Agenda of ORNL-UTK-UKY-LU zoom meeting August 18, 2025

1.	Lisa 5'	Update on the start beam time
2.	Yuri 10'	How we will see nTMM
3.	Matt 10'	Update on the neutron thresholds analysis
4.	Mubi 10'	UKY my prototype and COMSOL simul.
5.	Yuri 10'	Mu-metal susceptibility measurement by Dustin Gilbert (UTK)
6.	Shaun 5'	Status of UT mu-prototype construction
7.	Yuri 5'	Comment on the new paper from Japan on NNbar with UCN

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

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

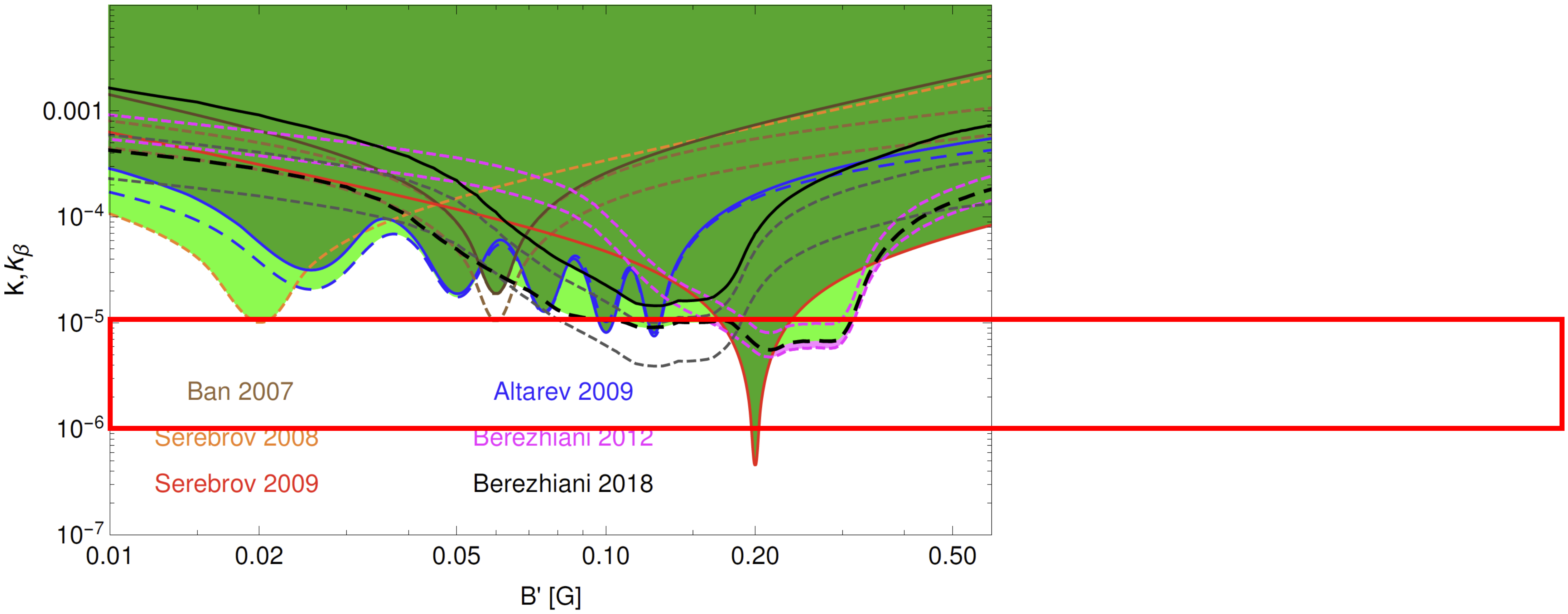
Background rate in ROI 20 x 20 cm2 :

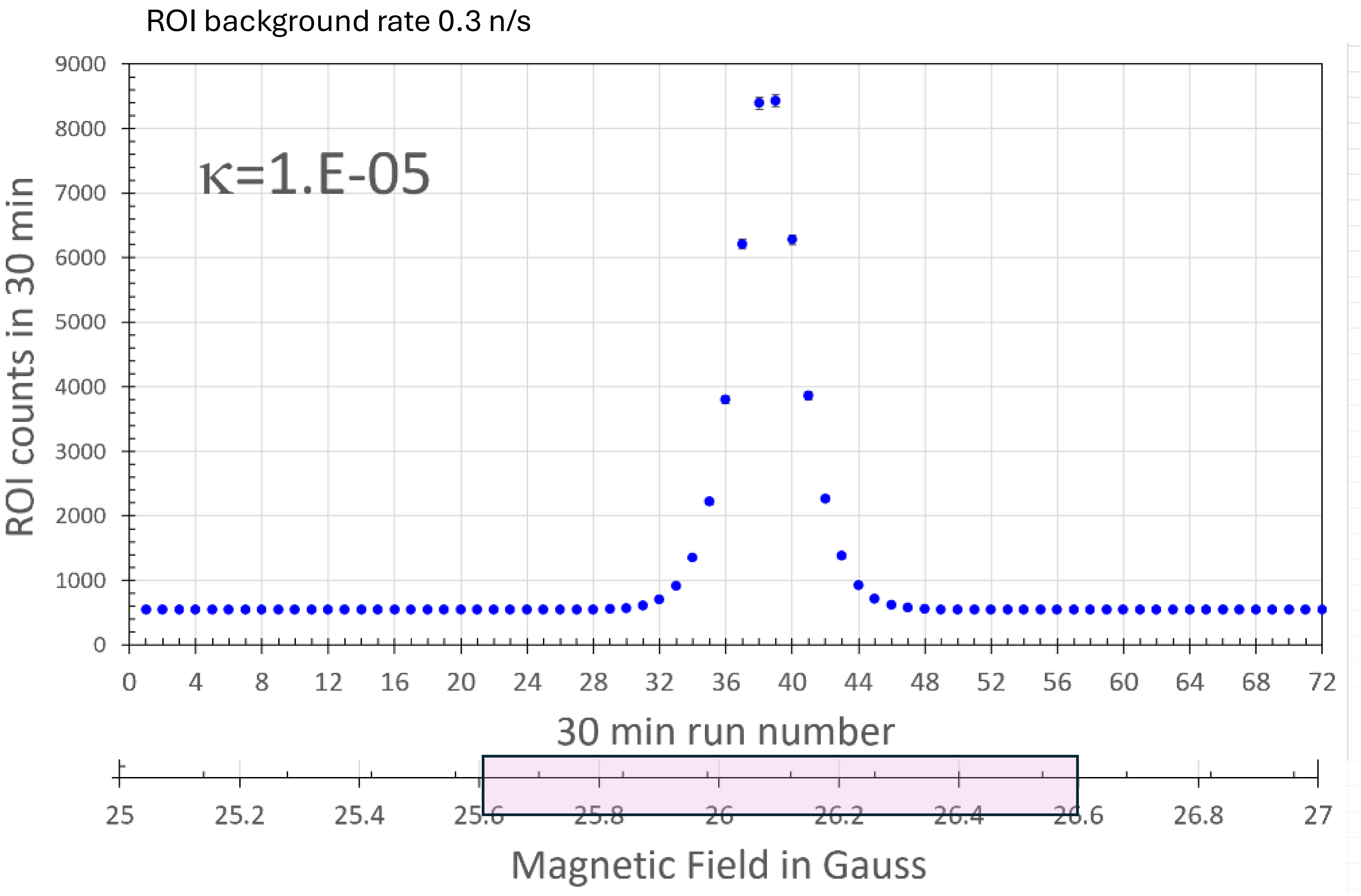
in January 2024 at 20 m with neutron beam ~ 2.2 n/s
in July 2021 at 20 m with neutron beam > 5.8 n/s

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

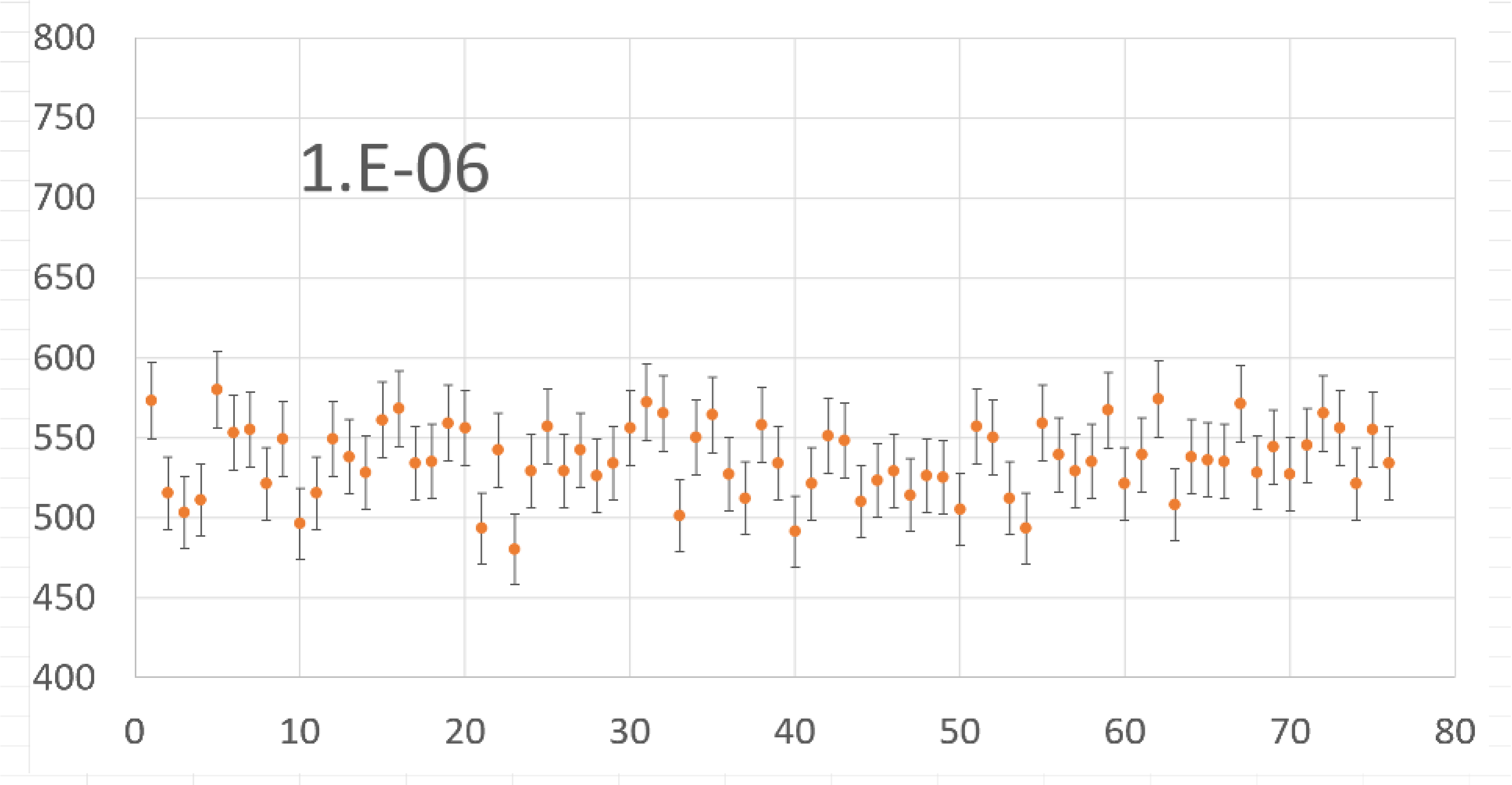
For simulations we assume ~ 0.3 n/s

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

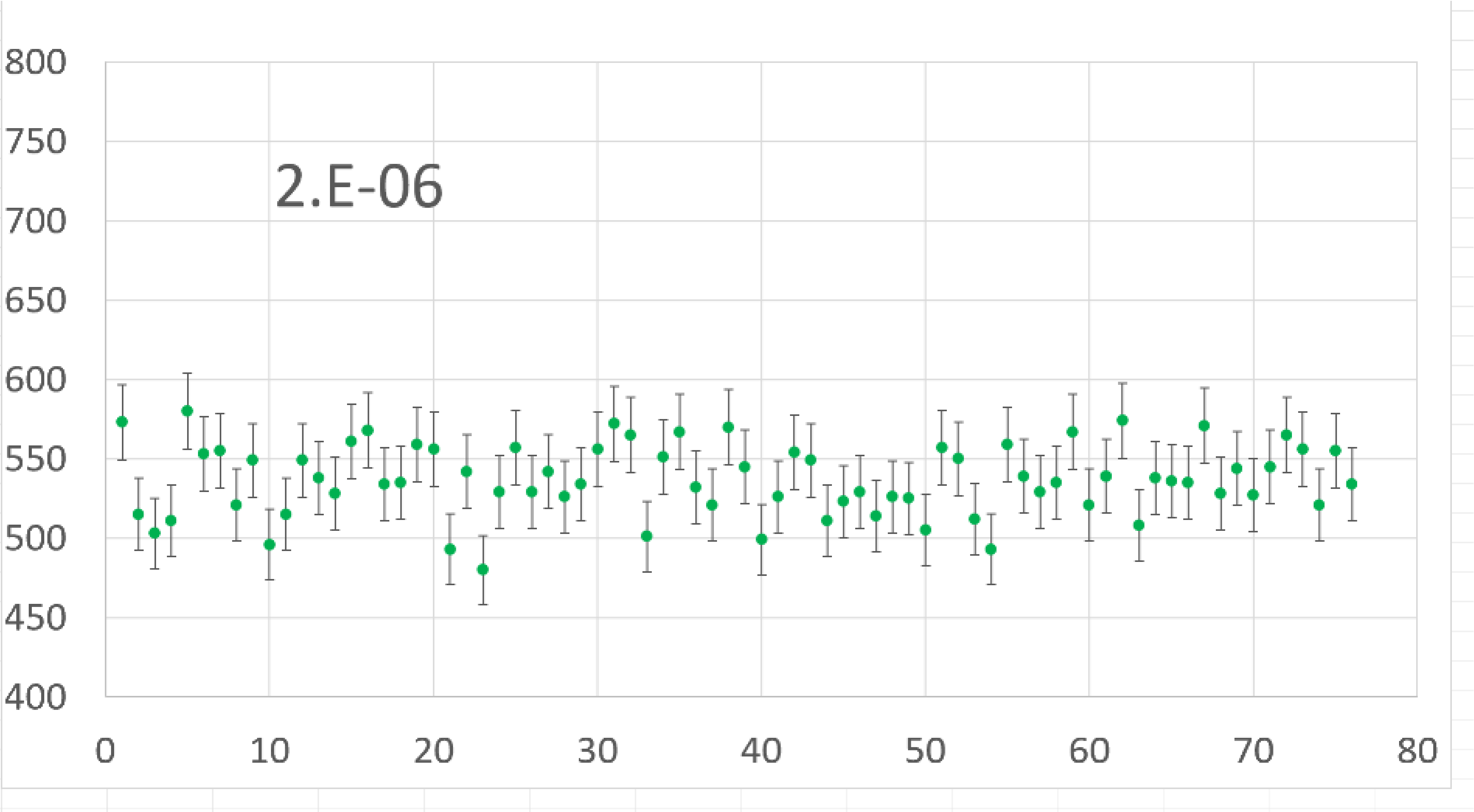



ROI background rate 0.3 n/s
κ=1.E-05
ROI counts in 30 min
30 min run number
Magnetic Field in Gauss
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72
25 25.2 25.4 25.6 25.8 26 26.2 26.4 26.6 26.8 27

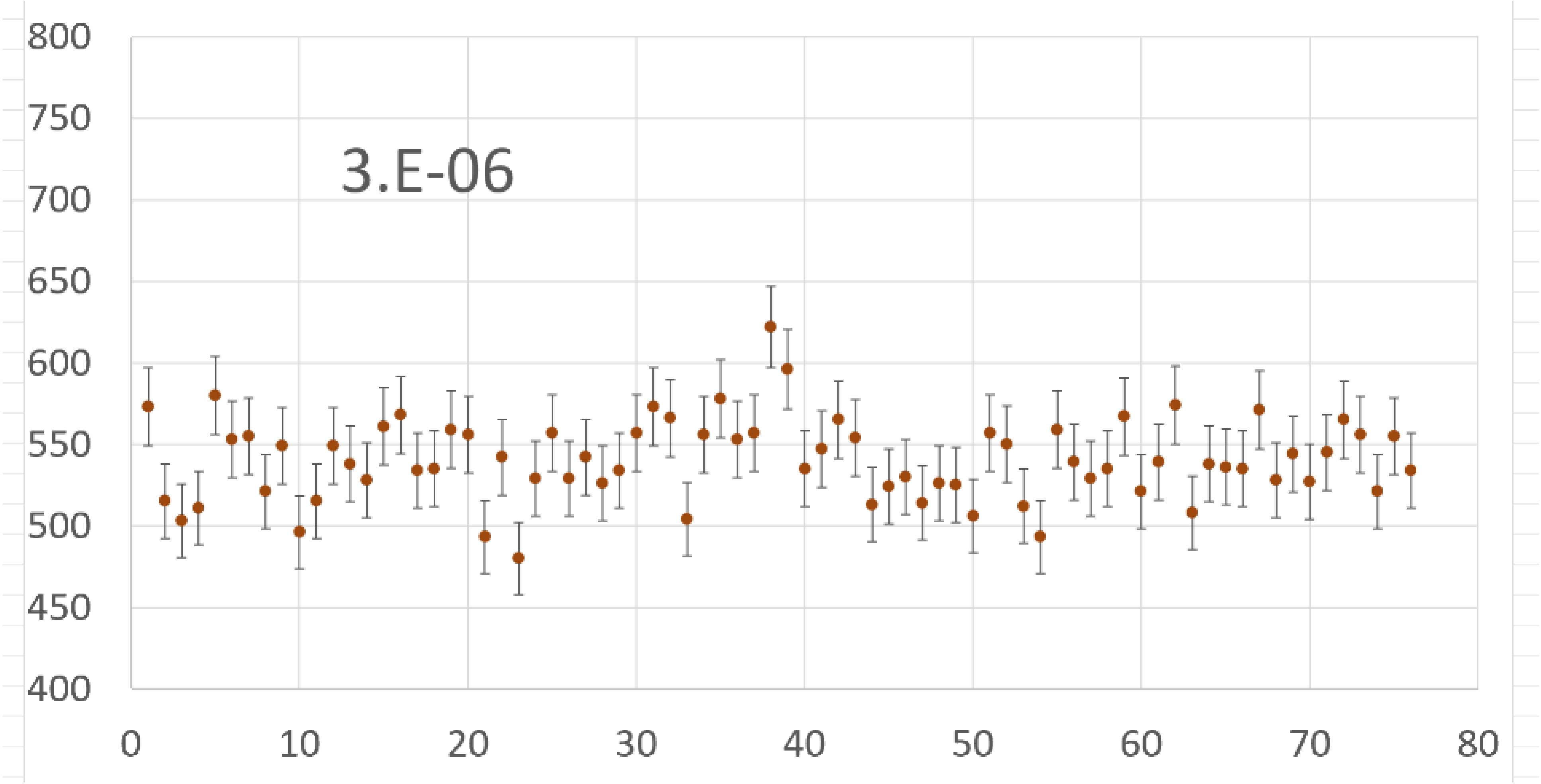
ROI background rate 0.3 n/s



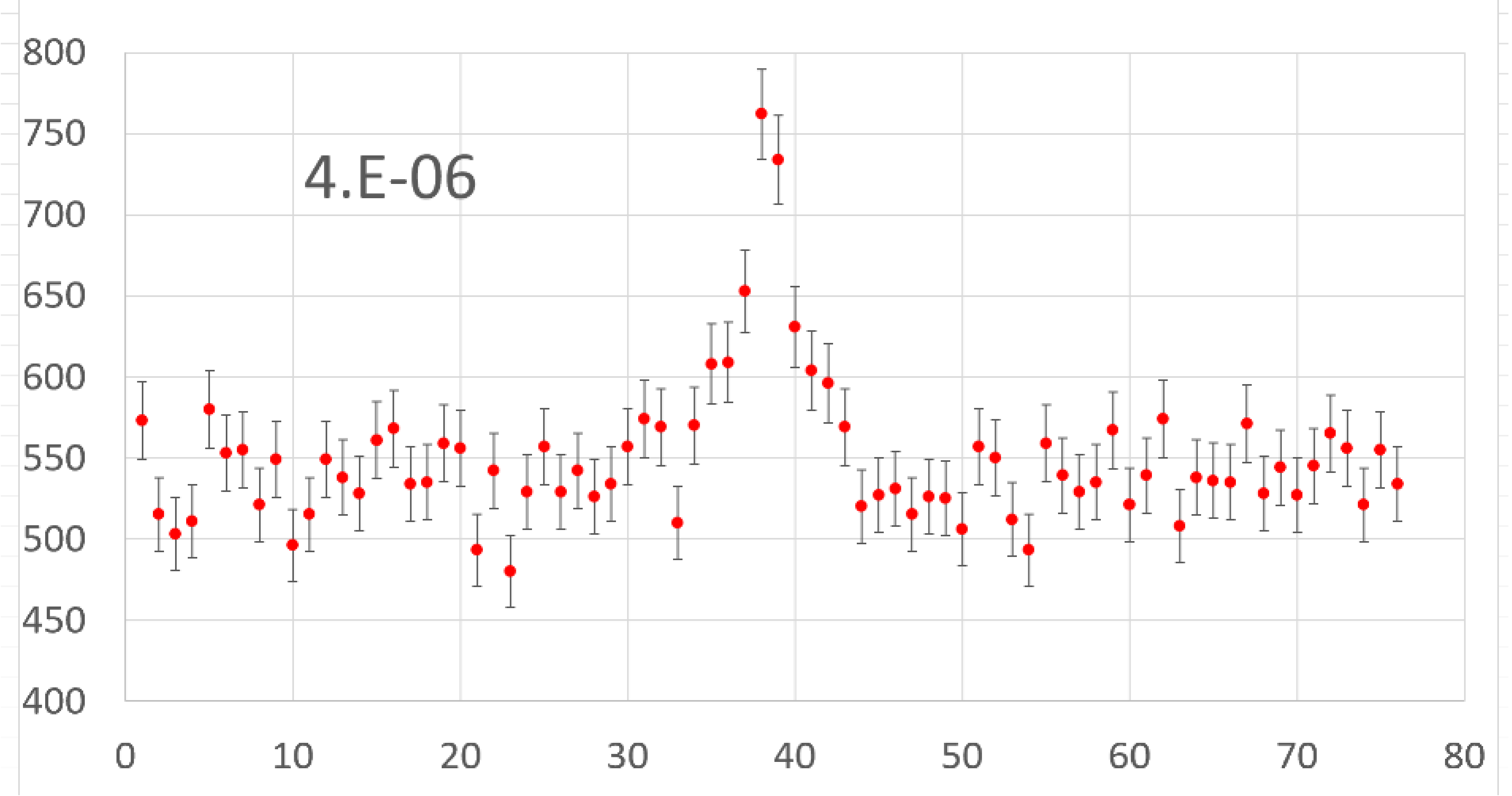
ROI background rate 0.3 n/s



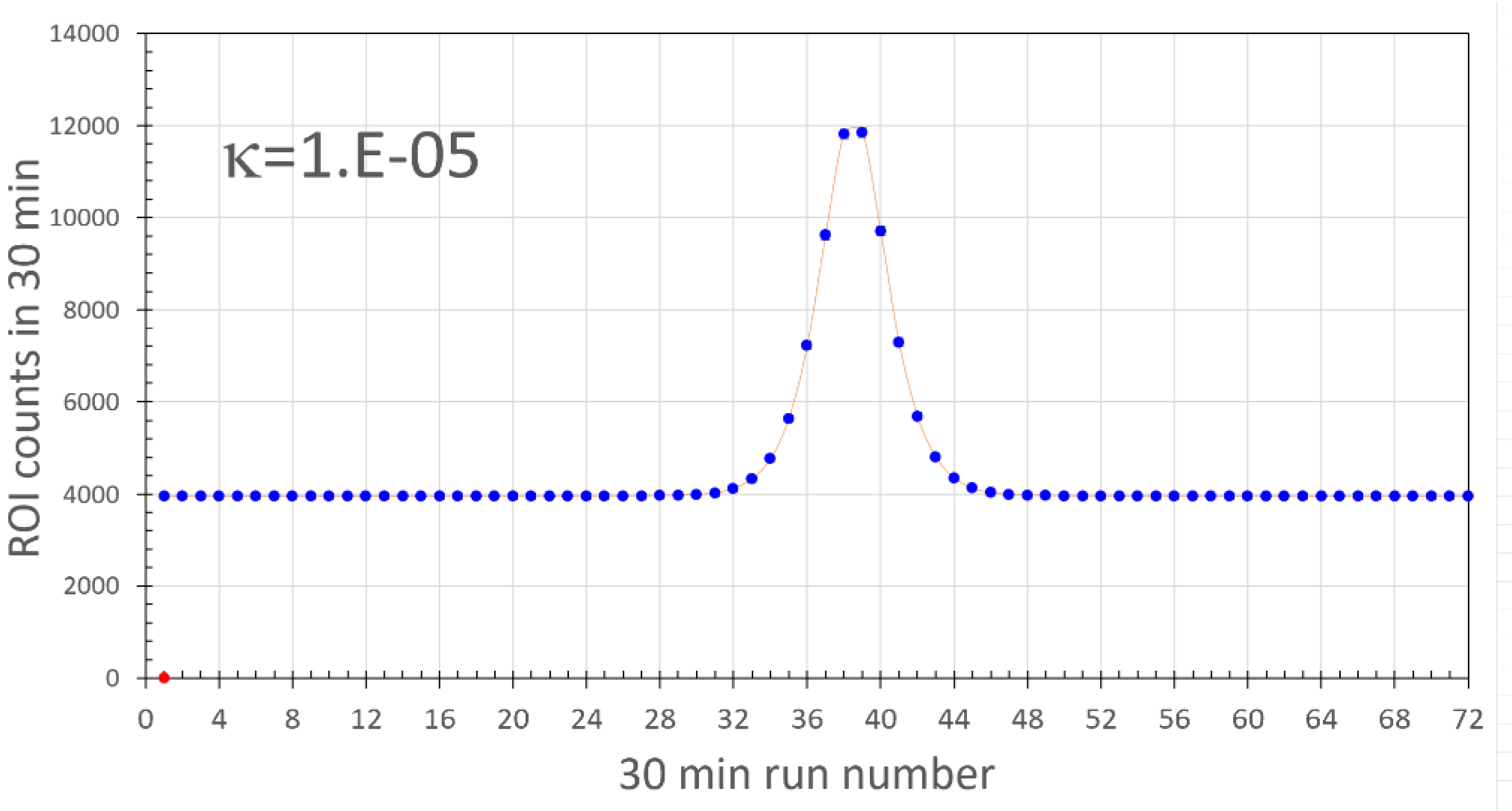
ROI background rate 0.3 n/s



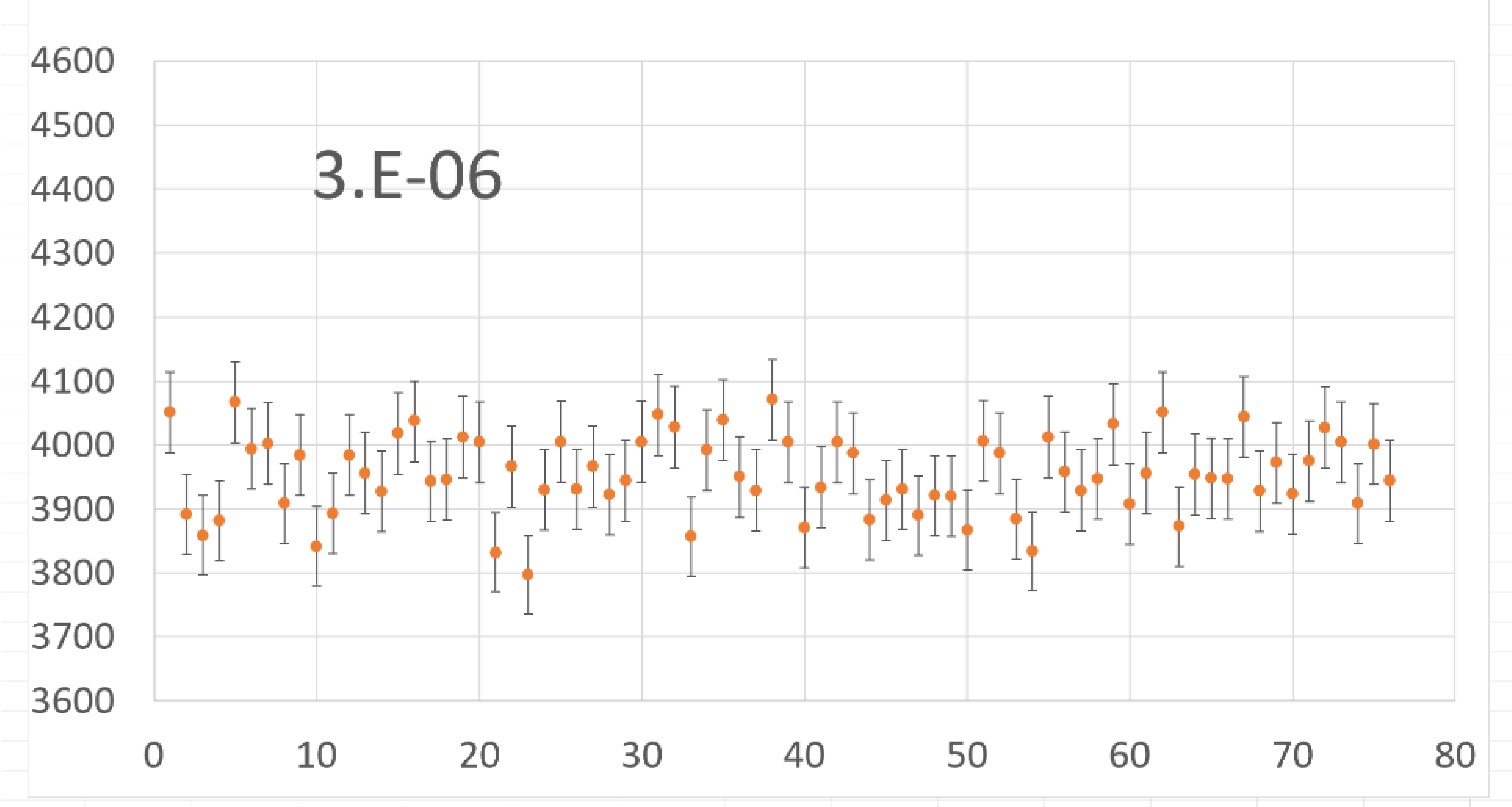
ROI background rate 0.3 n/s



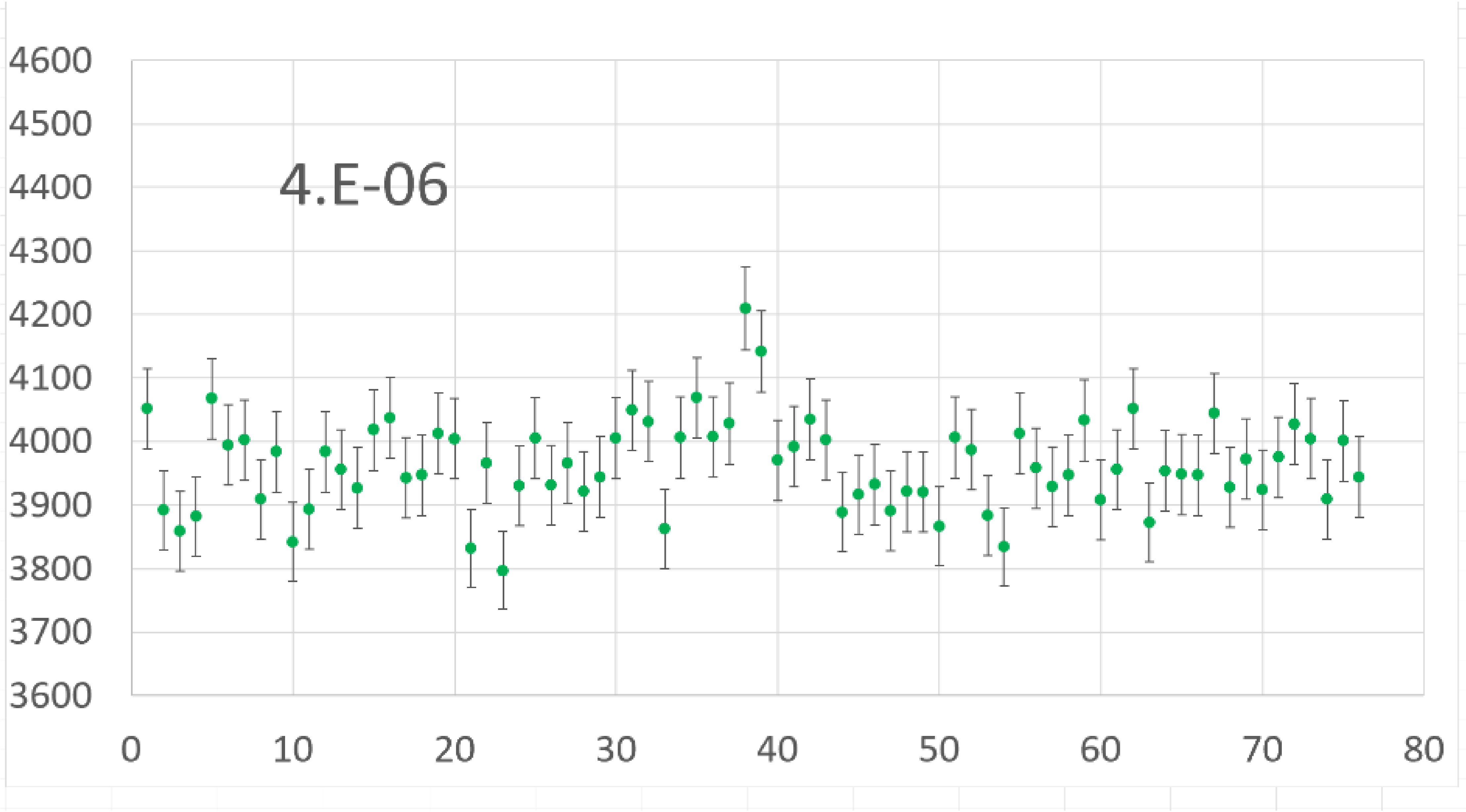
Now with ROI background rate 2.2 n/s



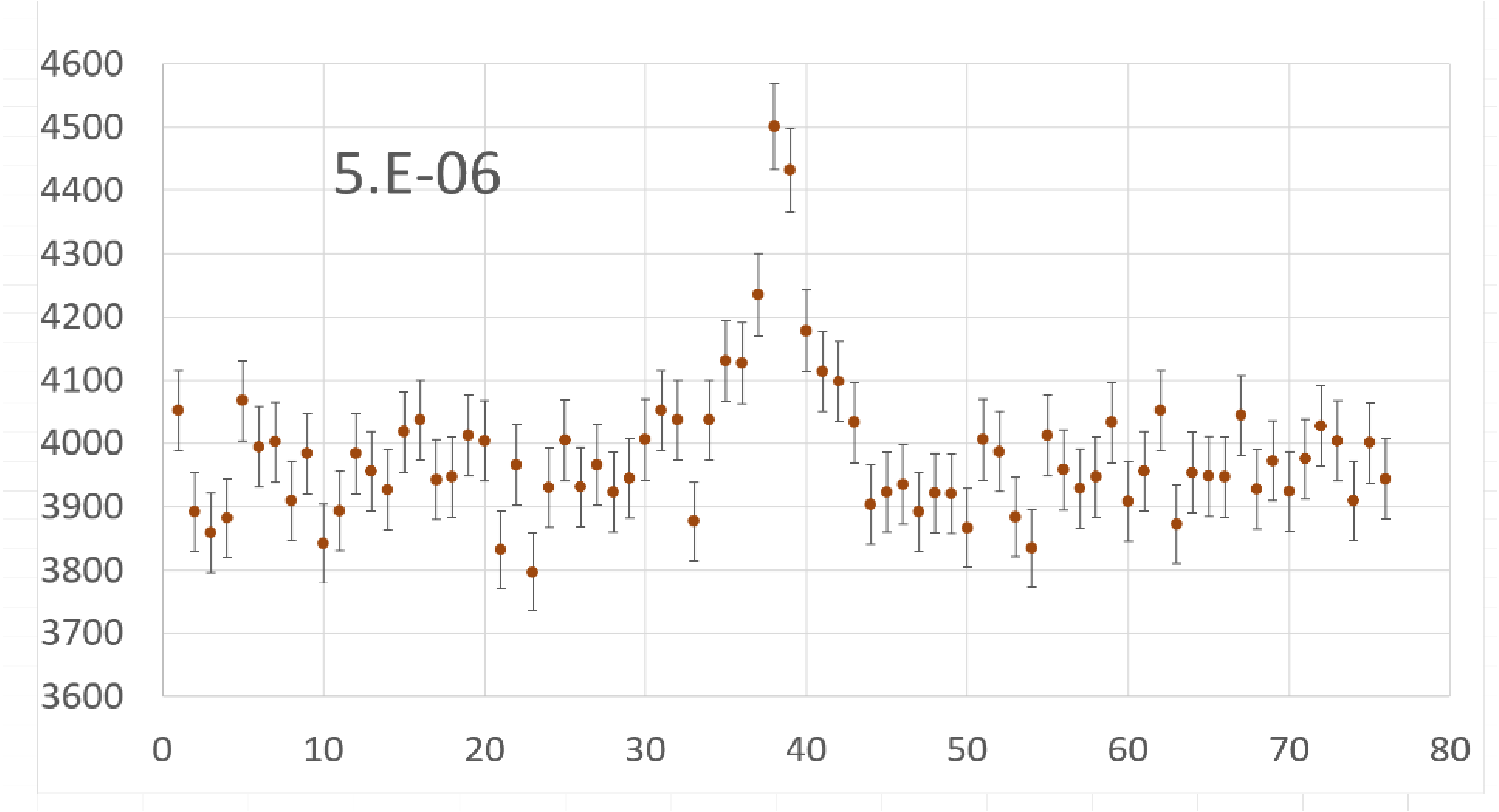
ROI background rate 2.2 n/s



ROI background rate 2.2 n/s



ROI background rate 2.2 n/s



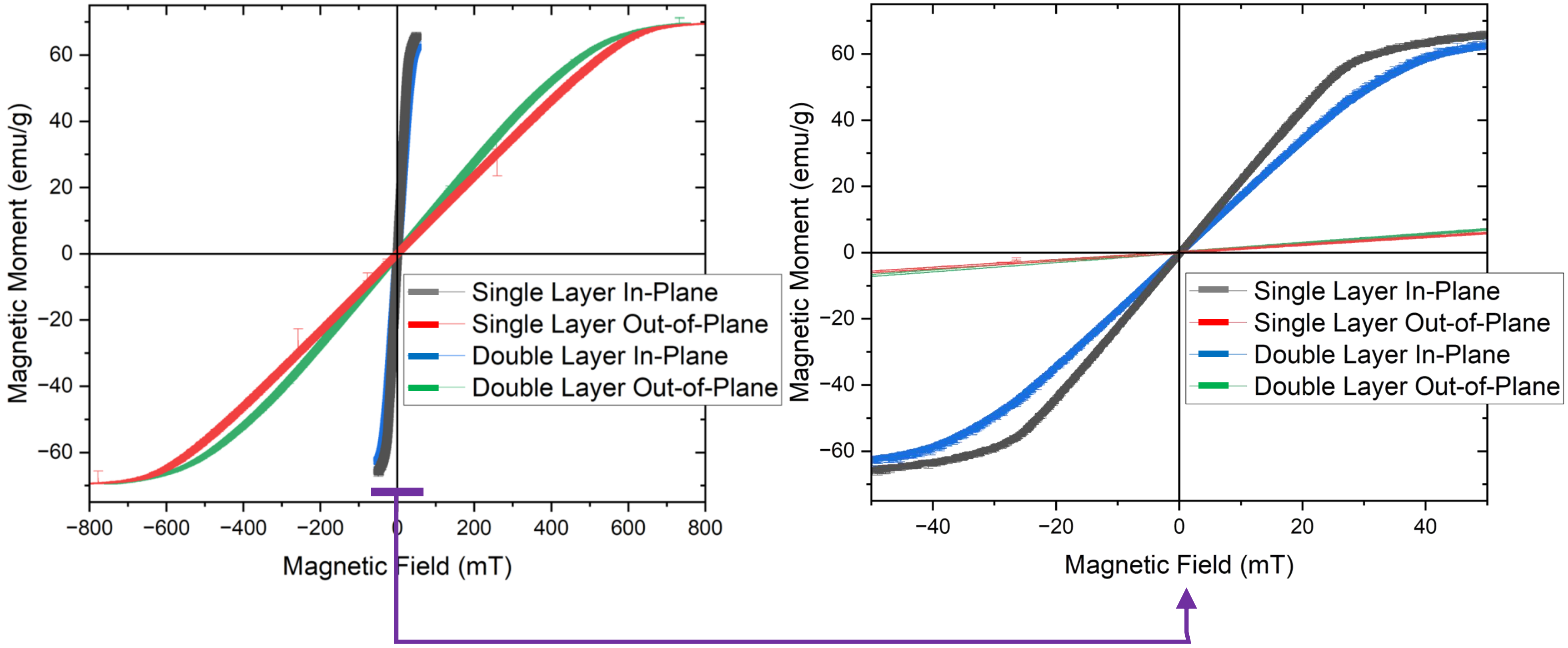
August 18, 2025 for zoom meeting

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)

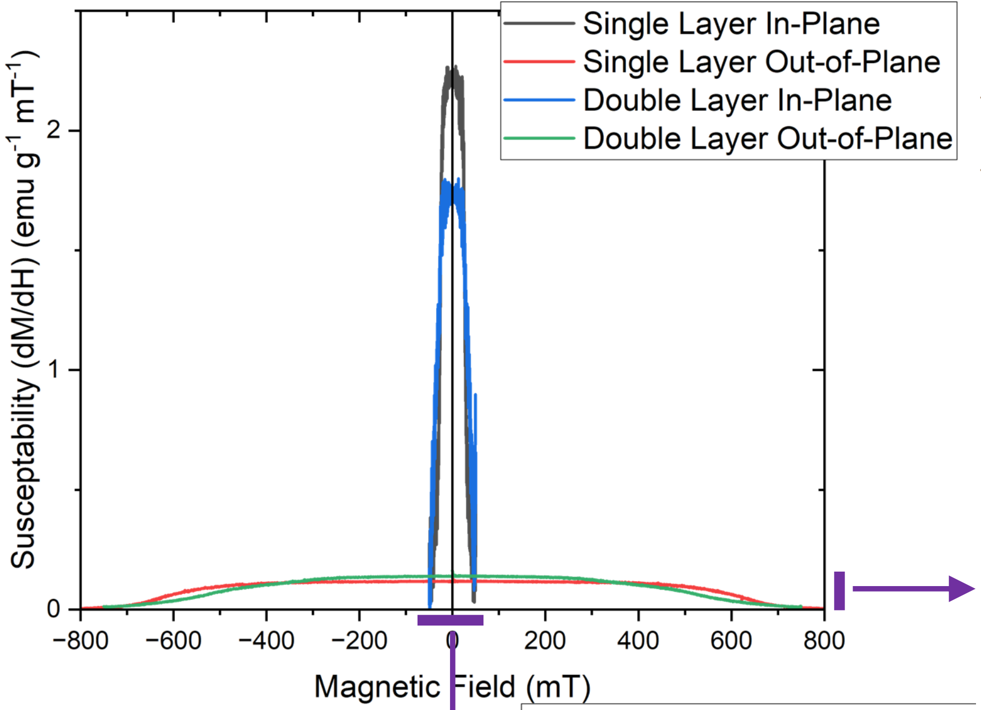
- I am asking Dustin for digital data of his measurements shown below to feed COMSOL simulations

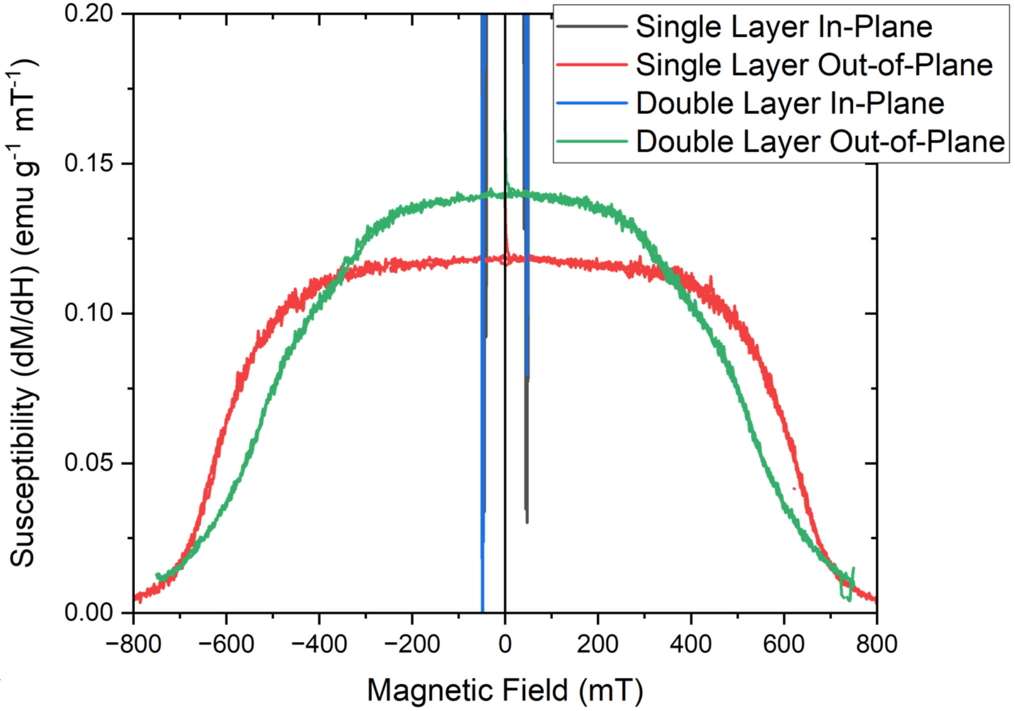


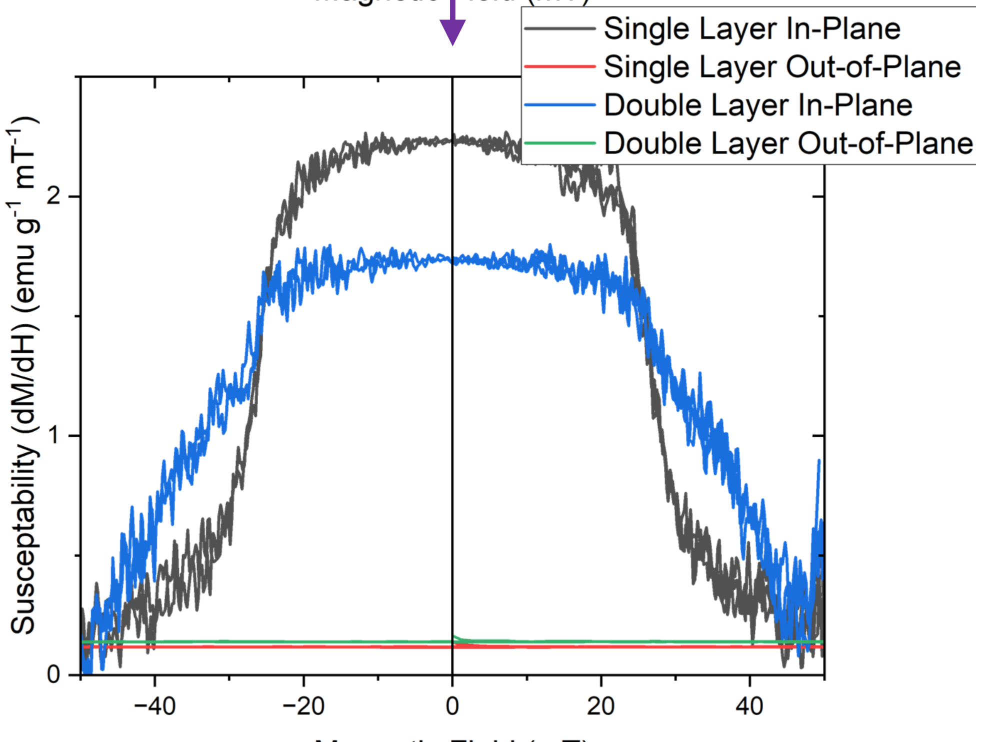
Magnetization versus magnetic field

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)

symmetry

MDPI

Type of the Paper (Article)

Experimental search for neutron-antineutron oscillation with use of ultra-cold neutrons revisited

Tatsushi Shima*

Research Center for Nuclear Physics. The University of Osaka
* Correspondence: shima@rcnp.osaka-u.ac.jp

Abstract

Neutron–antineutron oscillation (nnbar-osc) is a baryon-number–violating process and a sensitive probe for physics beyond the Standard Model. Ultra-cold neutrons (UCNs) are attractive for nnbar-osc searches because of their long storage time, but earlier analyses indicated that phase shifts on wall reflection differ for neutron and antineutron, leading to severe decoherence and loss of sensitivity. Here we revisit this problem by numerically solving the time-dependent Schrödinger equation for the two-component n/nbar wave function, explicitly including wall interactions. We show that decoherence can be strongly suppressed by selecting a wall material whose neutron and antineutron optical potentials are nearly equal. Using coherent scattering length data and estimates for antineutrons, we identify a Ni–Al (85%-15%) alloy composition that matches the potentials within a few percent while providing a high absolute value, enabling long UCN storage. With such a bottle and an improved UCN source, the sensitivity could reach an oscillation period of nnbar of order 10^{10} s, covering most of the range predicted by certain grand-unified models. This approach revives the feasibility of high-sensitivity nnbar-osc searches using stored UCNs and offers a clear path to probe baryon-number violation far beyond existing limits.