Agenda of ORNL-UTK-UKY-LU zoom meeting August 25, 2025

1. Lisa 5' update on start date
2. Lisa 5' UT undergraduate students access during run
3. Yuri 5' Express analysis organization
4. Matt 10' Availability of n threshold scan files for analysis
5. Yuri 5' Dustin Gilbert (UTK) χ-measurements of mu metal
6. Mubi 5' measurement mu from KY prototype
7. Mubi 5' Transmission factors for GP-SANS windows calculated
8. Yuri 10' PDFs of nTMM signal
9. Shaun 5' Status of UT prototype construction

$$(nTMM) \quad \eta = \kappa\mu \quad (neutron\ magnetic\ moment)$$

The nTMM effect will depend critically on the GP-SANS detector background counts

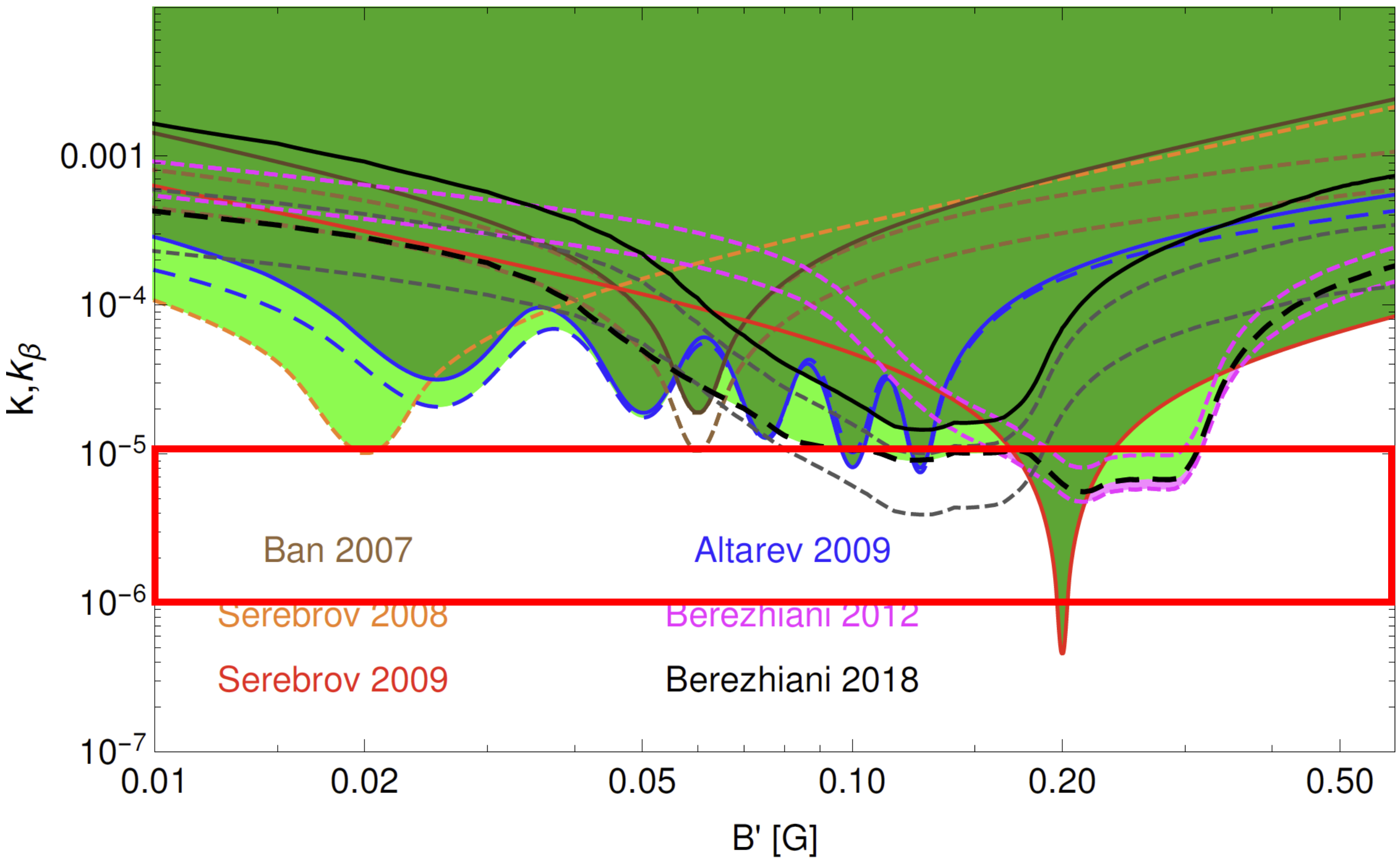
Background rate in ROI 20 x 20 cm2 :

in January 2024 at 20 m with neutron beam ~ 2.2 n/s
in July 2021 at 20 m with neutron beam > 5.8 n/s

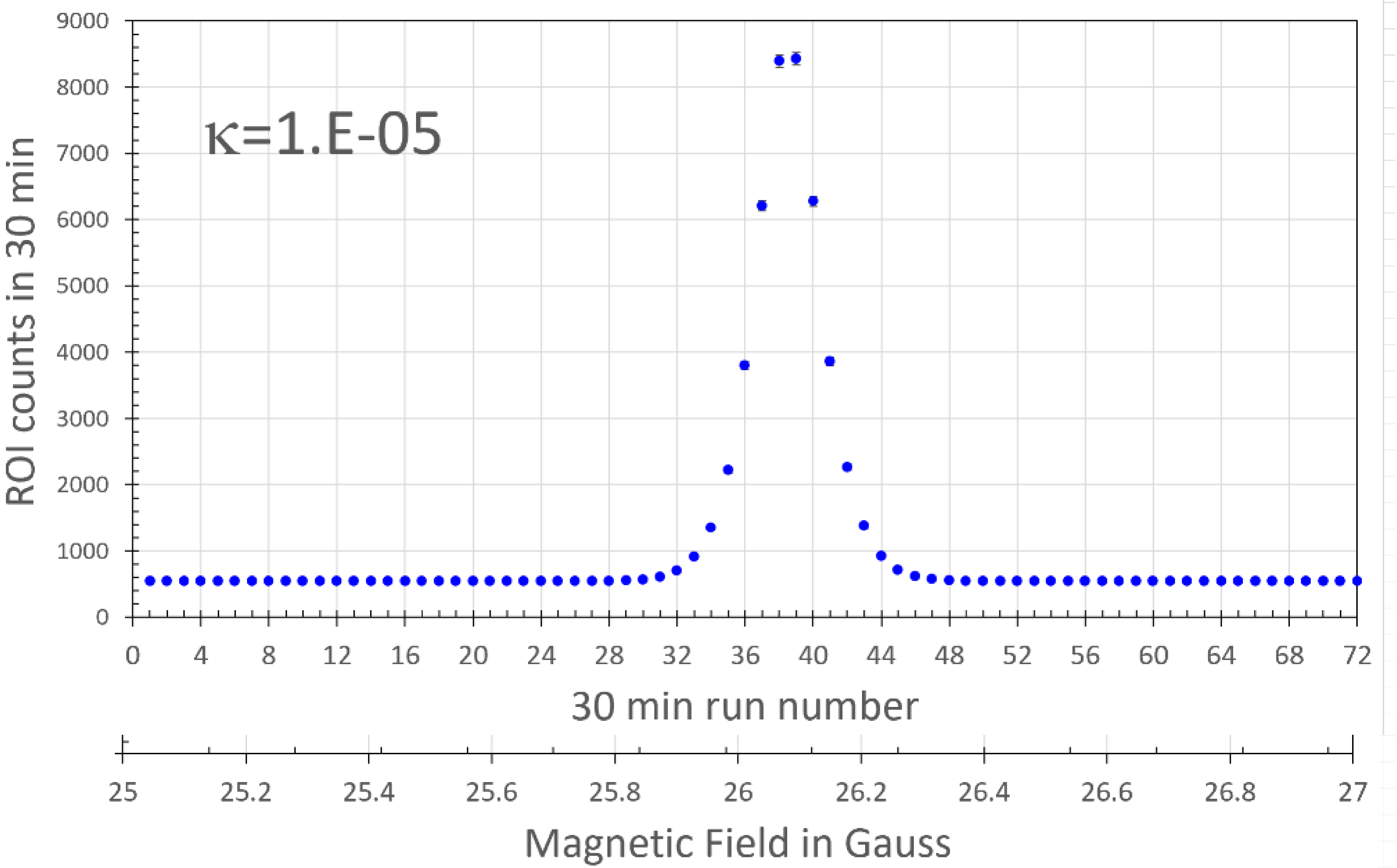
in July 2025 at 2 m, reactor off ~ 0.07 n/s
in July 2025 at 20 m, reactor off ~ 0.03 n/s

For simulations we assume ~ 0.3 n/s

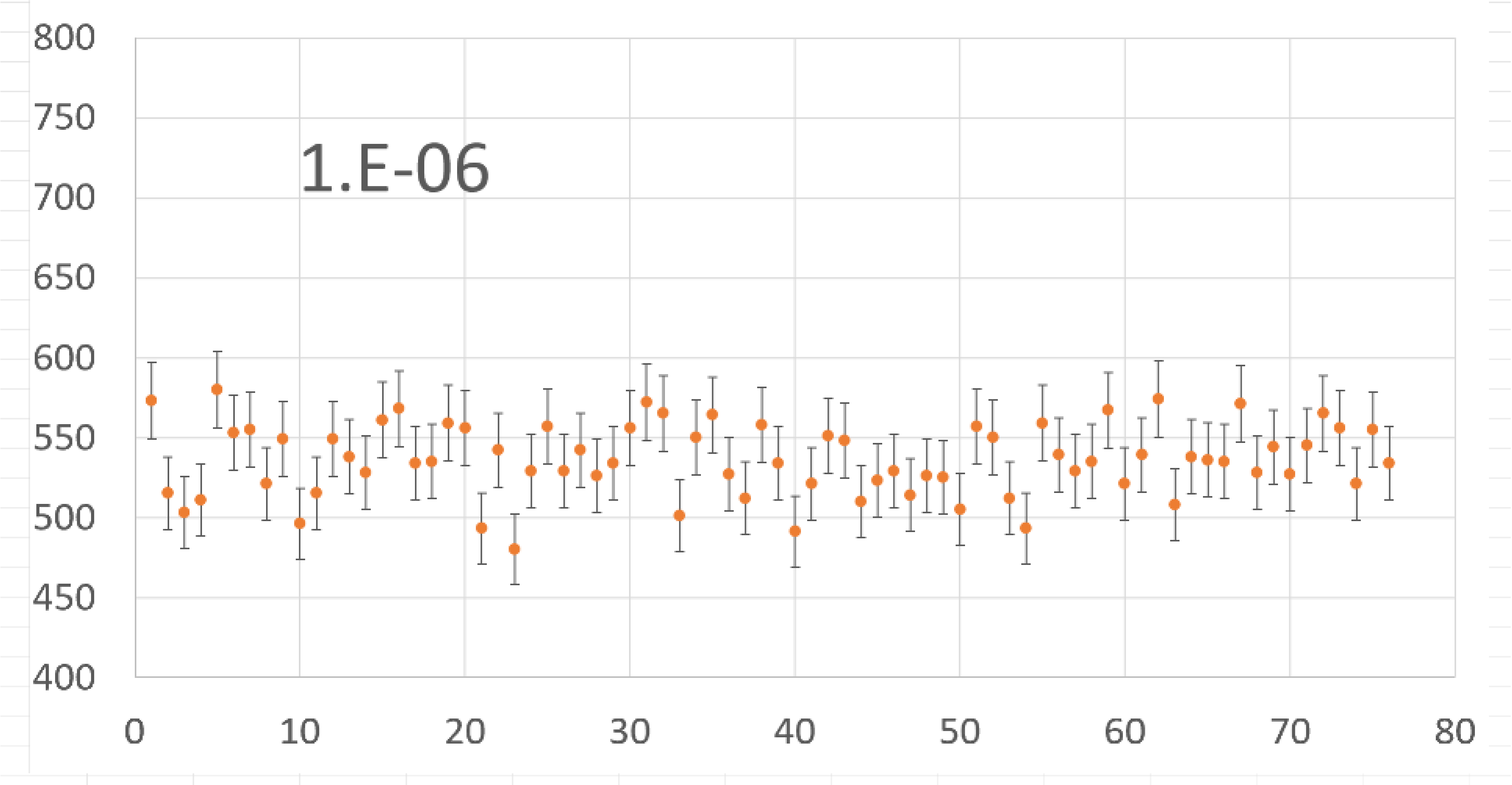
nTMM was never measured directly. It is possible to imply some limits on nTMM from the concept of mirror magnetic field. Outside $\Delta B = \pm 0.5$ Gauss κ can be >10^{-4}. Presence of mirror magnetic field will shift our resonance from the central position within our measured region $\Delta B = \pm 1.0$ Gauss



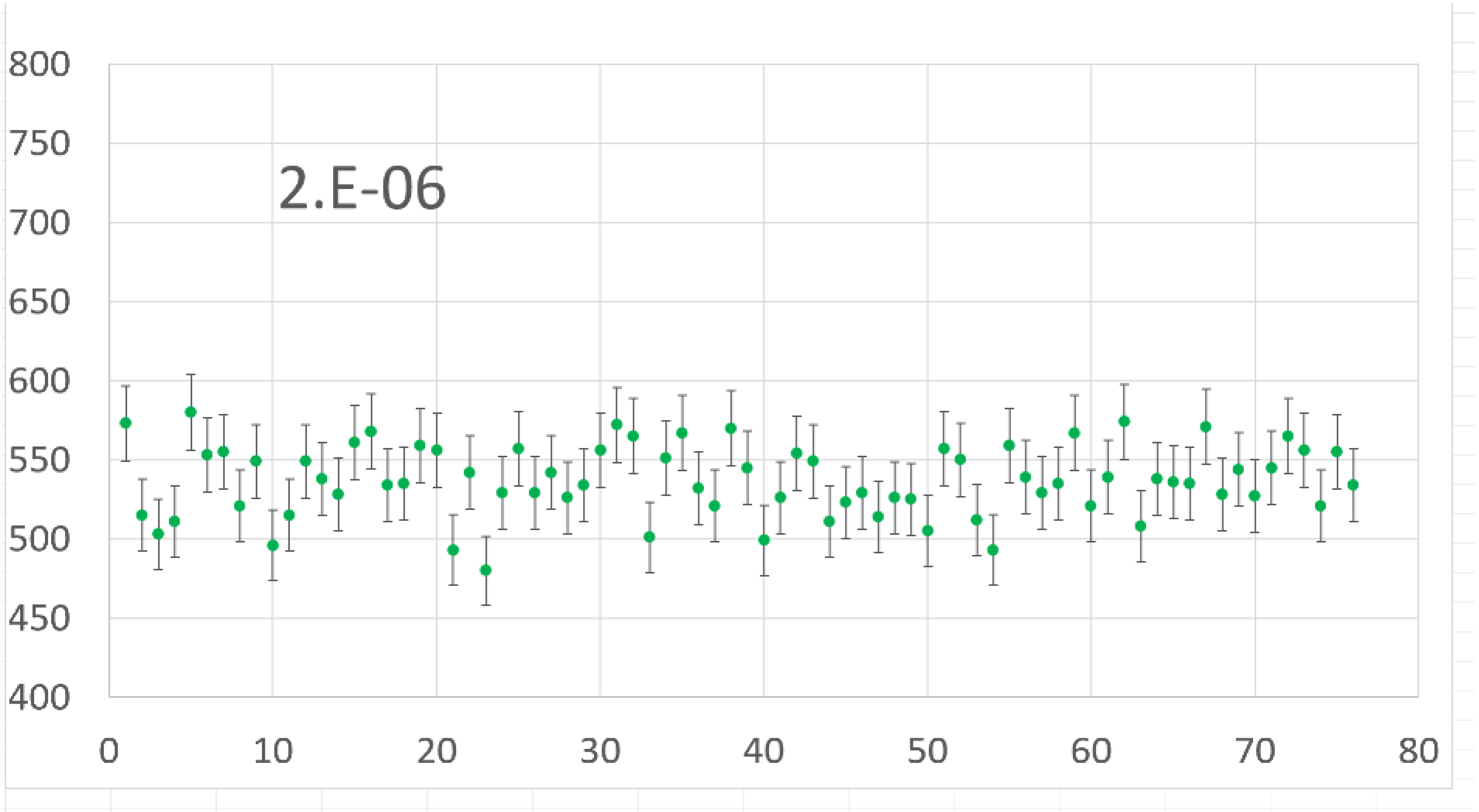
ROI background rate 0.3 n/s



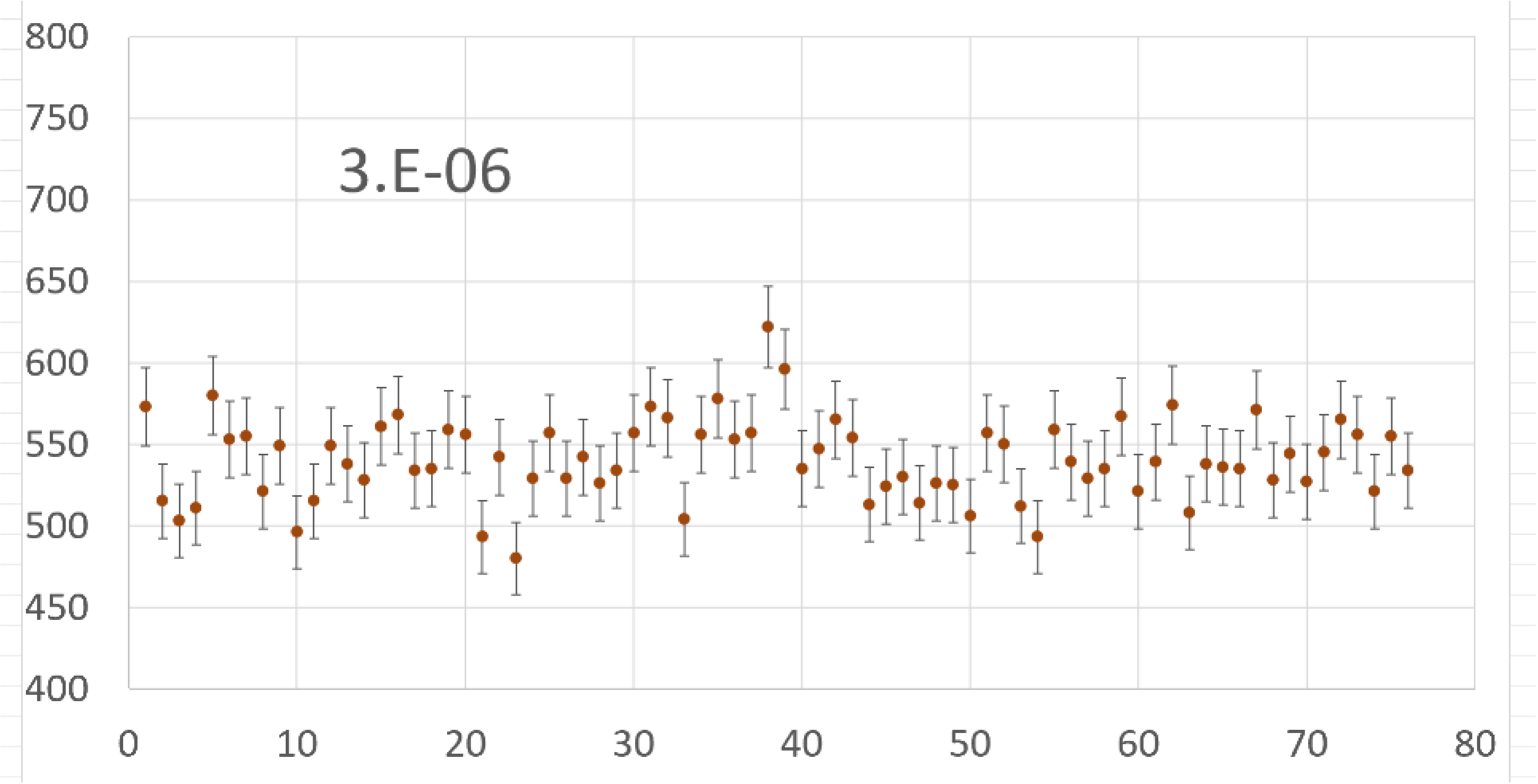
ROI background rate 0.3 n/s



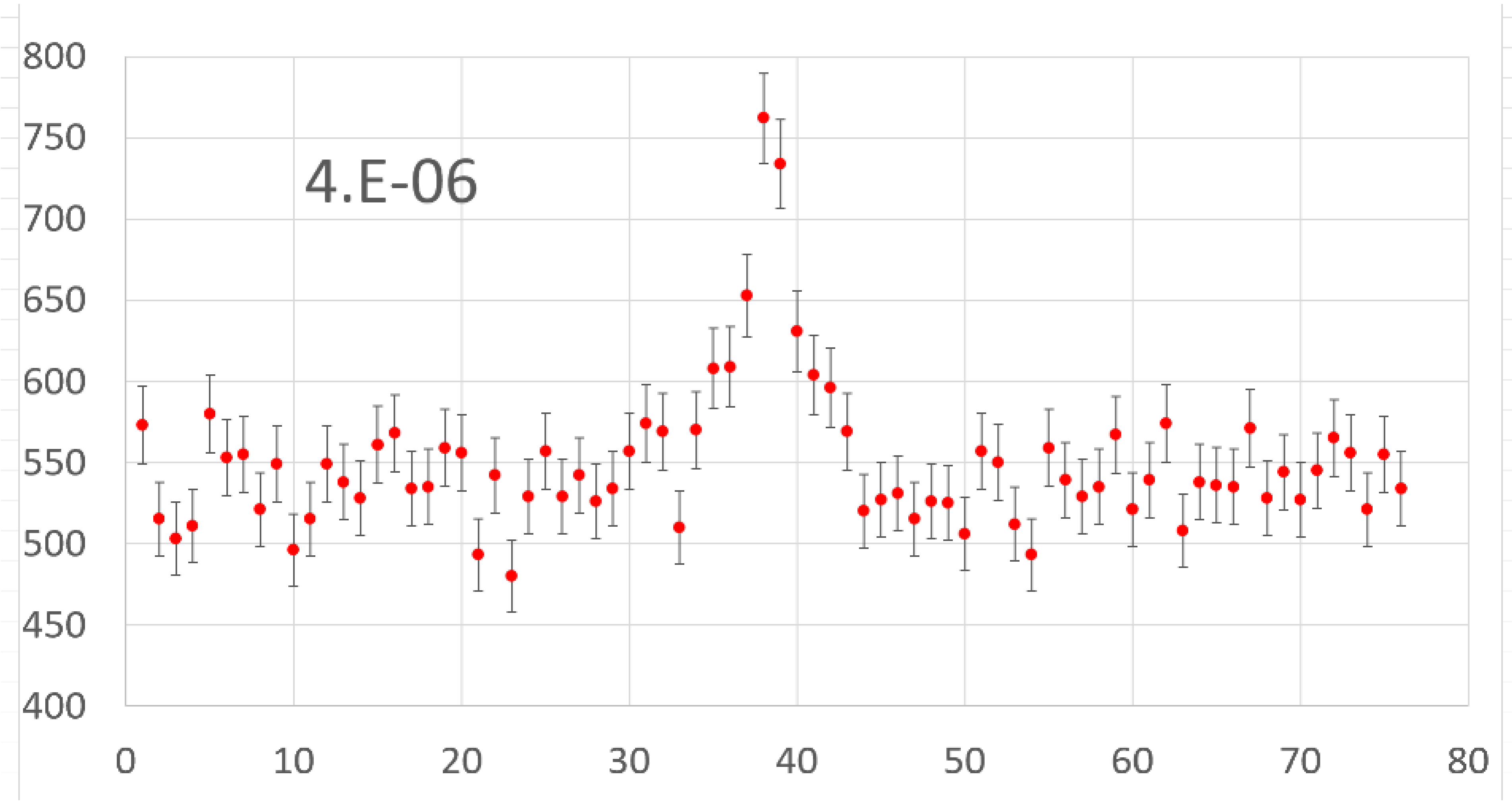
ROI background rate 0.3 n/s



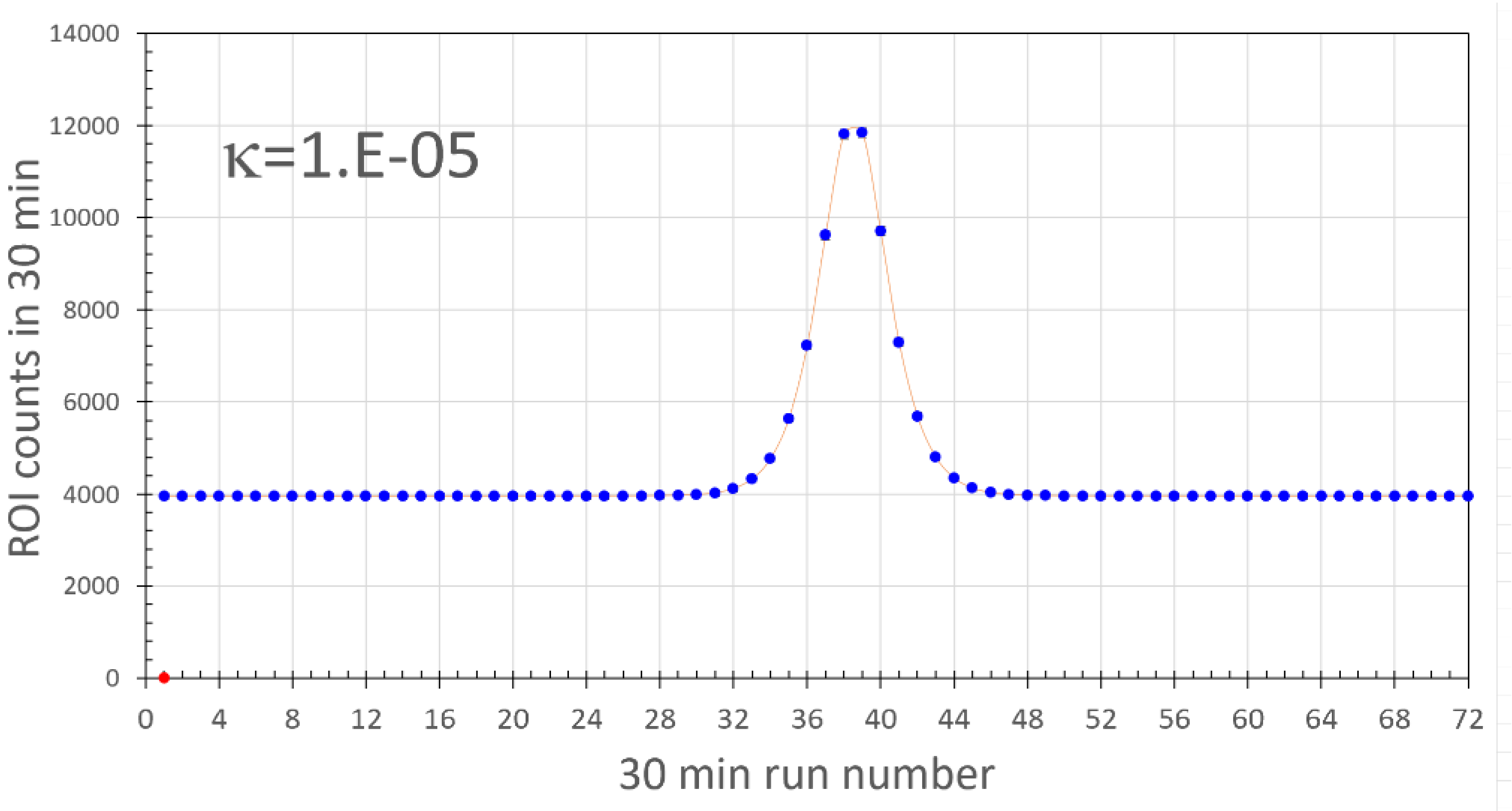
ROI background rate 0.3 n/s



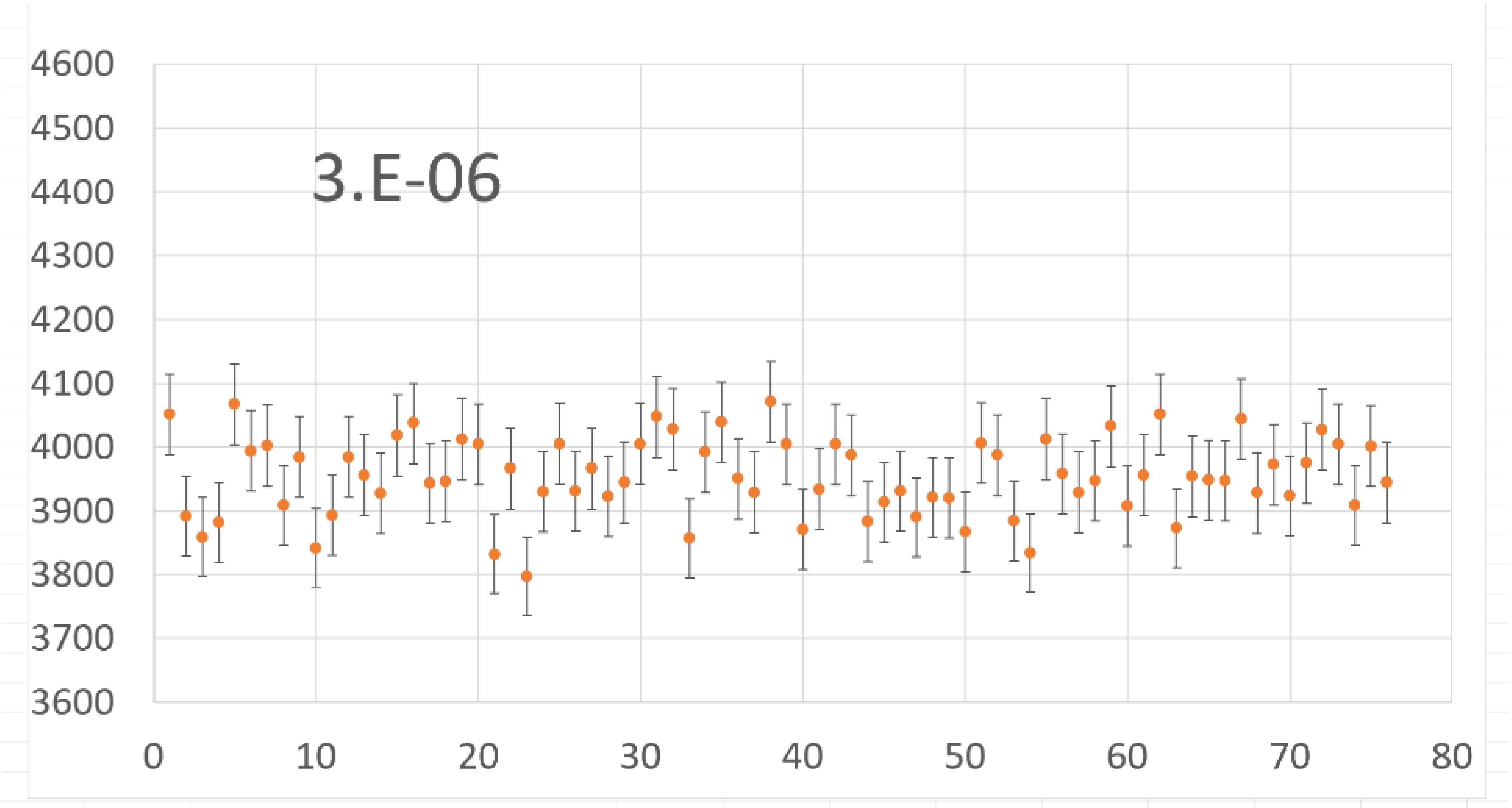
ROI background rate 0.3 n/s



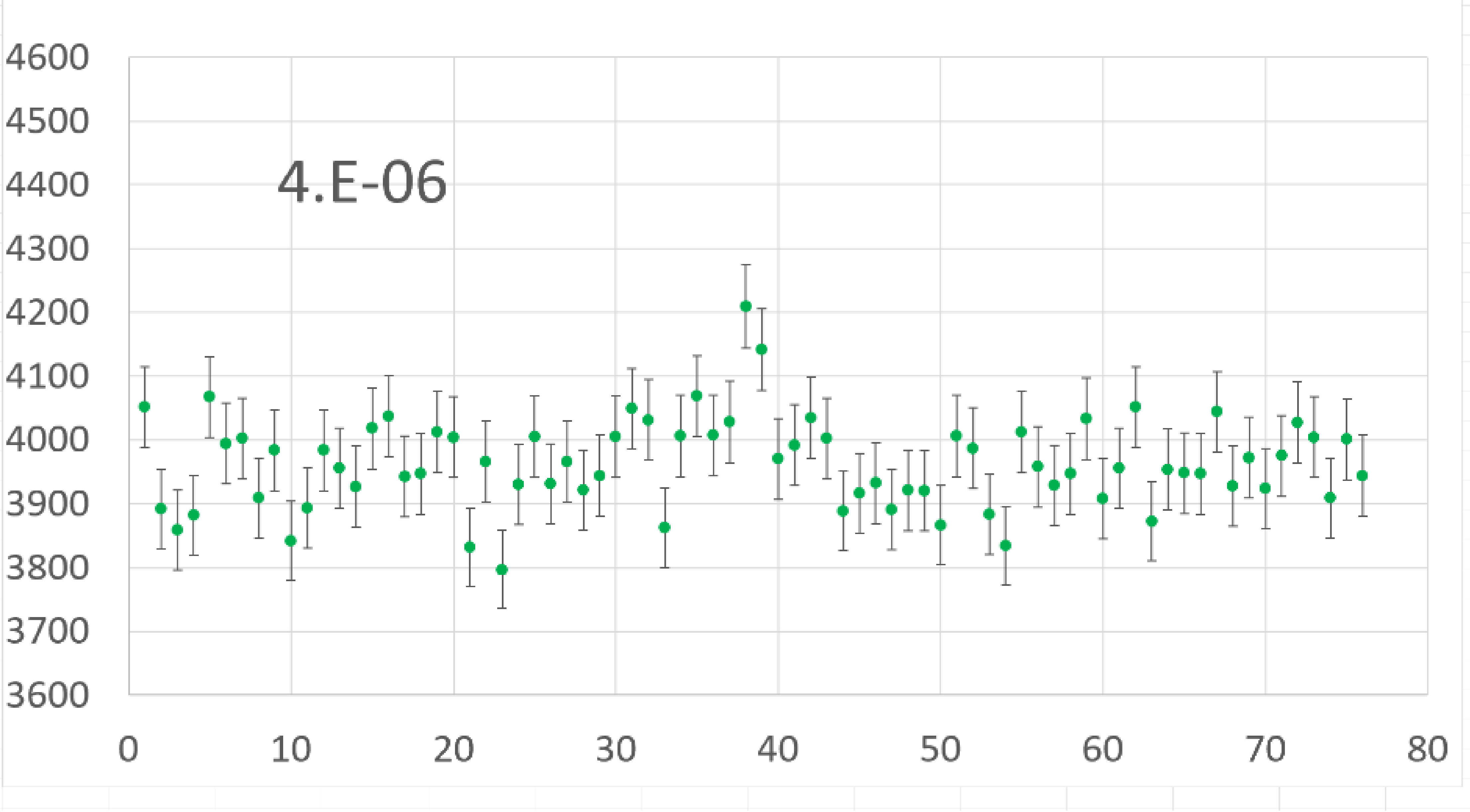
Now with ROI background rate 2.2 n/s



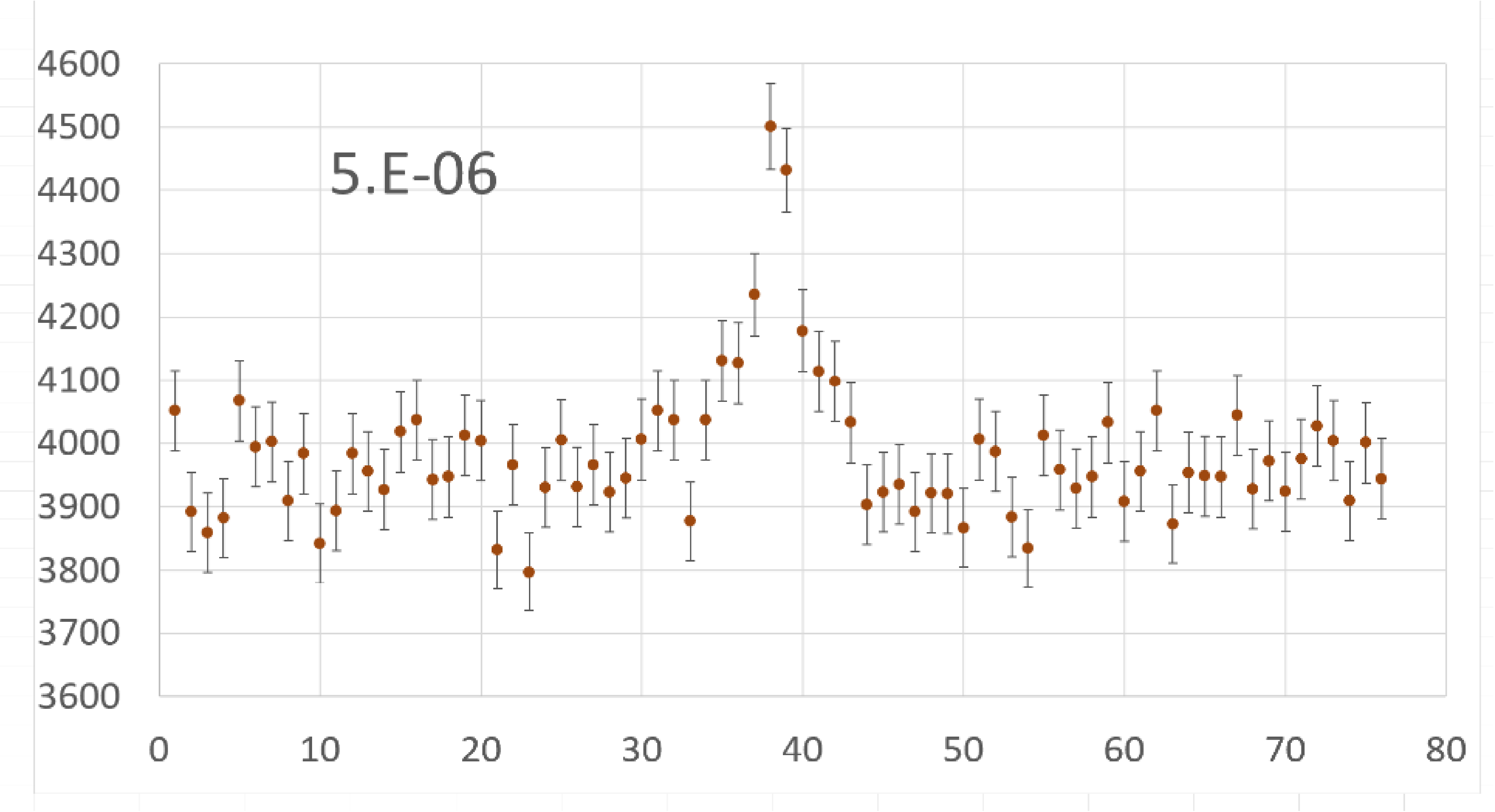
ROI background rate 2.2 n/s



ROI background rate 2.2 n/s

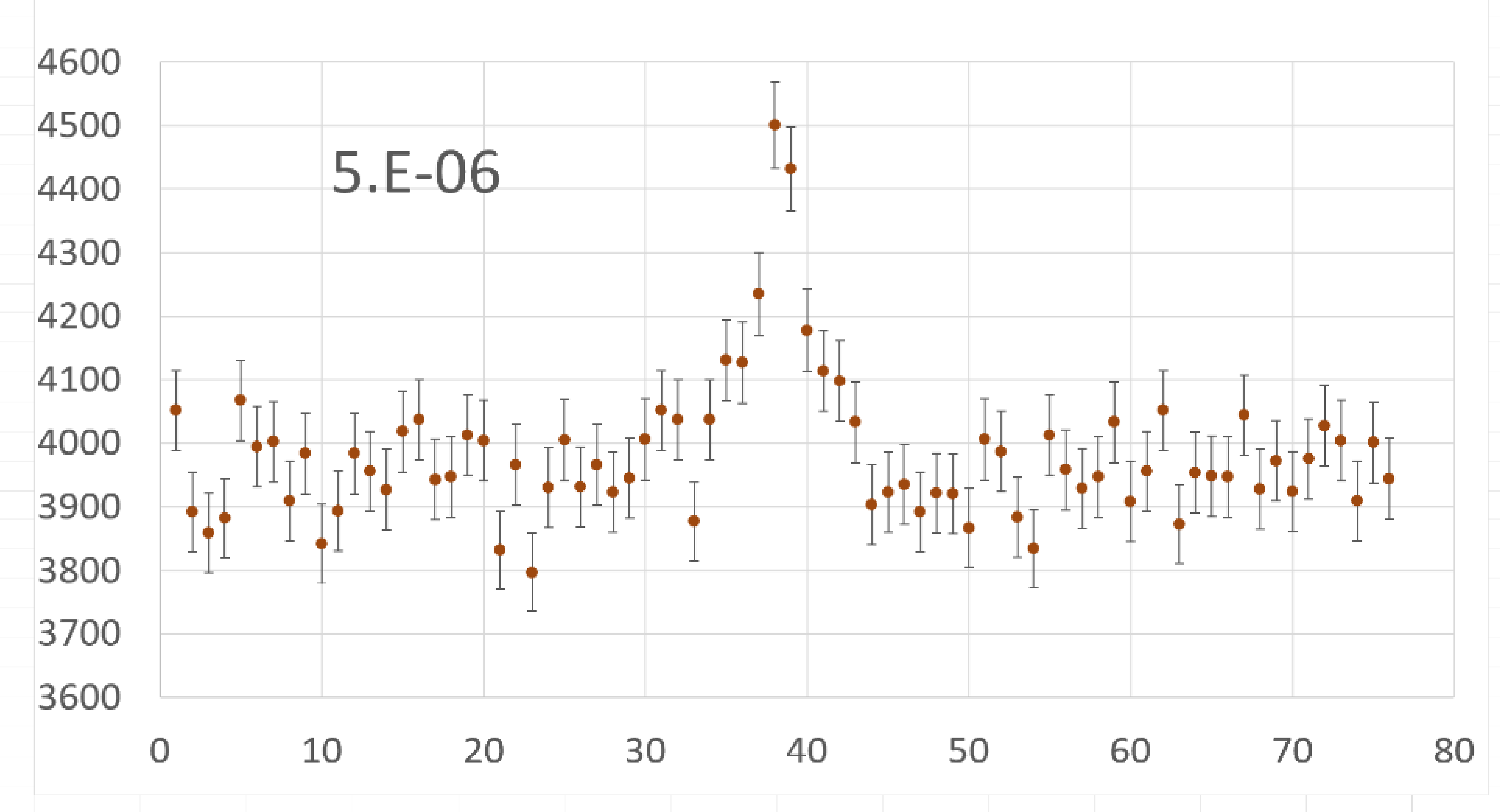


ROI background rate 2.2 n/s

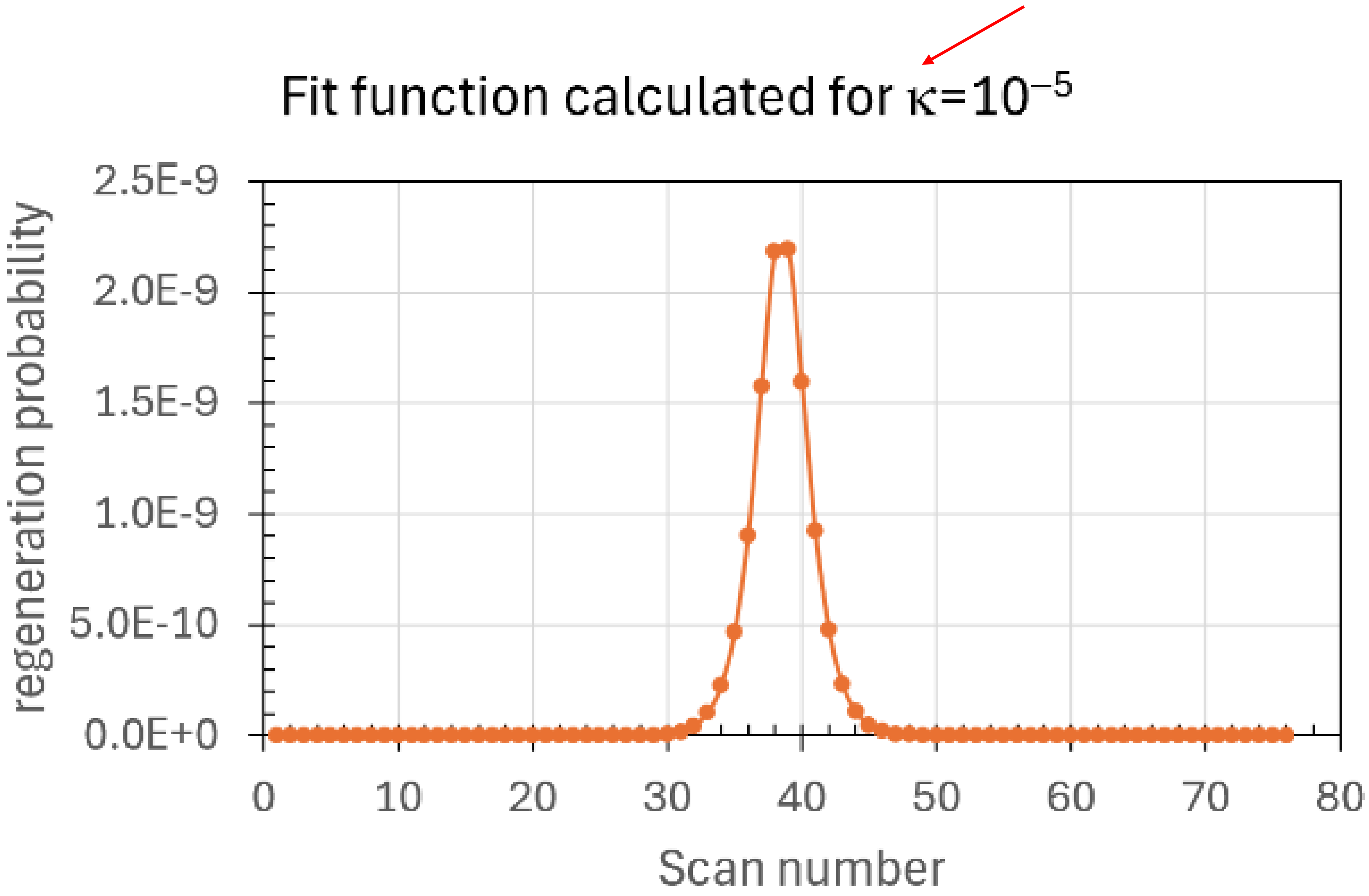


ROI background rate 2.2 n/s, Run time = 1800 s

Update Aug 25, 2025



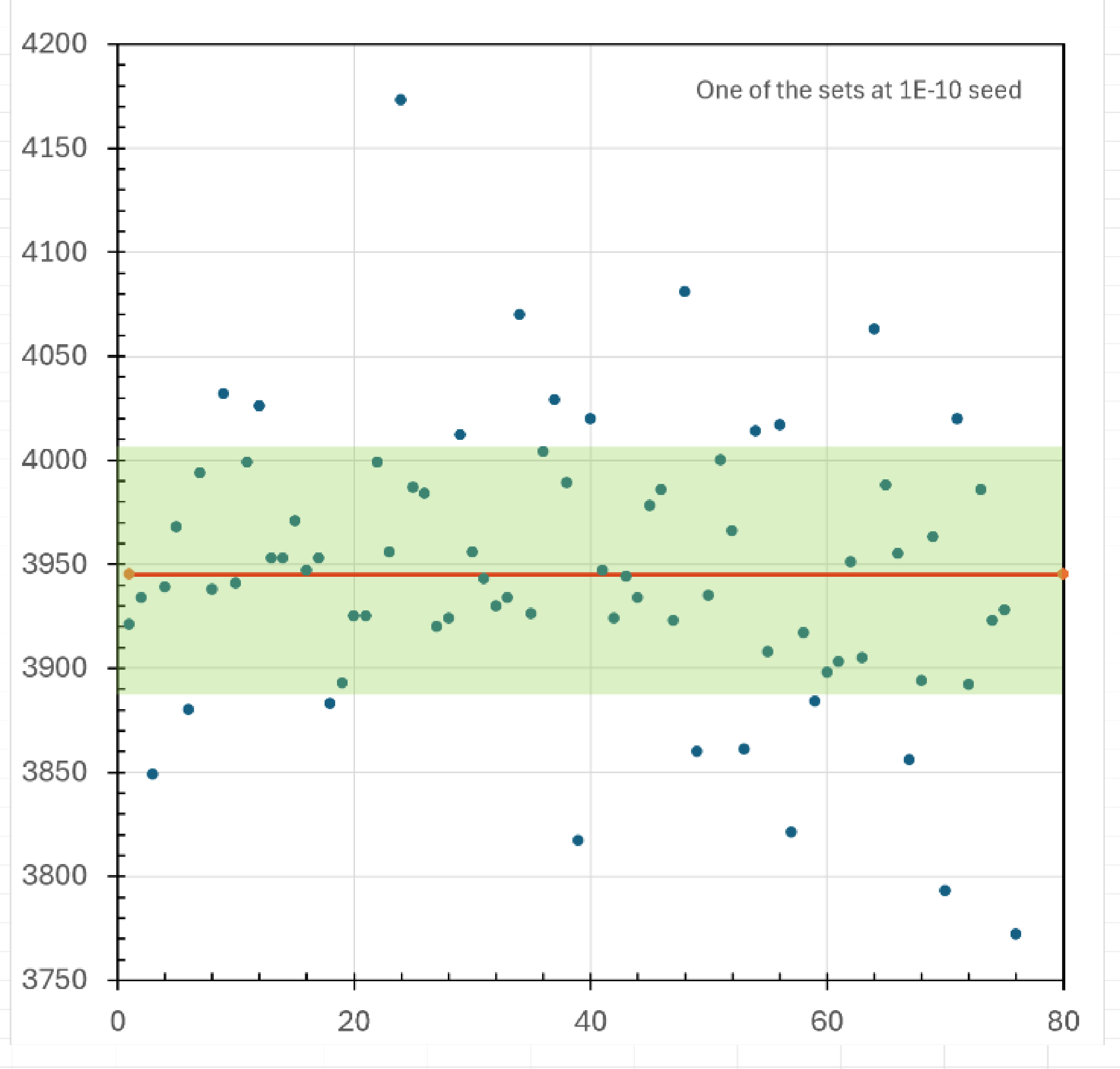
Fit of random experiment $f_i = a \cdot R_i + b \quad for\ i = 1{,}76$



It should be multiplied by beam intensity and by measurement time e.g. 1800 s time 30’

ROI bckgr=2.2 cps

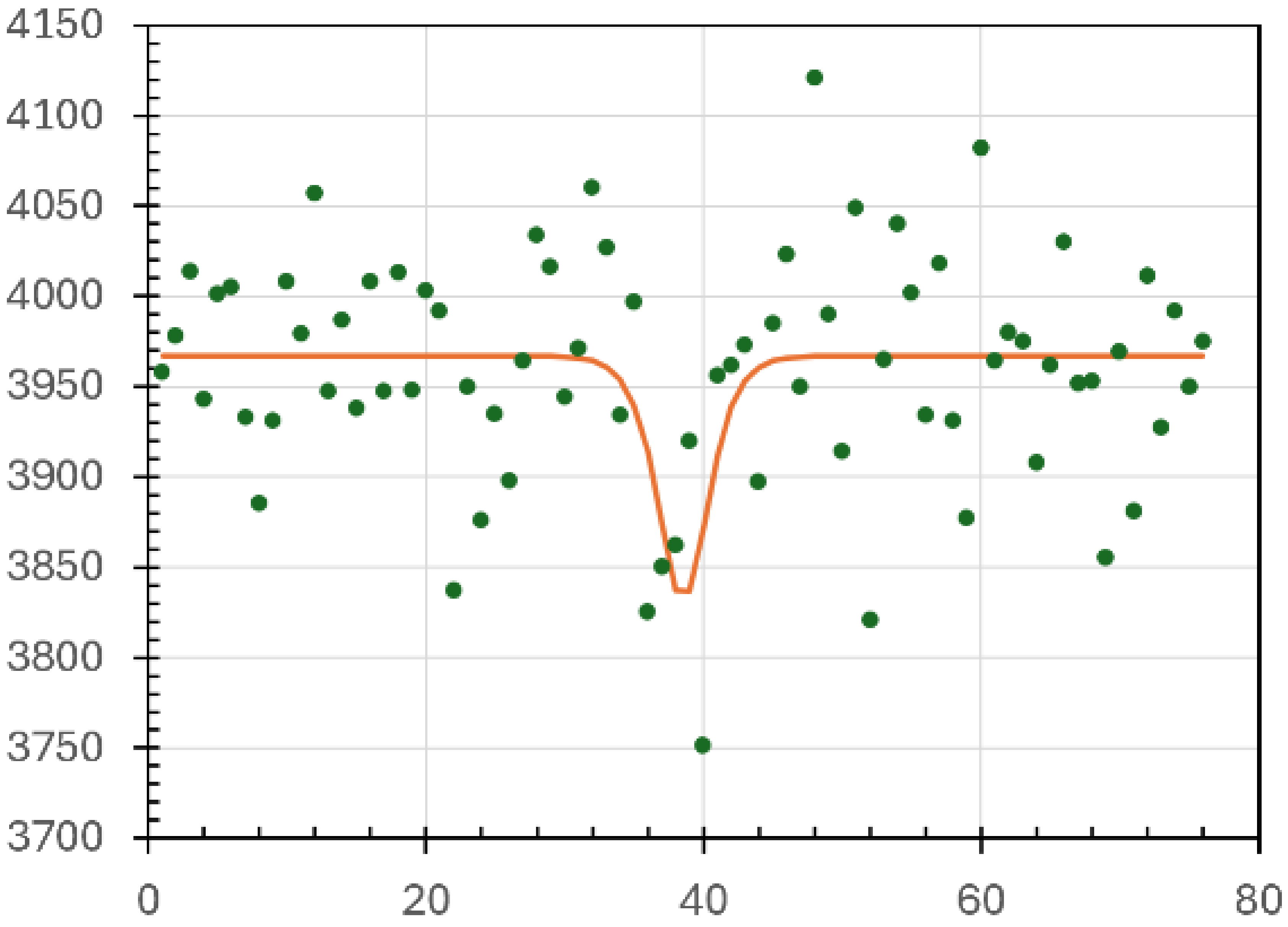
$\kappa = 1.\times 10^{-10}$



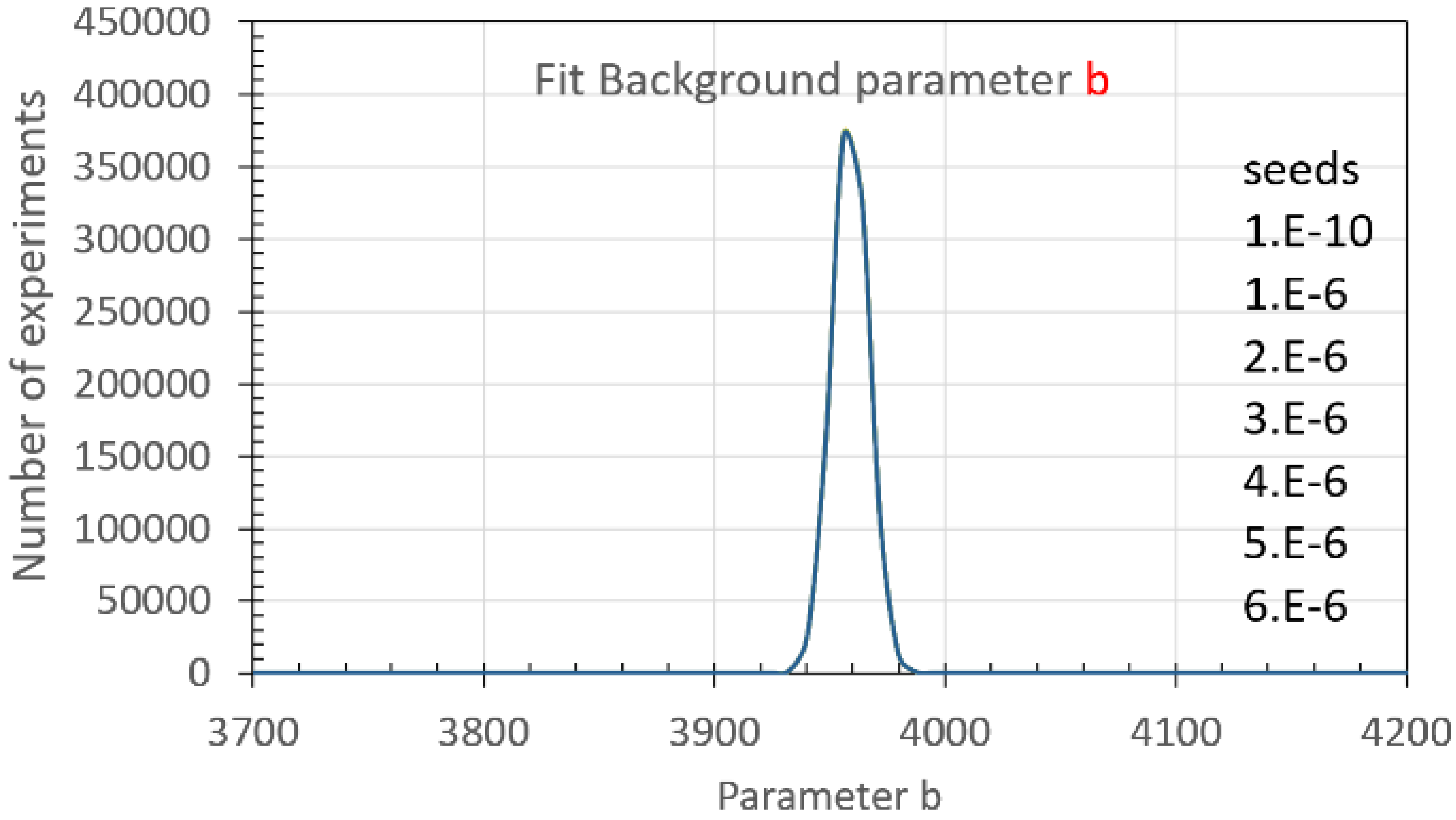
even in the absence of κ, due to statistical fluctuations, fit can show positive of negative effect, like here for time 30’

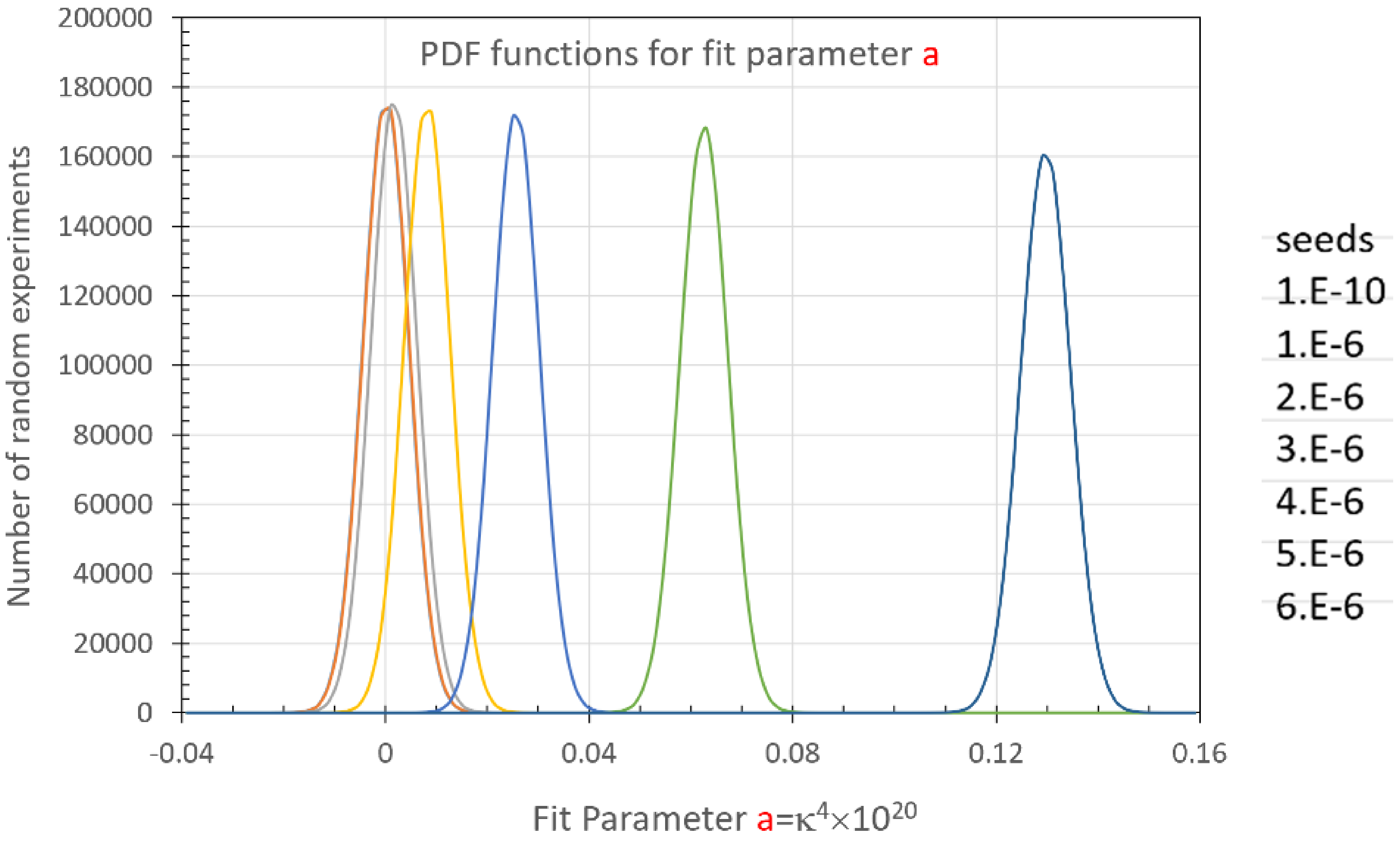
ROI bckgr=2.2 cps

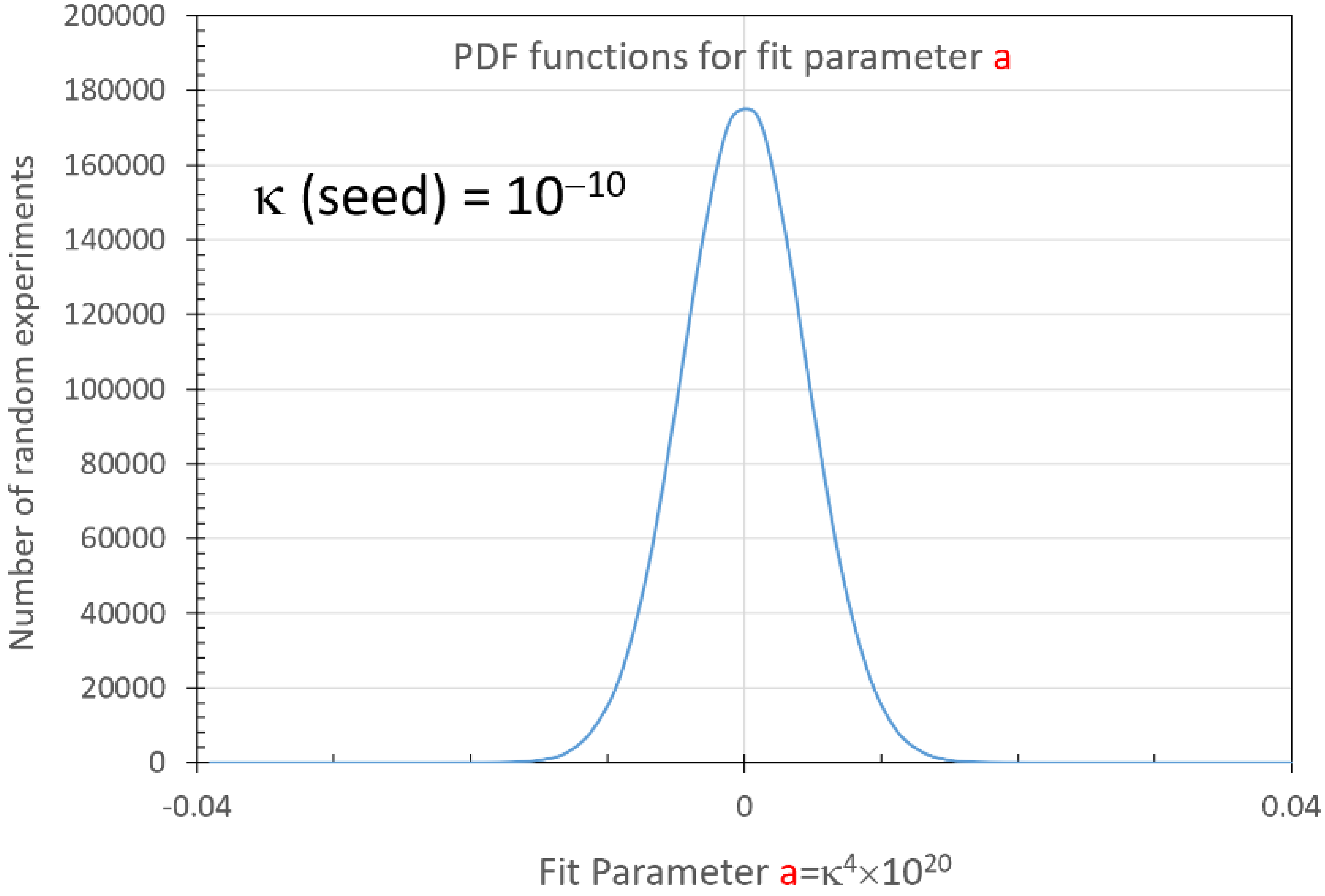
$\kappa = 1.\times 10^{-10}$

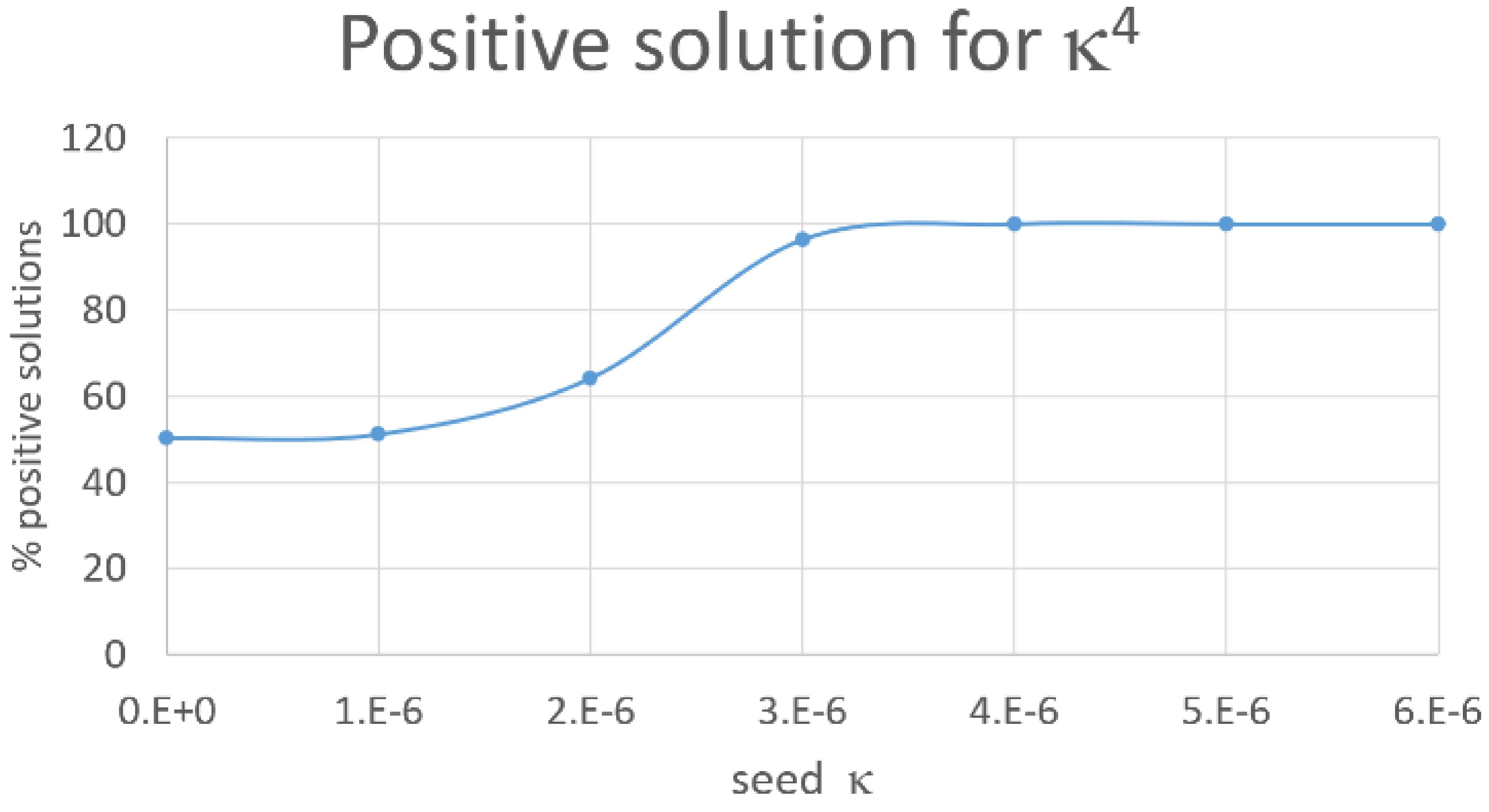


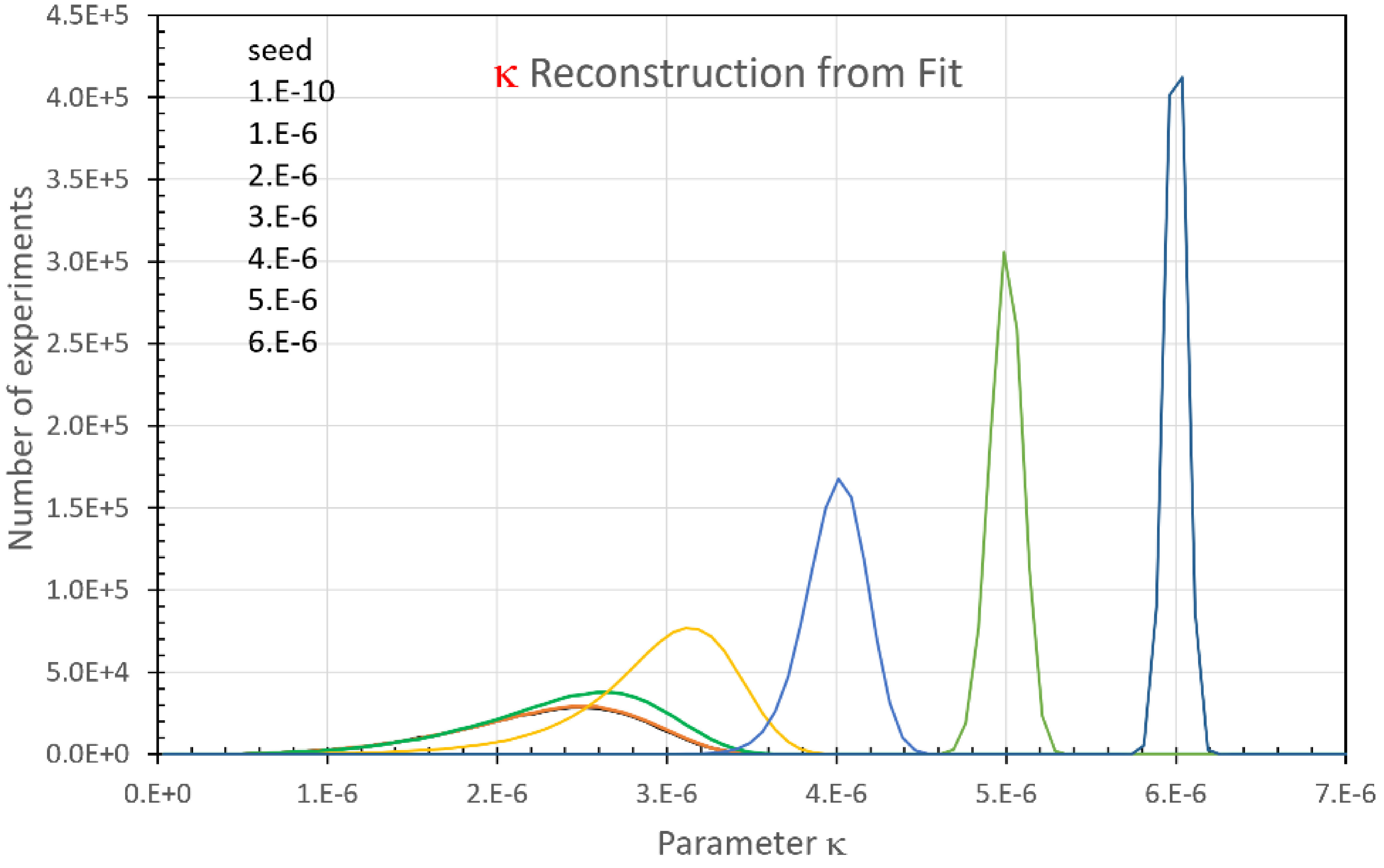
Distribution of fit parameter b for 1,000,000 stat. experiments




PDF functions for fit parameter a
Number of random experiments
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
-0.04
0
0.04
0.08
0.12
0.16
Fit Parameter a=κ4×1020
seeds
1.E-10
1.E-6
2.E-6
3.E-6
4.E-6
5.E-6
6.E-6


PDF functions for fit parameter a
κ (seed) = 10–10
Number of random experiments
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
-0.04
0
0.04
Fit Parameter a=κ4×1020


Positive solution for κ4
% positive solutions
120
100
80
60
40
20
0
0.E+0
1.E-6
2.E-6
3.E-6
4.E-6
5.E-6
6.E-6
seed κ

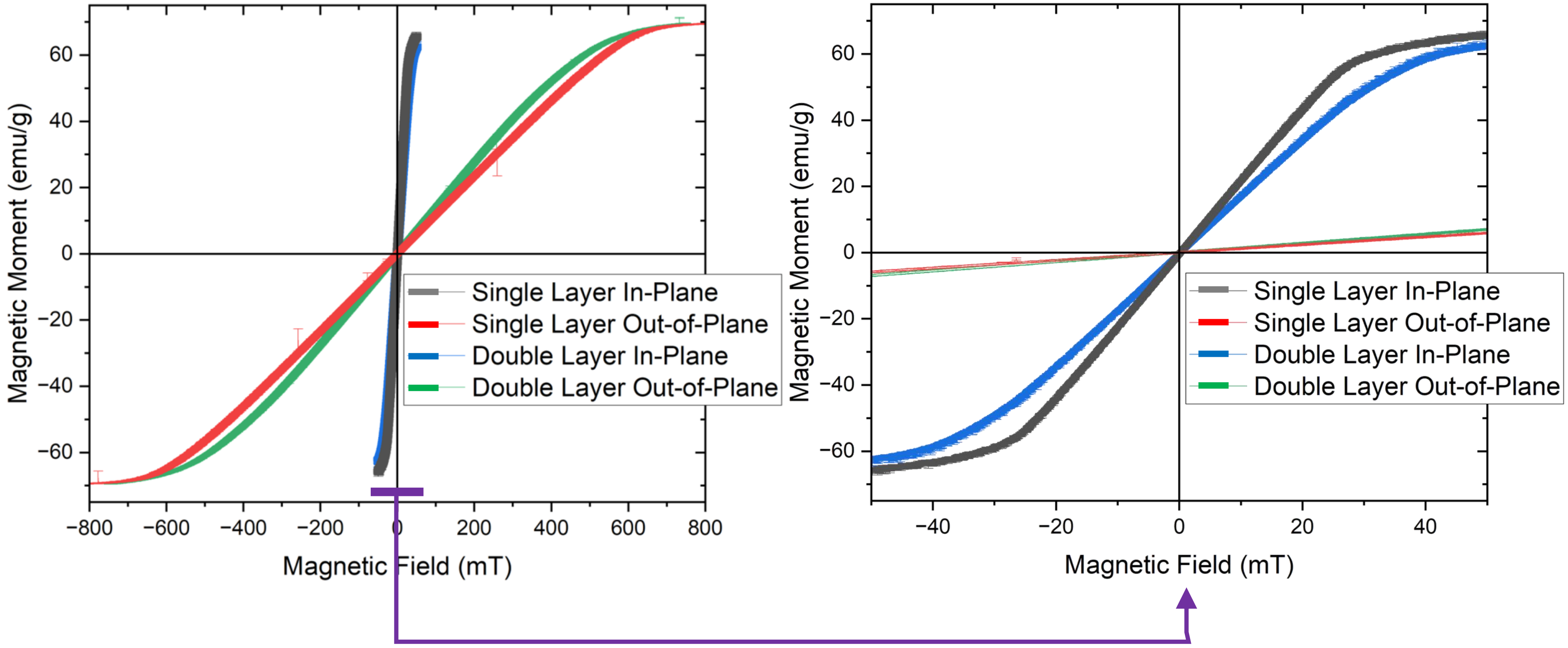

κ Reconstruction from Fit
seed
1.E-10
1.E-6
2.E-6
3.E-6
4.E-6
5.E-6
6.E-6
Number of experiments
Parameter κ
4.5E+5
4.0E+5
3.5E+5
3.0E+5
2.5E+5
2.0E+5
1.5E+5
1.0E+5
5.0E+4
0.0E+0
0.E+0
1.E-6
2.E-6
3.E-6
4.E-6
5.E-6
6.E-6
7.E-6

Magnetic susceptibility of mu-metal used in nTMM shielding was measured at UT

by UTK Professor Dustin Gilbert dagilbert@utk.edu

in Material Science and Engineering Department (Lisa's connection)

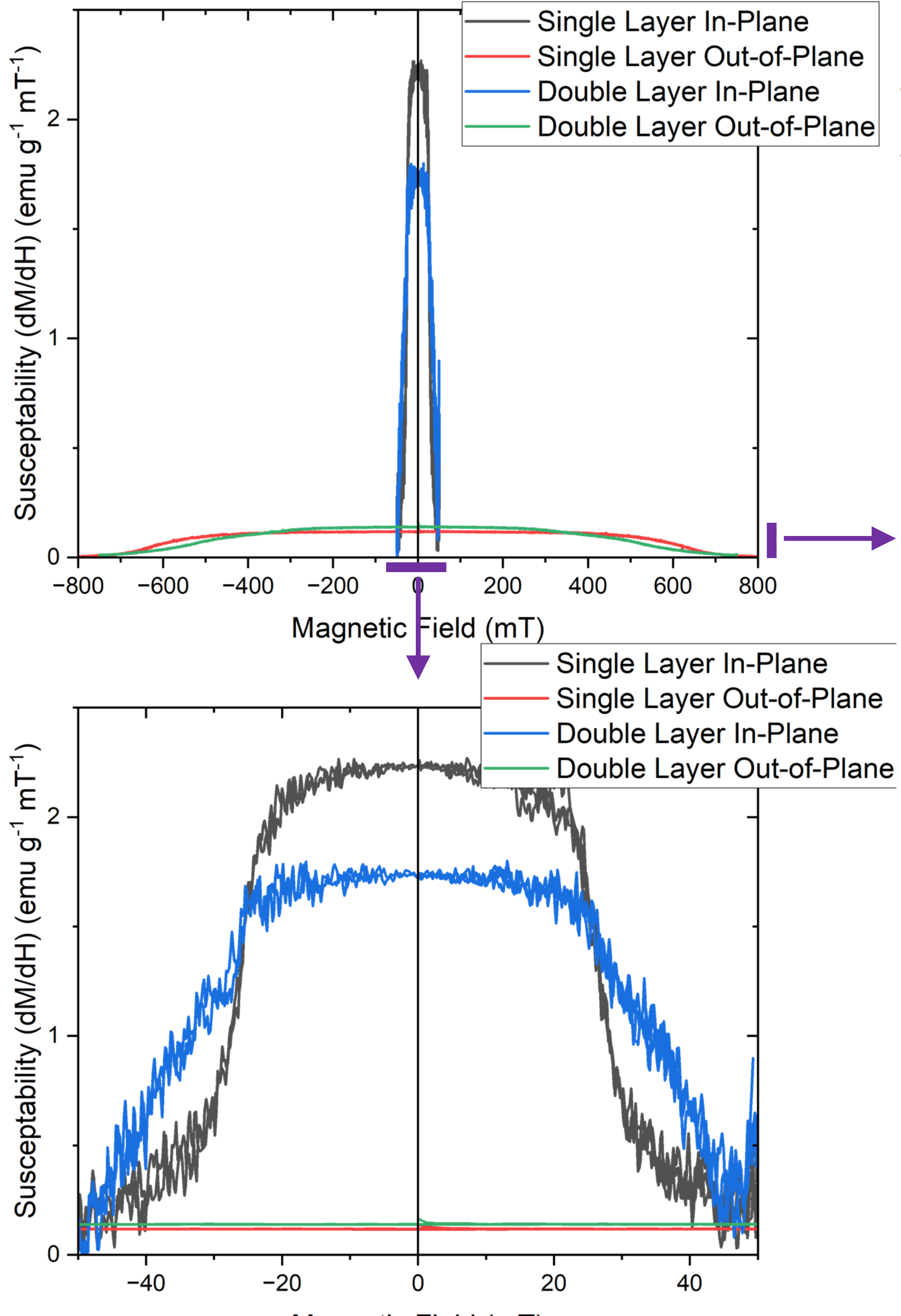
- I am asking Dustin for digital data of his measurements shown below to feed COMSOL simulations

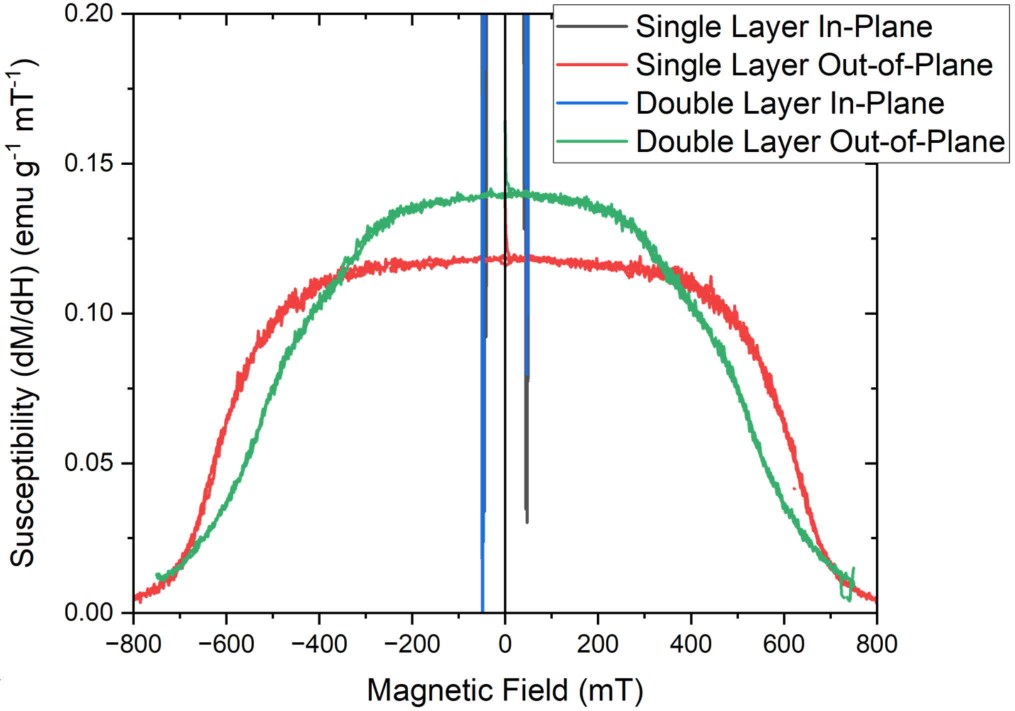


Magnetization versus magnetic field

The saturation field of the MuMetal measured in-plane versus out-of-plane is significantly different (shape anisotropy, the out-of-plane direction has self demagnetizing fields)

There are also differences in the loop shape of the single layer versus double layer, also likely due to the shape anisotropy (the double layer has less shape anisotropy because the aspect ratio is effectively less)





This is the susceptibility. If you need an explicit value to put into your COMSOL simulations, use the in-plane value, measured at the field you are operating at – the shape anisotropy contributes nothing for the in-plane measurements.

These are susceptibility and magnetization normalized by mass, if you need it volume normalized, the density I measured was 7 g/cm3 (so take these values and multiply by 7)