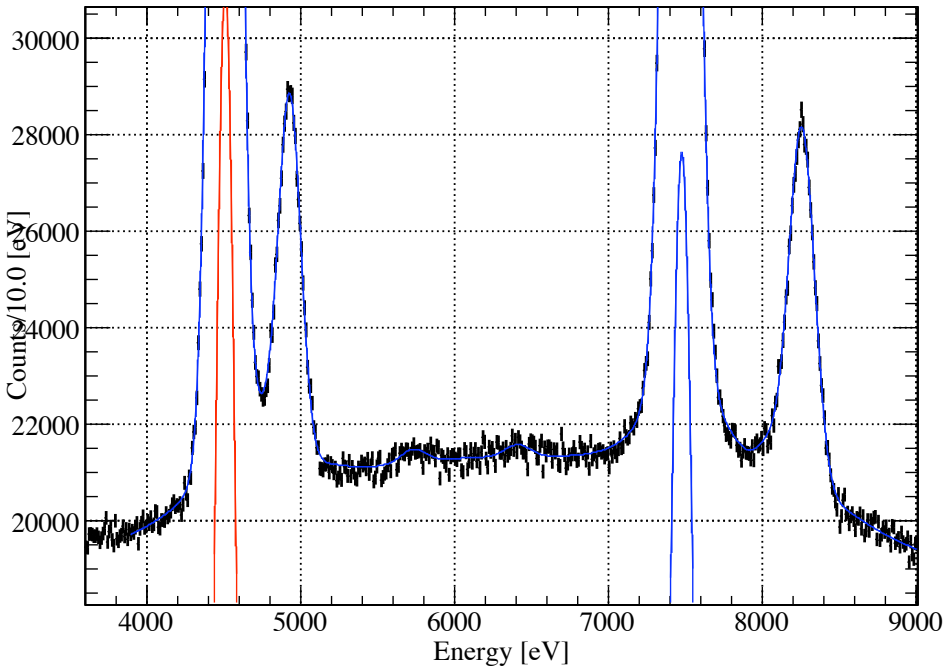
```
FCN=1543.57 FROM MINOS     STATUS=SUCCESSFUL  18965 CALLS       20281 TOTAL
                     EDM=0.268342    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          5.11972e+04   9.40611e+02  -6.79279e+02   1.43007e+03
  2  BGb          1.74203e+01   2.89858e-01  -4.41013e-01   2.10115e-01
  3  BGc         -1.37091e-03   2.15311e-05  -1.57748e-05   3.25712e-05
  4  Const Noise [eV]   5.44946e+01   6.55392e-01  -6.82732e-01   7.23965e-01
  5  Fano         1.28457e-01   3.41799e-03  -3.77924e-03   3.56043e-03
  6  Ti Kb/Ka1 ratio   2.41539e-01   2.33247e-03  -2.73924e-03   2.26162e-03
  7  Ni Kb/Ka1 ratio   2.79613e-01   2.65052e-03  -2.73680e-03   2.94240e-03
  8  TiKa1 Height   1.55290e+05   3.84763e+02  -3.83510e+02   4.41815e+02
  9  NiKa1 Height   1.38251e+05   5.36691e+02  -6.22447e+02   5.34350e+02
 10  TiKa1 Mean [eV]   4.51078e+03   2.05721e-01  -2.50582e-01   1.92705e-01
 11  NiKa1 Mean [eV]   7.47835e+03   3.06283e-01  -3.02163e-01   3.55019e-01
 12  TiKb1 Mean [eV]   4.93046e+03   6.64437e-01  -6.96351e-01   7.26589e-01
 13  NiKb1 Mean [eV]   8.25824e+03   7.35204e-01  -7.93401e-01   7.80730e-01
 14  TiKb1 Sigma [eV]   7.23737e+01   7.23230e-01  -8.05235e-01   7.42525e-01
 15  NiKb1 Sigma [eV]   8.42377e+01   7.81191e-01  -8.36327e-01   8.36337e-01
 16  Pile area factor   6.29850e-02   1.81549e-03  -1.91905e-03   1.96564e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.41463e-02   4.16084e-03  -5.34449e-03   3.67495e-03
 20  Tail area factor NiKa   8.01144e-02   5.17581e-03  -4.81176e-03   6.30912e-03
 21  Tail slope factor Ka   2.18047e+00   1.90035e-01  -1.90055e-01   2.20327e-01
 22  Tail area factor TiKb   3.40000e-02     fixed
 23  Tail area factor NiKb   8.00000e-02     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   6.01133e-03   1.02774e-03  -1.04096e-03   1.16319e-03
 26  Escape mean NiKa [eV]   5.73494e+03   2.00339e+01  -2.05513e+01   2.24528e+01
 27  FeKa Height factor   8.38218e-03   1.55786e-03  -1.49999e-03   1.84963e-03
 28  FeKa mean [eV]   6.40784e+03   2.40004e+01  -2.51962e+01   2.65273e+01
 29  CuKa Height factor   2.48831e-02   1.94306e-03  -1.98870e-03   2.17349e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 total

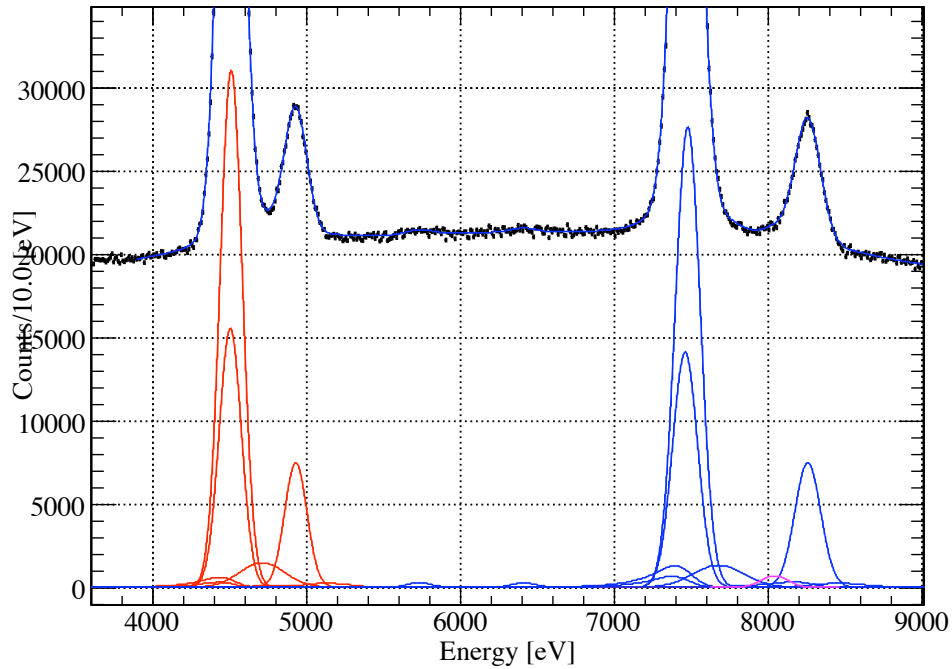
iterative calibration

```
Ti EVENT
KA1+KA2     = 840246
Pileup      = 52922.9
Pile/All = 0.059253
Ni EVENT
KA1+KA2     = 852142
Pileup      = 53672.2
Pile/All = 0.059253
TiKa1 Mean   = 4510.782 +-  0.222
TiKb1 Mean   = 4930.458 +-  0.711
NiKa1 Mean   = 7478.351 +-  0.329
NiKb1 Mean   = 8258.238 +-  0.787
Const Noise  = 54.495 +-  0.703
Fano         =  0.128 +-  0.004
TiKb1 Noise  = 72.374 +-  0.774
NiKb1 Noise  = 84.238 +-  0.836
Chisq/NDF    = 163.455/78
```

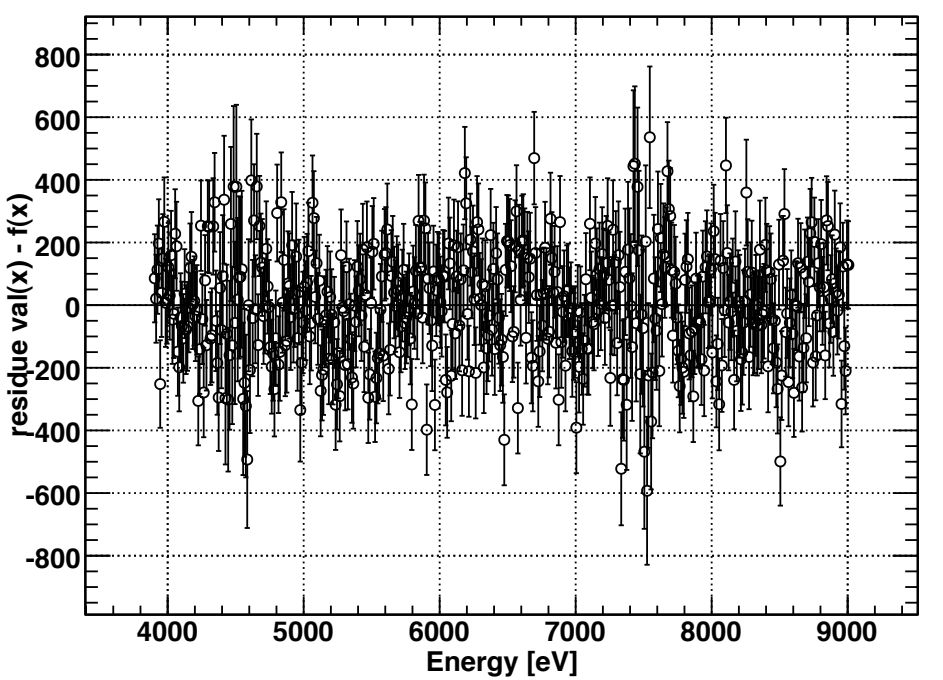
self total 2nd mean and noise free fit



self total 2nd mean and noise free fit



fit residue

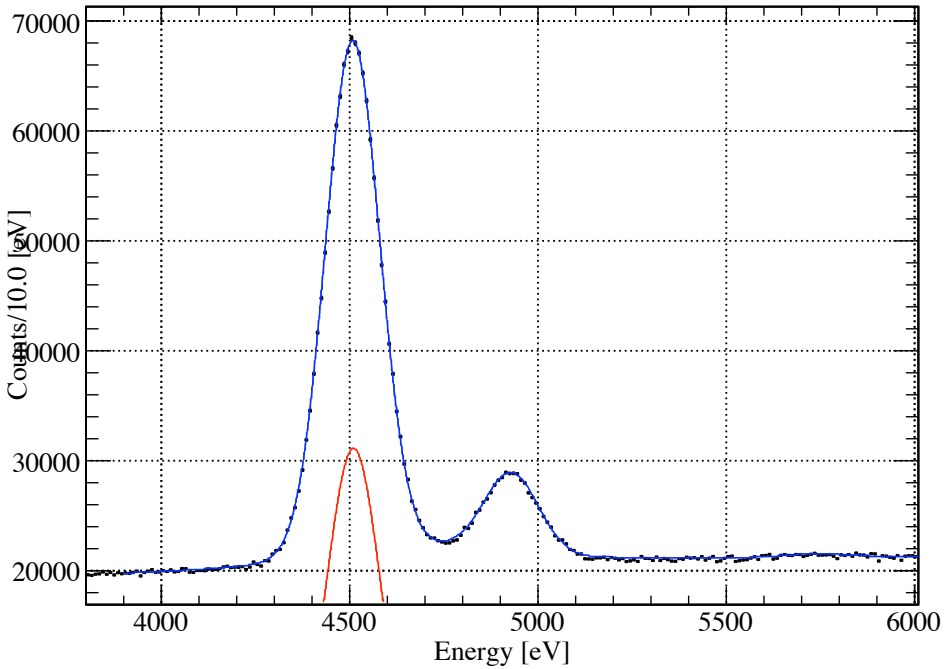


changed bin-width
50eV -> 10eV

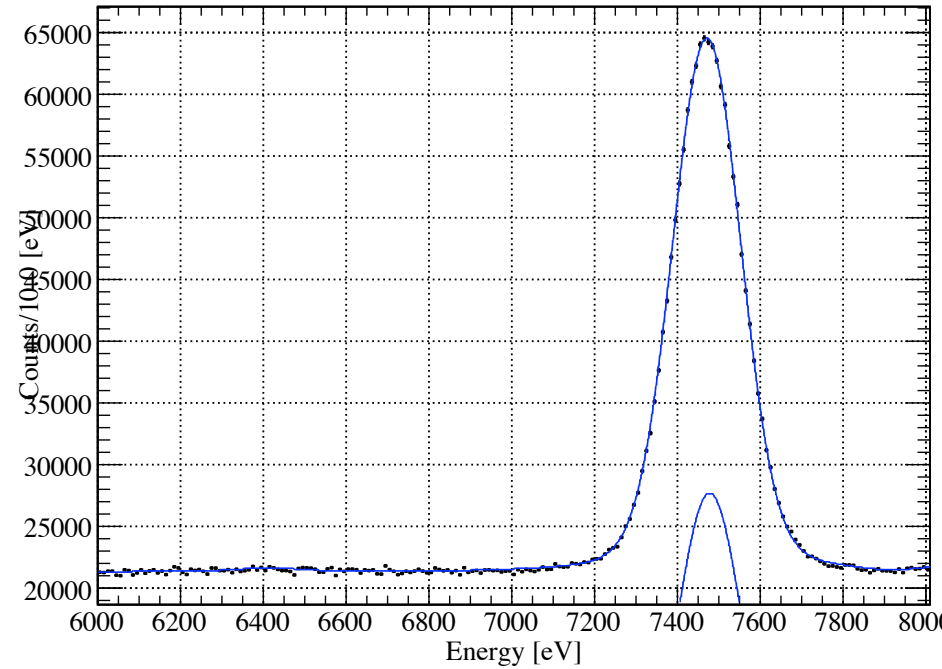
cycle2 total

iterative calibration

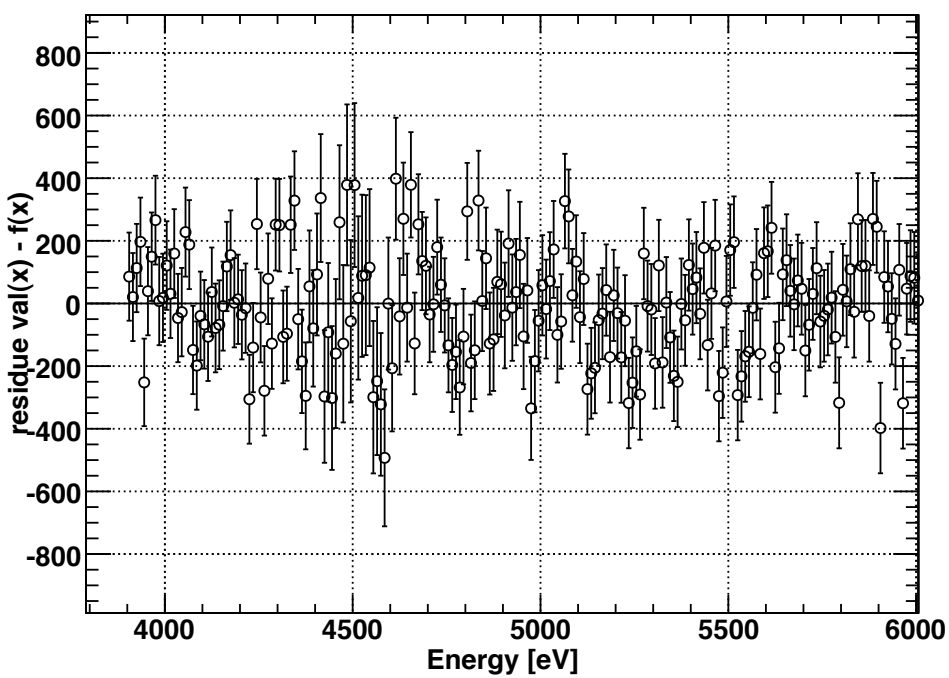
self total 2nd mean and noise free fit



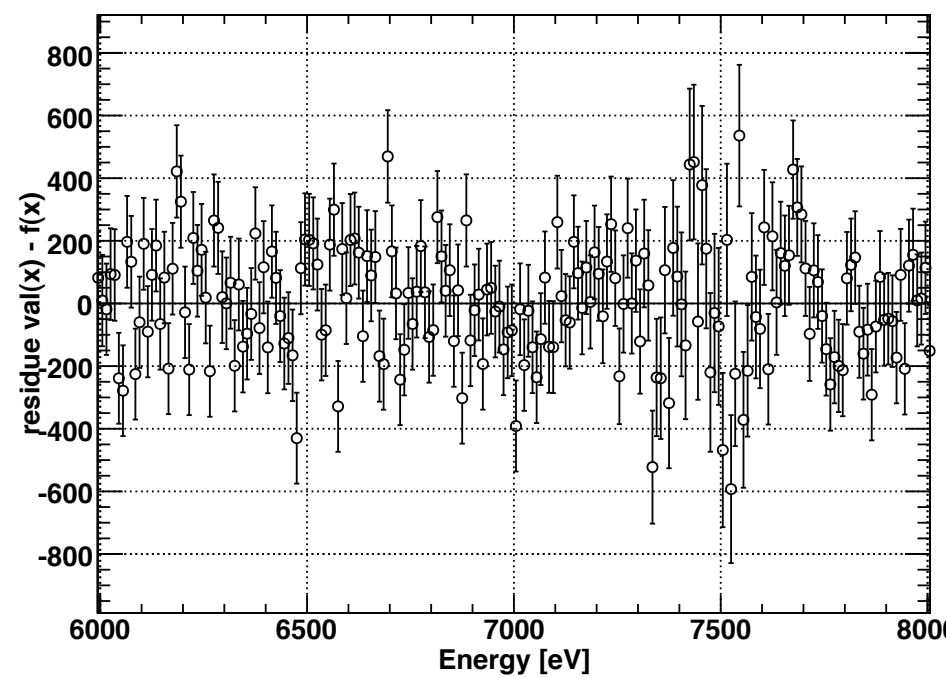
self total 2nd mean and noise free fit



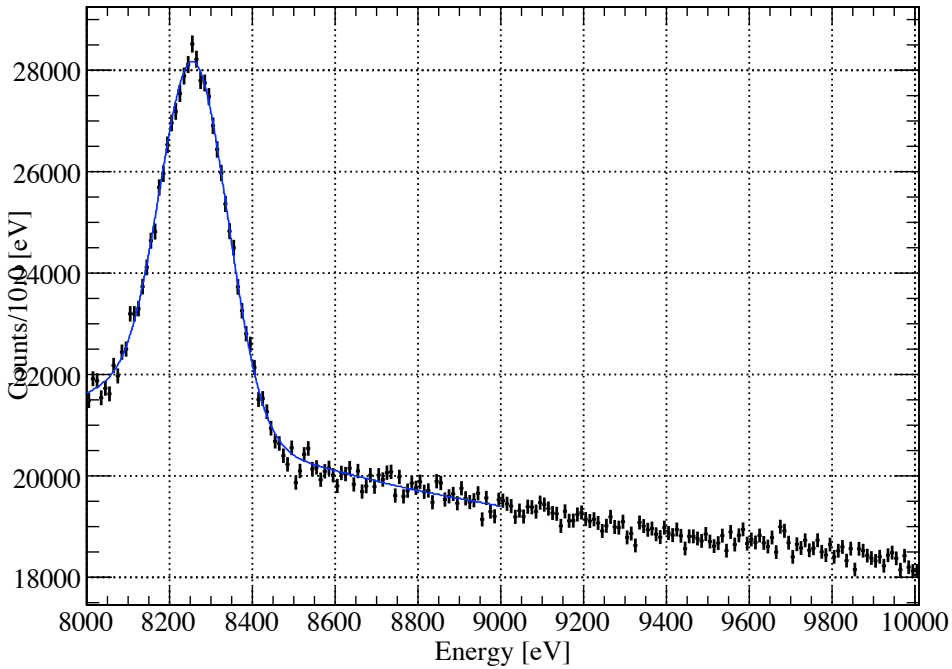
fit residue



fit residue



self total 2nd mean and noise free fit



cycle2 total

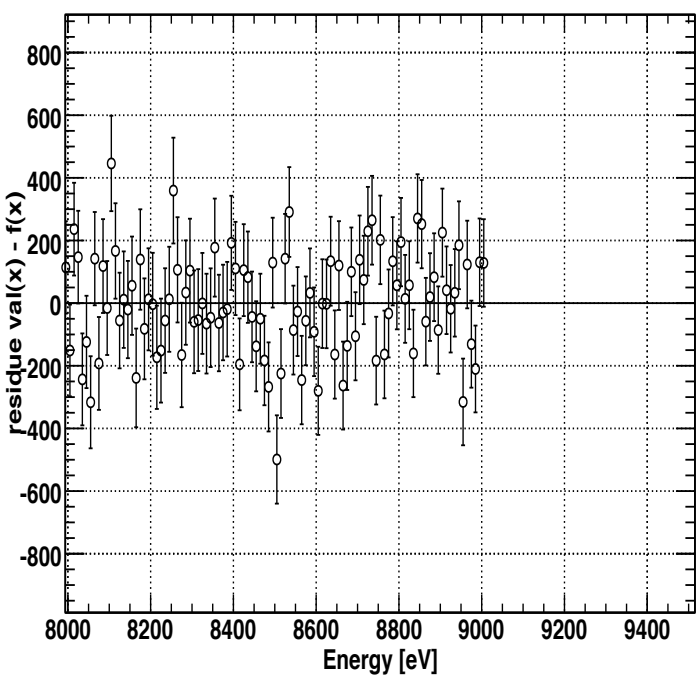
iterative calibration

Chisqr was improved drastically.

Other fit results have no change.

changed bin-width
50eV -> 10eV

fit residue




```
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KA1+KA2      = 840246
Pileup       = 52922.9
Pile/All = 0.059253
Ni EVENT
KA1+KA2      = 852142
Pileup       = 53672.2
Pile/All = 0.059253
TiKa1 Mean    = 4510.782 +-  0.222
TiKb1 Mean    = 4930.458 +-  0.711
NiKa1 Mean    = 7478.351 +-  0.329
NiKb1 Mean    = 8258.238 +-  0.787
Const Noise   = 54.495 +-  0.703
Fano          =  0.128 +-  0.004
TiKb1 Noise   = 72.374 +-  0.774
NiKb1 Noise   = 84.238 +-  0.836
Chisq/NDF     = 163.455/78
```

```
Ti EVENT
KA1+KA2      = 840641
Pileup       = 52963.4
Pile/All = 0.0592694
Ni EVENT
KA1+KA2      = 851938
Pileup       = 53675.2
Pile/All = 0.0592694
TiKa1 Mean    = 4510.739 +-  0.213
TiKb1 Mean    = 4930.526 +-  0.685
NiKa1 Mean    = 7478.365 +-  0.318
NiKb1 Mean    = 8258.240 +-  0.759
Const Noise   = 54.636 +-  0.668
Fano          =  0.128 +-  0.004
TiKb1 Noise   = 72.354 +-  0.730
NiKb1 Noise   = 84.059 +-  0.795
Chisq/NDF     = 634.178/486
```

```
FCN=6713.41 FROM MINOS     STATUS=SUCCESSFUL  17986 CALLS       19308 TOTAL
                     EDM=0.230928    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          1.02530e+04   1.82004e+02  -1.36939e+02   2.78076e+02
  2  BGb          3.47973e+00   5.61232e-02  -8.58307e-02   4.24391e-02
  3  BGc         -2.73838e-04   4.17394e-06  -3.18802e-06   6.34540e-06
  4  Const Noise [eV]   5.46357e+01   6.25336e-01  -6.50622e-01   6.85455e-01
  5  Fano         1.28078e-01   3.27737e-03  -3.59717e-03   3.40513e-03
  6  Ti Kb/Ka1 ratio   2.41381e-01   2.28090e-03  -2.65194e-03   2.21216e-03
  7  Ni Kb/Ka1 ratio   2.79174e-01   2.60181e-03  -2.67946e-03   2.85741e-03
  8  TiKa1 Height   3.10459e+04   7.55911e+01  -7.56523e+01   8.56679e+01
  9  NiKa1 Height   2.76339e+04   1.06461e+02  -1.22439e+02   1.05221e+02
 10  TiKa1 Mean [eV]   4.51074e+03   1.98673e-01  -2.38374e-01   1.87870e-01
 11  NiKa1 Mean [eV]   7.47837e+03   2.98552e-01  -2.92886e-01   3.42834e-01
 12  TiKb1 Mean [eV]   4.93053e+03   6.43908e-01  -6.71207e-01   6.99010e-01
 13  NiKb1 Mean [eV]   8.25824e+03   7.13246e-01  -7.64433e-01   7.52783e-01
 14  TiKb1 Sigma [eV]   7.23544e+01   6.86053e-01  -7.58710e-01   7.00424e-01
 15  NiKb1 Sigma [eV]   8.40589e+01   7.47045e-01  -7.98321e-01   7.90933e-01
 16  Pile area factor   6.30036e-02   1.76933e-03  -1.85877e-03   1.90187e-03
 17  Pile shift [eV]   2.00000e+02     fixed
 18  Pile sigma factor   2.00000e+00     fixed
 19  Tail area factor TiKa   3.35096e-02   4.05319e-03  -5.14112e-03   3.63030e-03
 20  Tail area factor NiKa   8.02076e-02   5.07981e-03  -4.71300e-03   6.12263e-03
 21  Tail slope factor Ka   2.16274e+00   1.86303e-01  -1.85774e-01   2.13202e-01
 22  Tail area factor TiKb   3.40000e-02     fixed
 23  Tail area factor NiKb   8.00000e-02     fixed
 24  Tail slope factor Kb   2.50000e+00     fixed
 25  Escape area factor NiKa   5.93997e-03   1.01471e-03  -1.02652e-03   1.13686e-03
 26  Escape mean NiKa [eV]   5.73320e+03   1.85218e+01  -1.90433e+01   2.05208e+01
 27  FeKa Height factor   8.55160e-03   1.53904e-03  -1.48572e-03   1.80802e-03
 28  FeKa mean [eV]   6.41170e+03   2.48834e+01  -2.60071e+01   2.71923e+01
 29  CuKa Height factor   2.51700e-02   1.89682e-03  -1.92683e-03   2.11035e-03
 30  CuKa mean [eV]   8.04104e+03     fixed
```

cycle2 total

iterative calibration

```
Ti EVENT
KA1+KA2     = 840641
Pileup      = 52963.4
Pile/All = 0.0592694
Ni EVENT
KA1+KA2     = 851938
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Chisq/NDF    = 634.178/486
```

changed bin-width
50eV -> 10eV