Kβ energy shifts (with FADC cut)

run 300 - 368
(except for run 301 and 354)

can't verifying because of the difference of the data size
(see Run Summary).
Maybe the FADC data taking was stopped at the
begging of the run 301 due to the accelerator trouble
(Linac down).

SDD 2,4 and 5 (runpart 20-24 of ver.5)

Cuts for calibration triggered events

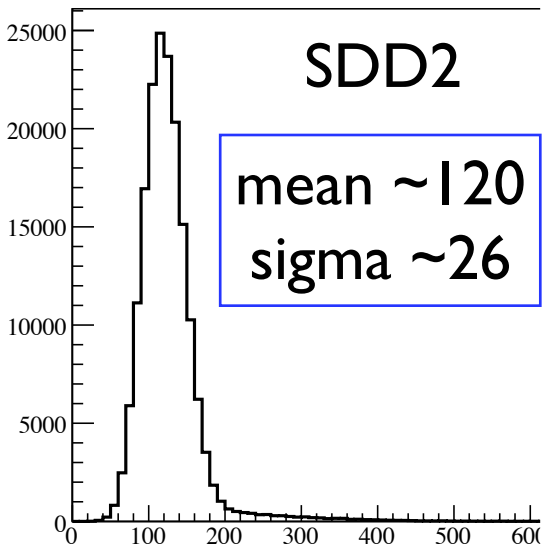
- TKO fout vs out correlation
- FADC main peak chisq cut <= 60k.
- FADC post slope cut <= -0.015.
- FADC pre pedestal cut <= mean+X*sigma

  (sigma is the standard deviation of the pedestal: SDD dependence)

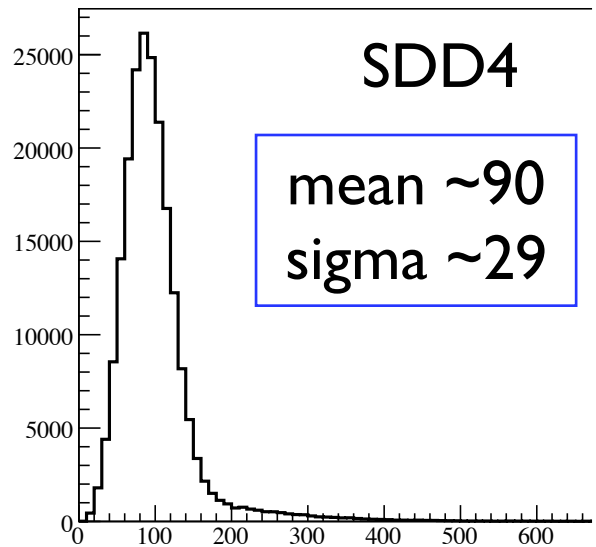
X=1.5,2.0,2.5,3.0 and 5.0

e.g. FADC pedestal: SDD2, 4 and 5

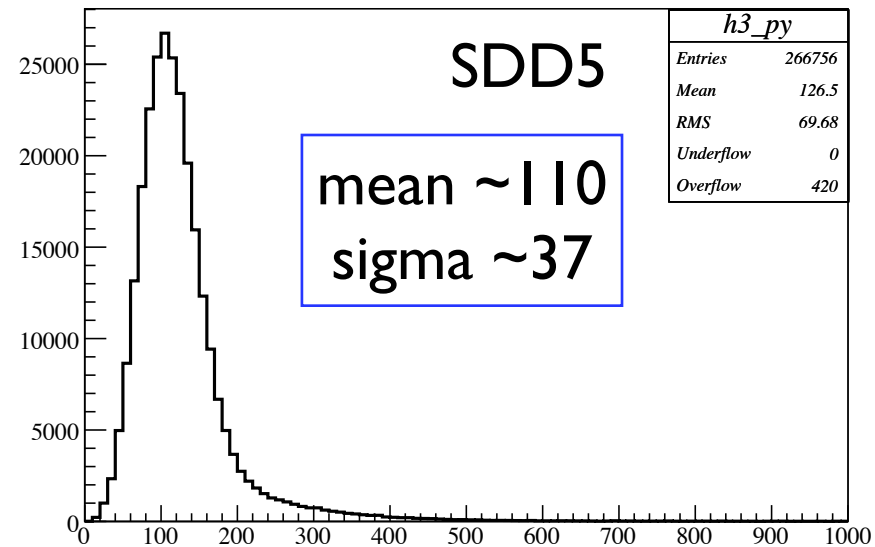
runpart-by-runpart fitting



fit region (50,170)



fit region (20,140)



fit region (40,170)

Fitting

global fit : Ti (Kα1,Kα2,Kβ) + Ni (Kα1,Kα2,Kβ) + background (pol2)

All parameters of Kβ peaks are free,
this means Kβ lines are parts of the background.

The energy and width of Kα2 are propagated from the fitted value of Kα1.

$$\sigma = \sqrt{(\text{noise})^2 + \text{Fano} * w * (\text{mean})}$$

fit parameters

from Gaussian mean

Fano : Fano factor (expected ~0.12 for Si)

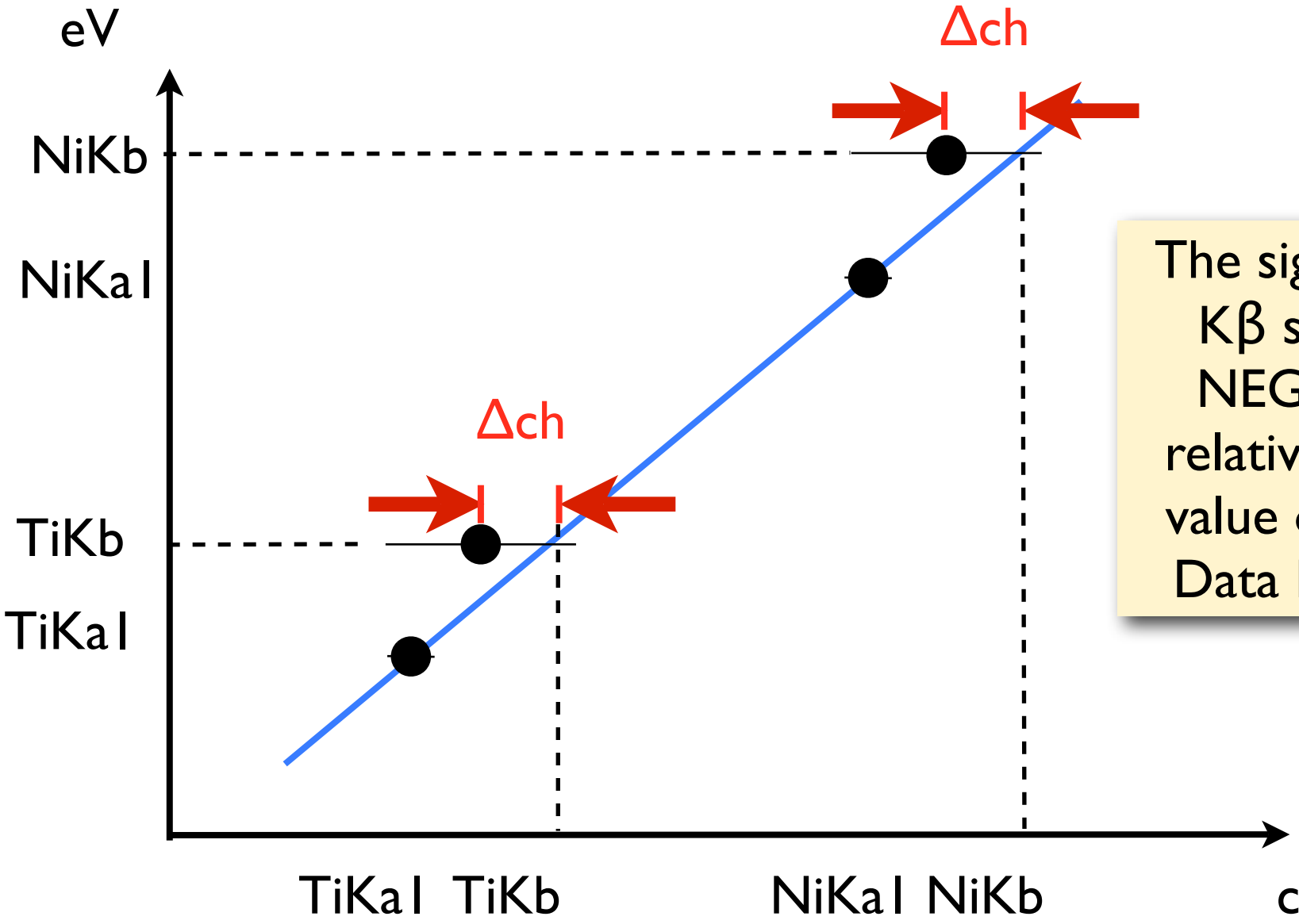
w [ch] (=3.81[eV] / e2c[eV/ch]): electron-hole pair creation energy

For example

```
FCN=215.512 FROM MINOS     STATUS=SUCCESSFUL   3311 CALLS        4230 TOTAL
                     EDM=5.55774e-06    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                   PARABOLIC         MINOS ERRORS
 NO.   NAME      VALUE            ERROR      NEGATIVE      POSITIVE
  1  BGa          4.31843e+02   3.38416e+01  -3.38338e+01   3.38455e+01
  2  BGb          2.98089e-01   3.06741e-02  -3.06781e-02   3.06659e-02
  3  BGc         -7.35229e-05   6.66293e-06  -6.66100e-06   6.66385e-06
  4  Const Noise [ch]   2.28334e+01   2.09589e+00  -2.18976e+00   2.02181e+00
  5  Fano         1.81862e-01   3.54706e-02  -3.55271e-02   3.55847e-02
  6  Ti Ka1Kb1 ratio   2.68946e-01   2.14016e-02  -2.09224e-02   2.19535e-02
  7  Ni Ka1Kb1 ratio   3.09714e-01   1.85444e-02  -1.82737e-02   1.88301e-02
  8  TiKa1 Height   8.20988e+02   1.37328e+01  -1.37005e+01   1.37679e+01
  9  NiKa1 Height   8.26282e+02   1.26599e+01  -1.26343e+01   1.26873e+01
 10  TiKa1 Mean [ch]   1.57489e+03   5.00018e-01  -5.00557e-01   4.99666e-01
 11  NiKa1 Mean [ch]   2.58055e+03   5.11395e-01  -5.11166e-01   5.11687e-01
 12  TiKb1 Mean [ch]   1.71532e+03   2.77801e+00  -2.84325e+00   2.75279e+00
 13  NiKb1 Mean [ch]   2.83998e+03   2.08815e+00  -2.11535e+00   2.07416e+00
 14  TiKb1 Sigma [ch]   3.46906e+01   3.20208e+00  -3.05300e+00   3.38030e+00
 15  NiKb1 Sigma [ch]   3.46568e+01   2.45142e+00  -2.35789e+00   2.55429e+00
e2c[eV/ch]    =  2.951 +-  0.002
icp[eV]       = -136.080 +-  3.620
TiKa1 Mean    = 1574.892 +-  0.500
NiKa1 Mean    = 2580.546 +-  0.511
TiKb1 Mean    = 1715.319 +-  2.798
NiKb1 Mean    = 2839.976 +-  2.095
noise [ch]    = 22.833 +-  2.106
Fano          =  0.182 +-  0.036
Chisq/ndf     = 215.512/223
```

not included the acceptance correction

Kα peaks are fitted and the blue line is drawn.
(This time Kβ peaks are not used to fit)



The sign of the Kβ shifts is NEGATIVE relative to the value of X-ray Data Booklet

Summary

The pedestal cuts contribute to reduce the shifts especially for SDD5 (the noisiest SDD) but can't solve the problem perfectly.

⇨ The shift of Ni Kβ is larger than that of Ti Kβ.
(the shift of Ti seems to be disappeared ?)

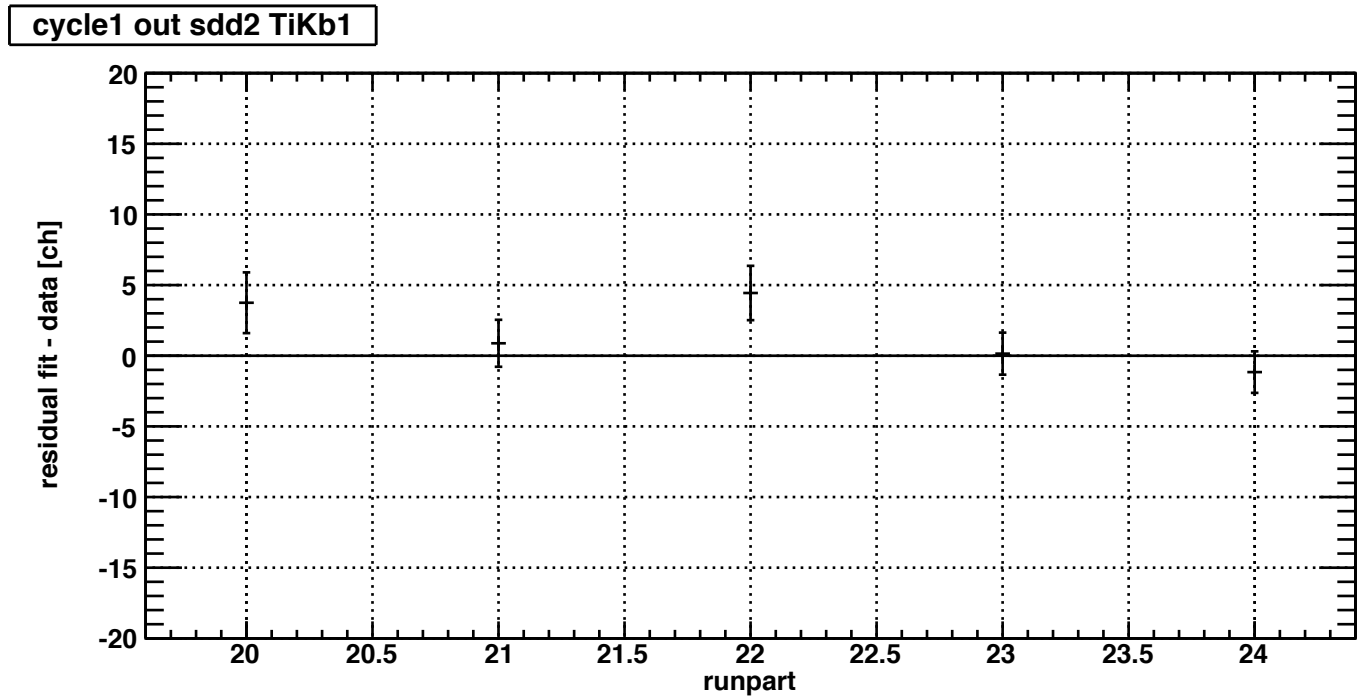
⇨ Is this caused by the different configuration of *3d* electron ?
or ADC non-linearity ?

This paper is interesting and useful to relate the Kα/Kβ ratio
and the ionic configuration.
T.K. Li and R.L. Watson, Phys. Rev. A **9** 1574 (1974)

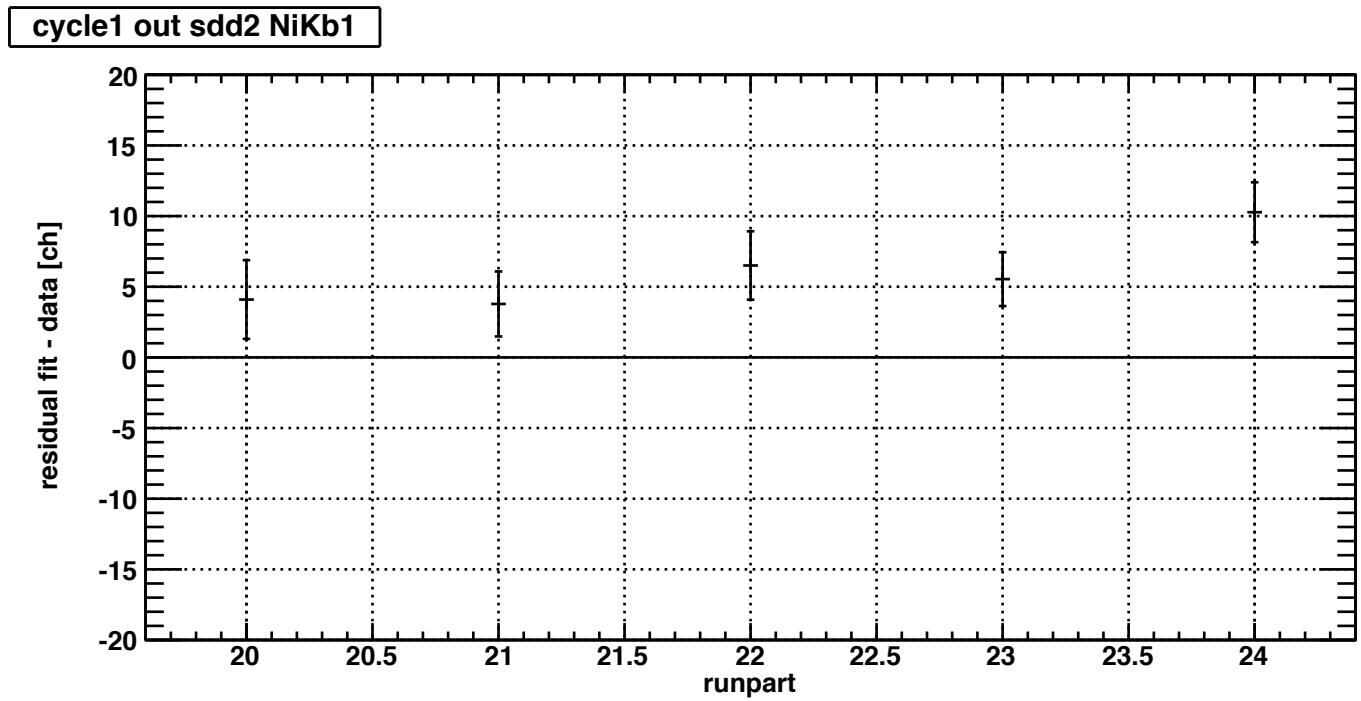
- FADC pre pedestal cut <= mean+5.0*sigma
  (sigma is the standard deviation of the pedestal: SDD dependence)

5.0σ cut

Δ ch

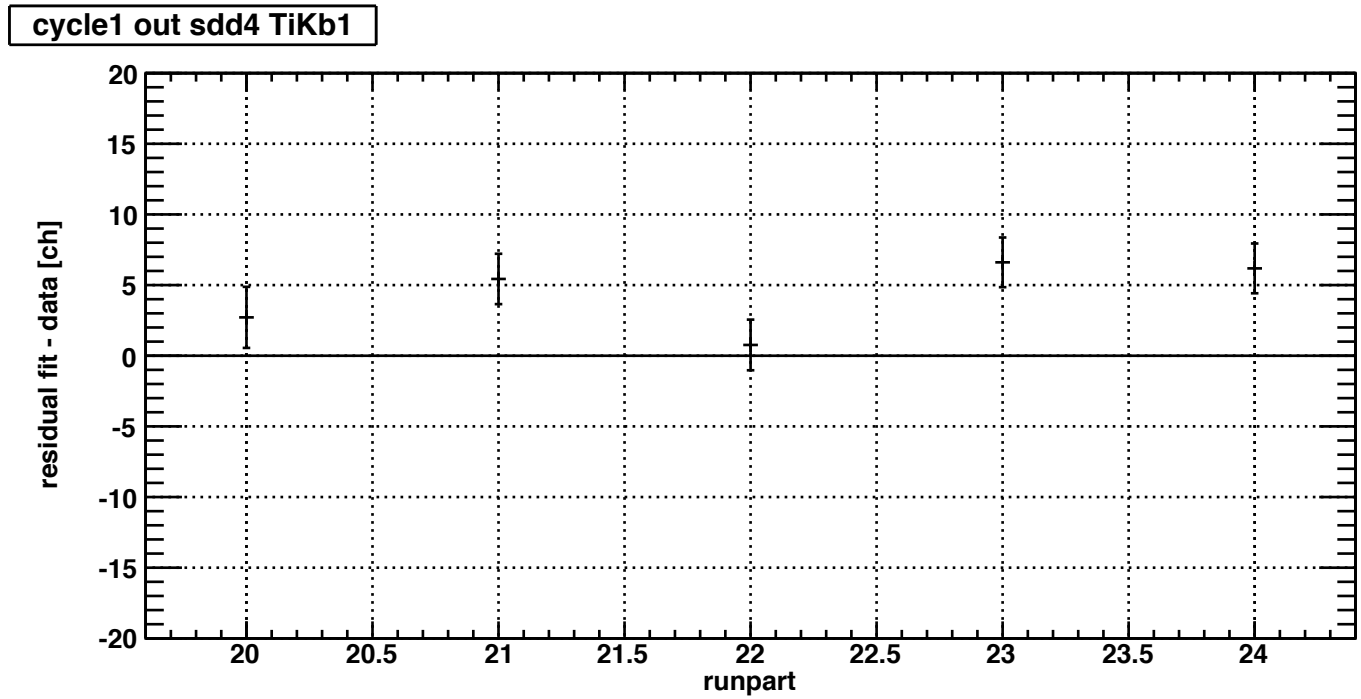


Δ ch

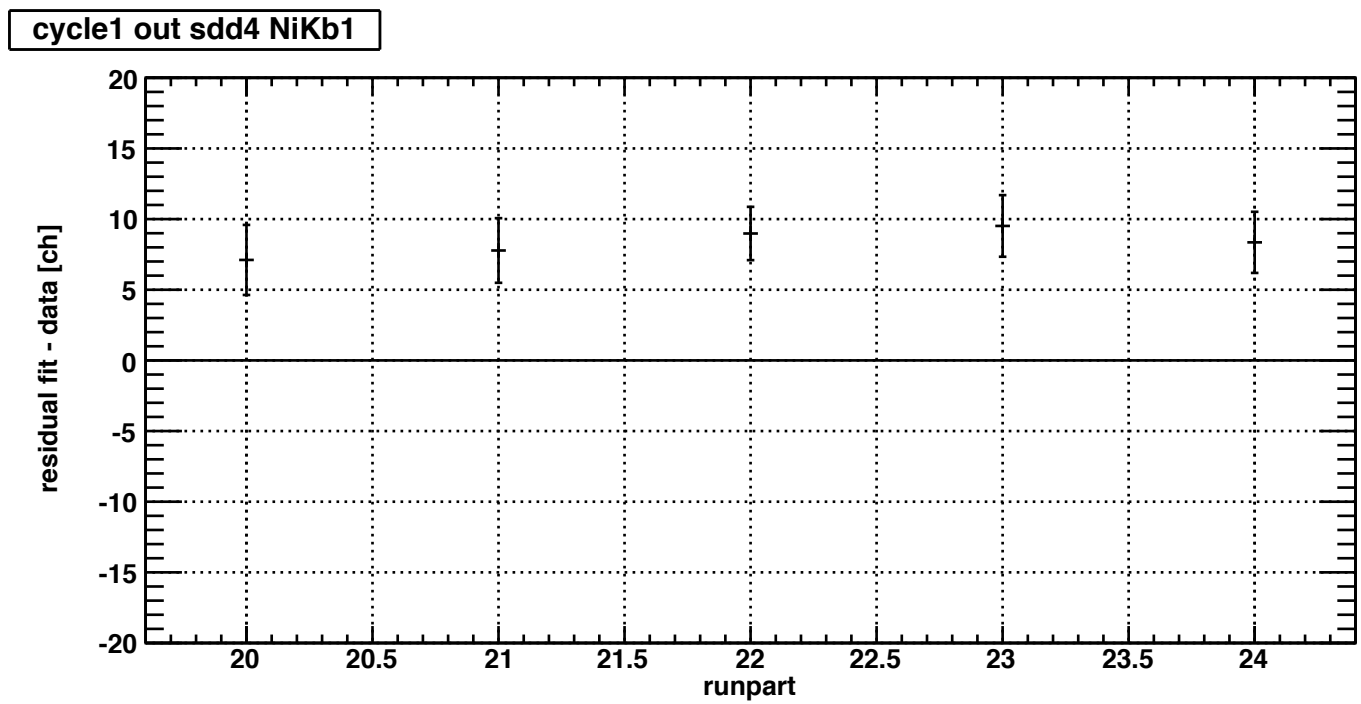


5.0σ cut

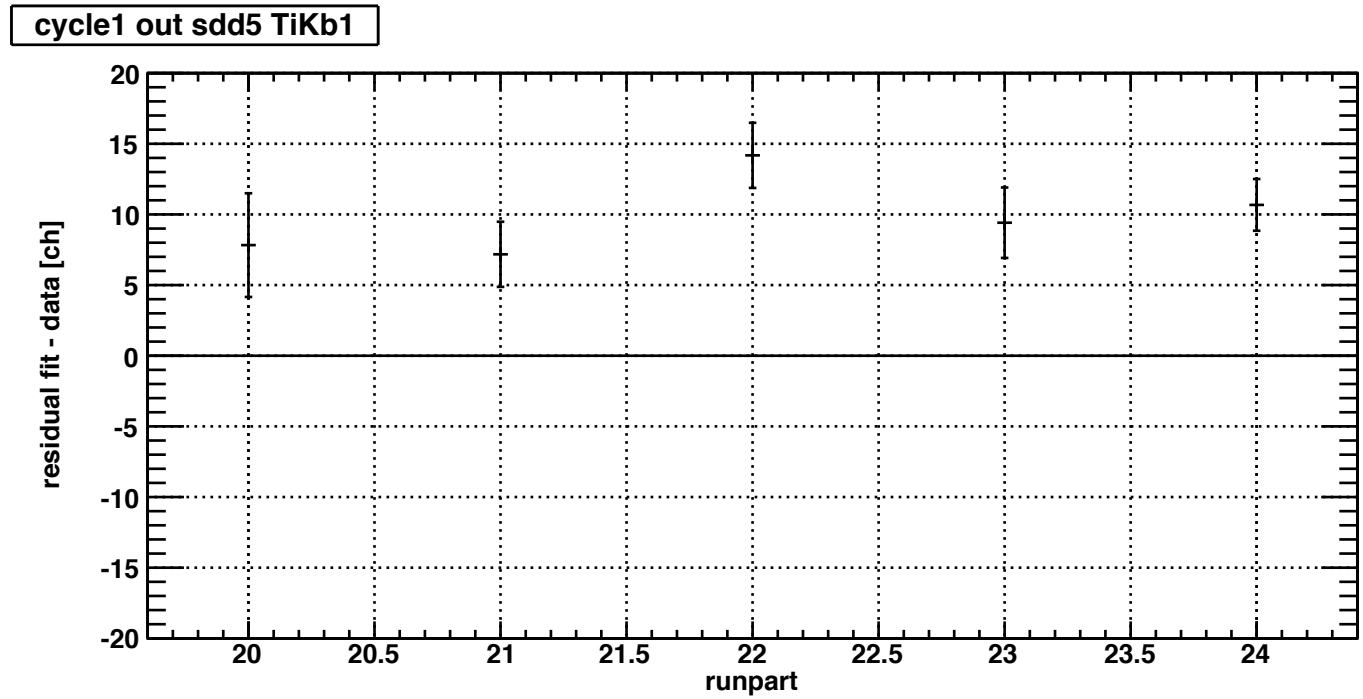
Δ ch

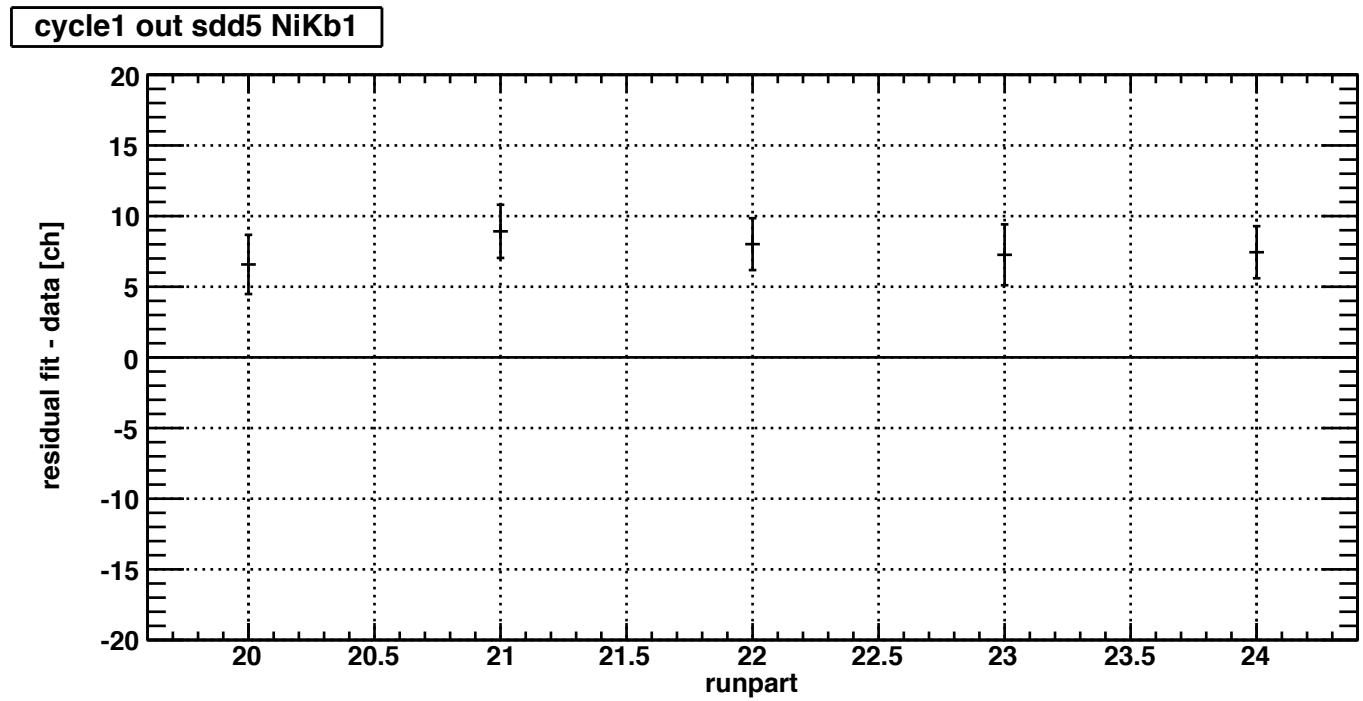


Δ ch



5.0σ cut

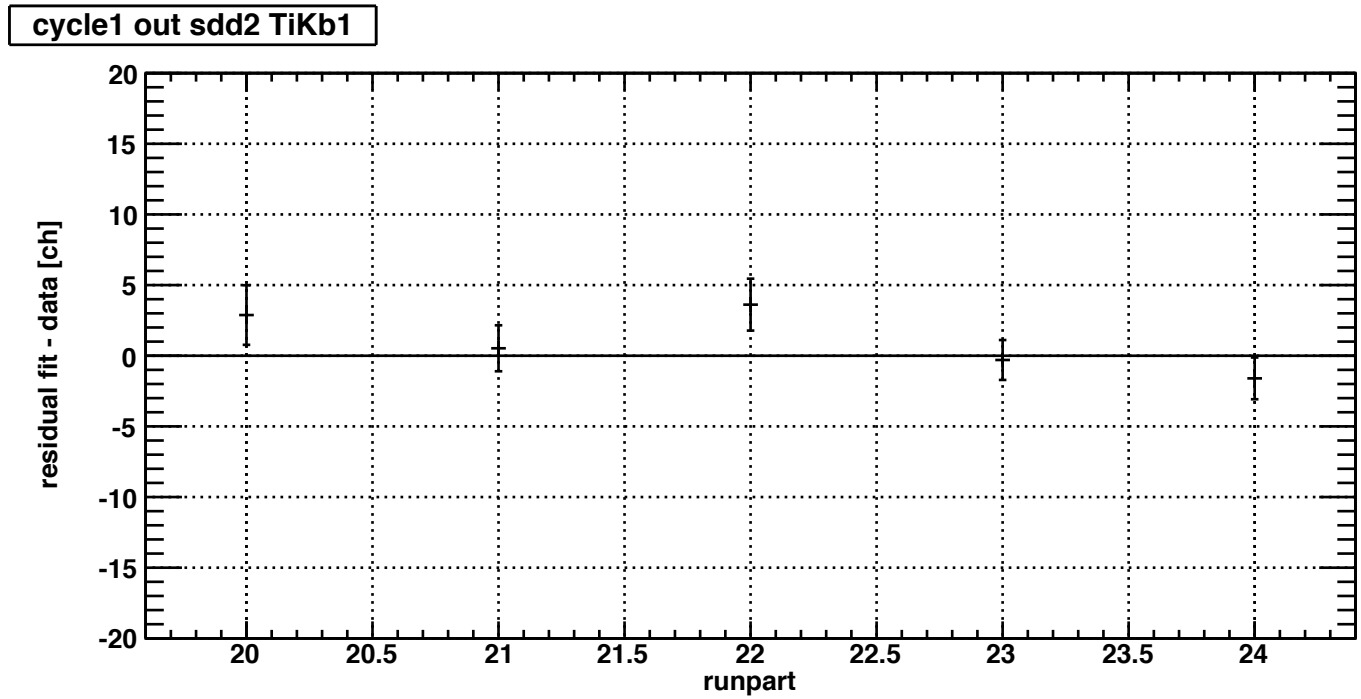

cycle1 out sdd5 TiKb1
residual fit - data [ch]
runpart
Δ ch
20
15
10
5
0
-5
-10
-15
-20
20
20.5
21
21.5
22
22.5
23
23.5
24


cycle1 out sdd5 NiKb1
residual fit - data [ch]
runpart
Δ ch
20
15
10
5
0
-5
-10
-15
-20
20
20.5
21
21.5
22
22.5
23
23.5
24

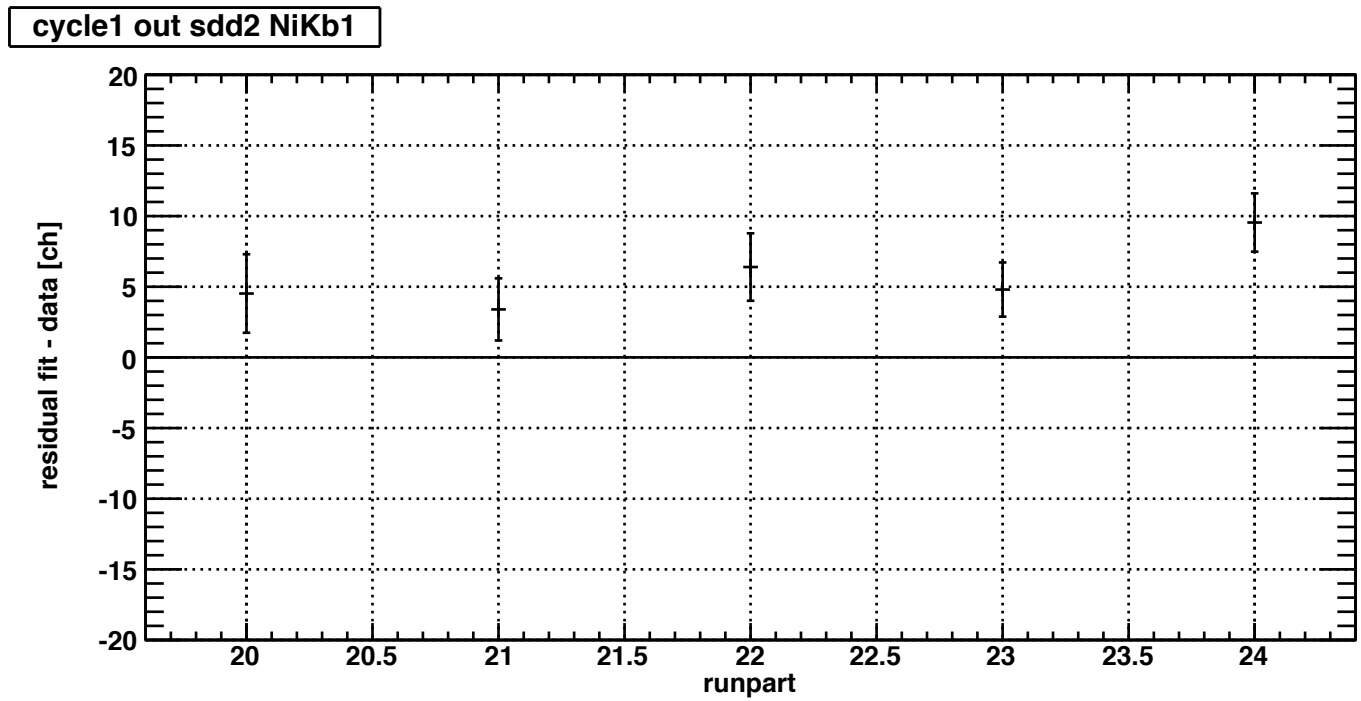
- FADC pre pedestal cut <= mean+3.0*sigma
  (sigma is the standard deviation of the pedestal: SDD dependence)

3σ cut

Δ ch

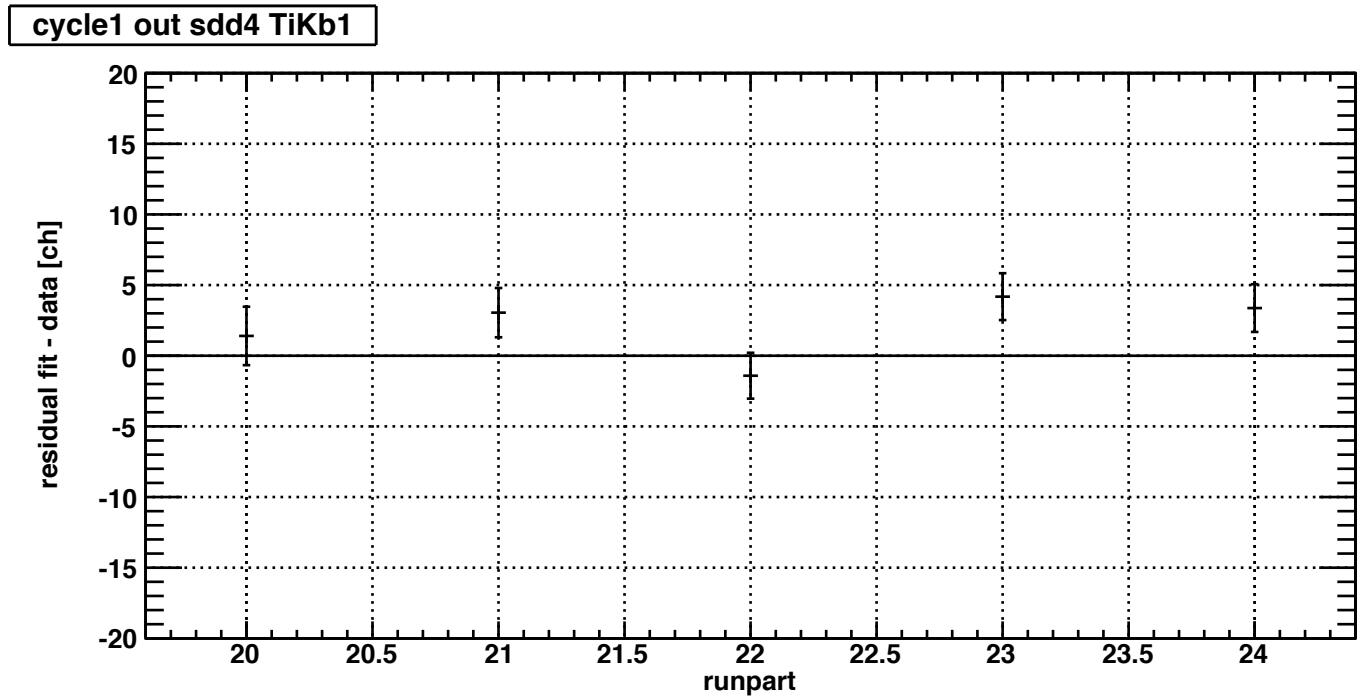


Δ ch

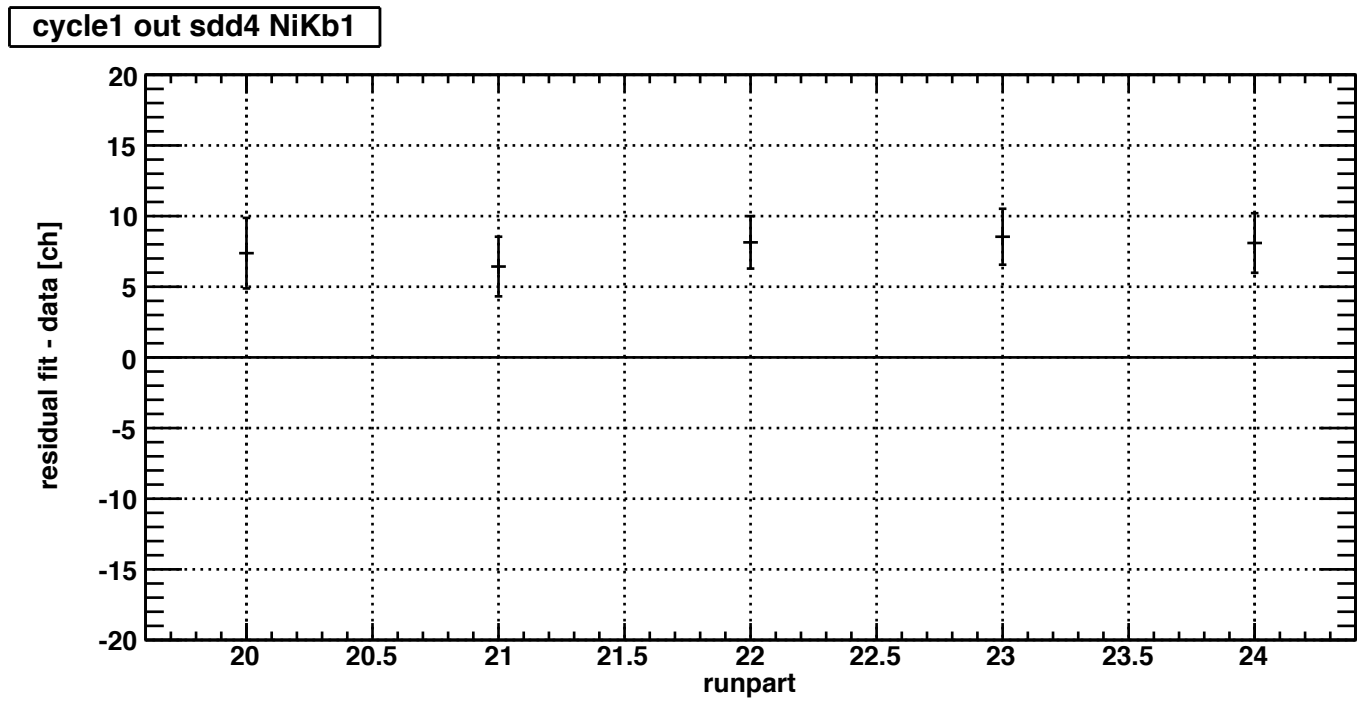


3σ cut

Δ ch

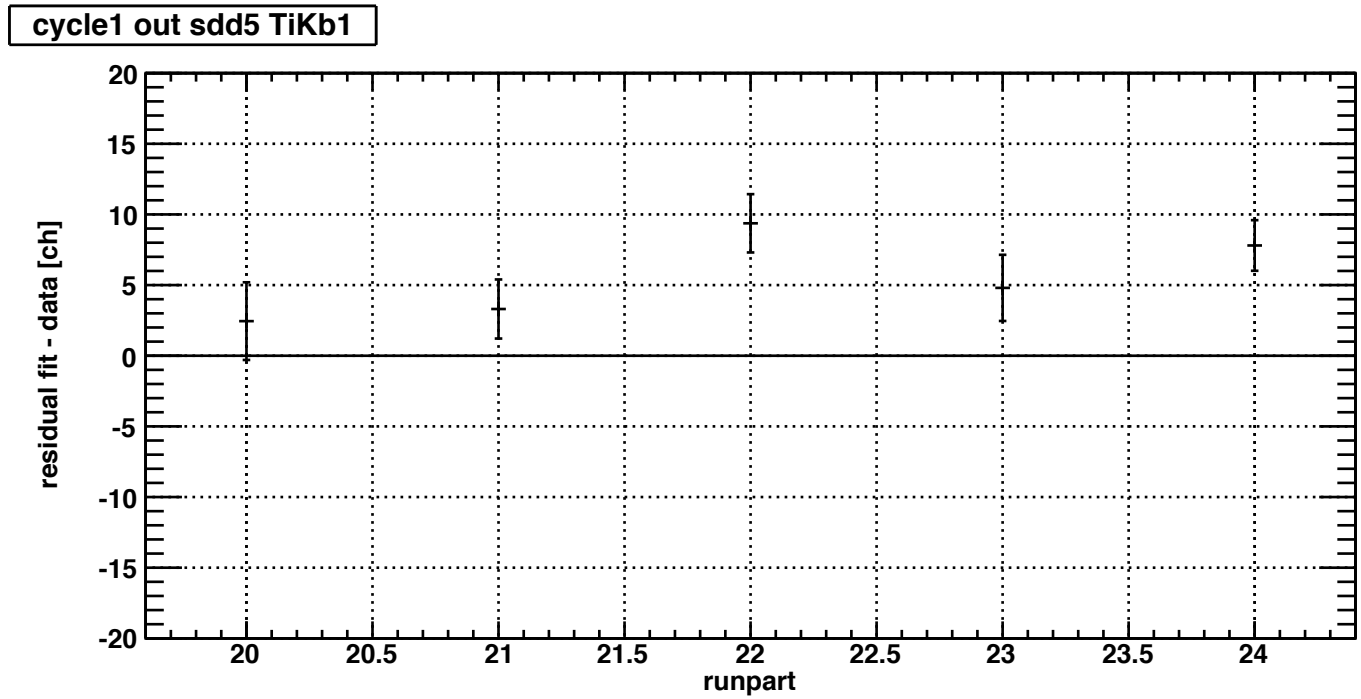


Δ ch

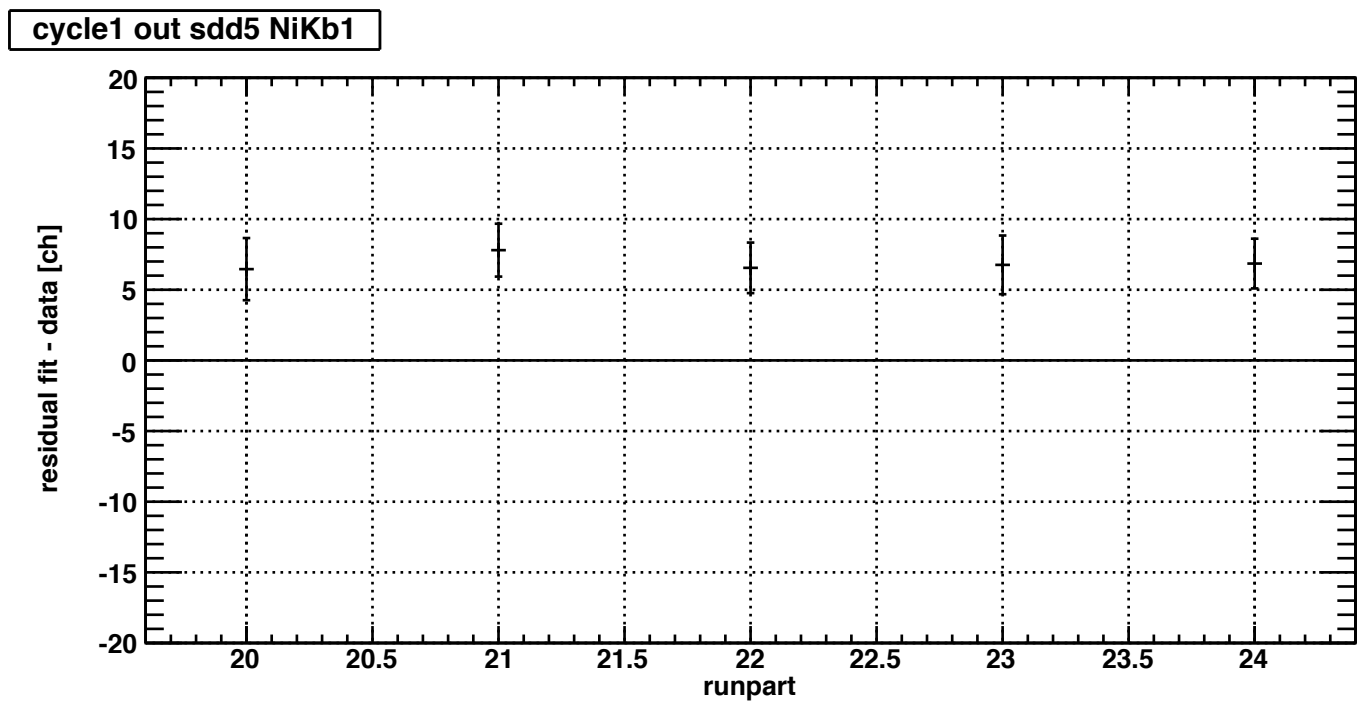


3σ cut

Δ ch



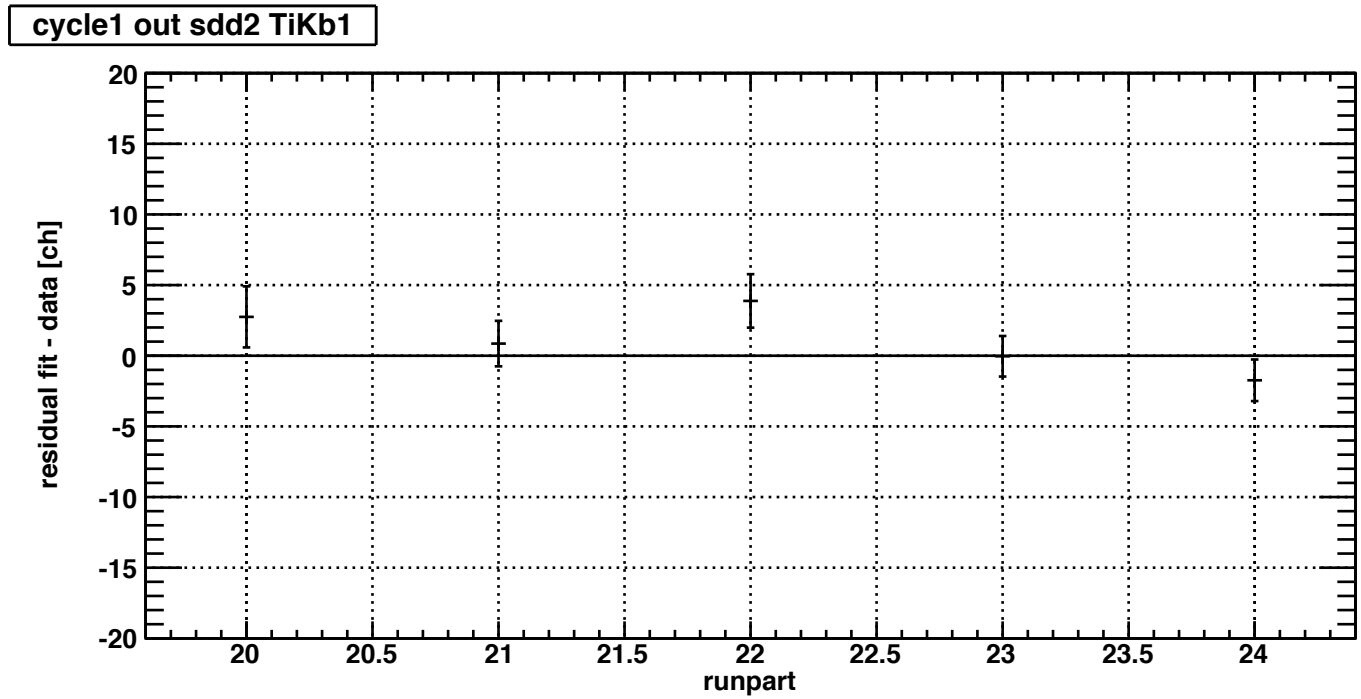
Δ ch



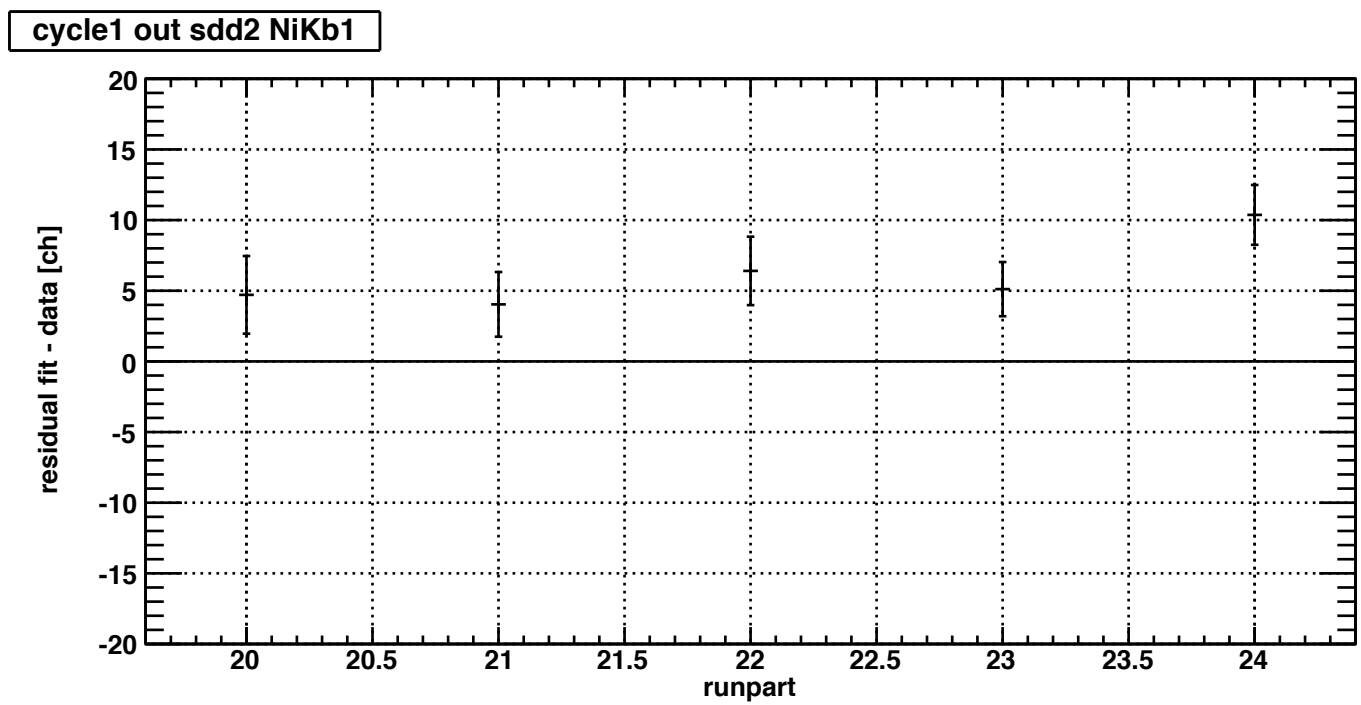
- FADC pre pedestal cut <= mean+2.5*sigma
  (sigma is the standard deviation of the pedestal: SDD dependence)

2.5σ cut

Δ ch

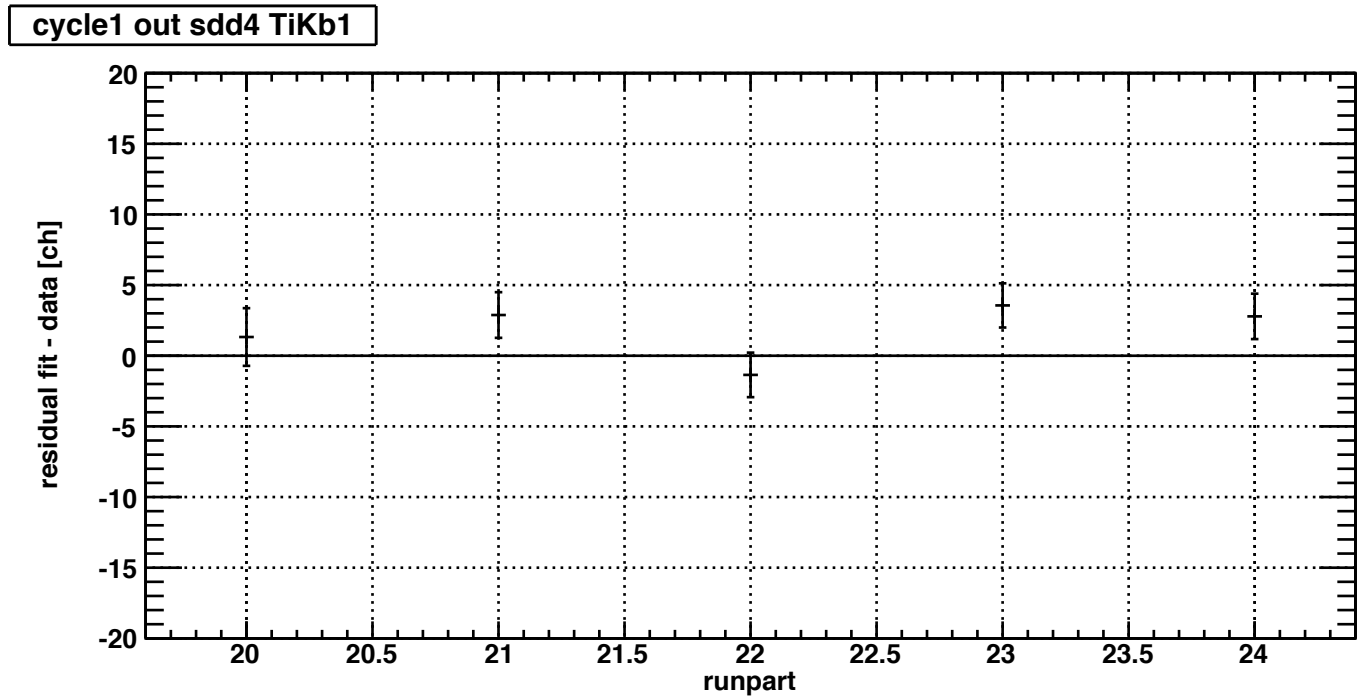


Δ ch

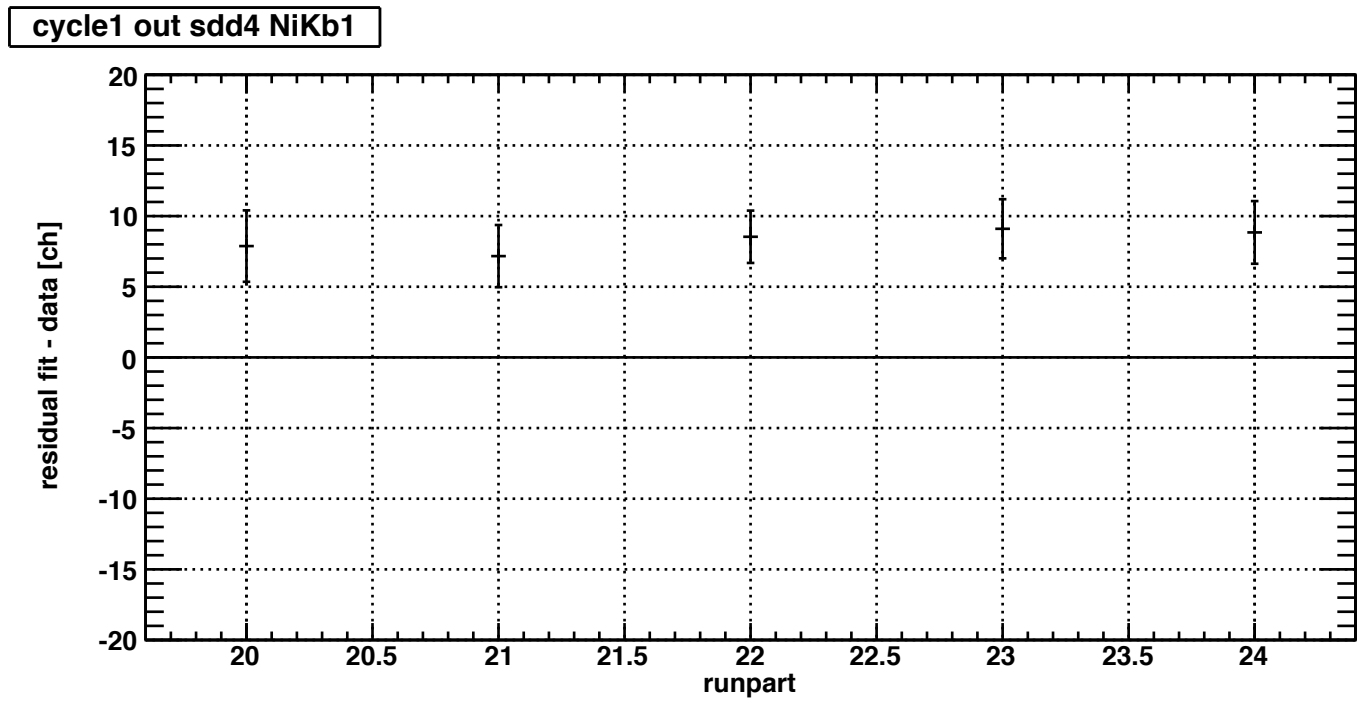


2.5σ cut

Δ ch

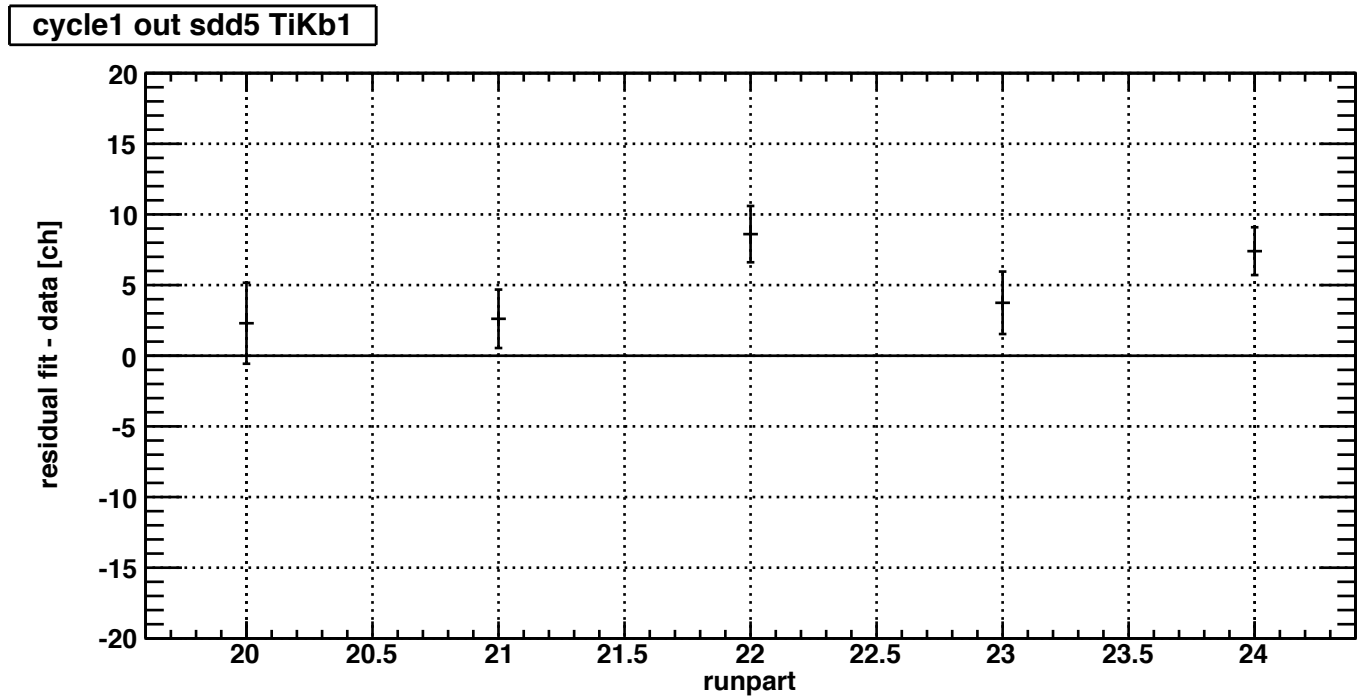


Δ ch

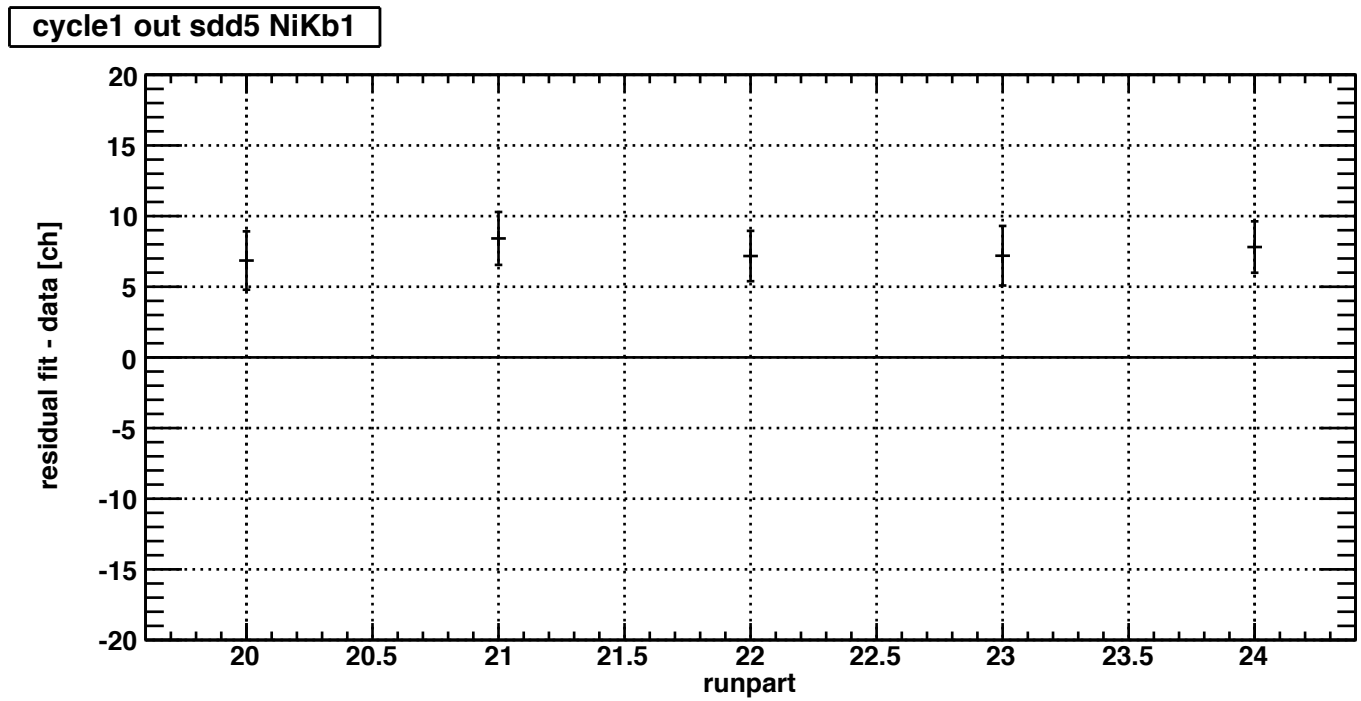


2.5σ cut

Δ ch



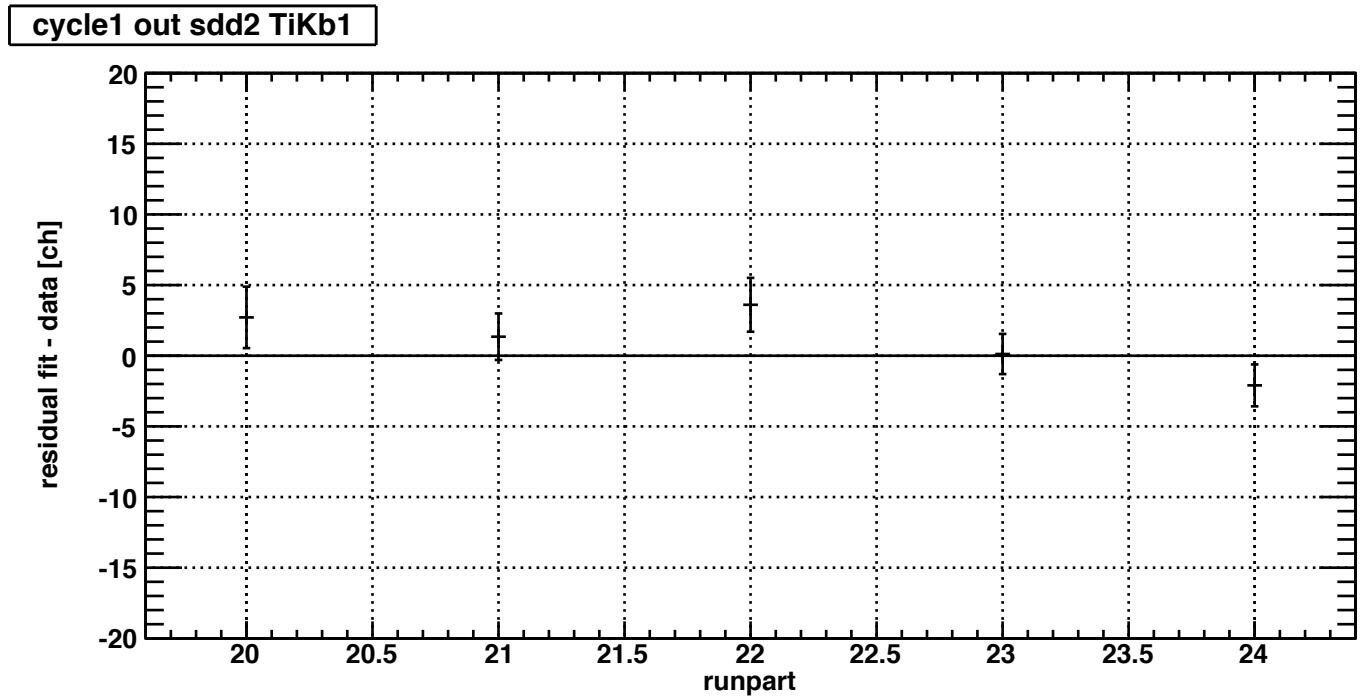
Δ ch



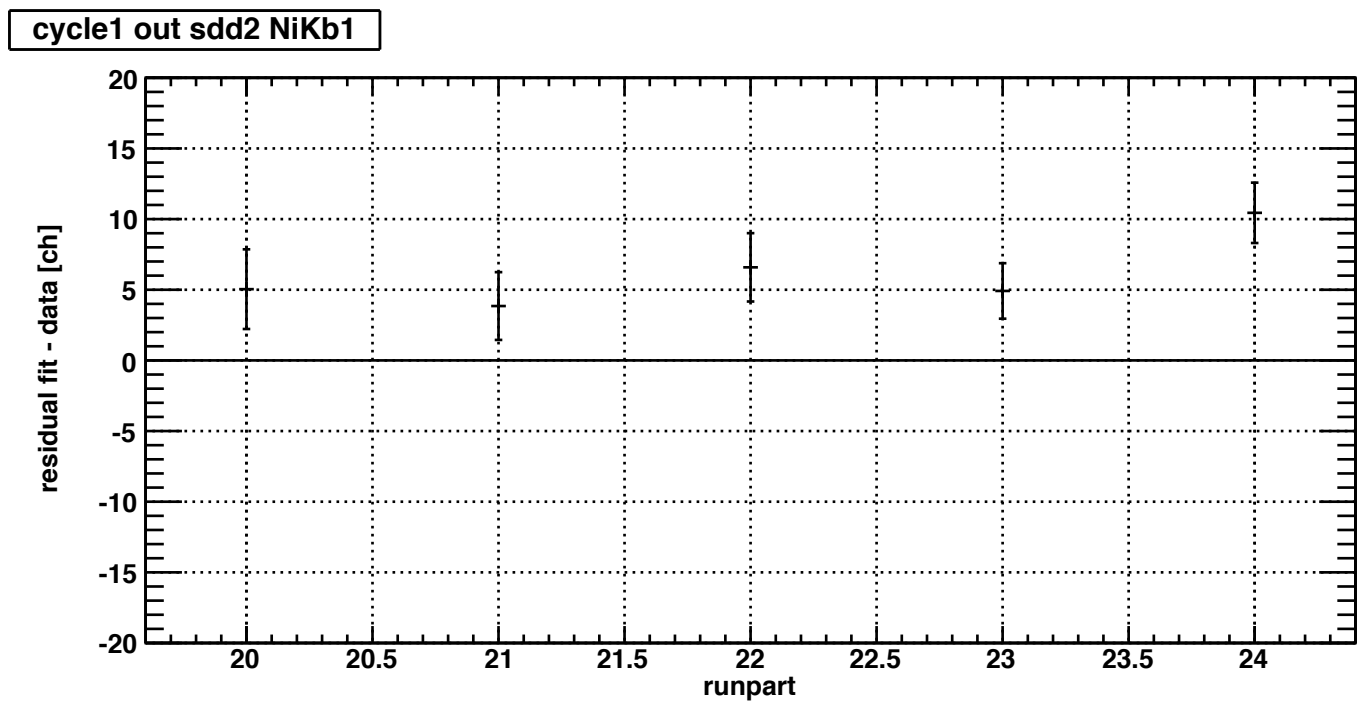
- FADC pre pedestal cut <= mean+2.0*sigma
  (sigma is the standard deviation of the pedestal: SDD dependence)

2.0σ cut

Δ ch

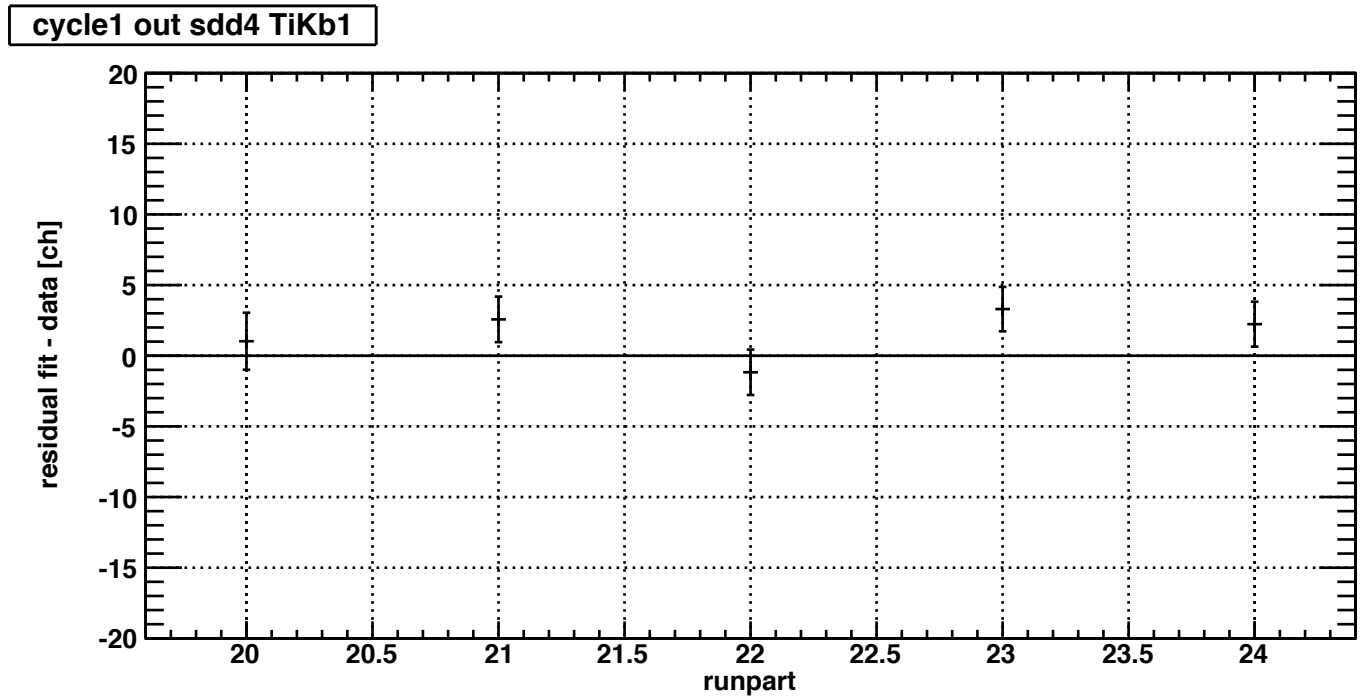


Δ ch

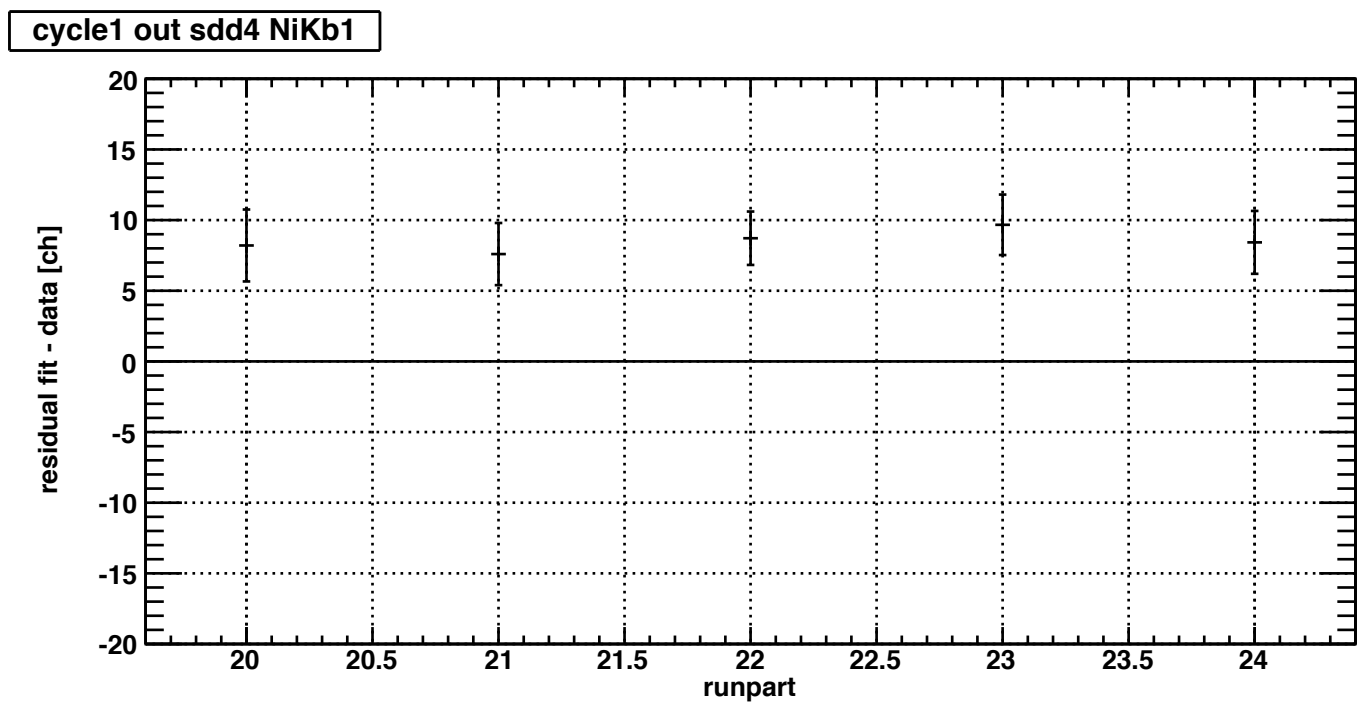


2.0σ cut

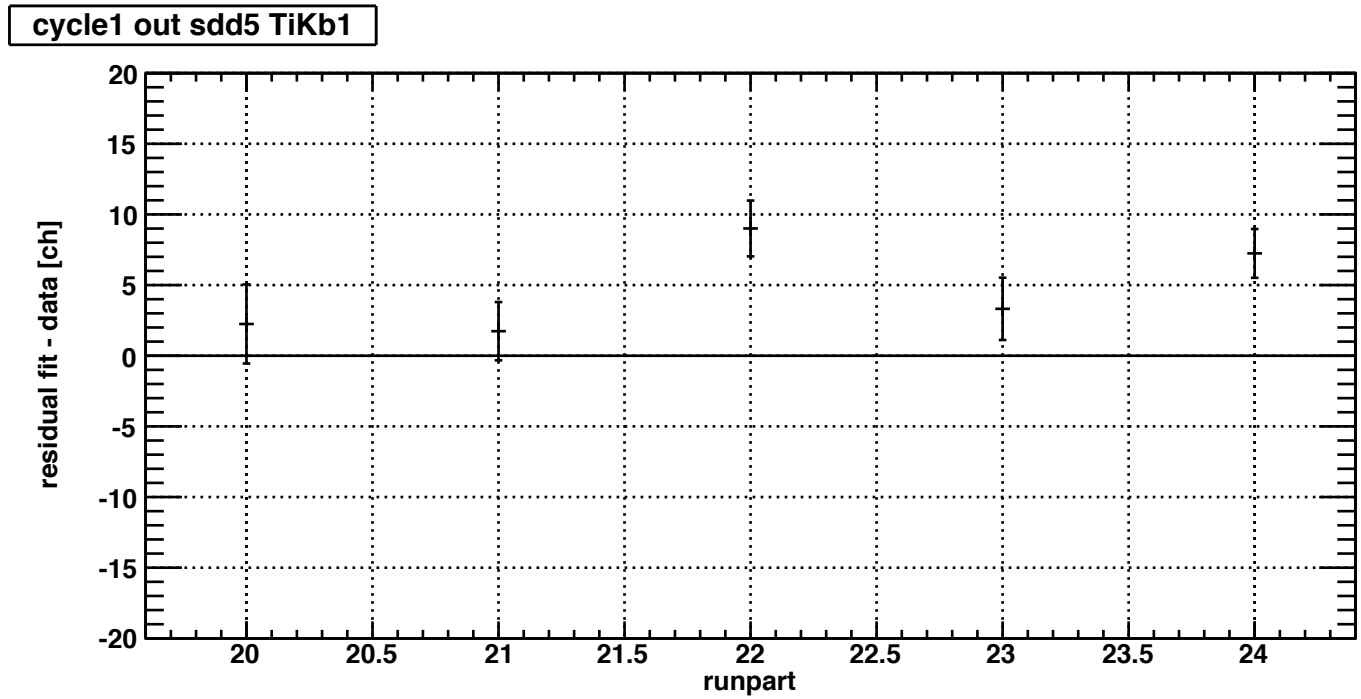
Δ ch

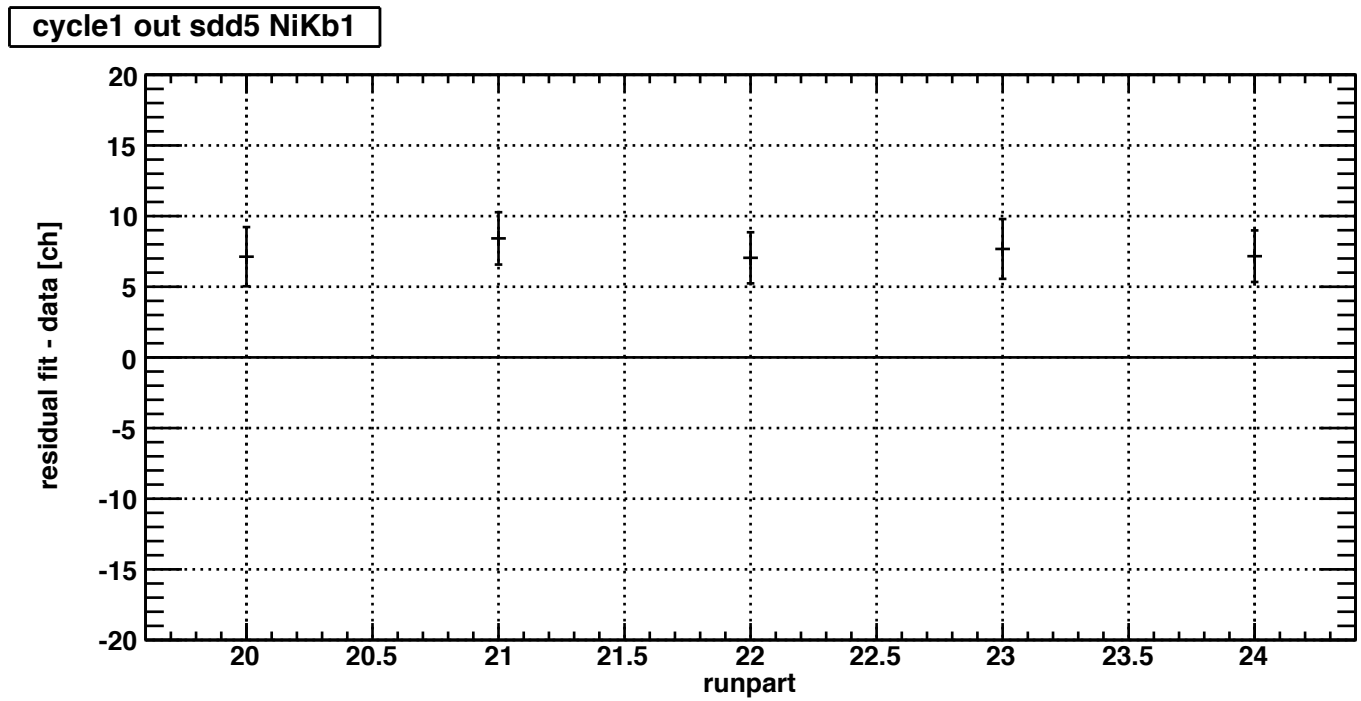


Δ ch



2.0σ cut

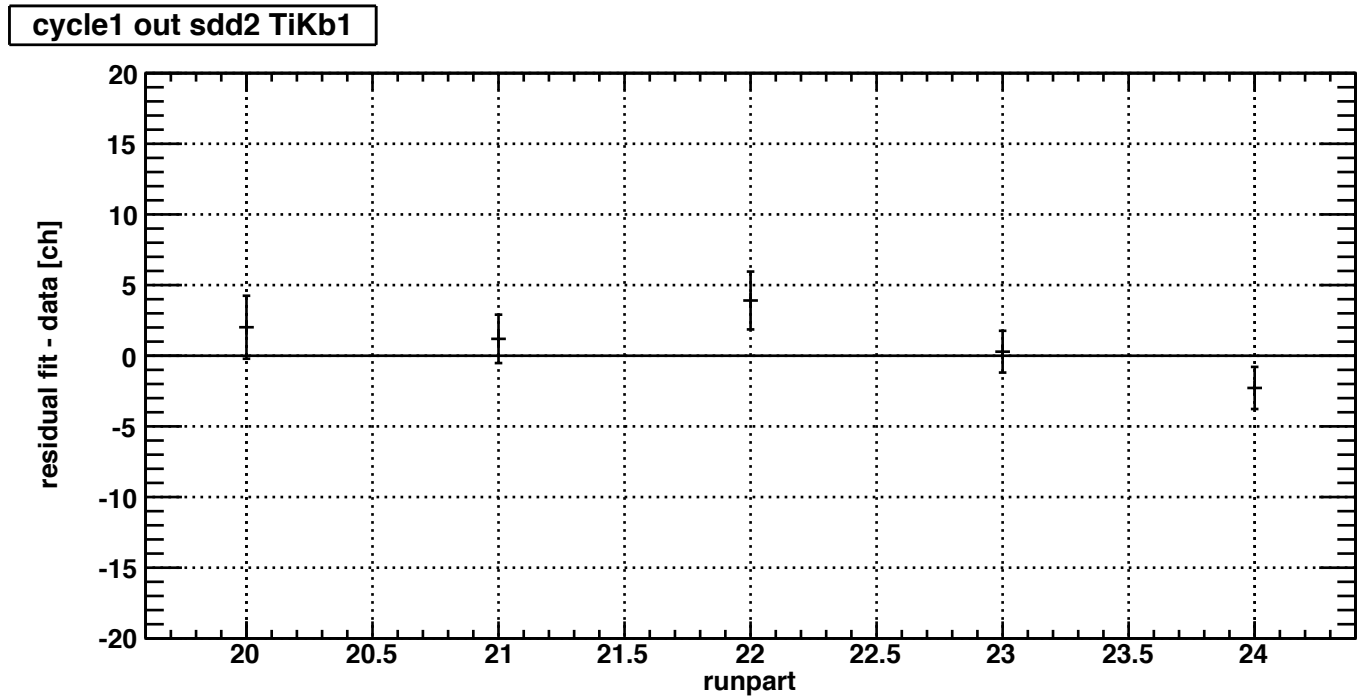

cycle1 out sdd5 TiKb1
Δ ch
residual fit - data [ch]
20
15
10
5
0
-5
-10
-15
-20
20
20.5
21
21.5
22
22.5
23
23.5
24
runpart


cycle1 out sdd5 NiKb1
Δ ch
residual fit - data [ch]
20
15
10
5
0
-5
-10
-15
-20
20
20.5
21
21.5
22
22.5
23
23.5
24
runpart

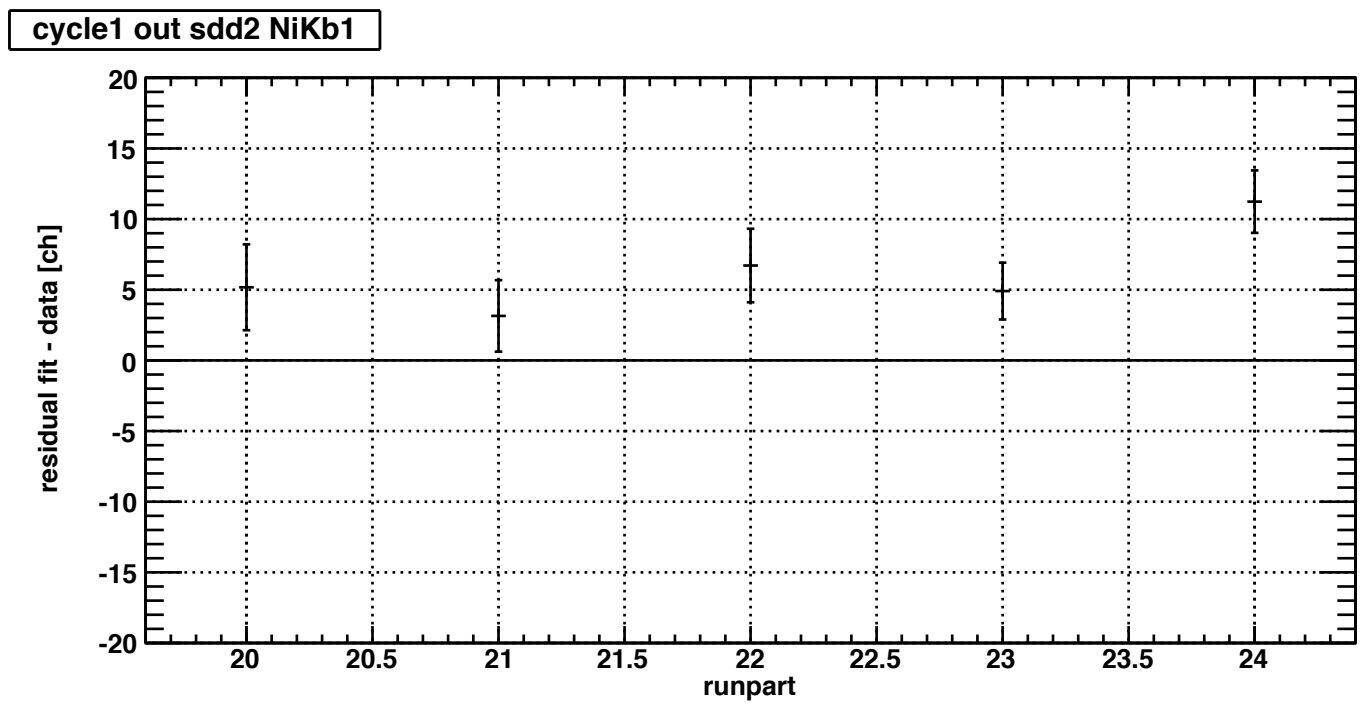
- FADC pre pedestal cut <= mean+1.5*sigma
  (sigma is the standard deviation of the pedestal: SDD dependence)

1.5σ cut

Δ ch

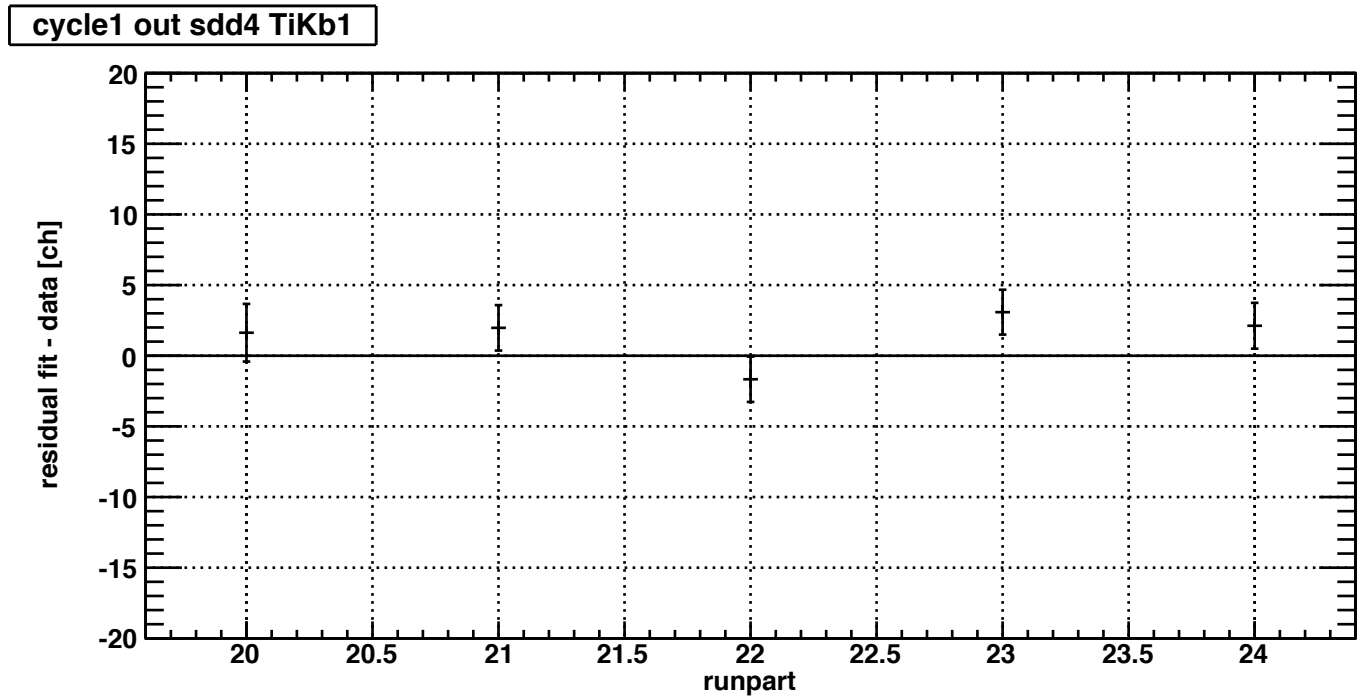


Δ ch

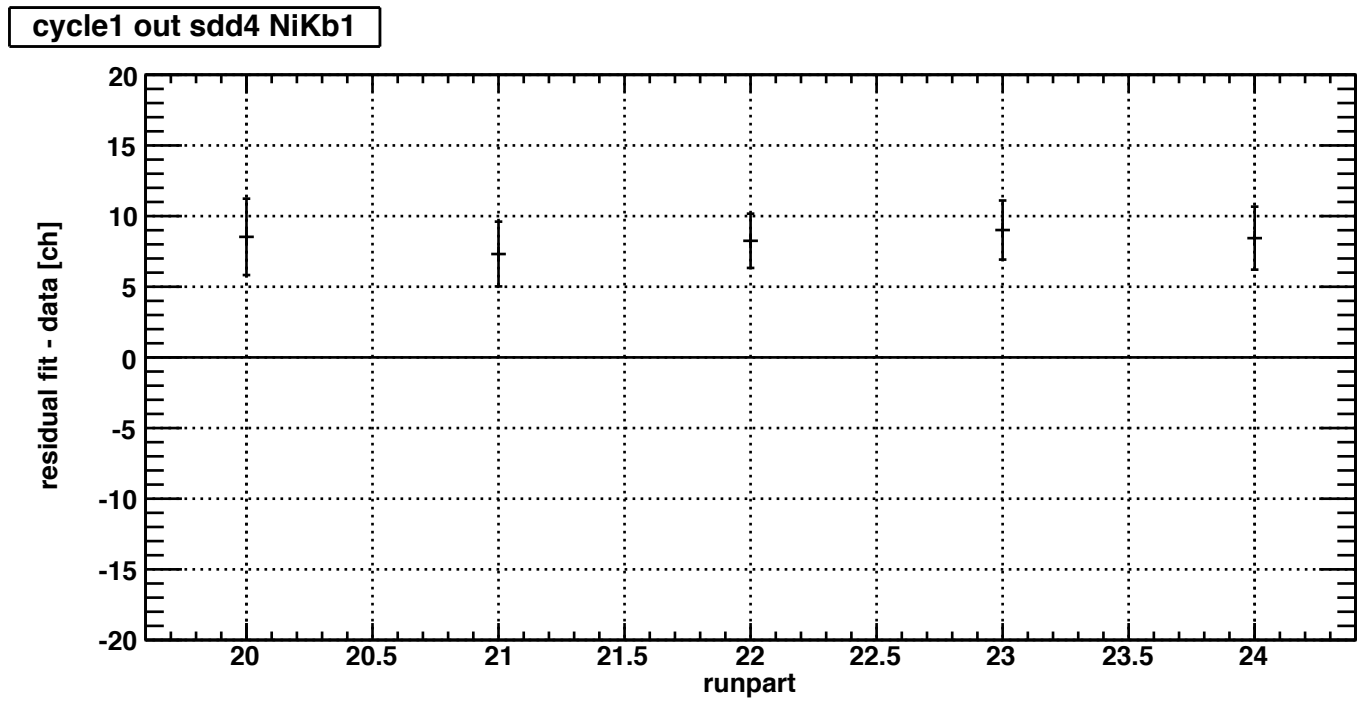


1.5σ cut

Δ ch

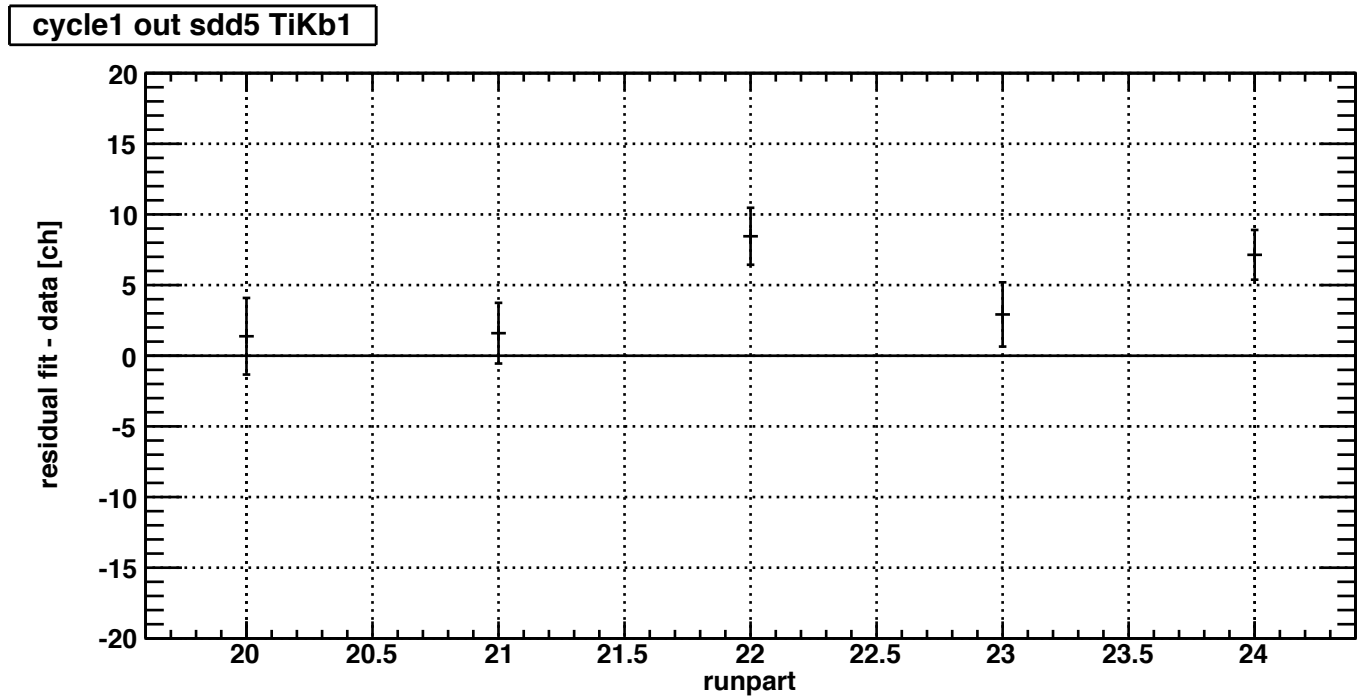


Δ ch



1.5σ cut

Δ ch



Δ ch