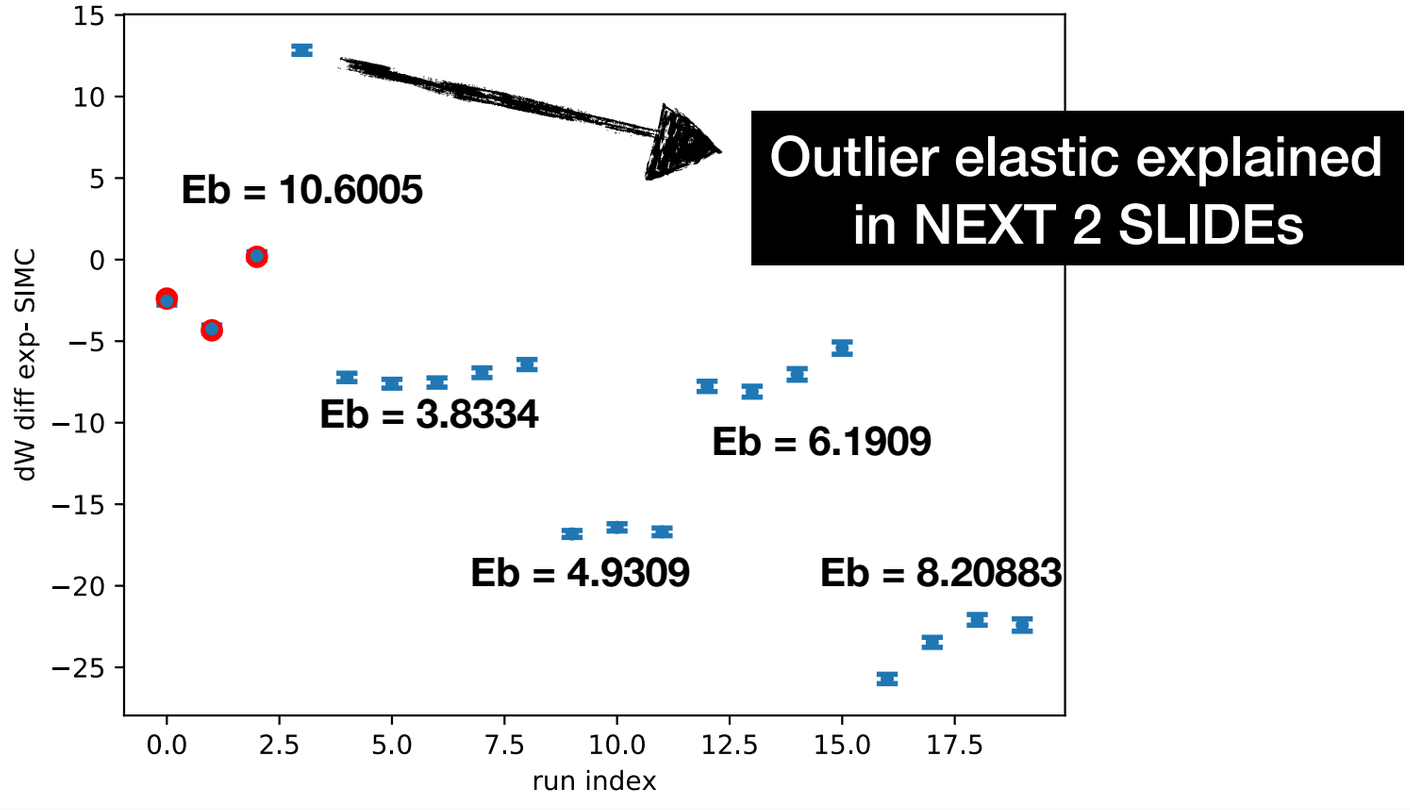
Heep Chi2 Min Update

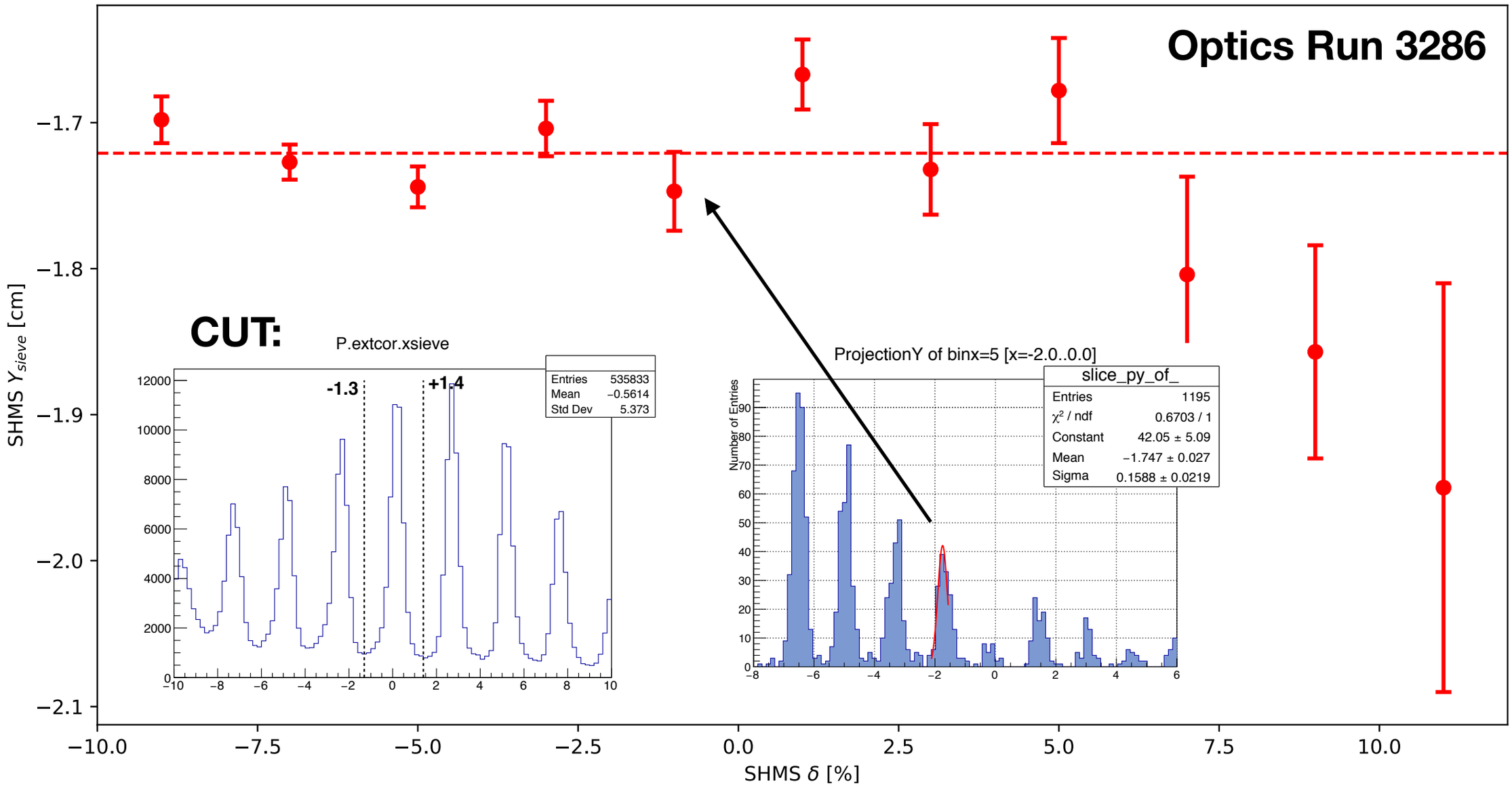
September 25, 2019

Group 1 (Heep Elastics from Deuteron Experiment)

Our data had already been corrected independently (by aligning Emiss)



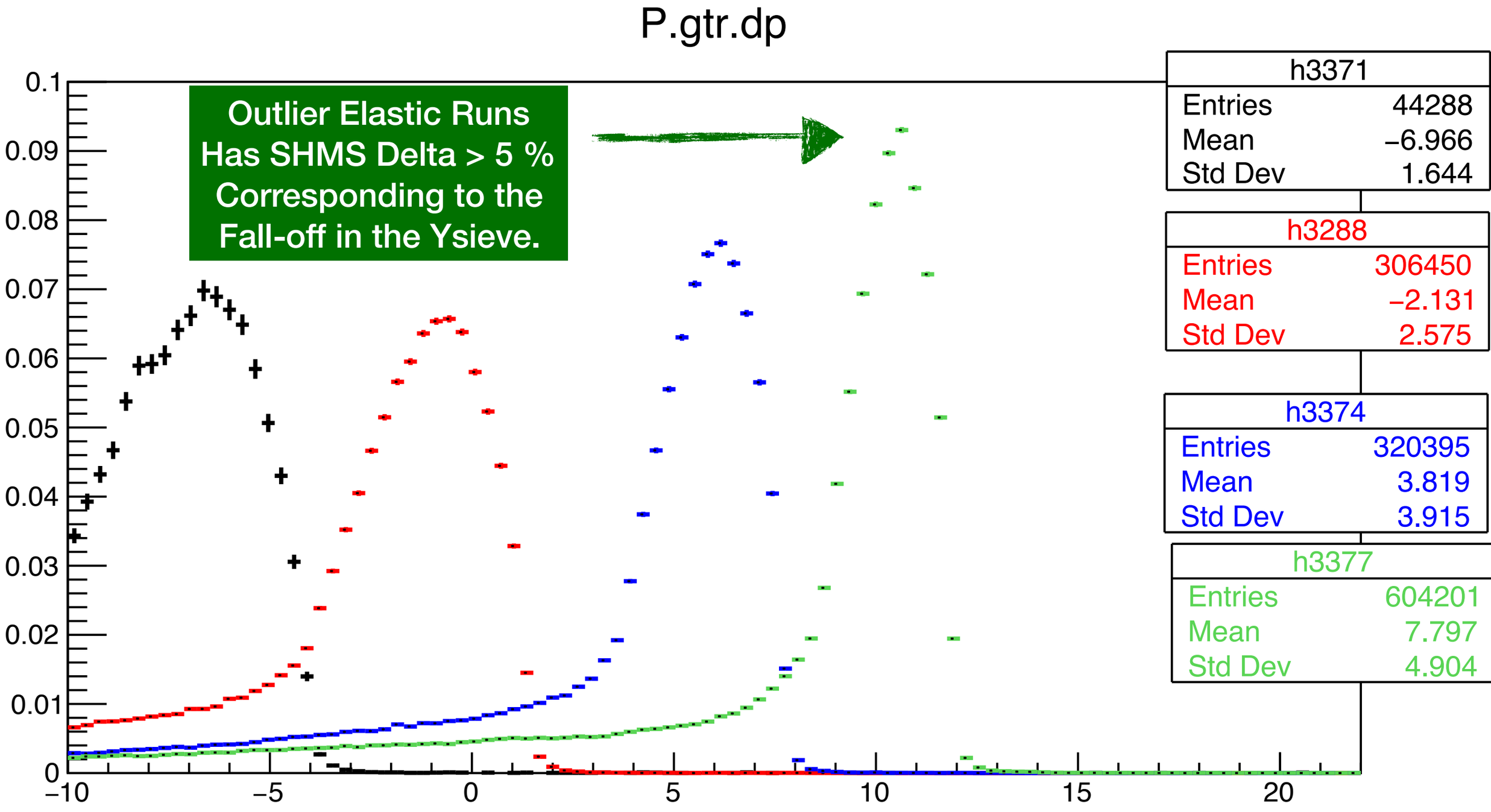

```
========================================
===fit_group1 (3288, 3371, 3374)===  Eb = 10.6005
========================================
chisq/dof =  0.540289740868
Eb = 0.0 +/- 0.0
Ef = -0.0010884488893692906 +/- 7.464177800367767e-05
theta_e = 0.0006838631267084847 +/- 3.907829179981091e-05
covariance matrix:
[[ 1.03118653e-08 -5.35058404e-09]
 [-5.35058404e-09  2.82647027e-09]]
Correlation matrix:
[[ 1.         -0.99108377]
 [-0.99108377  1.        ]]
```

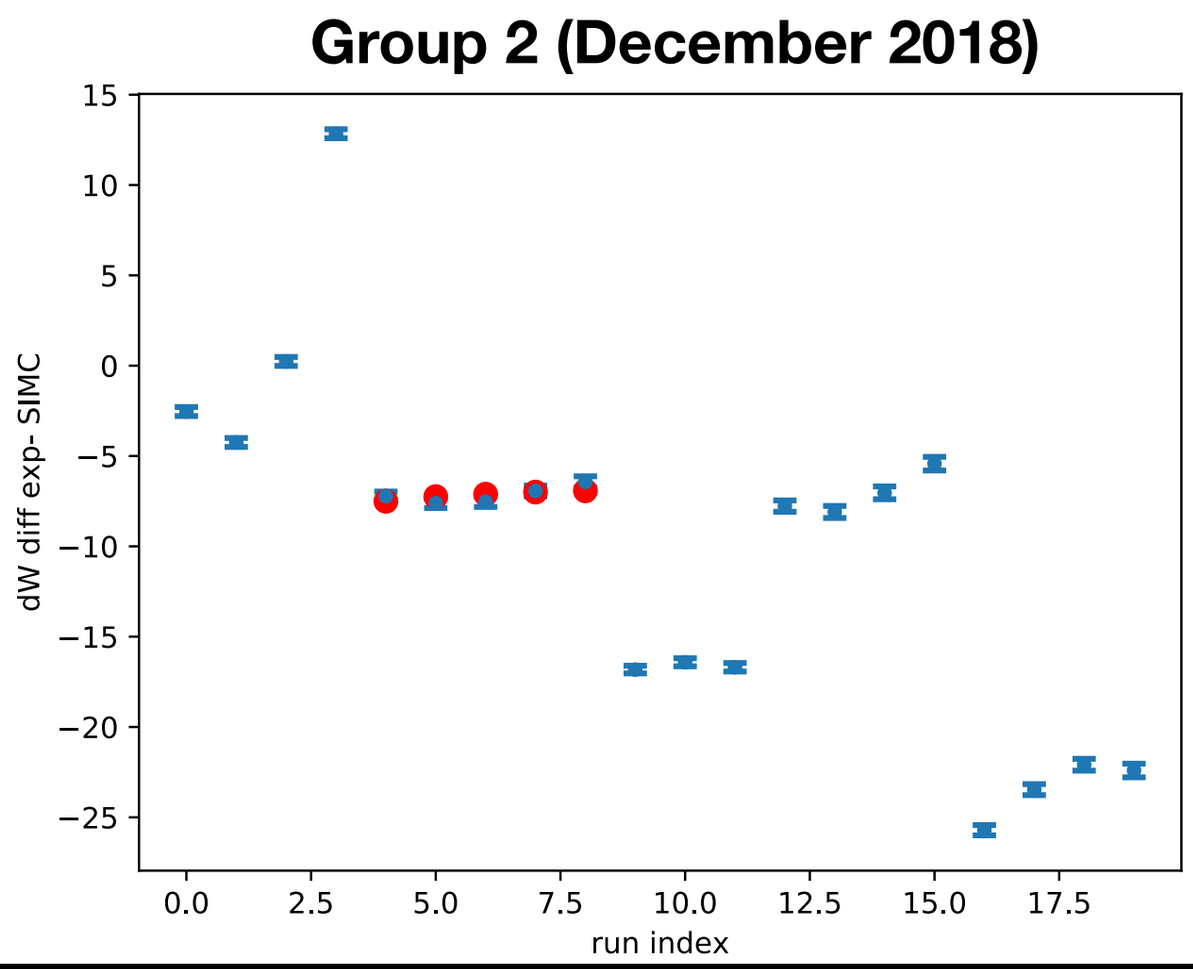


- **A cut on SHMS Xsive slit was made at (-1.3, 1.4)cm to select the central band in Xseive**

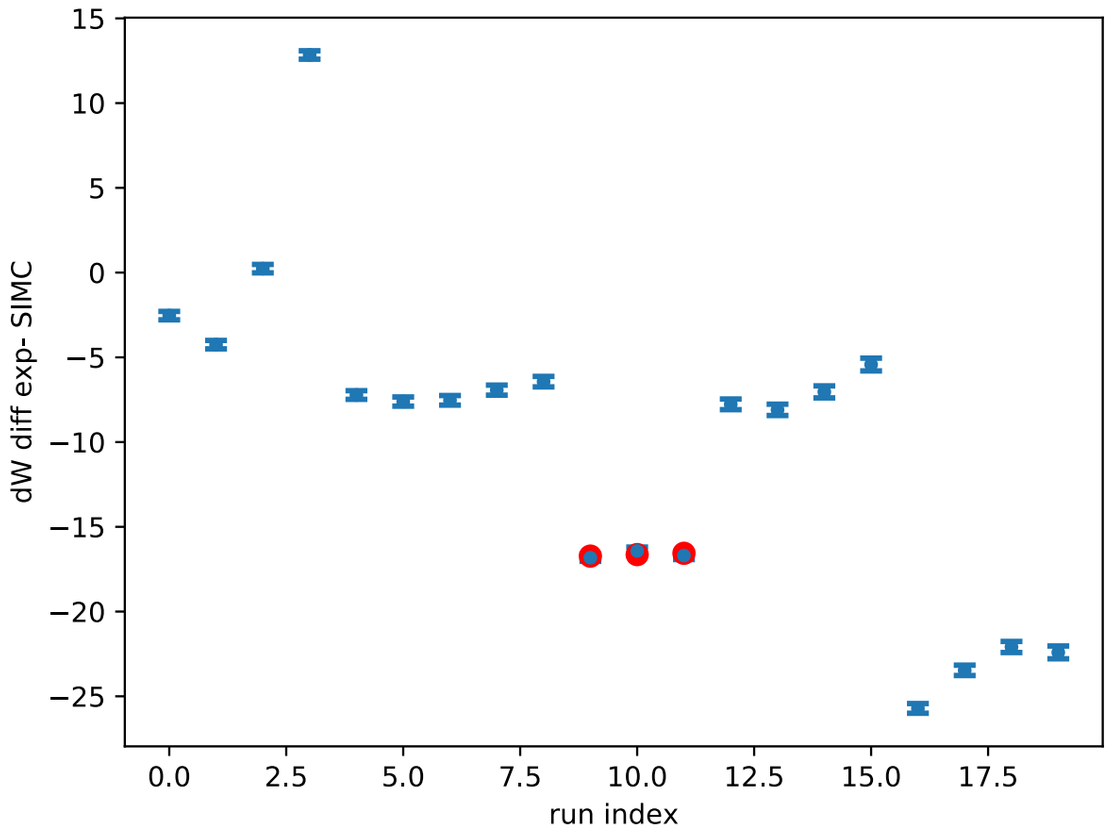
- **The projections in Ysieve were studied (shown above), and the peak adjacent to the central sieve hole was fitted in intervals of 2 % in SHMS delta**

- **The fall-off at >5% SHMS delta indicates the Y'tar optics in this region is not well known at this point.**

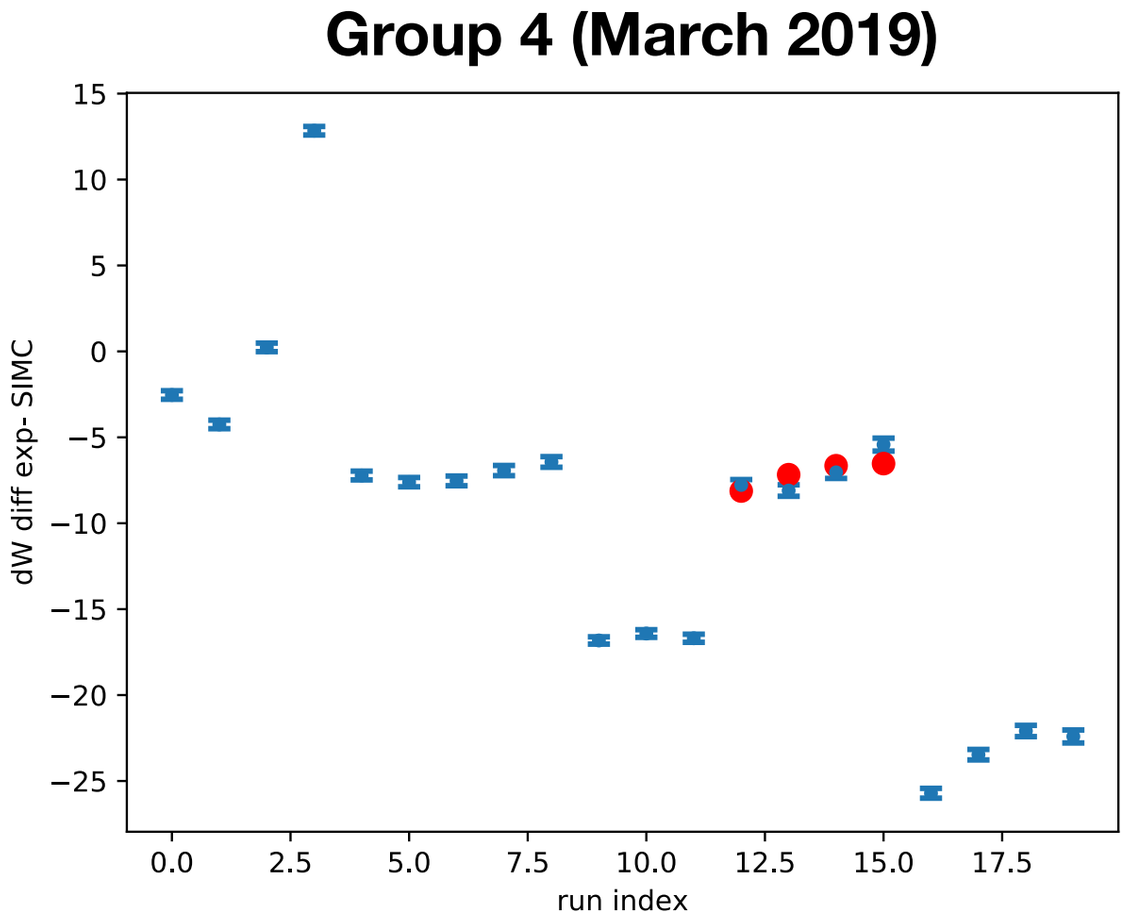

P.gtr.dp
Outlier Elastic Runs
Has SHMS Delta > 5 %
Corresponding to the
Fall-off in the Ysieve.
h3371
Entries 44288
Mean −6.966
Std Dev 1.644
h3288
Entries 306450
Mean −2.131
Std Dev 2.575
h3374
Entries 320395
Mean 3.819
Std Dev 3.915
h3377
Entries 604201
Mean 7.797
Std Dev 4.904
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
−10
−5
0
5
10
15
20




```
==================================================
===fit_group2 (6621, 6625, 6626, 6629, 6632)===  Eb =  3.8334
==================================================
chisq/dof =  2.60557506521
Eb = 0.0 +/- 0.0
Ef = 0.0030140622113737914 +/- 0.0011003144715524098
theta_e = -0.00091405924362275 57 +/- 0.0008817379087079619
covariance matrix:
[[ 4.64654407e-07 -3.71920645e-07]
 [-3.71920645e-07  2.98383935e-07]]
Correlation matrix:
[[ 1.         -0.99884371]
 [-0.99884371  1.        ]]
```

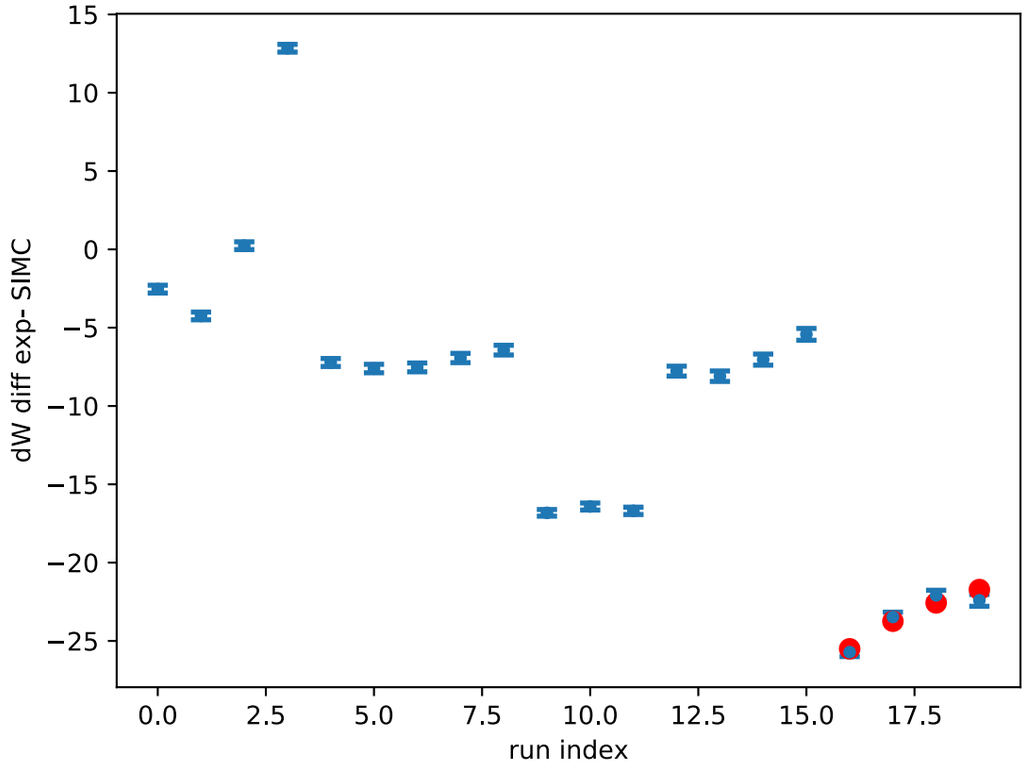



```
==================================================
===    fit_group3 (6869, 6873, 6876)         ===  Eb = 4.9309
==================================================
chisq/dof =  1.49979046879
Eb = 0.0 +/- 0.0
Ef = 0.003458282341558011 +/- 0.00019246471030193746
theta_e = -8.63139208403807e-05 +/- 0.00019996419684810331
covariance matrix:
[[ 2.46985599e-08 -2.53046807e-08]
 [-2.53046807e-08  2.66608442e-08]]
Correlation matrix:
[[ 1.         -0.98611621]
 [-0.98611621  1.        ]]
```

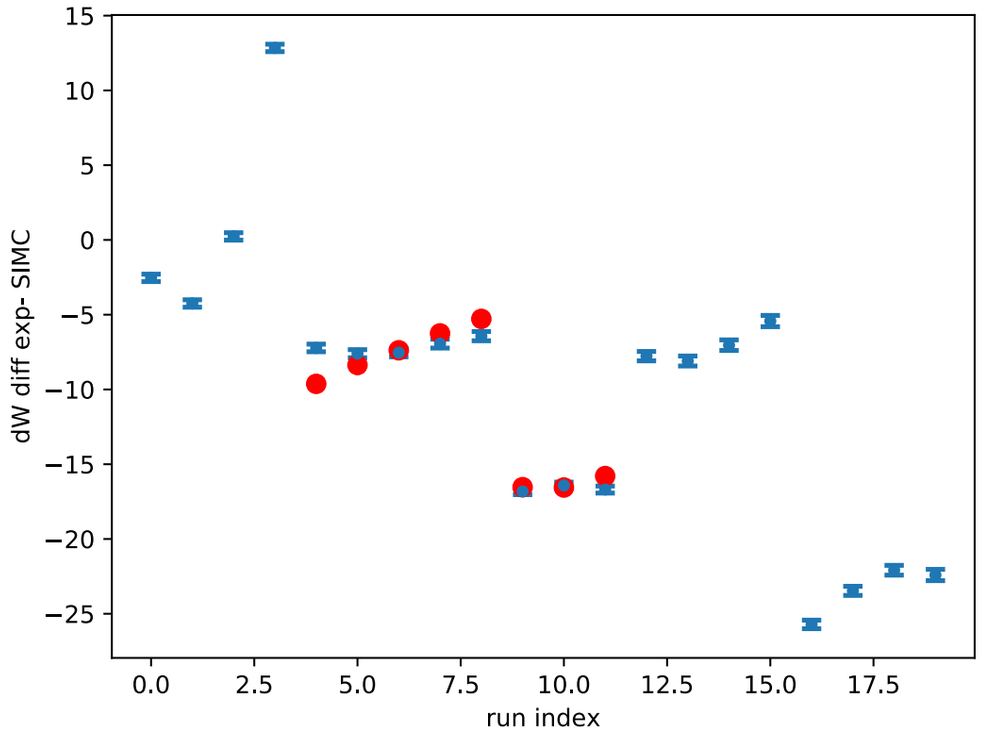



```
==================================================
===    fit_group4 (7848,7853, 7856, 7860 )       ===  Eb = 6.1909
==================================================
chisq/dof =  9.35055414684
Eb = 0.0 +/- 0.0
Ef = 0.011679574729342335 +/- 0.008525916568154445
theta_e = -0.0060710105768553 29 +/- 0.004921800665095362
covariance matrix:
[[ 7.77400485e-06 -4.48751964e-06]
 [-4.48751964e-06  2.59066162e-06]]
Correlation matrix:
[[ 1.         -0.99995076]
 [-0.99995076  1.        ]]
```

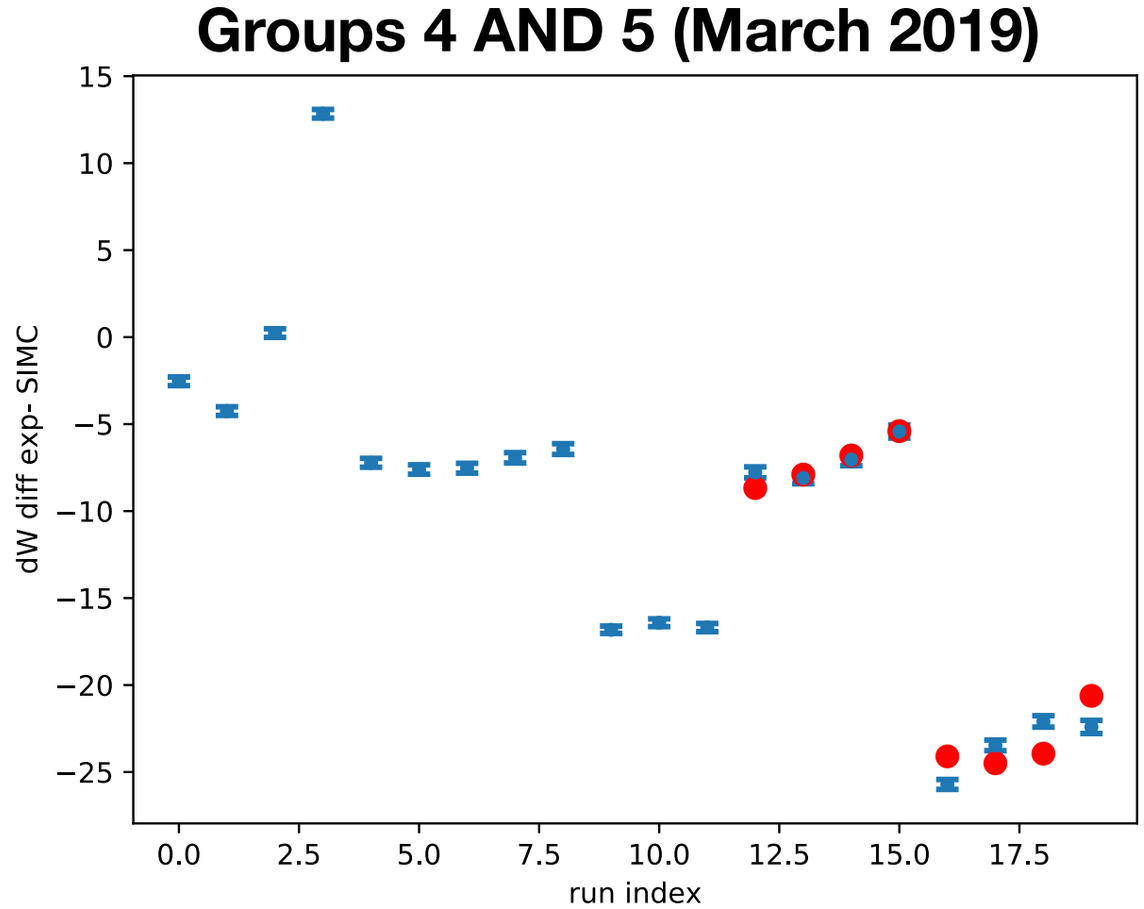
Group 5 (March 2019)



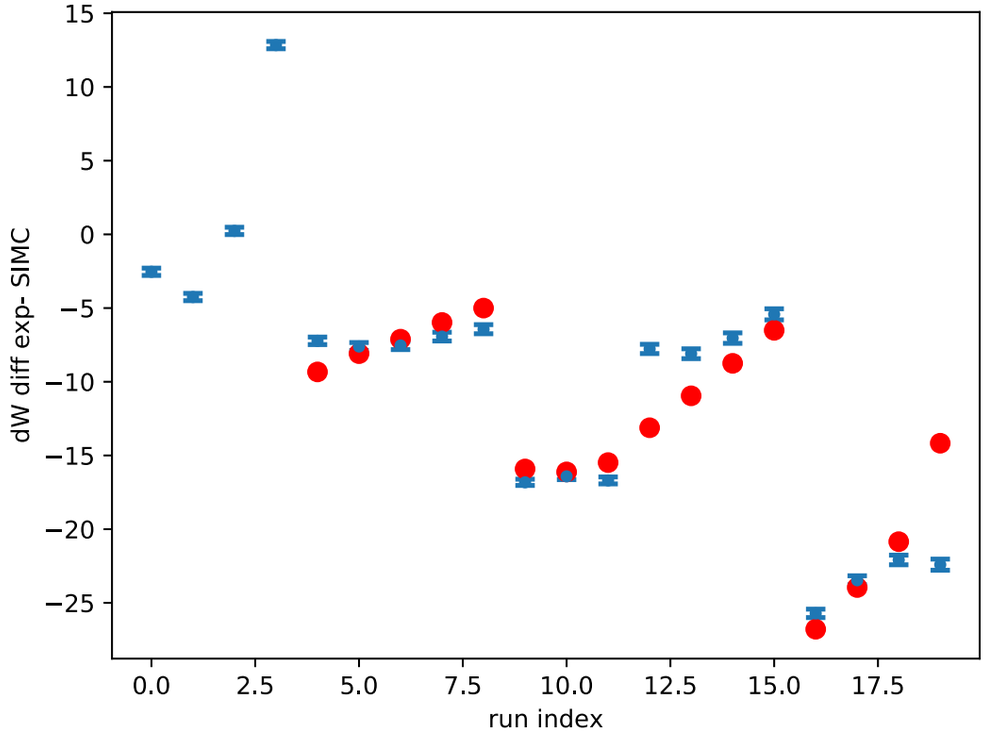

```
==================================================
===    fit_group5 (7962,7964, 7966, 7970 )       ===  Eb = 8.20883
==================================================
chisq/dof =  3.43020153708
Eb = 0.0 +/- 0.0
Ef = 0.009280593613515 63 +/- 0.0013329555799337187
theta_e = -0.0032631663082214324 +/- 0.0006794495831767186
covariance matrix:
[[ 5.17978480e-07 -2.63933747e-07]
 [-2.63933747e-07  1.34584435e-07]]
Correlation matrix:
[[ 1.         -0.99963544]
 [-0.99963544  1.        ]]
```




```
==================================
GROUPS 2 AND 3 (DECEMBER 2018 RUN) --DO NOT IGNORE BEAM ENERGY, AS IT CHANGES NOW
==================================
chisq/dof =  26.6209730473
Eb = -0.010825549134994672 +/- 0.002728140984385050 5
Ef = -0.008499536632233795 +/- 0.003659578753660930 7
theta_e = 0.002180236168911664 5 +/- 0.001379724974924242 2
covariance matrix:
[[ 2.79582313e-07  3.70220678e-07 -1.30107820e-07]
 [ 3.70220678e-07  5.03081410e-07 -1.83956338e-07]
 [-1.30107820e-07 -1.83956338e-07  7.15090693e-08]]
Correlation matrix:
[[ 1.          0.98715805 -0.92016983]
 [ 0.98715805  1.         -0.96987342]
 [-0.92016983 -0.96987342  1.        ]]
```




```
==================================
GROUPS 4 AND 5 (MARCH 2019 RUN) --DO NOT IGNORE BEAM ENERGY, AS IT CHANGES NOW
==================================
chisq/dof =  21.3531536035
Eb = -0.007322449178460151 +/- 0.0012646151918928605
Ef = -0.013154639700456161 +/- 0.0014056137946025326
theta_e = 0.005795911852679525 +/- 0.0006312069134182754
covariance matrix:
[[ 7.48953346e-08  4.41379480e-08  1.22046999e-09]
 [ 4.41379480e-08  9.25273230e-08 -3.44241367e-08]
 [ 1.22046999e-09 -3.44241367e-08  1.86587038e-08]]
Correlation matrix:
[[ 1.          0.53021225  0.03264818]
 [ 0.53021225  1.         -0.8284901 ]
 [ 0.03264818 -0.8284901   1.        ]]
```




```
==========================================
ALL GROUPS (EXCEPT GROUP 1)
==========================================
chisq/dof =  81.0959500848
Eb = -0.011051254776785202 +/- 0.0018046042065499373
Ef = -0.008999979032478123 +/- 0.0020422852130948 31
theta_e = 0.002393858581914876 +/- 0.0005365231011196908
covariance matrix:
[[ 4.01573240e-08  4.44126734e-08 -1.03761835e-08]
 [ 4.44126734e-08  5.14320245e-08 -1.28440073e-08]
 [-1.03761835e-08 -1.28440073e-08  3.54958586e-09]]
Correlation matrix:
[[ 1.          0.9772546  -0.86909333]
 [ 0.9772546   1.         -0.95059361]
 [-0.86909333 -0.95059361  1.        ]]
```

SUMMARY

* We can try to make sense out of the fit results from each group

or

* Put additional constraints into the fit, i.e. Missing Energy and Missing Momentum On GROUP 1 ONLY (AS IT IS THE ONLY COINCIDENCE DATA IN THIS LIST)

dW_pred (ai) = dW_obs

dEm_pred (ai) = dEm_obs

dPmx_pred (ai) = dPmx_obs

dPmx_pred (ai) = dPmx_obs

dPmx_pred (ai) = dPmx_obs

$$\begin{bmatrix} \frac{\partial W}{\partial E_b} & \dots \\ & \frac{\partial E_m}{\partial P_p} \\ \dots & \frac{\partial P_{mx}}{\partial \phi_e} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \\ a_7 \end{bmatrix} = \begin{bmatrix} \text{dW\_obs} \\ \text{dEm\_obs} \\ \text{dPmx\_obs} \\ \text{dPmy\_obs} \\ \text{dPmz\_obs} \end{bmatrix}$$

$$a_1 = \frac{dE_b}{E_b}, a_2 = \frac{dE_f}{E_f}, a_3 = \frac{dP_p}{P_p},$$

$$a_4 = d\theta_e, a_5 = d\theta_p, a_6 = d\phi_e, a_7 = d\phi_p$$