How to fit the excess between Ka and Kb

- last meeting...

  ・the excess is caused by a superposition of X-ray signals and pedestal (noise)

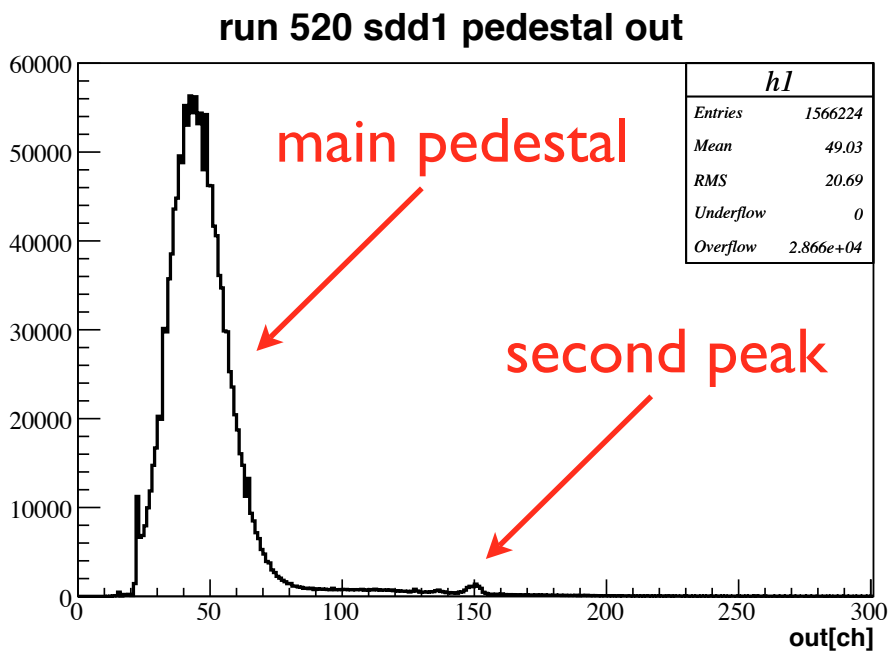
  ・a fitting with an exponential structure for the higher side tail doesn't converged ... --> I will try again

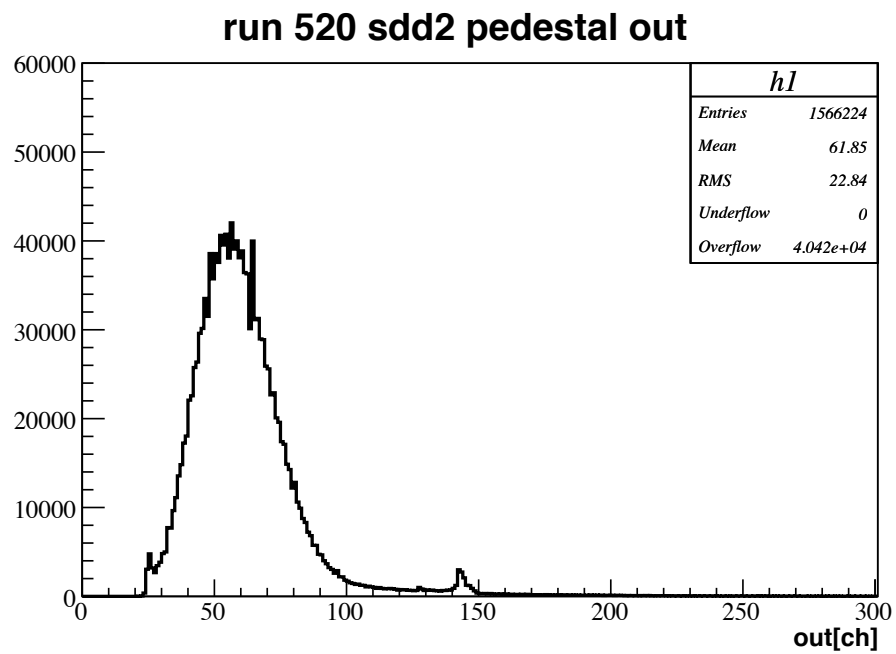
- this meeting...

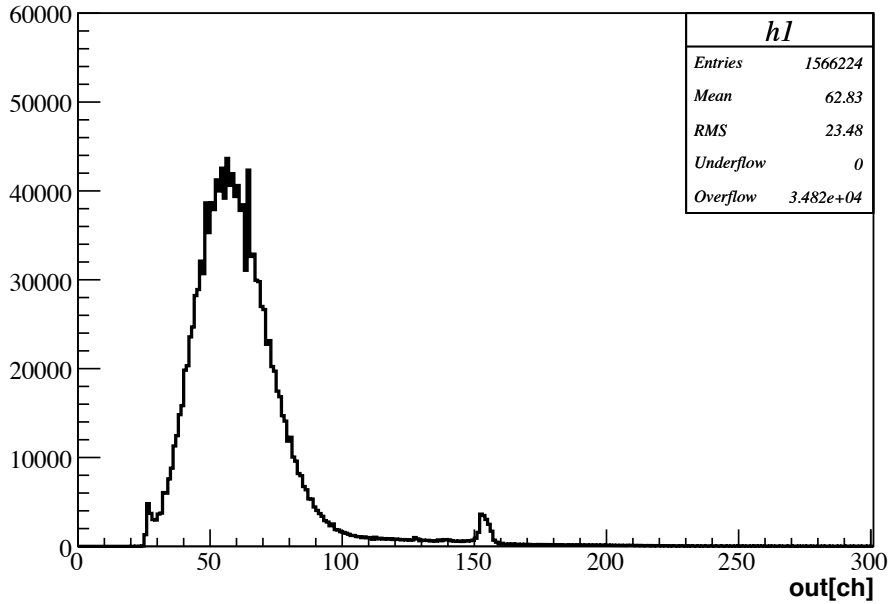
  ・a second peak which exists in a pedestal spectrum can produce the excess ?

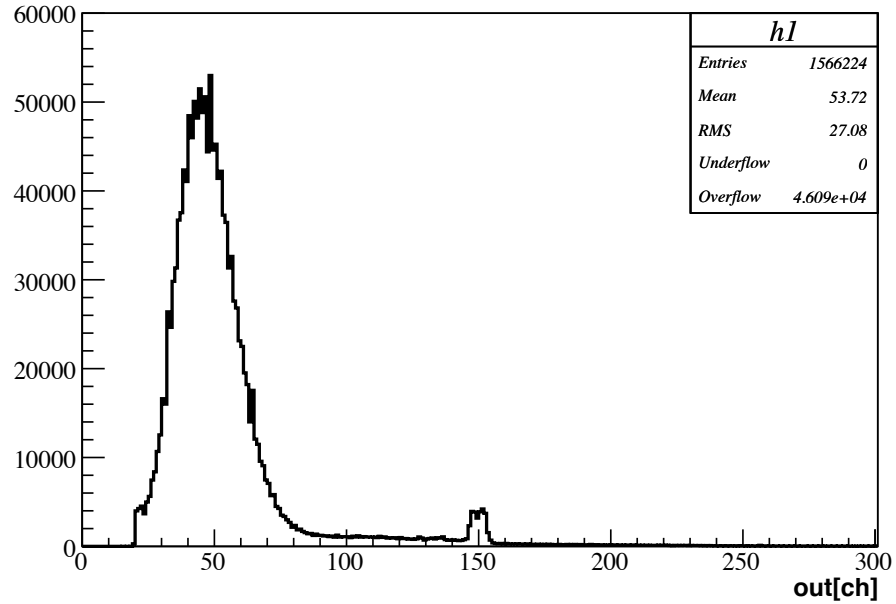
  --> today I will show a simulation of the excess

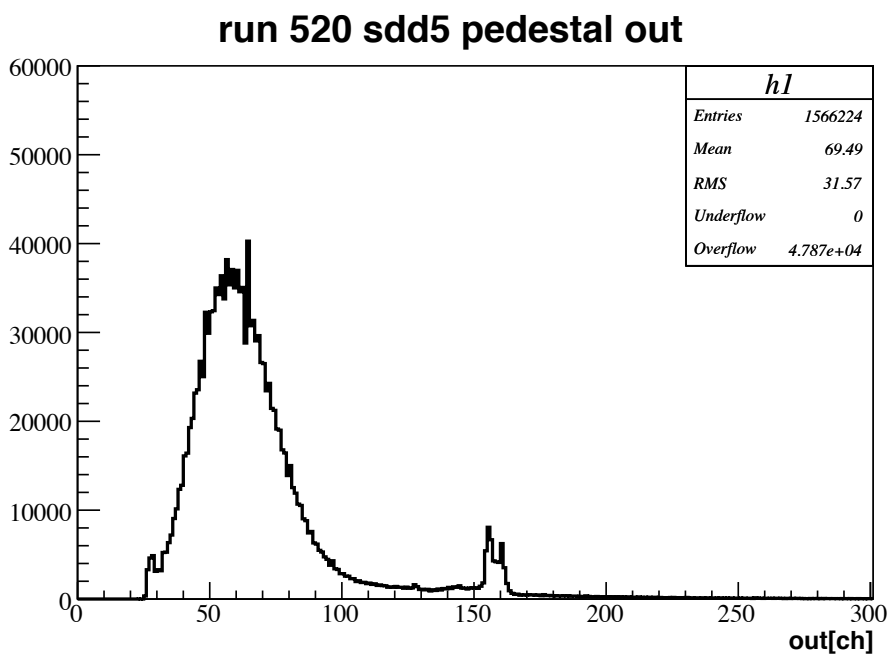
sorry still preliminary


run 520 sdd1 pedestal out
h1
Entries 1566224
Mean 49.03
RMS 20.69
Underflow 0
Overflow 2.866e+04
main pedestal
second peak
out[ch]


run 520 sdd2 pedestal out
h1
Entries 1566224
Mean 61.85
RMS 22.84
Underflow 0
Overflow 4.042e+04
out[ch]

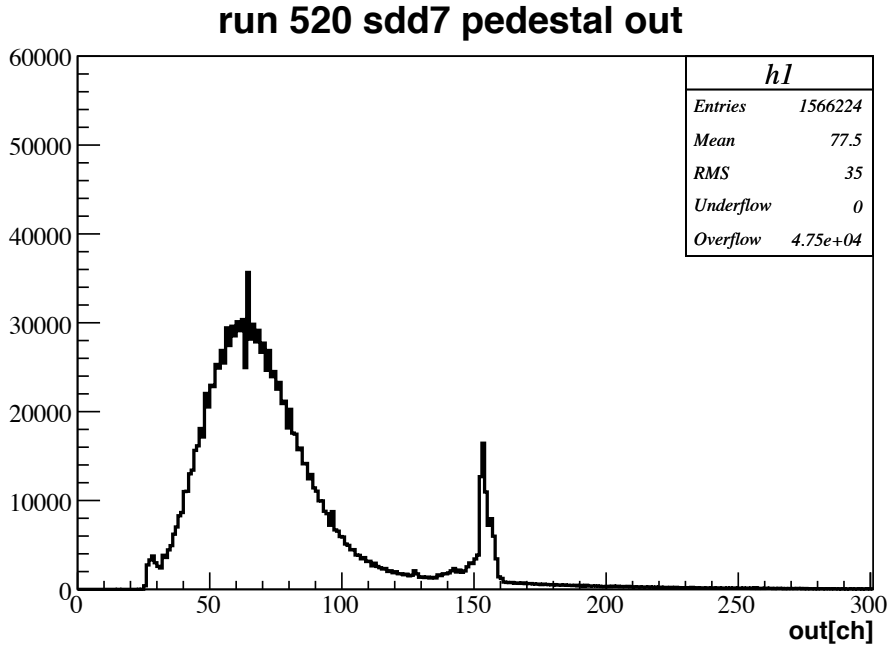

run 520 sdd3 pedestal out
h1
Entries 1566224
Mean 62.83
RMS 23.48
Underflow 0
Overflow 3.482e+04
out[ch]

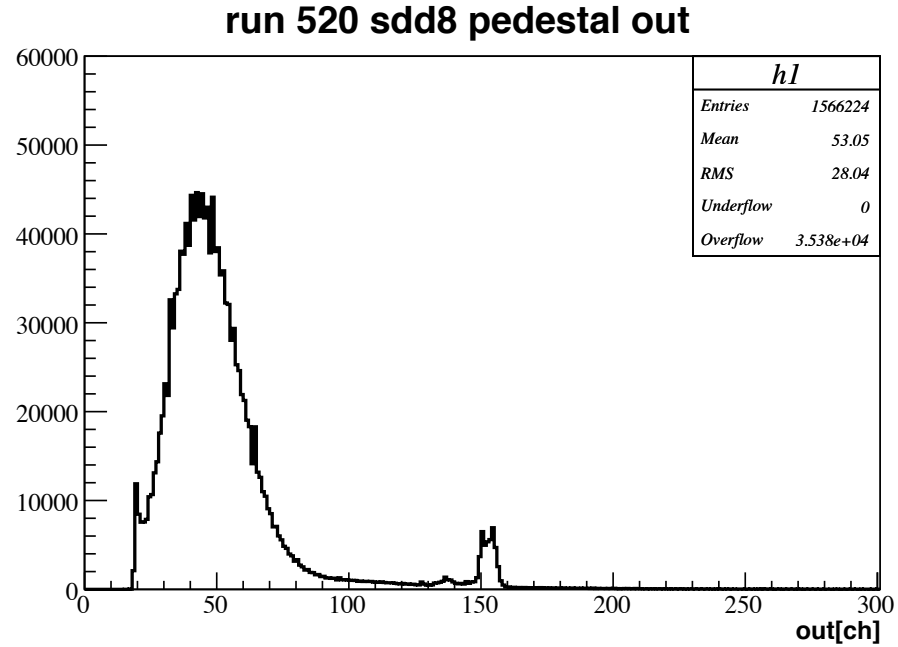

run 520 sdd4 pedestal out
h1
Entries 1566224
Mean 53.72
RMS 27.08
Underflow 0
Overflow 4.609e+04
out[ch]



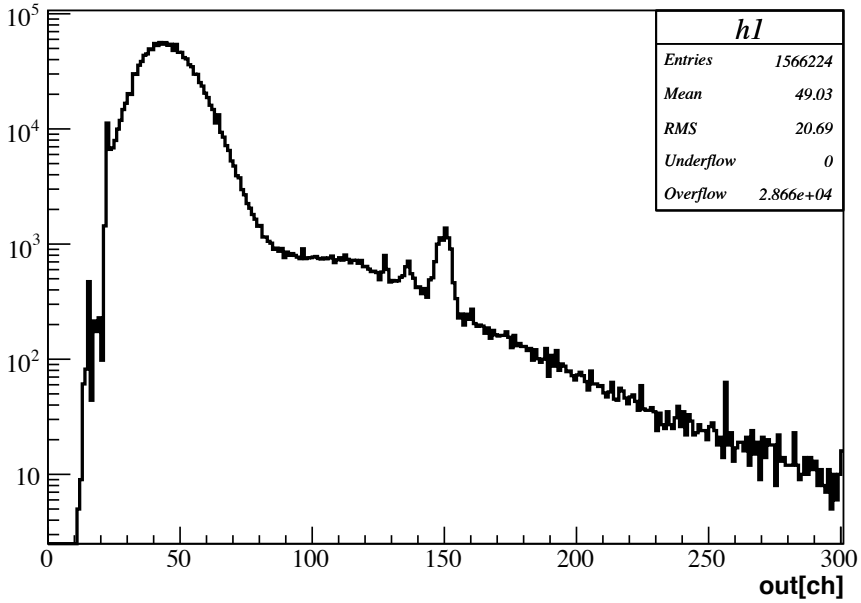
the relative intensity of a main pedestal and a second peak depends on SDD or the module channel.

---> this can explain why the excess has a SDD dependence.

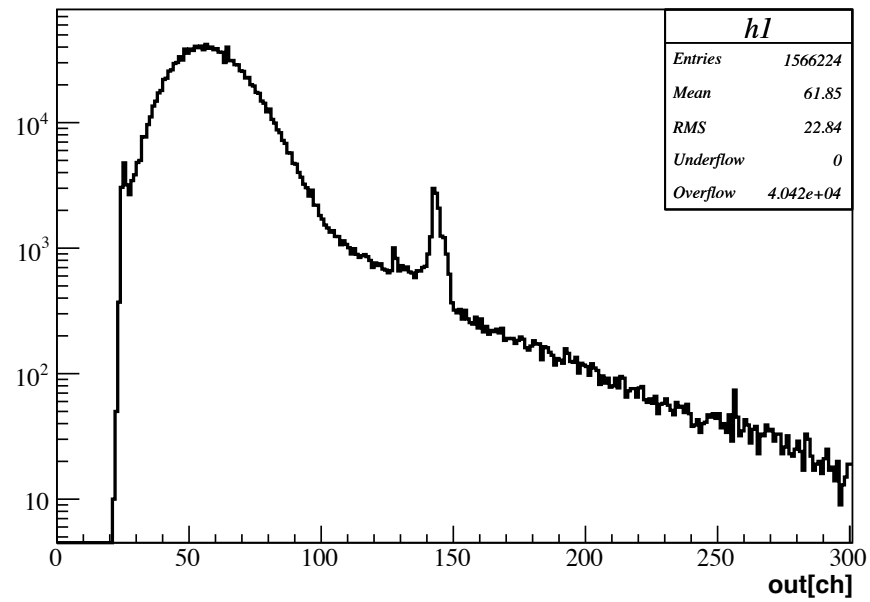




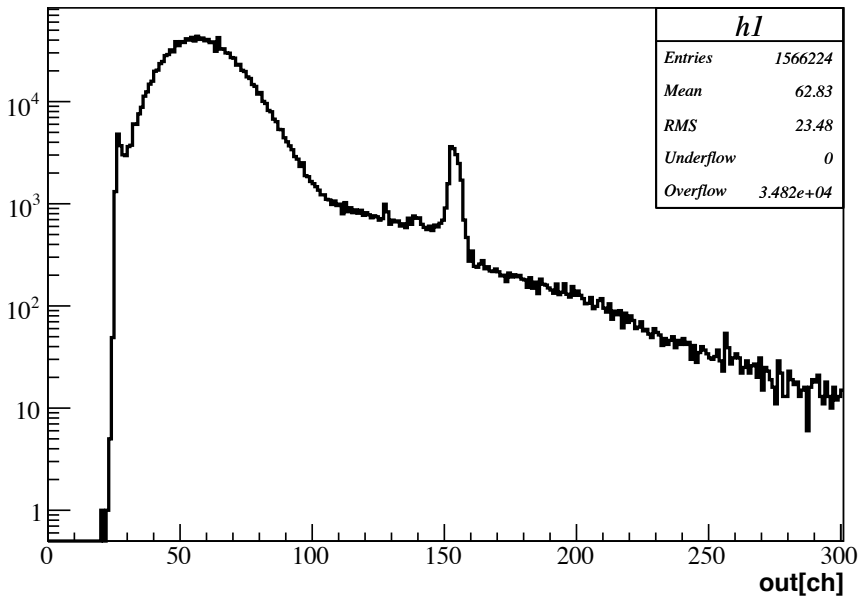
run 520 sdd1 pedestal out



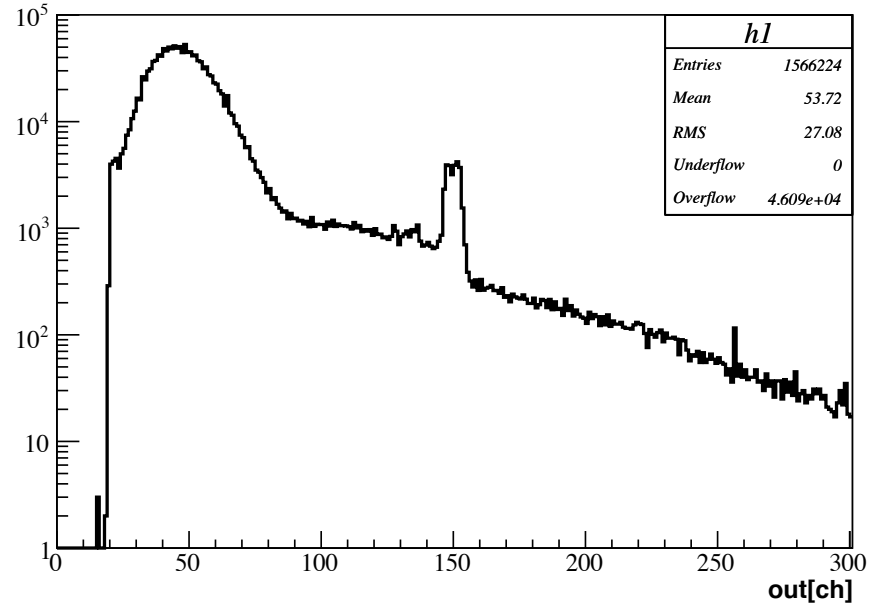
run 520 sdd2 pedestal out



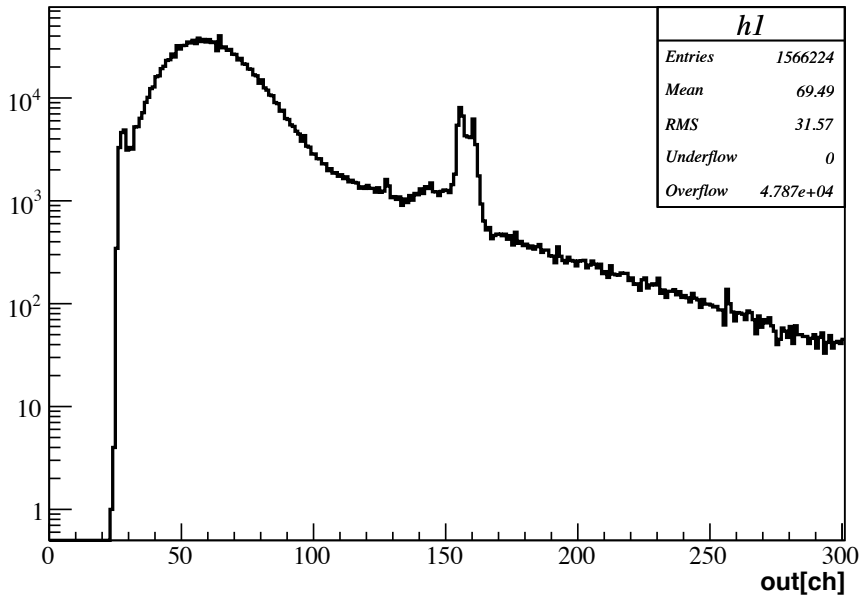
run 520 sdd3 pedestal out



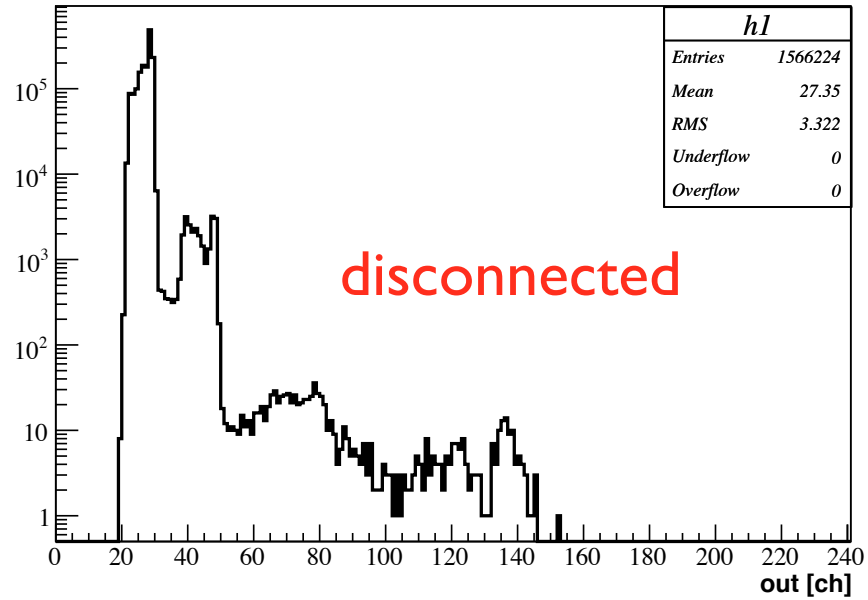
run 520 sdd4 pedestal out



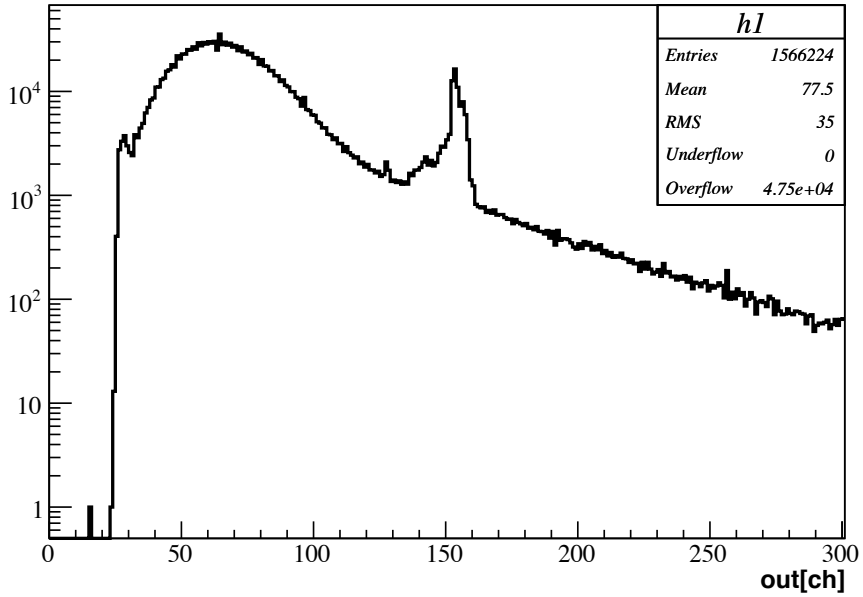
run 520 sdd5 pedestal out



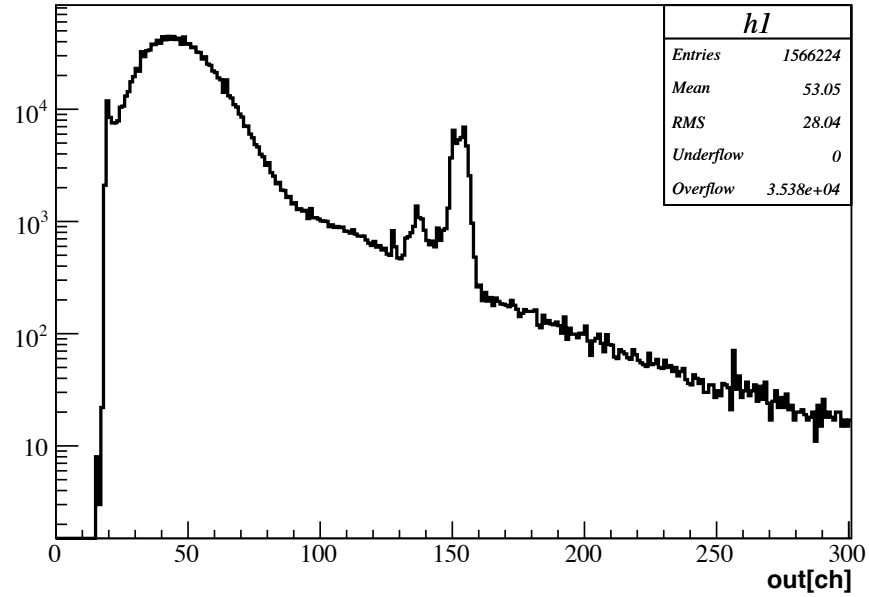
run520 sdd6 pedestal out



run 520 sdd7 pedestal out

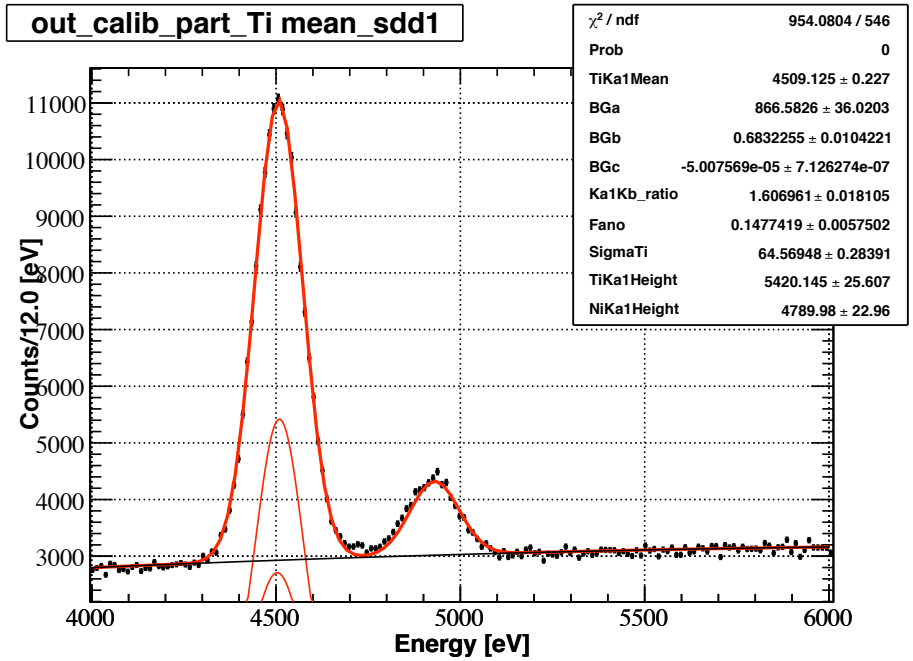


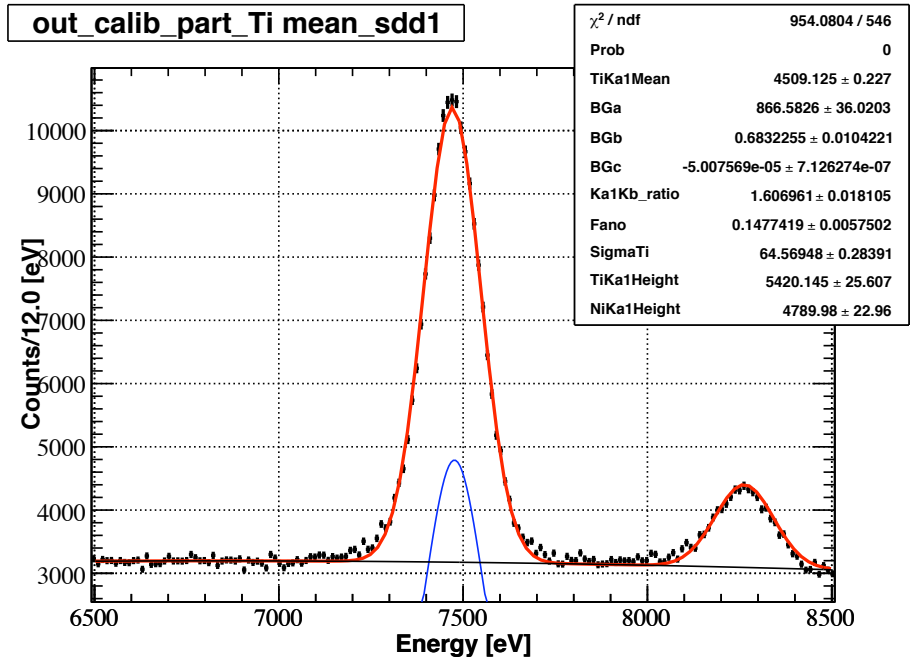
run 520 sdd8 pedestal out

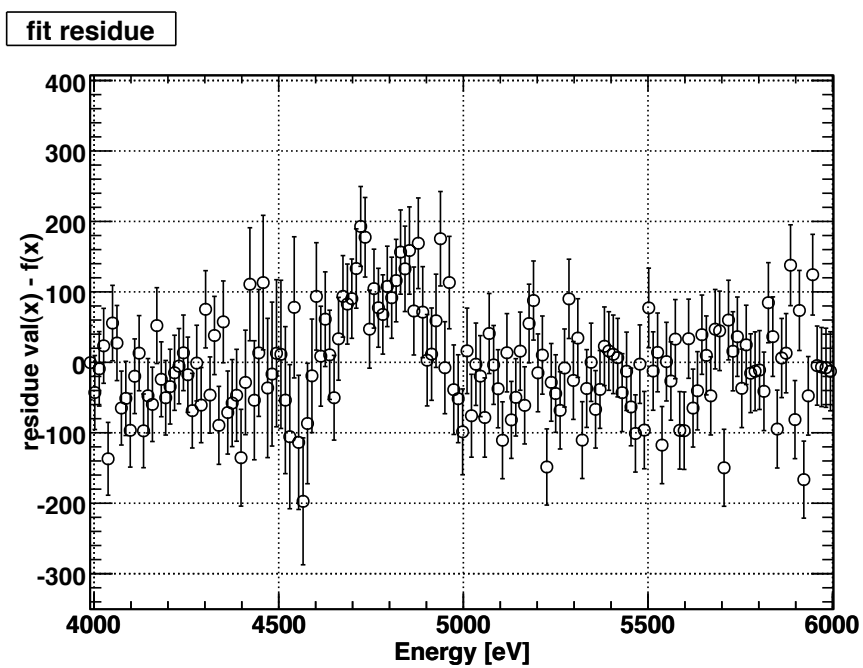


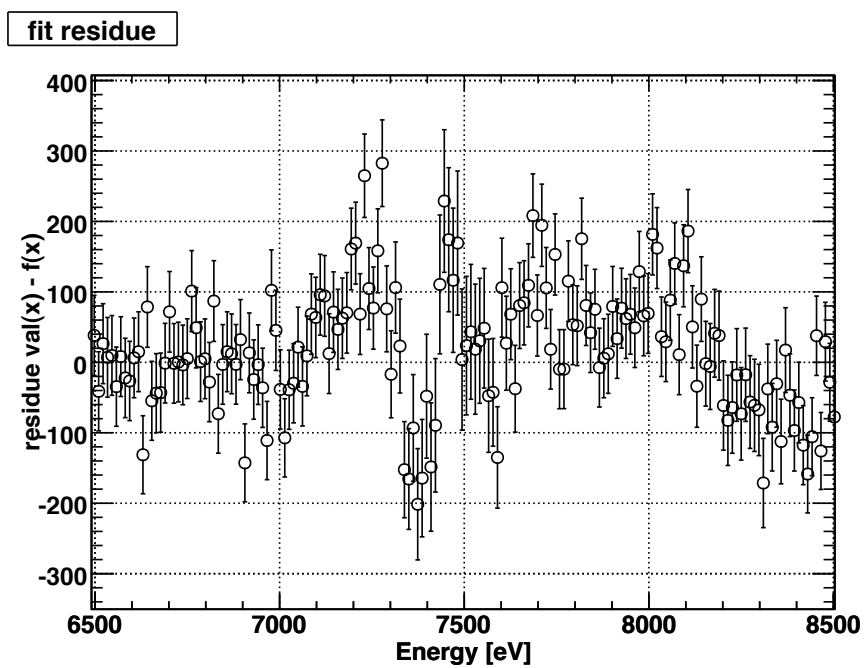
relative excess intensities

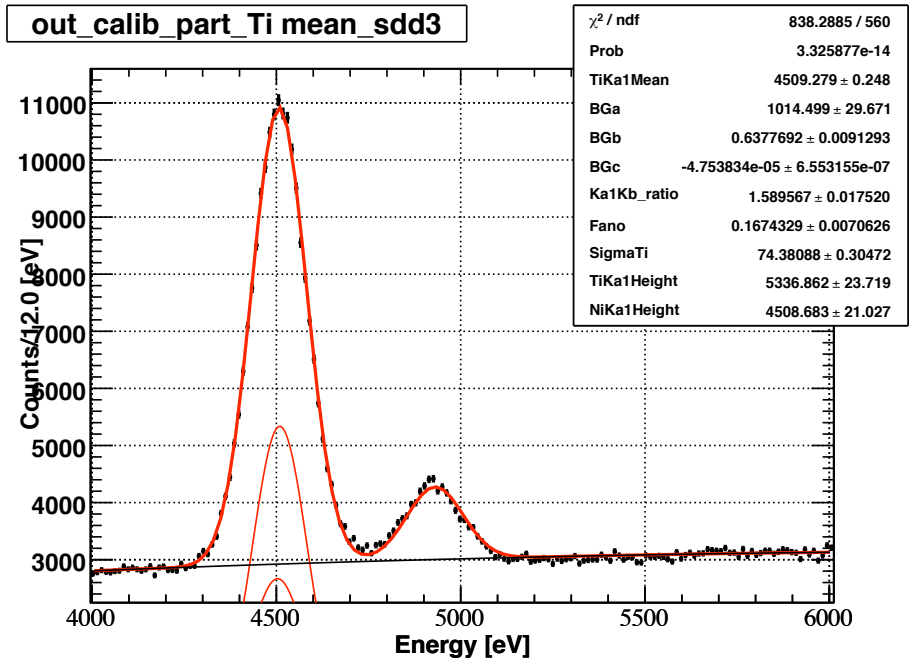
- fit ...
  - considered the pedestal stability
  - not included Cu X-rays
  - added residue plots

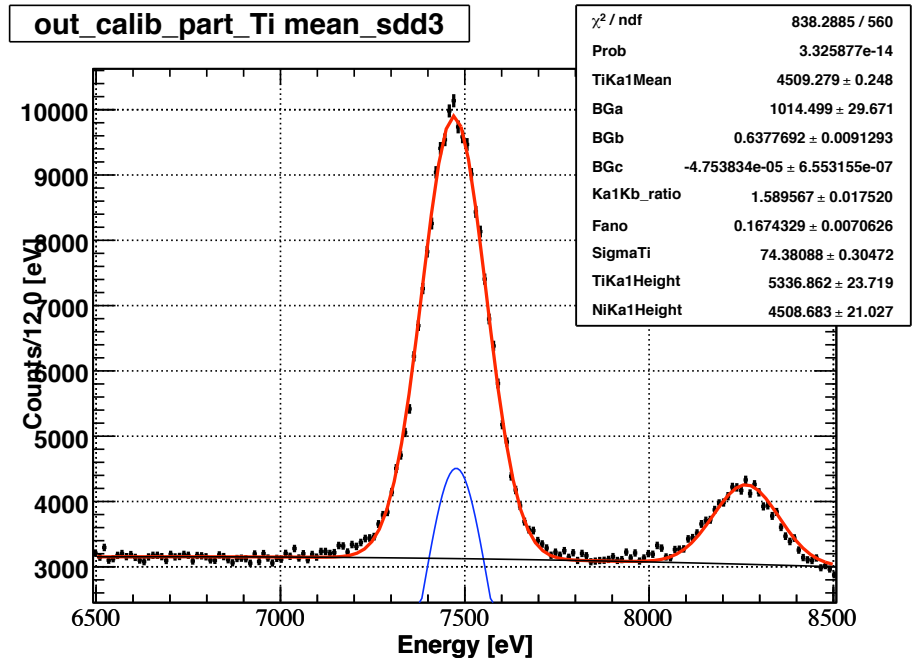

out_calib_part_Ti mean_sdd1
χ² / ndf 954.0804 / 546
Prob 0
TiKa1Mean 4509.125 ± 0.227
BGa 866.5826 ± 36.0203
BGb 0.6832255 ± 0.0104221
BGc -5.007569e-05 ± 7.126274e-07
Ka1Kb_ratio 1.606961 ± 0.018105
Fano 0.1477419 ± 0.0057502
SigmaTi 64.56948 ± 0.28391
TiKa1Height 5420.145 ± 25.607
NiKa1Height 4789.98 ± 22.96
Counts/12.0 [eV]
Energy [eV]


out_calib_part_Ti mean_sdd1
χ² / ndf 954.0804 / 546
Prob 0
TiKa1Mean 4509.125 ± 0.227
BGa 866.5826 ± 36.0203
BGb 0.6832255 ± 0.0104221
BGc -5.007569e-05 ± 7.126274e-07
Ka1Kb_ratio 1.606961 ± 0.018105
Fano 0.1477419 ± 0.0057502
SigmaTi 64.56948 ± 0.28391
TiKa1Height 5420.145 ± 25.607
NiKa1Height 4789.98 ± 22.96
Counts/12.0 [eV]
Energy [eV]


fit residue
residue val(x) - f(x)
Energy [eV]


fit residue
residue val(x) - f(x)
Energy [eV]


out_calib_part_Ti mean_sdd3
χ² / ndf 838.2885 / 560
Prob 3.325877e-14
TiKa1Mean 4509.279 ± 0.248
BGa 1014.499 ± 29.671
BGb 0.6377692 ± 0.0091293
BGc -4.753834e-05 ± 6.553155e-07
Ka1Kb_ratio 1.589567 ± 0.017520
Fano 0.1674329 ± 0.0070626
SigmaTi 74.38088 ± 0.30472
TiKa1Height 5336.862 ± 23.719
NiKa1Height 4508.683 ± 21.027
Counts/12.0 [eV]
Energy [eV]


out_calib_part_Ti mean_sdd3
χ² / ndf 838.2885 / 560
Prob 3.325877e-14
TiKa1Mean 4509.279 ± 0.248
BGa 1014.499 ± 29.671
BGb 0.6377692 ± 0.0091293
BGc -4.753834e-05 ± 6.553155e-07
Ka1Kb_ratio 1.589567 ± 0.017520
Fano 0.1674329 ± 0.0070626
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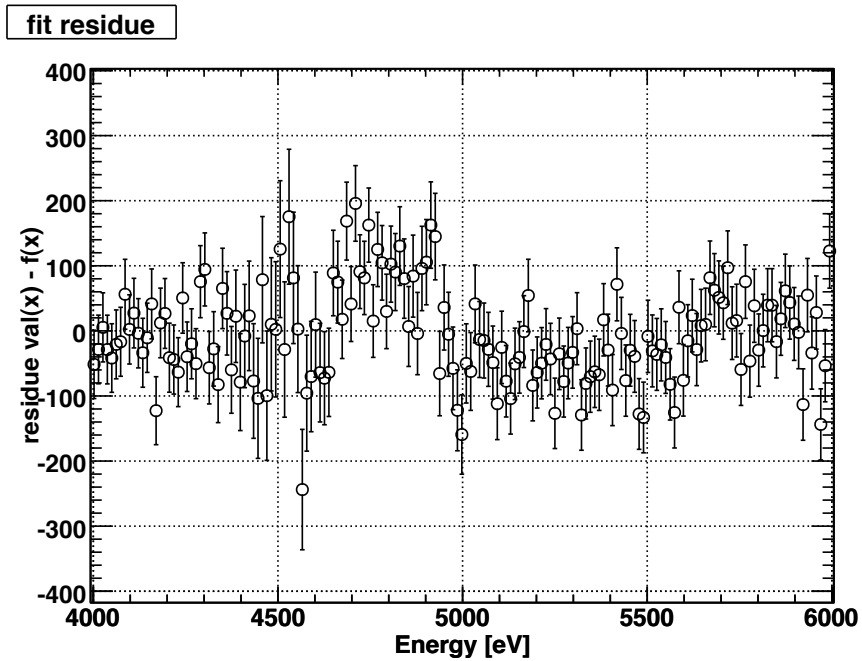
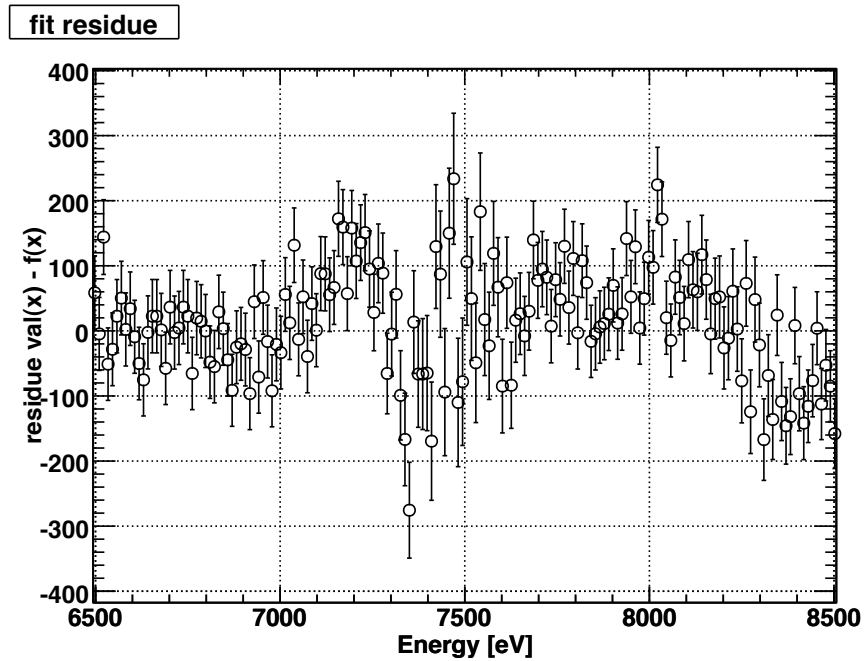
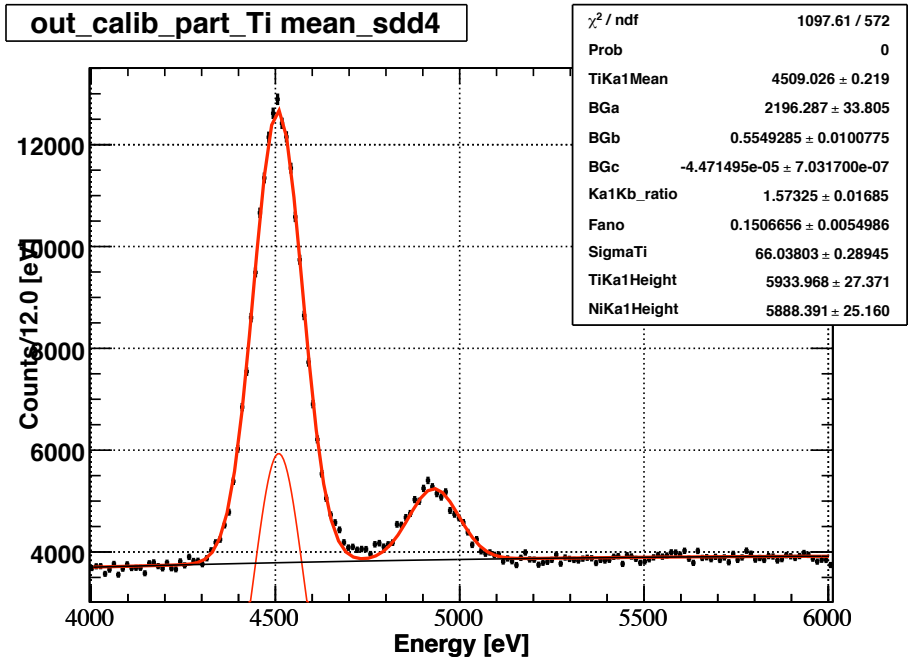
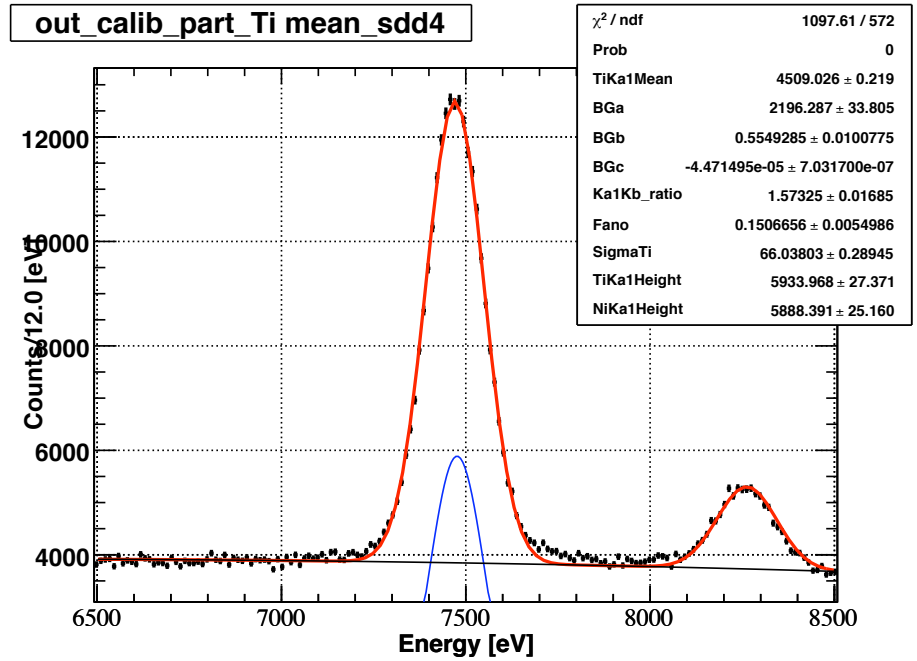
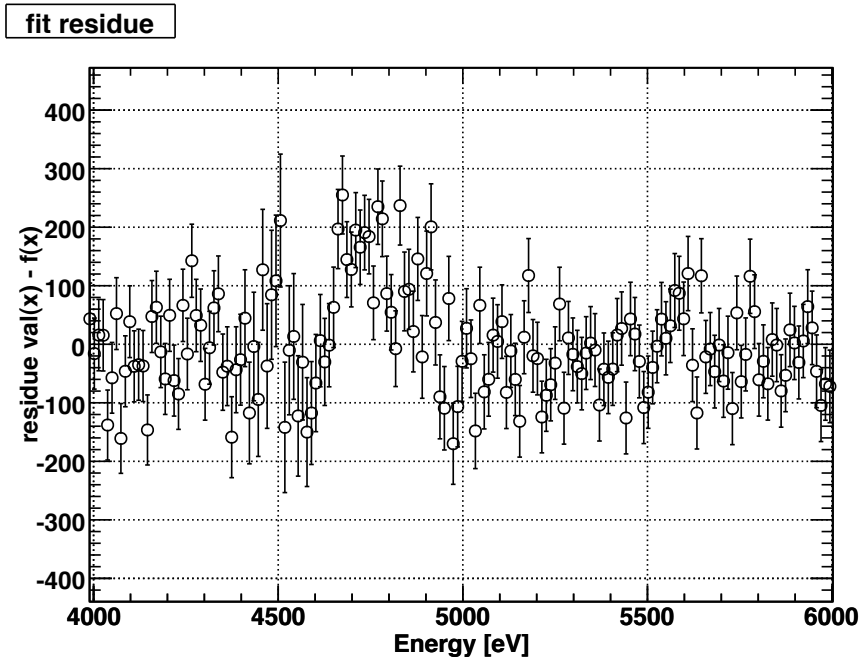
NiKa1Height 4508.683 ± 21.027
Counts/12.0 [eV]
Energy [eV]

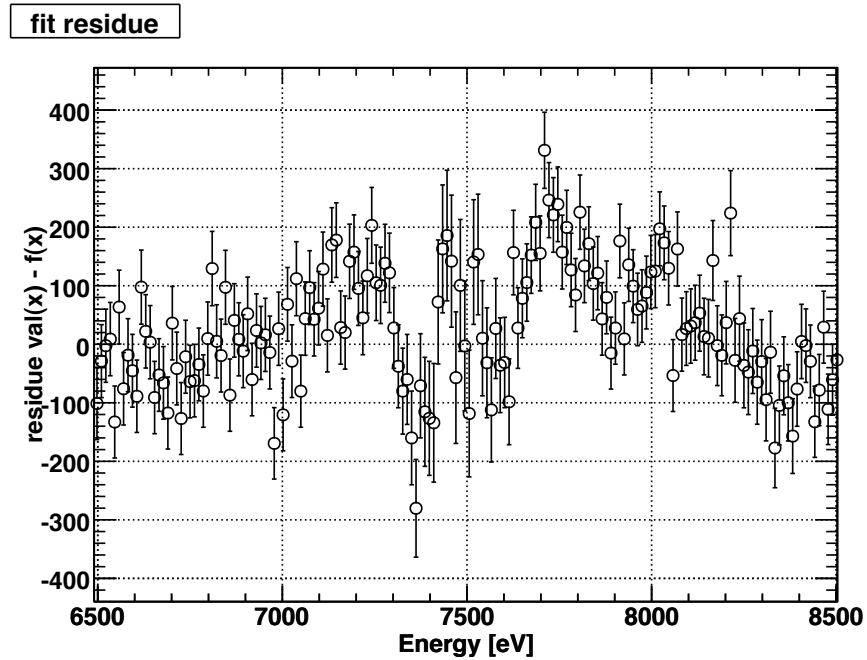

fit residue
residue val(x) - f(x)
Energy [eV]

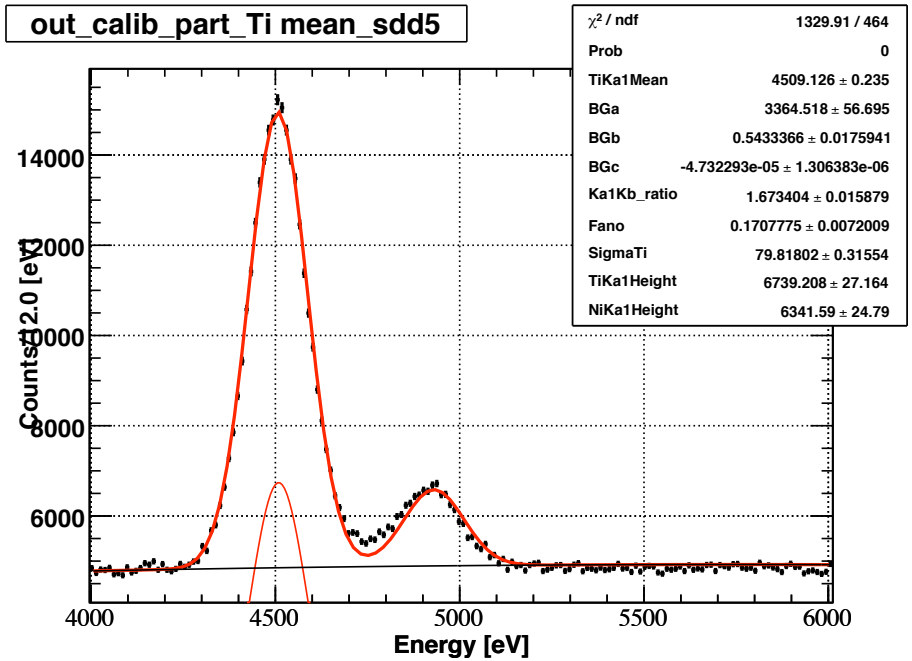

fit residue
residue val(x) - f(x)
Energy [eV]

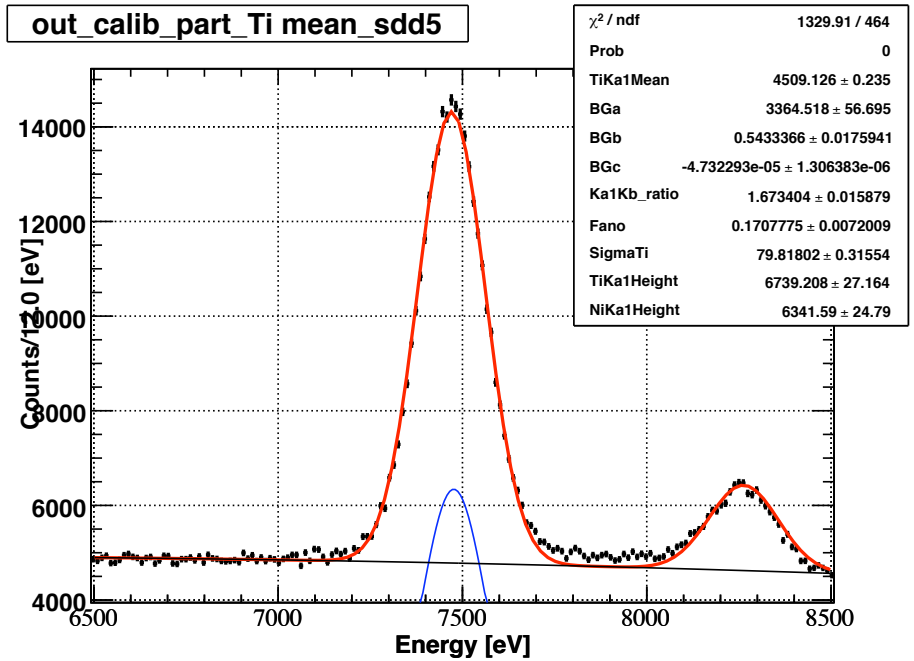

out_calib_part_Ti mean_sdd4
χ² / ndf 1097.61 / 572
Prob 0
TiKa1Mean 4509.026 ± 0.219
BGa 2196.287 ± 33.805
BGb 0.5549285 ± 0.0100775
BGc -4.471495e-05 ± 7.031700e-07
Ka1Kb_ratio 1.57325 ± 0.01685
Fano 0.1506656 ± 0.0054986
SigmaTi 66.03803 ± 0.28945
TiKa1Height 5933.968 ± 27.371
NiKa1Height 5888.391 ± 25.160
Counts/12.0 [eV]
Energy [eV]

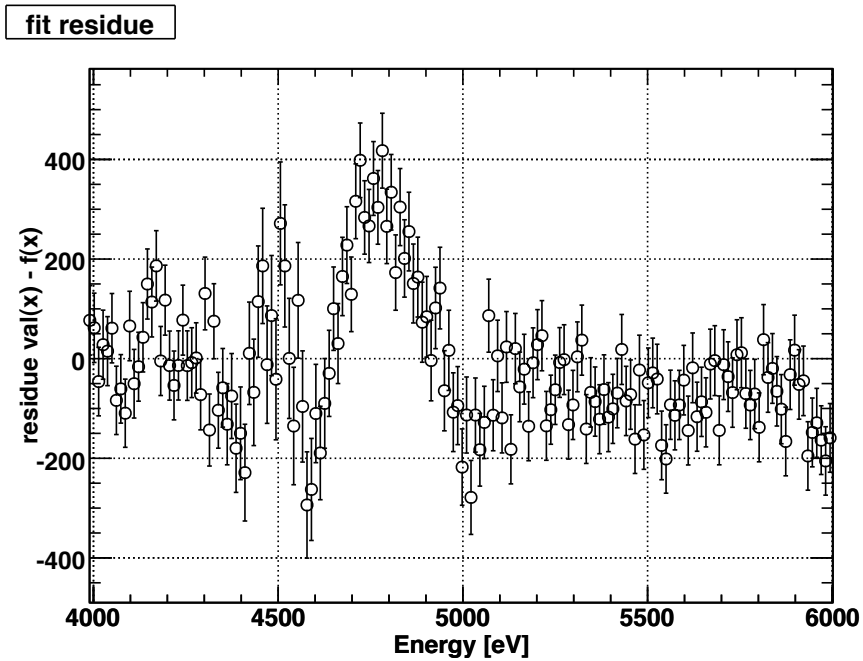

out_calib_part_Ti mean_sdd4
χ² / ndf 1097.61 / 572
Prob 0
TiKa1Mean 4509.026 ± 0.219
BGa 2196.287 ± 33.805
BGb 0.5549285 ± 0.0100775
BGc -4.471495e-05 ± 7.031700e-07
Ka1Kb_ratio 1.57325 ± 0.01685
Fano 0.1506656 ± 0.0054986
SigmaTi 66.03803 ± 0.28945
TiKa1Height 5933.968 ± 27.371
NiKa1Height 5888.391 ± 25.160
Counts/12.0 [eV]
Energy [eV]

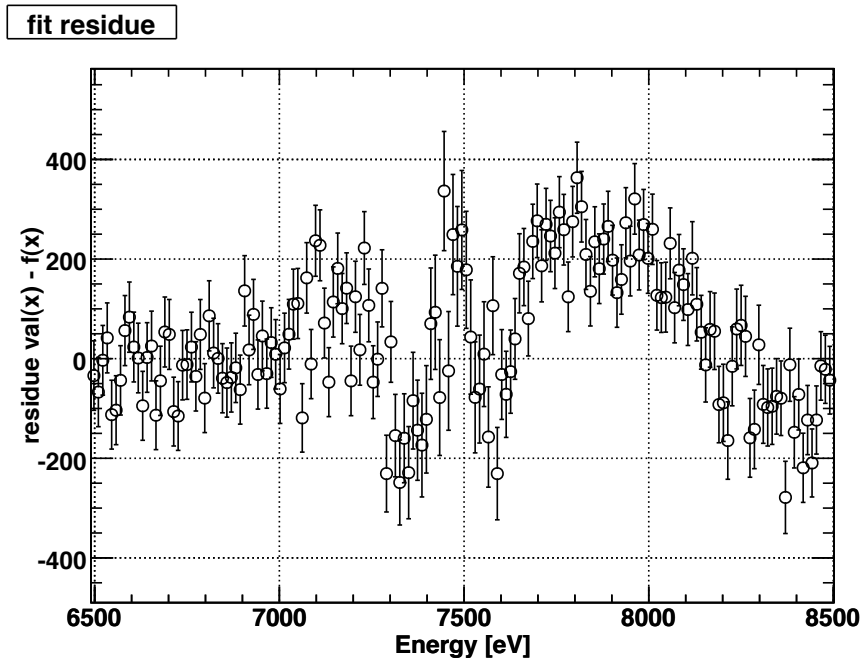

fit residue
residue val(x) - f(x)
Energy [eV]

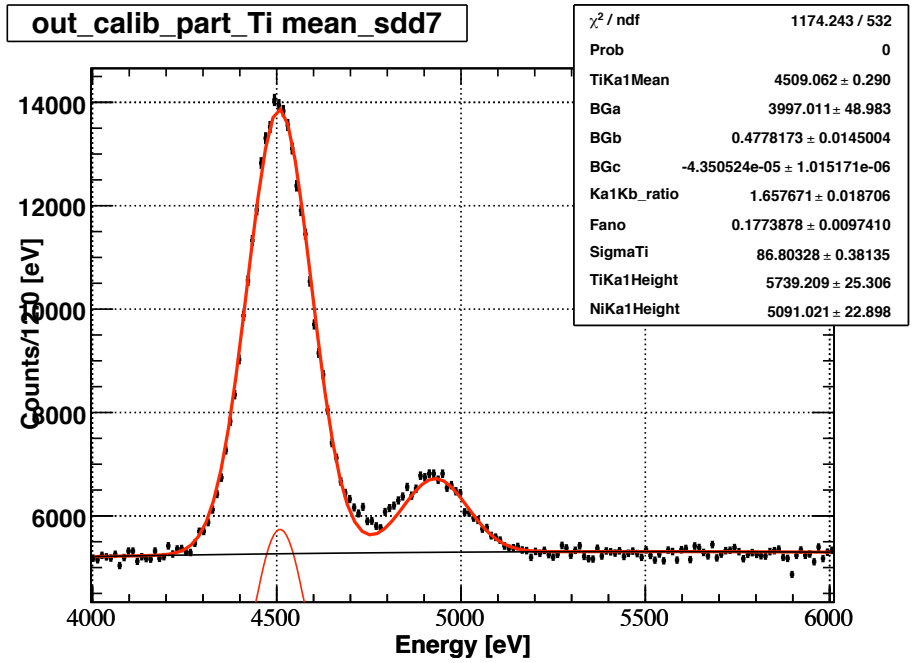

fit residue
residue val(x) - f(x)
Energy [eV]

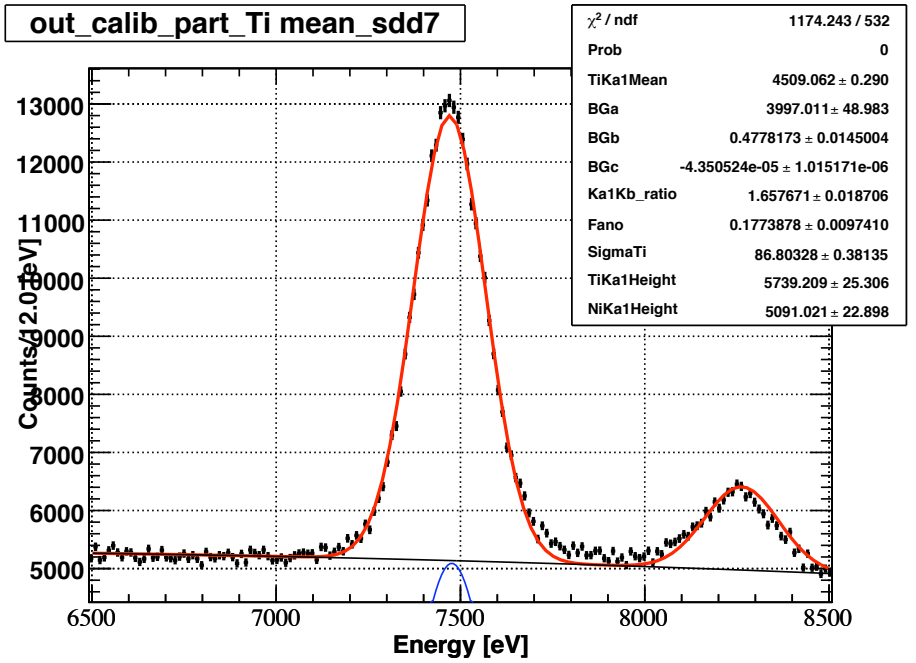

out_calib_part_Ti mean_sdd5
χ² / ndf 1329.91 / 464
Prob 0
TiKa1Mean 4509.126 ± 0.235
BGa 3364.518 ± 56.695
BGb 0.5433366 ± 0.0175941
BGc -4.732293e-05 ± 1.306383e-06
Ka1Kb_ratio 1.673404 ± 0.015879
Fano 0.1707775 ± 0.0072009
SigmaTi 79.81802 ± 0.31554
TiKa1Height 6739.208 ± 27.164
NiKa1Height 6341.59 ± 24.79
Counts/12.0 [eV]
Energy [eV]

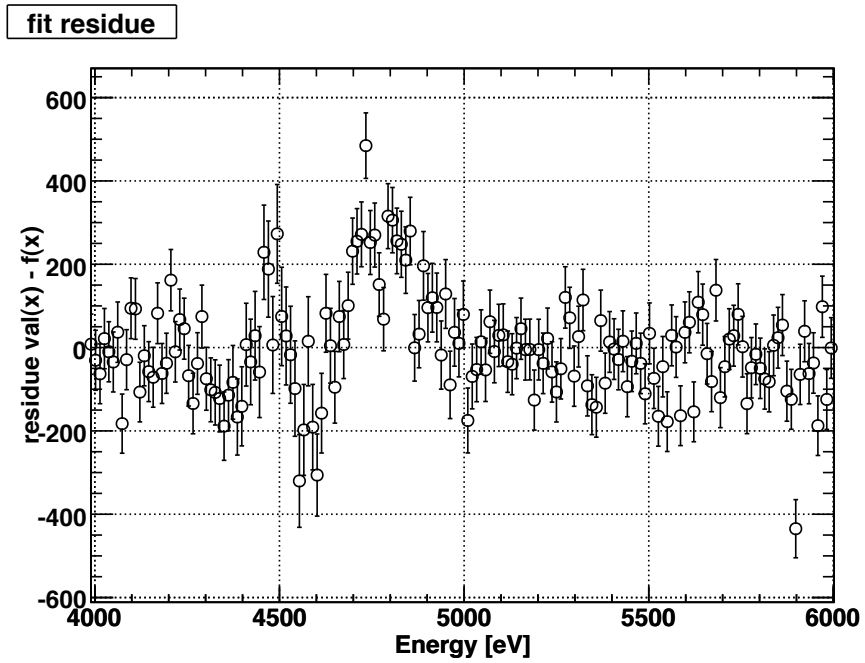

out_calib_part_Ti mean_sdd5
χ² / ndf 1329.91 / 464
Prob 0
TiKa1Mean 4509.126 ± 0.235
BGa 3364.518 ± 56.695
BGb 0.5433366 ± 0.0175941
BGc -4.732293e-05 ± 1.306383e-06
Ka1Kb_ratio 1.673404 ± 0.015879
Fano 0.1707775 ± 0.0072009
SigmaTi 79.81802 ± 0.31554
TiKa1Height 6739.208 ± 27.164
NiKa1Height 6341.59 ± 24.79
Counts/12.0 [eV]
Energy [eV]

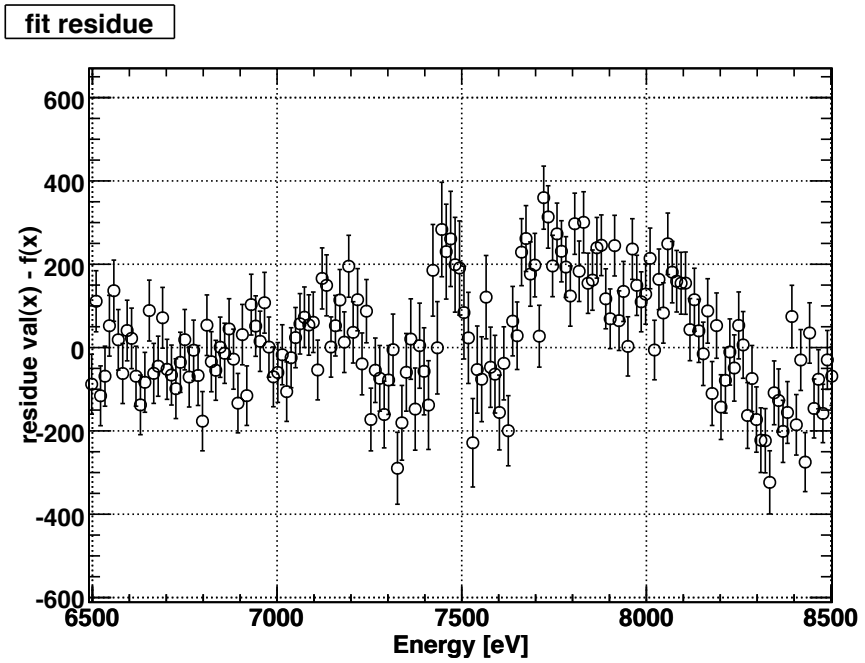

fit residue
residue val(x) - f(x)
Energy [eV]


fit residue
residue val(x) - f(x)
Energy [eV]


out_calib_part_Ti mean_sdd7
χ² / ndf 1174.243 / 532
Prob 0
TiKa1Mean 4509.062 ± 0.290
BGa 3997.011 ± 48.983
BGb 0.4778173 ± 0.0145004
BGc -4.350524e-05 ± 1.015171e-06
Ka1Kb_ratio 1.657671 ± 0.018706
Fano 0.1773878 ± 0.0097410
SigmaTi 86.80328 ± 0.38135
TiKa1Height 5739.209 ± 25.306
NiKa1Height 5091.021 ± 22.898
Counts/12.00 [eV]
Energy [eV]


out_calib_part_Ti mean_sdd7
χ² / ndf 1174.243 / 532
Prob 0
TiKa1Mean 4509.062 ± 0.290
BGa 3997.011 ± 48.983
BGb 0.4778173 ± 0.0145004
BGc -4.350524e-05 ± 1.015171e-06
Ka1Kb_ratio 1.657671 ± 0.018706
Fano 0.1773878 ± 0.0097410
SigmaTi 86.80328 ± 0.38135
TiKa1Height 5739.209 ± 25.306
NiKa1Height 5091.021 ± 22.898
Counts/12.00 [eV]
Energy [eV]


fit residue
residue val(x) - f(x)
Energy [eV]


fit residue
residue val(x) - f(x)
Energy [eV]

Construct a pedestal shape

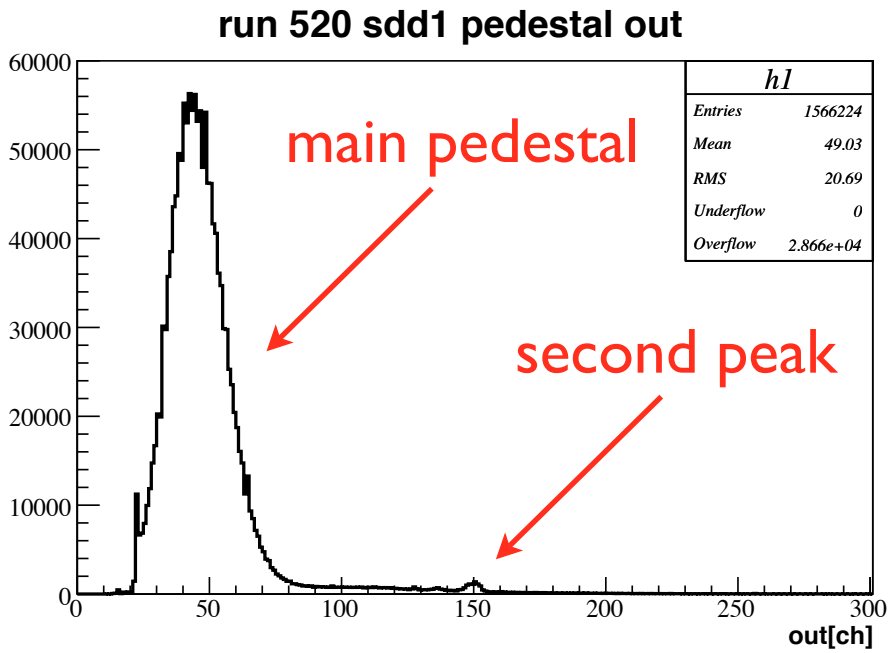
- second peak fit ...

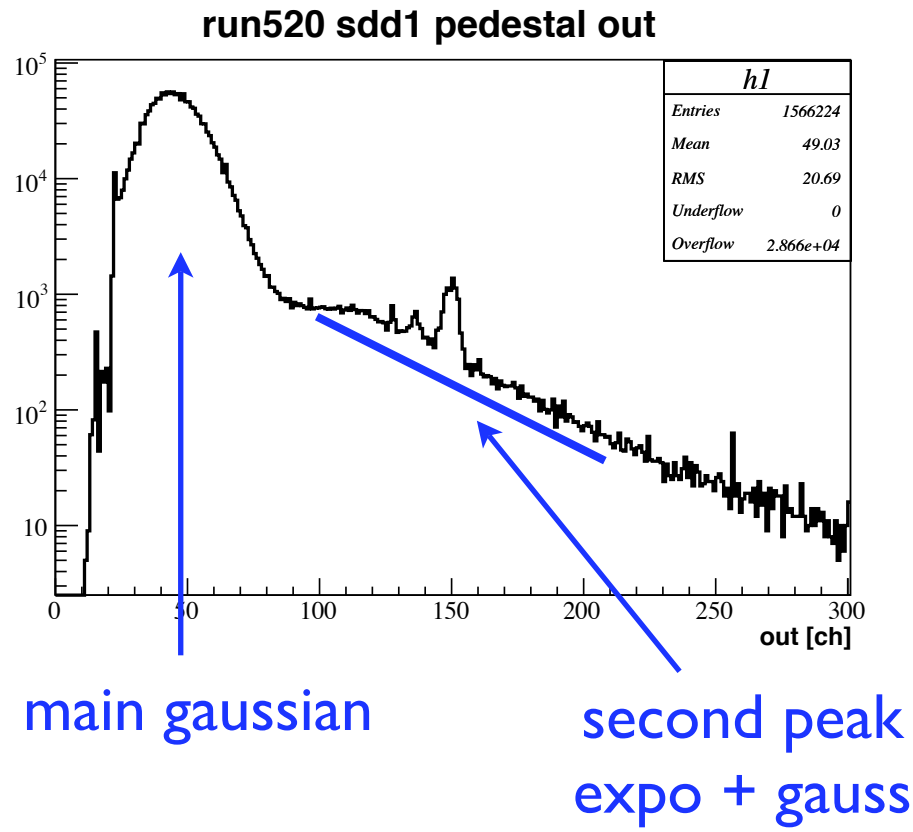
  • the fit function is a gaussian (height, mean and sigma) and an exponential (constant and slope)

- construct pedestal shape ...

  • a main gaussian and second peak;
  2 gaussians and an exponential

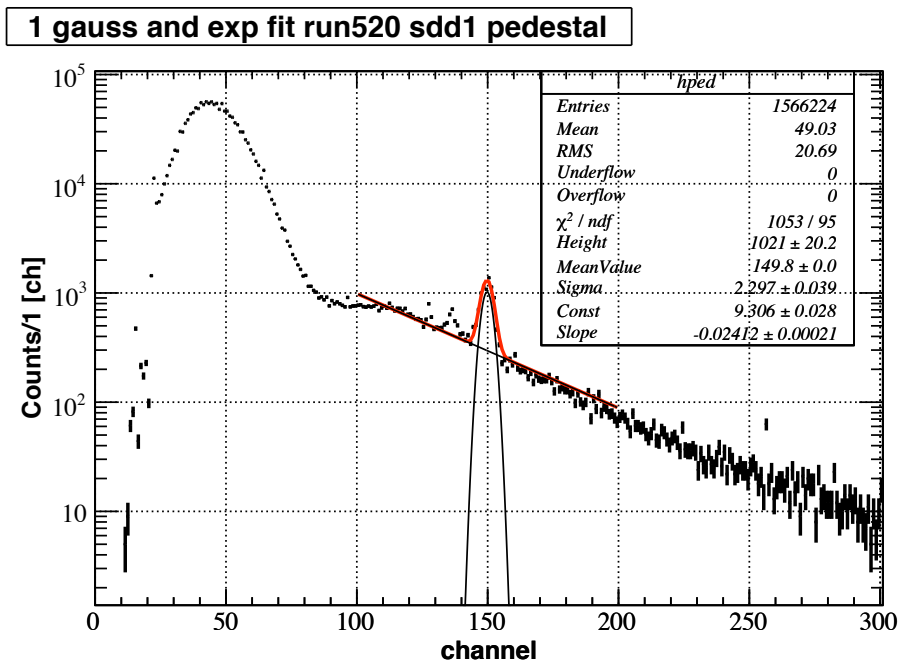
only for sdd1

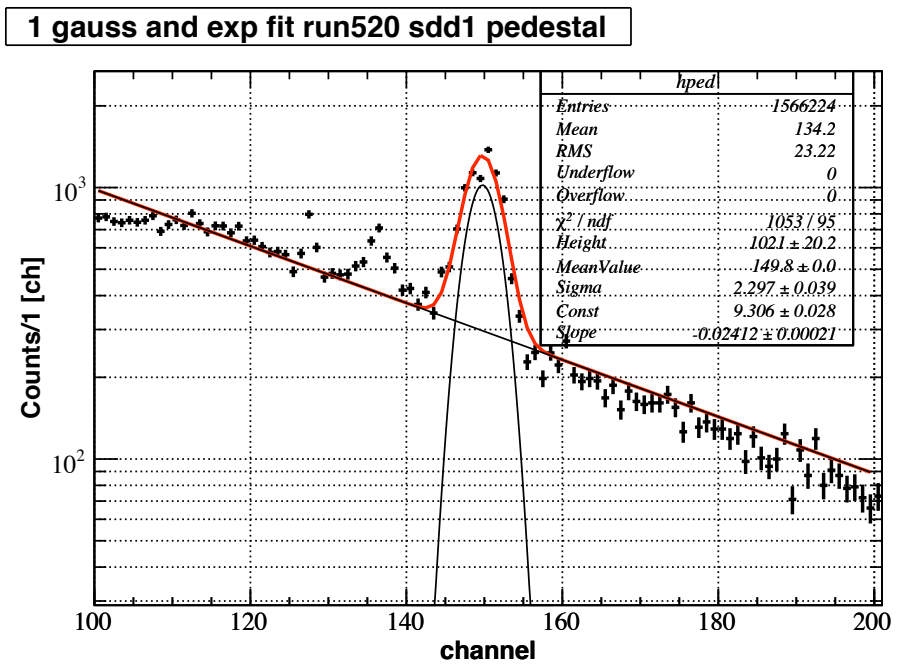




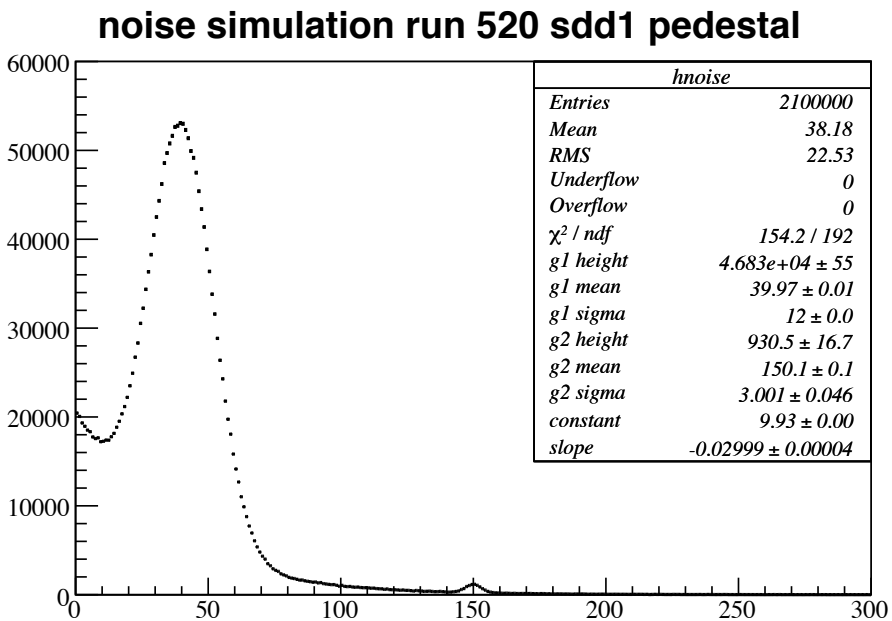
second peak fit

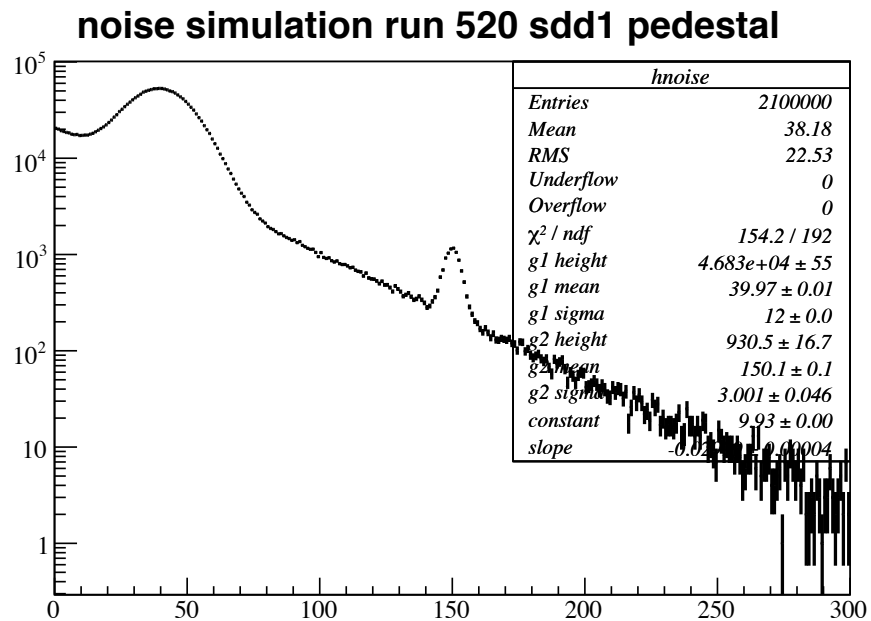
a gaussian + an exponential





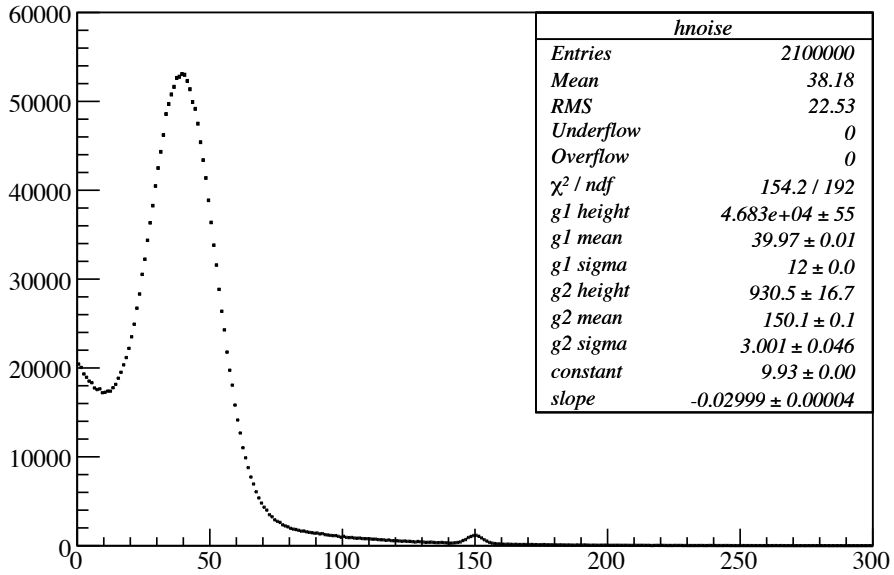
Construct pedestal shape



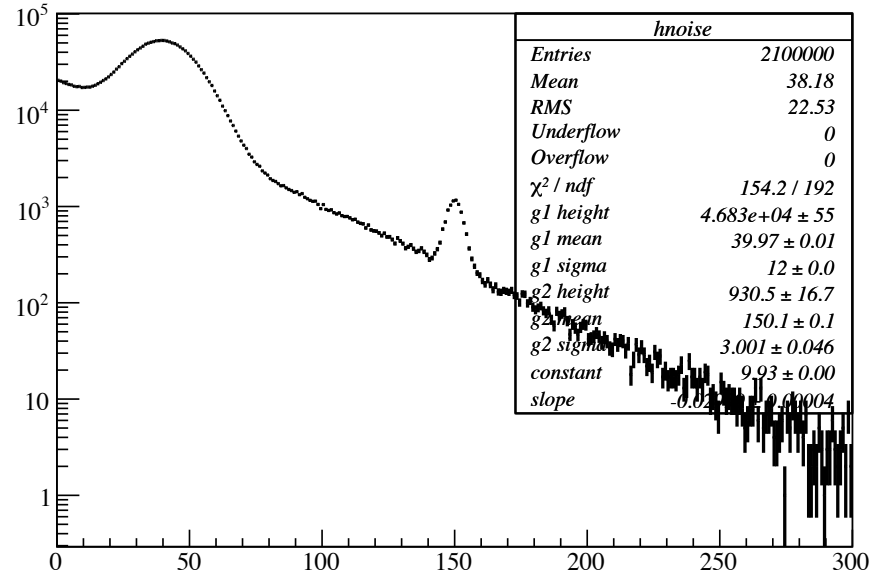


not realize under 20 ch

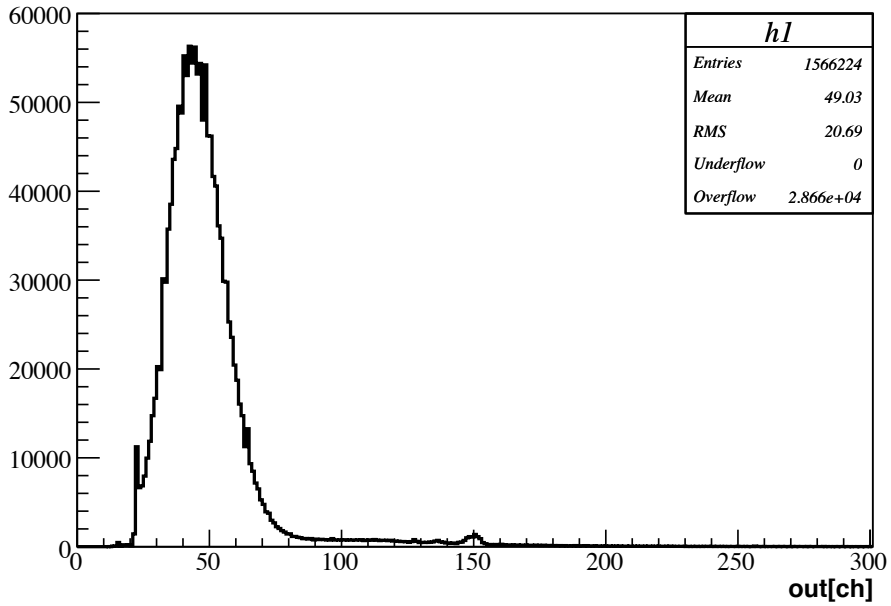
noise simulation run 520 sdd1 pedestal



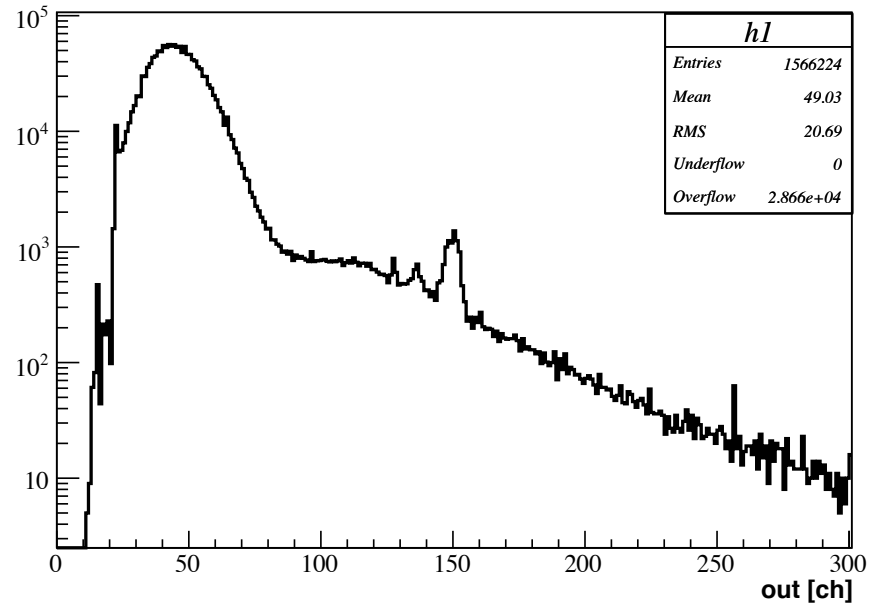
noise simulation run 520 sdd1 pedestal



run 520 sdd1 pedestal out



run520 sdd1 pedestal out



Simulation

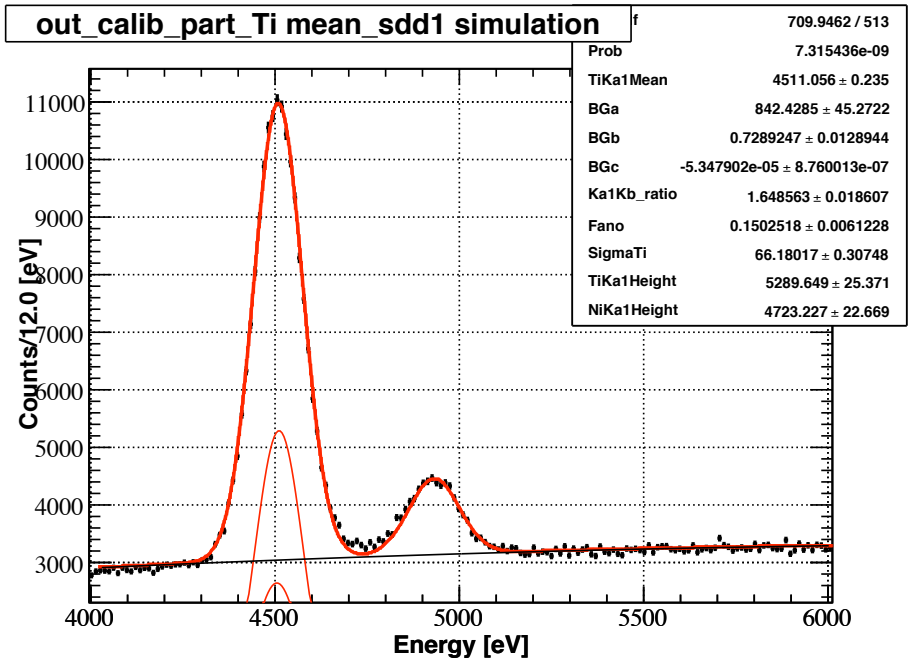
- histogram fill ...

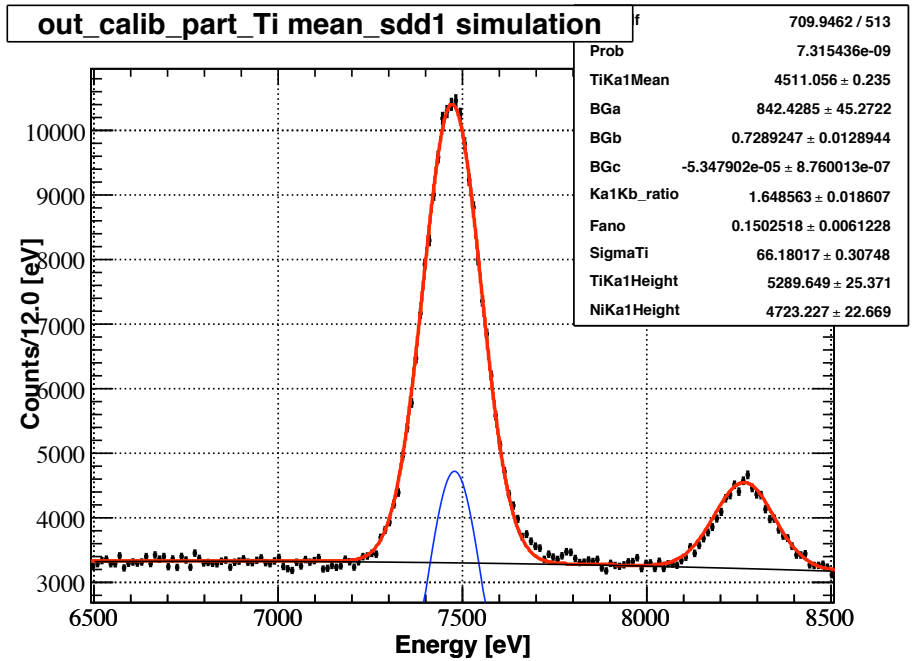
  -> randomize the pedestal value in consideration of the weight on the pedestal function, and if the value is within 3 sigma of main pedestal gaussian, a fit function value is filled, if not, the pedestal value is added on it.

- that means ...

  -> because the fit function doesn't have the excess events, if a filled histogram has some excess, we can say it is cause by not gaussian part pedestal.

simulation


out_calib_part_Ti mean_sdd1 simulation
f 709.9462 / 513
Prob 7.315436e-09
TiKa1Mean 4511.056 ± 0.235
BGa 842.4285 ± 45.2722
BGb 0.7289247 ± 0.0128944
BGc -5.347902e-05 ± 8.760013e-07
Ka1Kb_ratio 1.648563 ± 0.018607
Fano 0.1502518 ± 0.0061228
SigmaTi 66.18017 ± 0.30748
TiKa1Height 5289.649 ± 25.371
NiKa1Height 4723.227 ± 22.669
Counts/12.0 [eV]
Energy [eV]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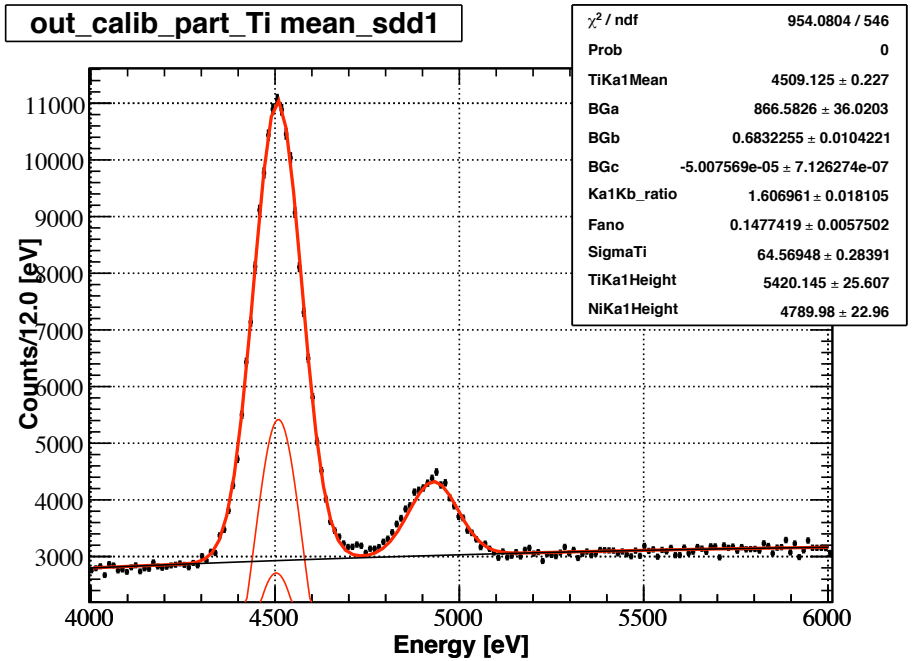
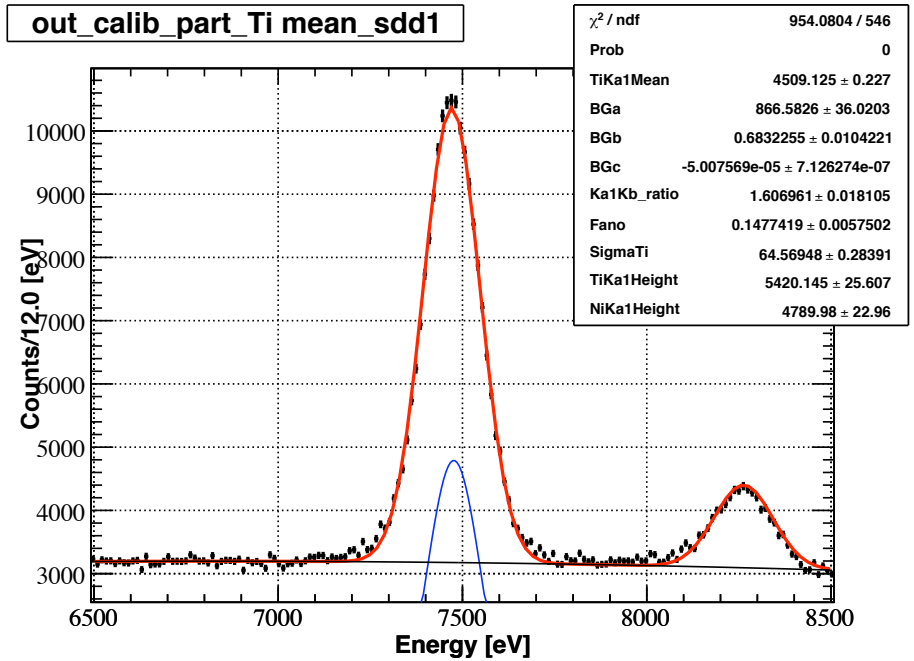
Counts/12.0 [eV]
Energy [eV]


out_calib_part_Ti mean_sdd1
χ² / ndf 954.0804 / 546
Prob 0
TiKa1Mean 4509.125 ± 0.227
BGa 866.5826 ± 36.0203
BGb 0.6832255 ± 0.0104221
BGc -5.007569e-05 ± 7.126274e-07
Ka1Kb_ratio 1.606961 ± 0.018105
Fano 0.1477419 ± 0.0057502
SigmaTi 64.56948 ± 0.28391
TiKa1Height 5420.145 ± 25.607
NiKa1Height 4789.98 ± 22.96
Counts/12.0 [eV]
Energy [eV]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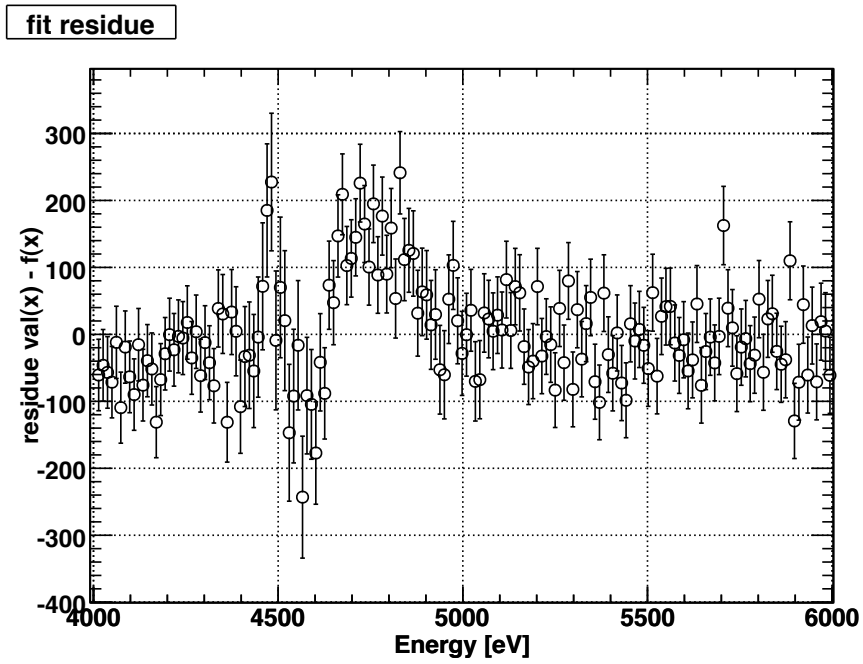
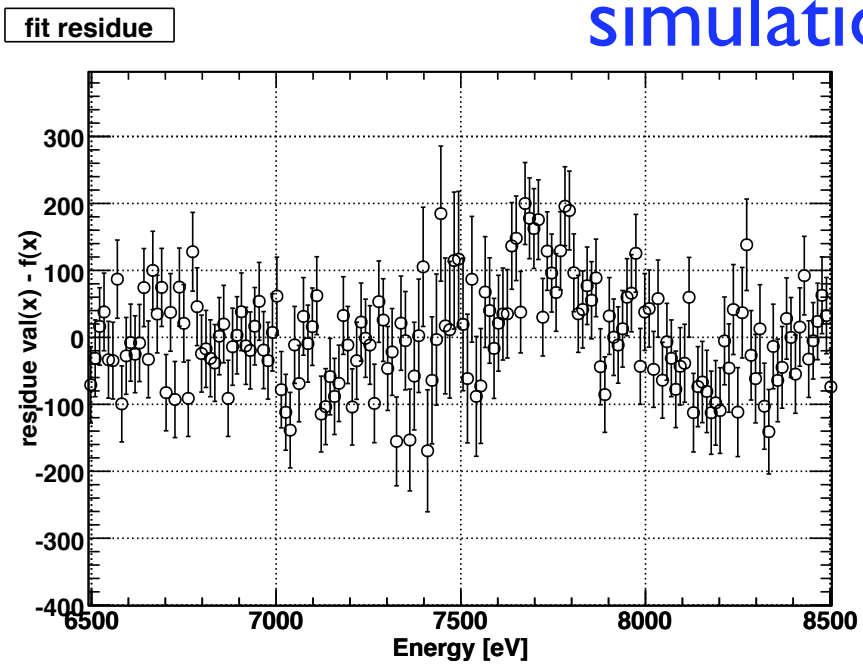
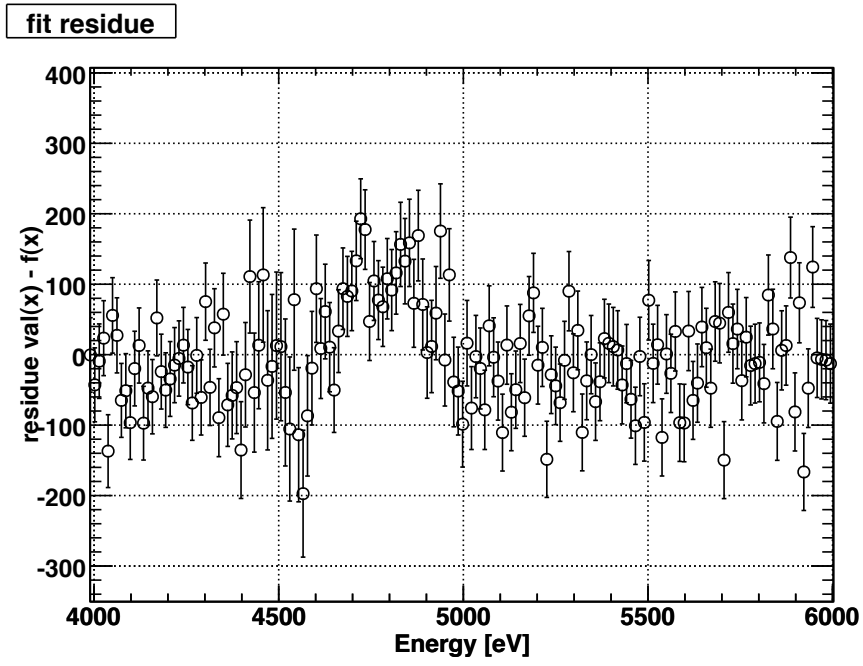
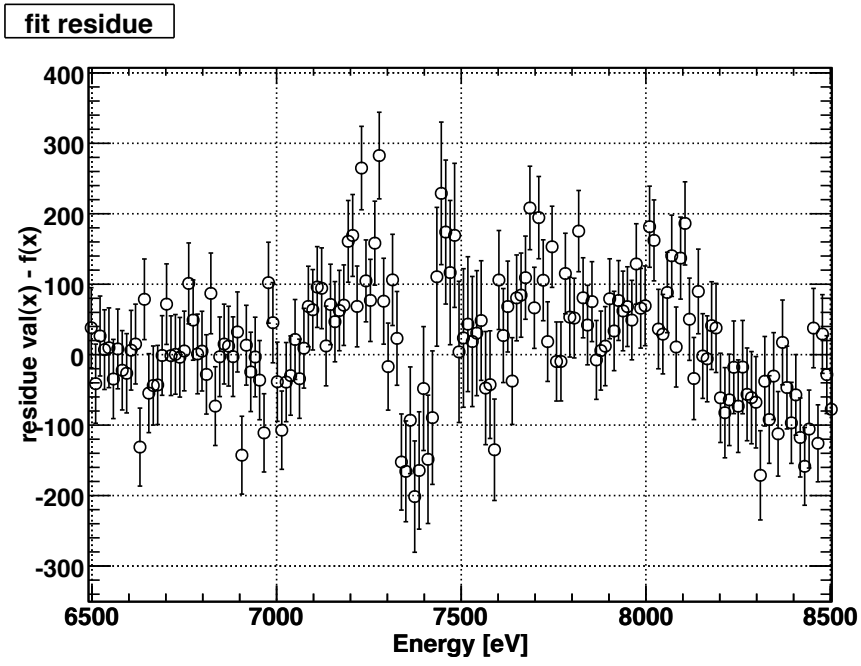
NiKa1Height 4789.98 ± 22.96
Counts/12.0 [eV]
Energy [eV]

simulation


fit residue
residue val(x) - f(x)
Energy [eV]
300
200
100
0
-100
-200
-300
-400
4000
4500
5000
5500
6000


fit residue
residue val(x) - f(x)
Energy [eV]
300
200
100
0
-100
-200
-300
-400
6500
7000
7500
8000
8500


fit residue
residue val(x) - f(x)
Energy [eV]
400
300
200
100
0
-100
-200
-300
4000
4500
5000
5500
6000


fit residue
residue val(x) - f(x)
Energy [eV]
400
300
200
100
0
-100
-200
-300
6500
7000
7500
8000
8500

The simulation shows the excess, but...

- we can't explain what the second peak is...

- there is no guarantee that a second peak really does pile-up with a signal. It's possible the peak is localized near some channels by ADC hardware problem. In fact a pulser spectrum has no pile-up event. (figures from Okada-san)