

# IPTS 24916 (2021 Experiment) Revisited

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## Experimental Search for Neutron to Mirror Neutron Oscillations as an Explanation of the Neutron Lifetime Anomaly

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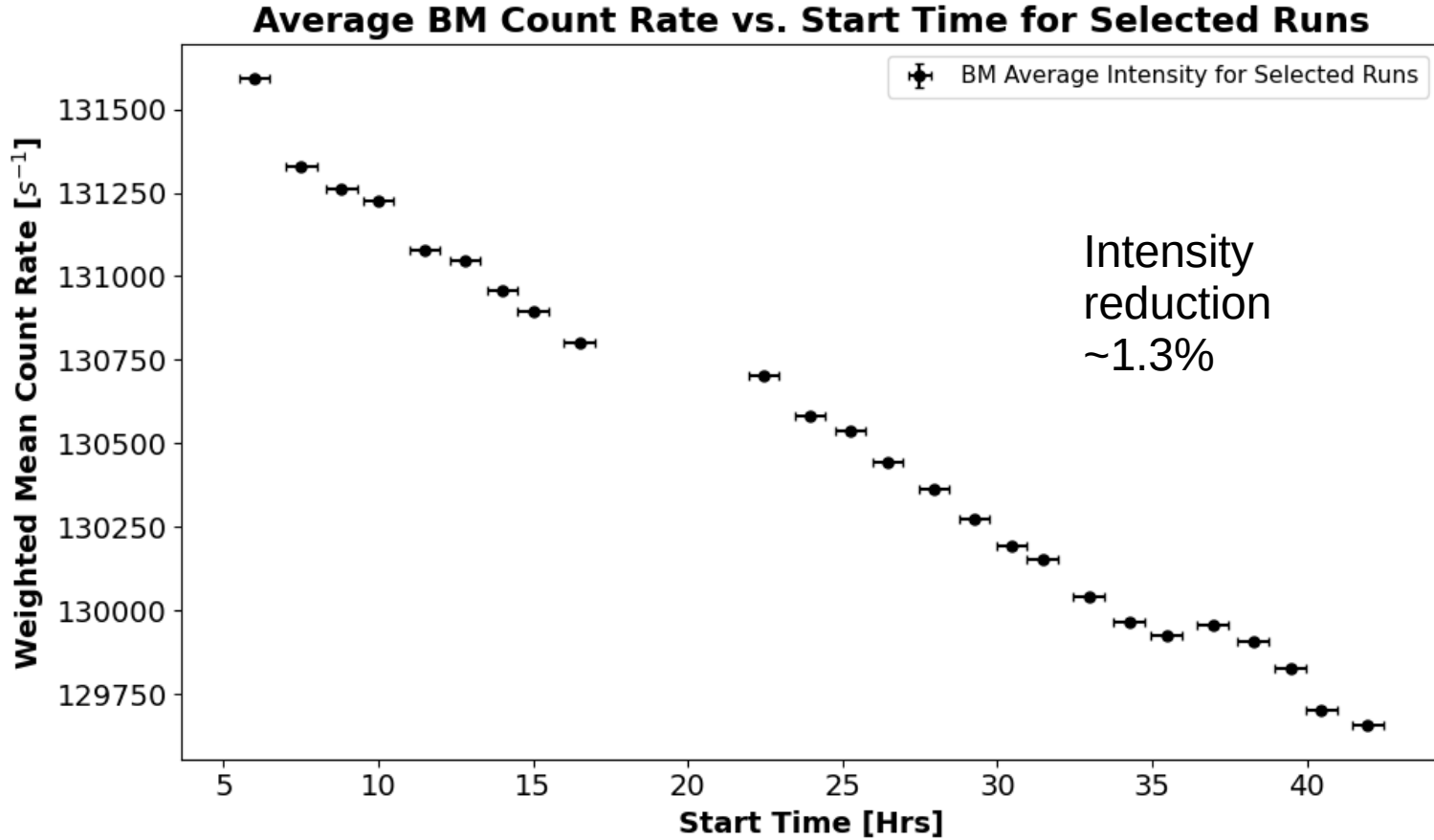
An unexplained  $> 4\sigma$  discrepancy persists between “beam” and “bottle” measurements of the neutron lifetime. A new model proposed that conversions of neutrons  $n$  into mirror neutrons  $n'$ , part of a dark mirror sector, can increase the apparent neutron lifetime by 1% via a small mass splitting  $\Delta m$  between  $n$  and  $n'$  inside the 4.6 T magnetic field of the National Institute of Standards and Technology Beam Lifetime experiment. A search for neutron conversions in a 6.6 T magnetic field was performed at the Spallation Neutron Source which excludes this explanation for the neutron lifetime discrepancy.

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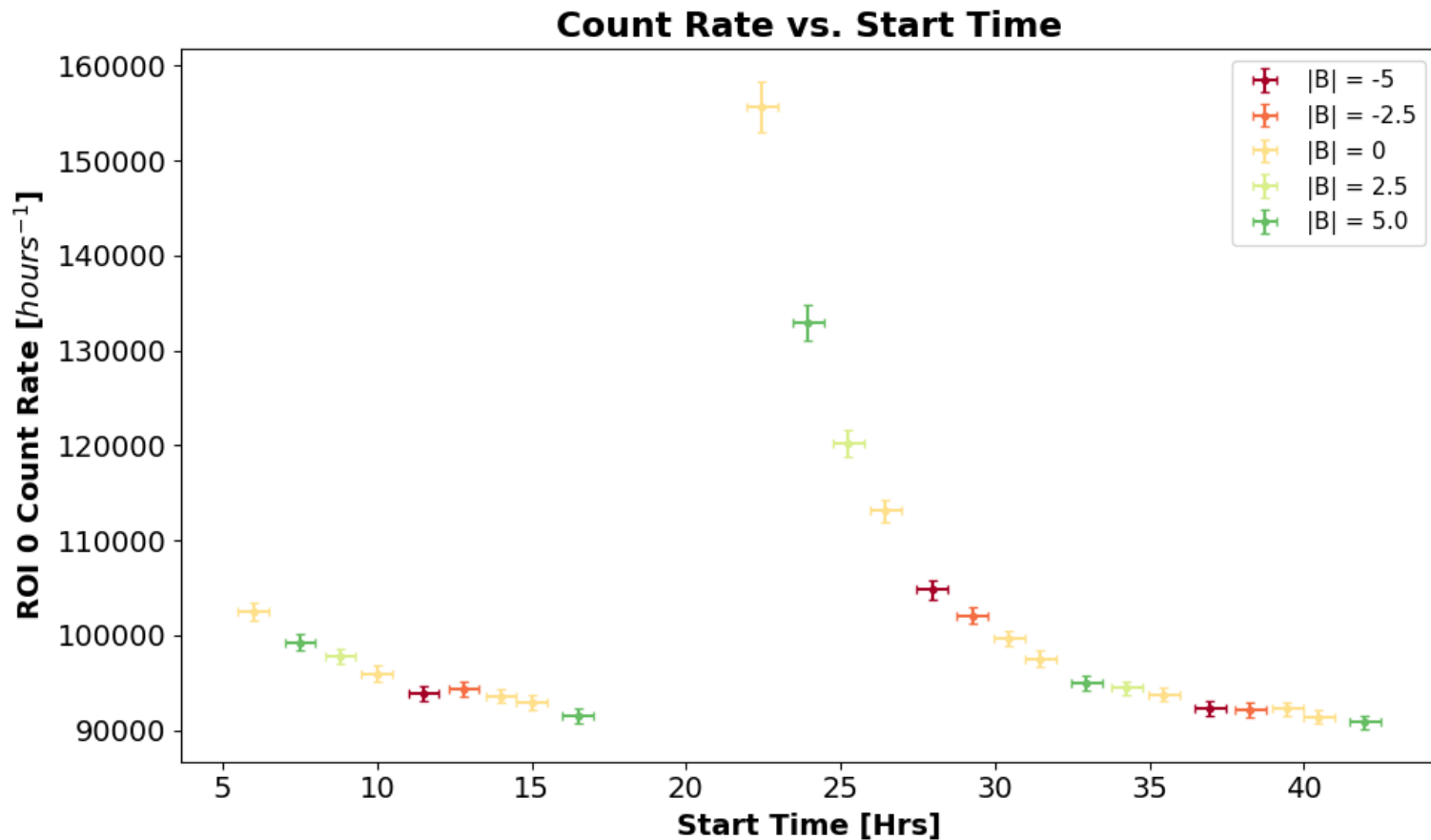


- 1) Exponential fit on  $\Delta t$  histogram for new vs old GPM shows different tau
- 2)  $\Delta t$  histogram shows drop off at high  $\Delta t$
- 3) LEM in 2021 experiment shows unexpected behavior for small  $\Delta t$ ; possible double counting?

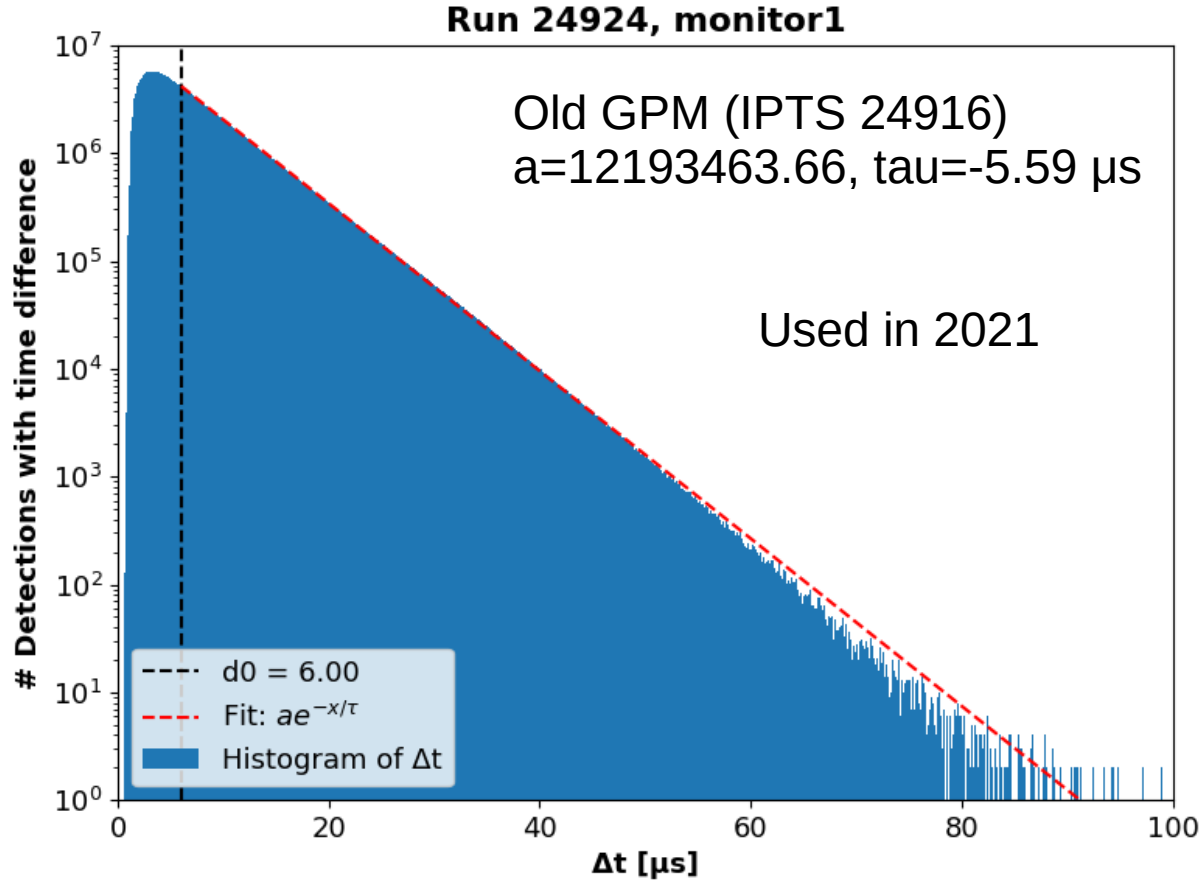
# GPM Countrates in 1 hour runs



# GP-SANS Countrates in 1 hour runs

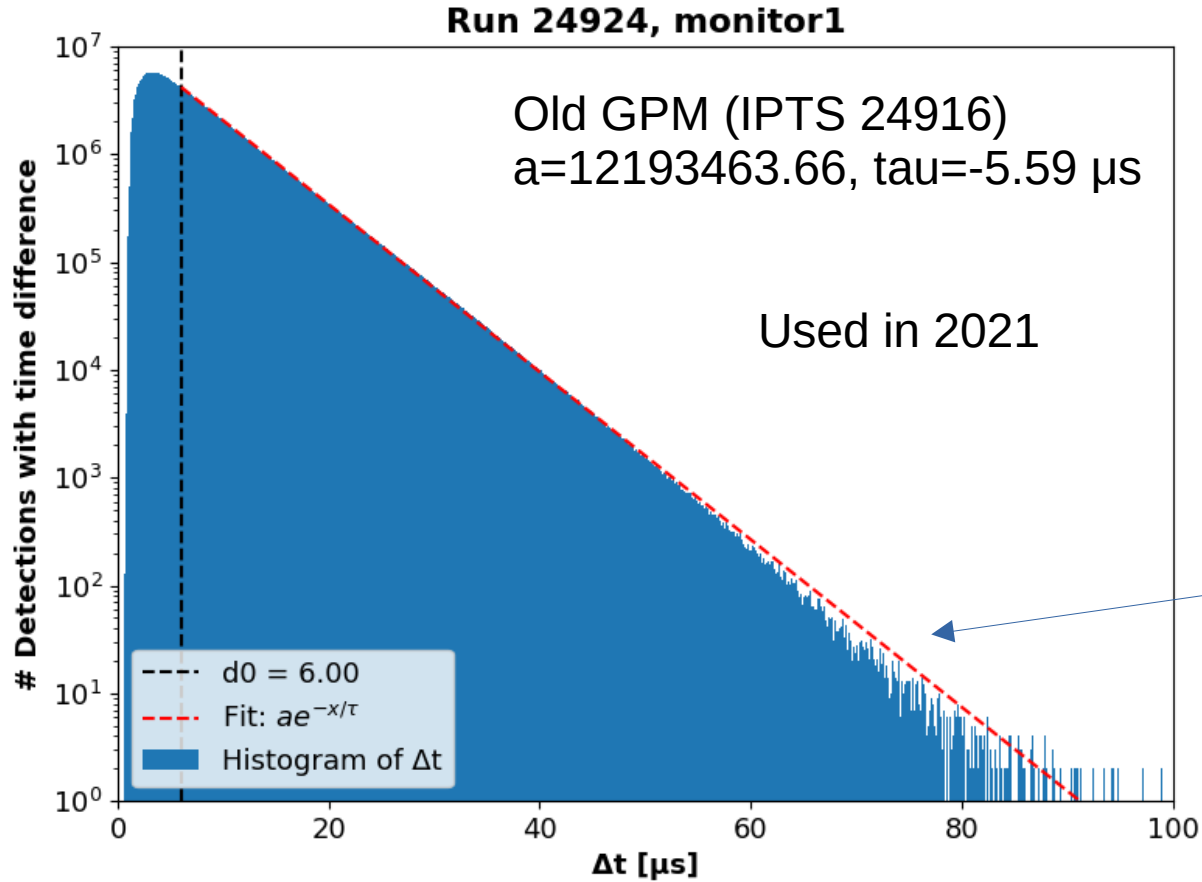


# GPM $\Delta T$ Histogram Slope differs between old vs new monitors



- “New GPM” was installed in 2023
- IPTS 24916 was conducted 2021
- Using exponential fit of  $\Delta t$  histogram past  $6.00\mu\text{s}$ , fit tau was:
  - $5.59 \mu\text{s}$  (OLD)
  - $8.09 \mu\text{s}$  (NEW)

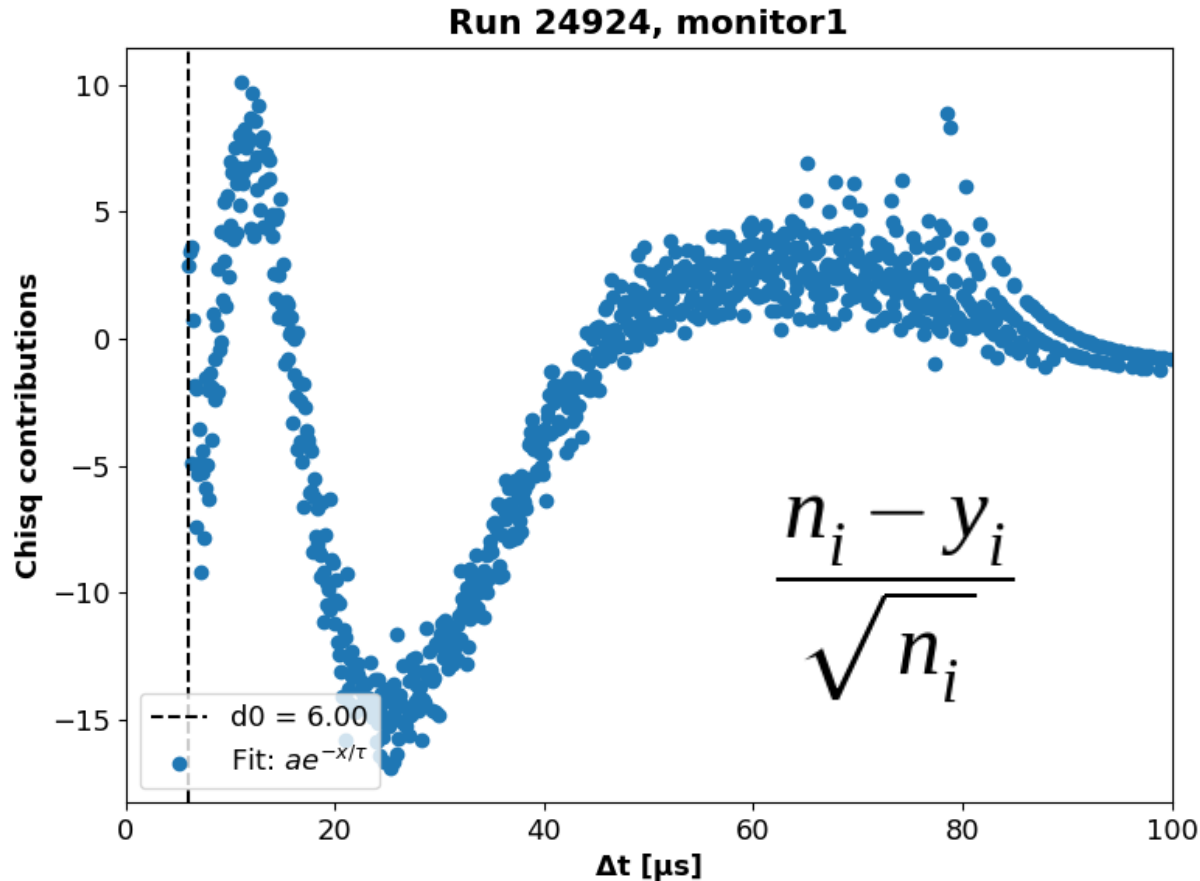
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Newly observed  
Discrepancy

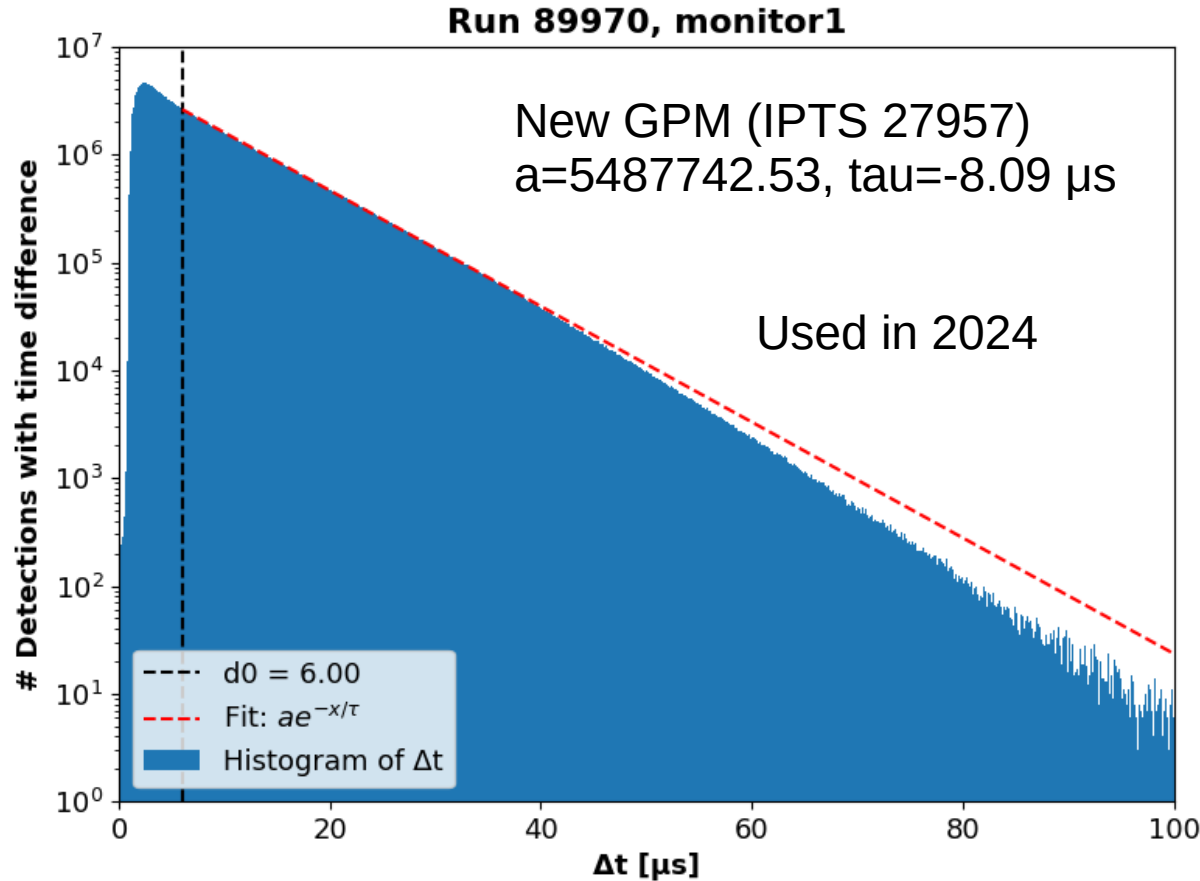
# Residual of fit for GPM in 2021 experiment



$$\chi^2 = \sum \left( \frac{n_i - y_i}{\sqrt{n_i}} \right)^2$$

- Residual plotted by “chi squared contributions” to show relative effect

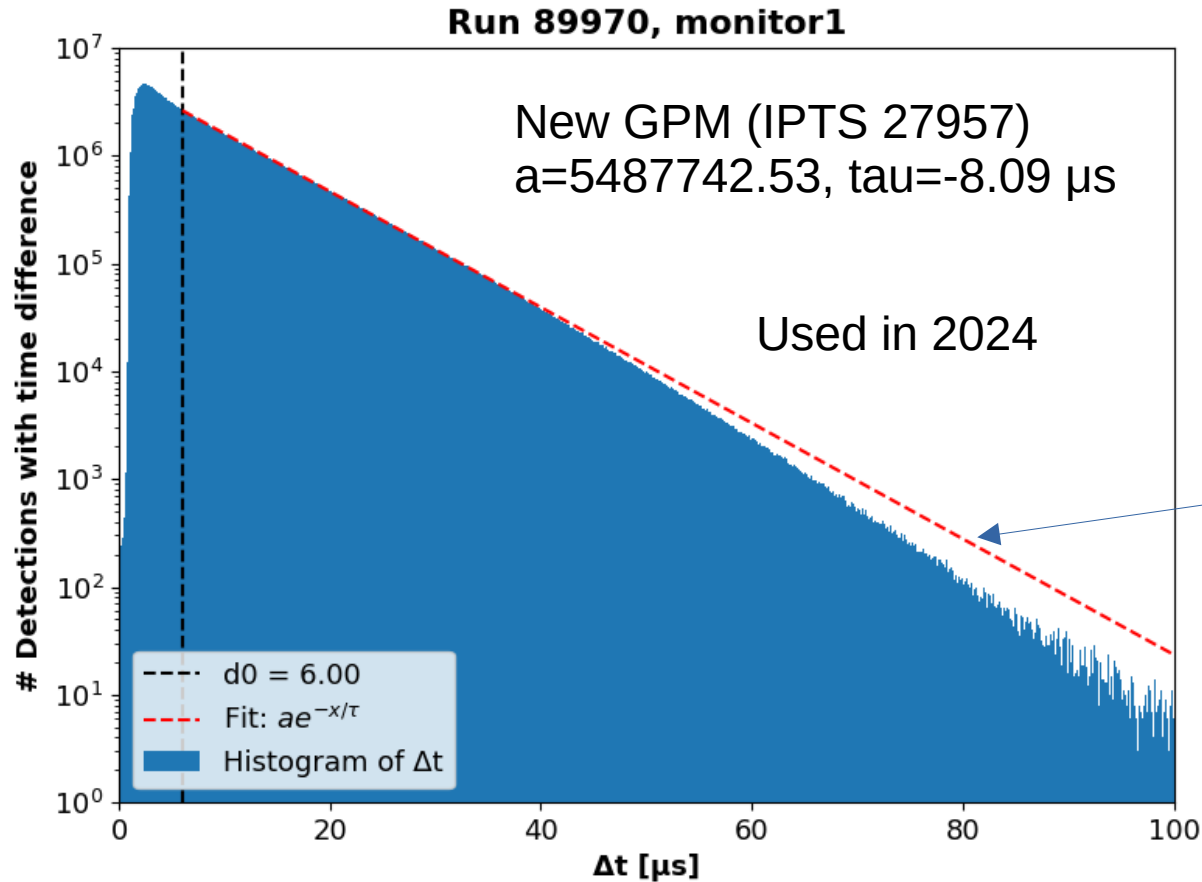
# GPM $\Delta T$ Histogram Slope differs between old vs new monitors



- “New GPM” was installed in 2023
- IPTS 27957 was conducted 2024
- Using exponential fit of  $\Delta t$  histogram past  $6.00\mu\text{s}$ , fit tau was:
  - $5.59 \mu\text{s}$  (OLD)
  - $8.09 \mu\text{s}$  (NEW)

# GPM $\Delta T$ Histogram Slope differs between old vs new monitors

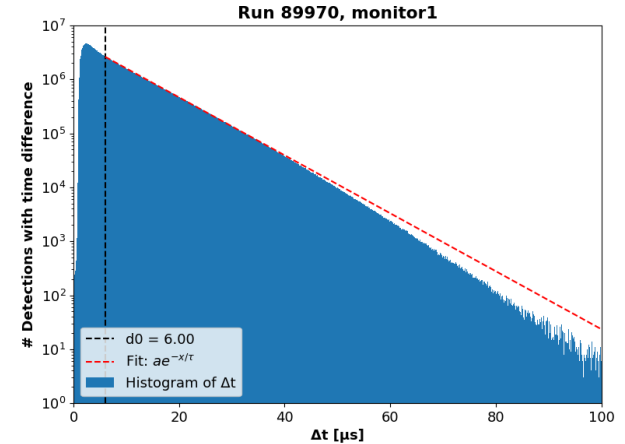
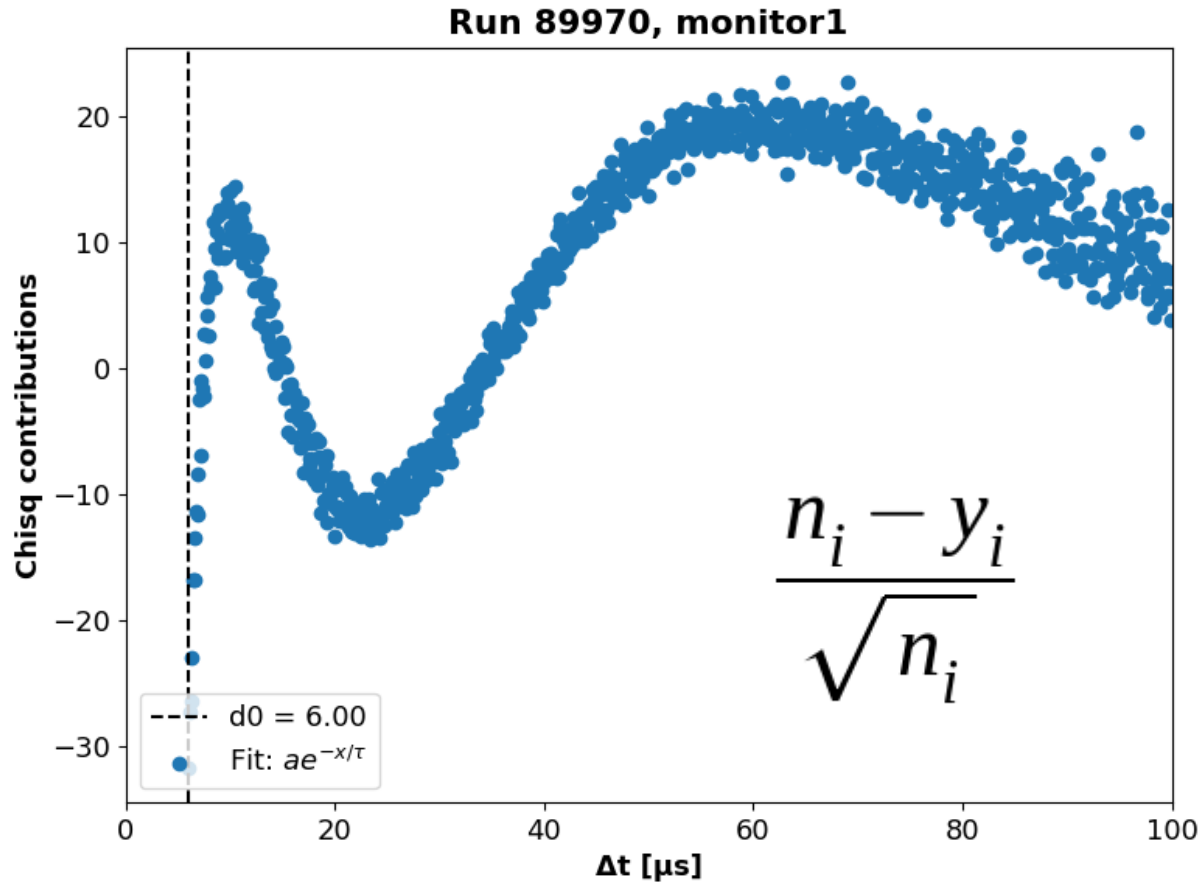
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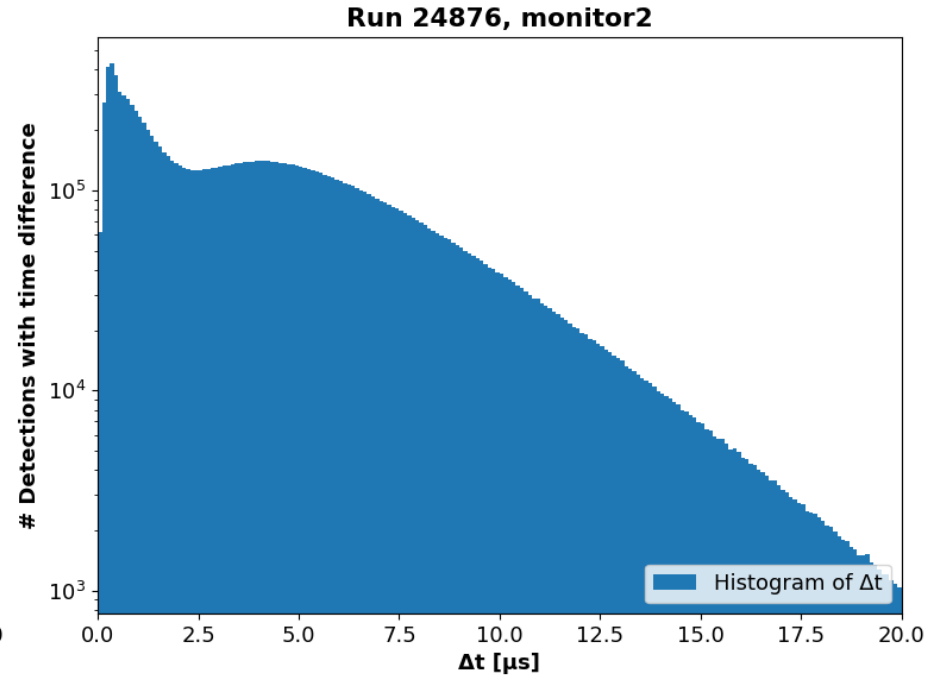
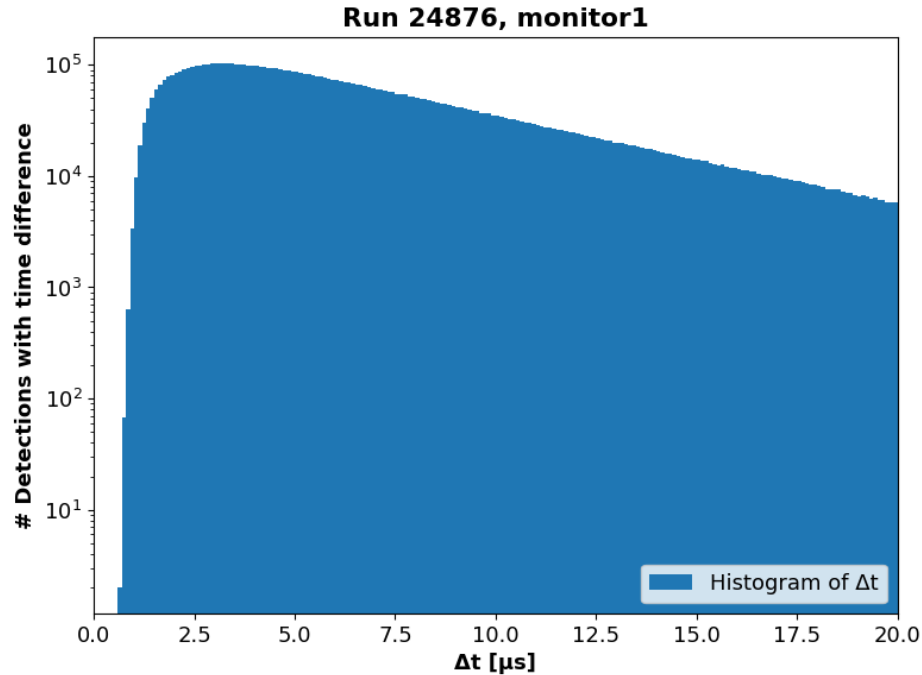
Newly observed  
Discrepancy

# Residual of fit for GPM in 2024 experiment



- Chi squared residuals aren't randomly distributed
- We cannot be certain which slope on the  $\Delta t$  plot to follow
- Following the slope for 80-100 $\mu\text{s}$  may suggest high intensity conflicting with gold foil measurement

# LEM $\Delta T$ Histogram Shows odd behavior in 2021 Experiment



- Left (monitor1) is GPM in 2021 experiment
- Right (monitor2) **is assumed to be** LEM in 2021 experiment
- “Lowell monitor” was present for runs 24876, 24877 in 2021 experiment
- “monitor2” shows odd behavior in 0.0 – 2.5  $\mu\text{s}$  region of  $\Delta t$  histogram.
  - Possible double counting effect? - affected original intensity determination