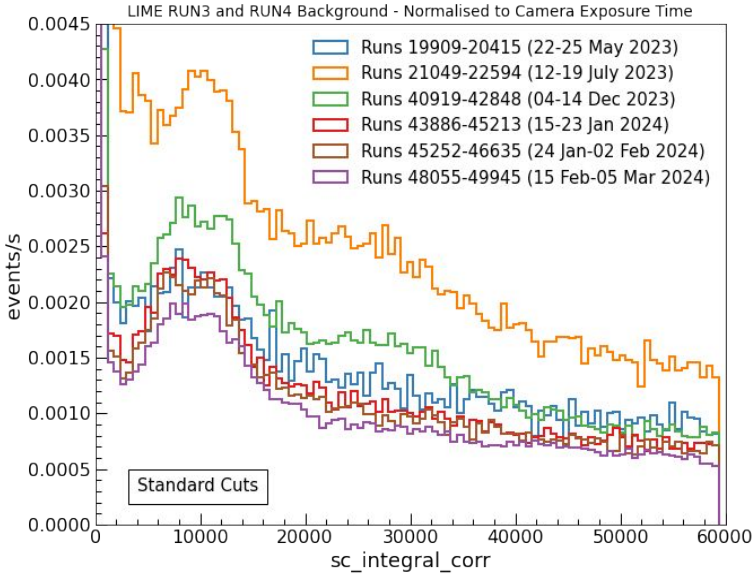
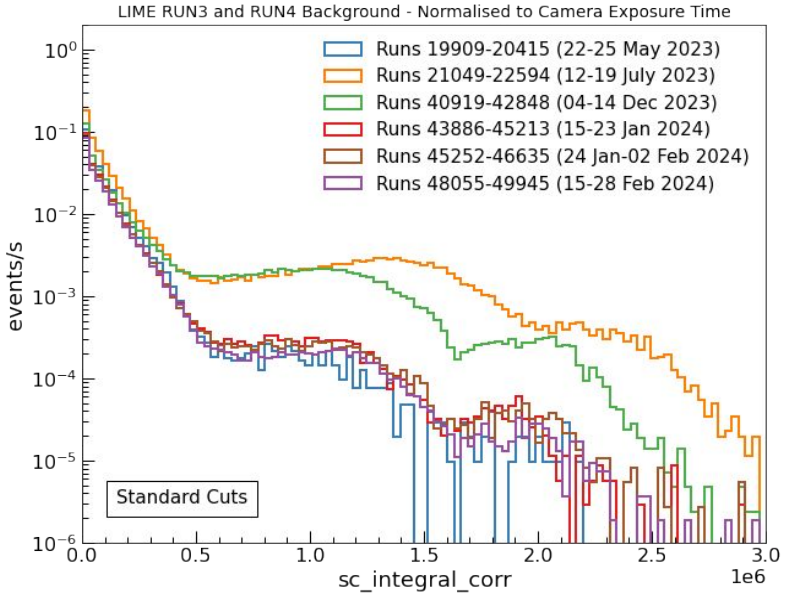
Rn, Cu and Fiorina Peaks

(Method Update)

Energy Histograms





Standard Cuts applied:

- sc_rms > 6
- sc_tgausssigma*0.152 > 0.5
- sc_xmin > 255 & sc_xmax < 2000
- sc_ymin > 300 & sc_ymax < 2000

Data taking periods:

RUN3

- 22-25 May 2023 → runs 19909 - 20415
- 12-19 July 2023 → runs 21049 - 22514

RUN4

- 4-14 Dec 2023 → runs 40919 - 42848
- 15-23 Jan 2024 → runs 43886 - 45213
- 24 Jan-2 Feb 2024 → runs 45252 - 46635
- 15-28 Feb 2024 → runs 48055 - 49945

Method

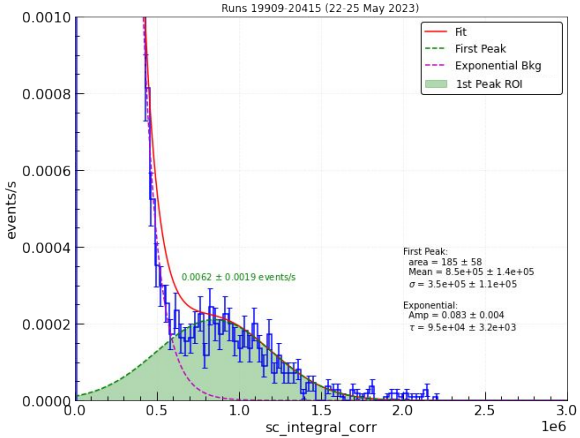
- **Previously, a Gaussian was fitted to each peak and its values at the bin centers were summed to determine the total event rate for each peak.**

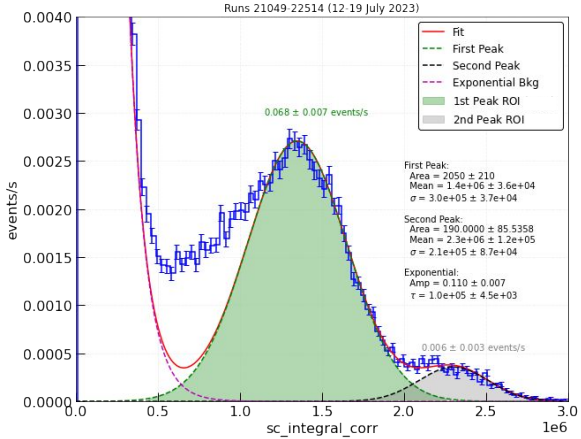
```
def fit_function(x, amp_gauss, mean_gauss, sigma_gauss,
                 amp_gauss2, mean_gauss2, sigma_gauss2,
                 amp_exp1, tau_exp1,  # slow exp.
                 amp_exp2, tau_exp2):  # fast exp.
    gaussian1 = amp_gauss * np.exp(-(x - mean_gauss)**2 / (2 * sigma_gauss**2))
    gaussian2 = amp_gauss2 * np.exp(-(x - mean_gauss2)**2 / (2 * sigma_gauss2**2))
    exponential1 = amp_exp1 * np.exp(-x/tau_exp1)
    exponential2 = amp_exp2 * np.exp(-x/tau_exp2)
    return gaussian1 + gaussian2 + exponential1 + exponential2
```

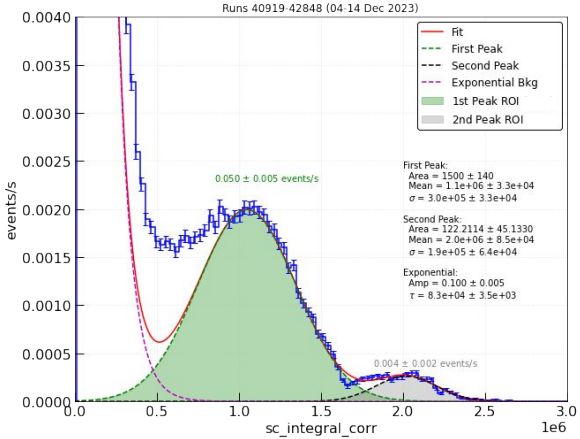
- **With the present method, the Gaussian function was normalised to 1/σ*sqrt(2π).**
- **The total area under the curve corresponds directly to the factor *amp_gauss*.**

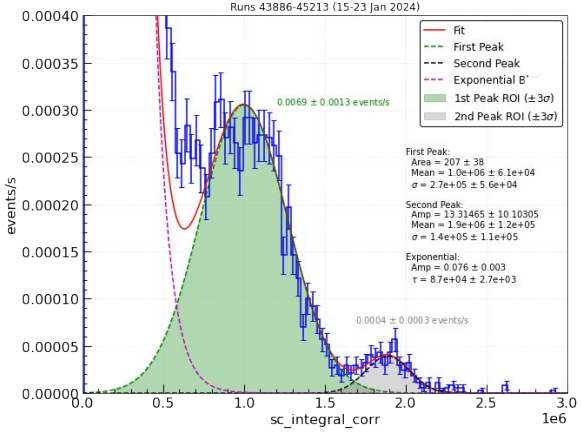
```
def fit_function(x, amp_gauss, mean_gauss, sigma_gauss,
                 amp_gauss2, mean_gauss2, sigma_gauss2,
                 amp_exp1, tau_exp1,  # slow exp.
                 amp_exp2, tau_exp2):  # fast exp.
    gaussian1 = (amp_gauss / (sigma_gauss * np.sqrt(2*np.pi))) * np.exp(-(x - mean_gauss)**2 / (2 * sigma_gauss**2))
    gaussian2 = (amp_gauss2 / (sigma_gauss2 * np.sqrt(2*np.pi))) * np.exp(-(x - mean_gauss2)**2 / (2 * sigma_gauss2**2))
    exponential1 = amp_exp1 * np.exp(-x/tau_exp1)
    exponential2 = amp_exp2 * np.exp(-x/tau_exp2)
    return gaussian1 + gaussian2 + exponential1 + exponential2
```

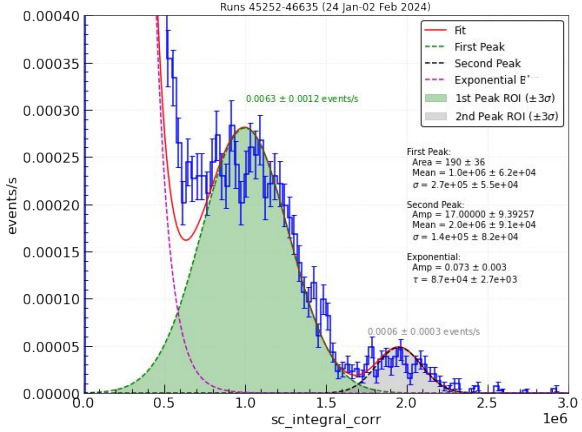
High energy events

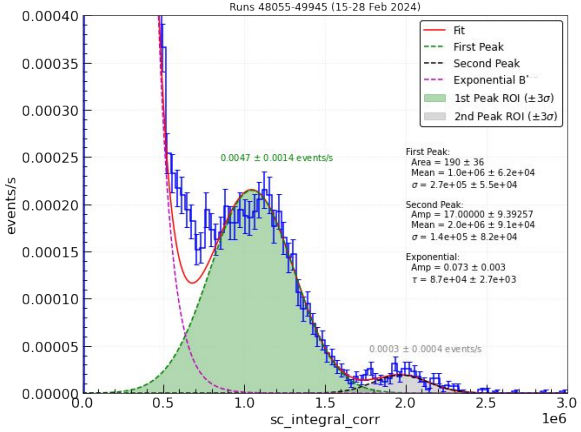




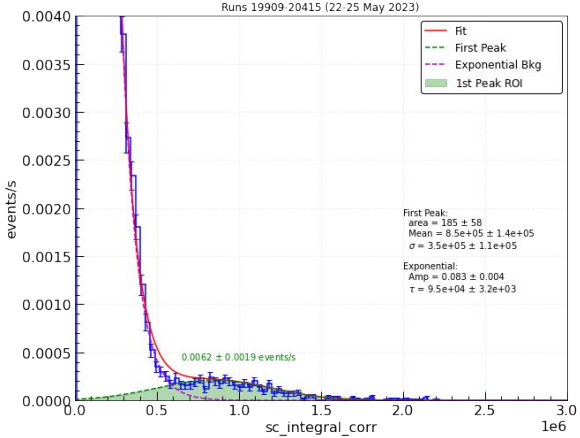


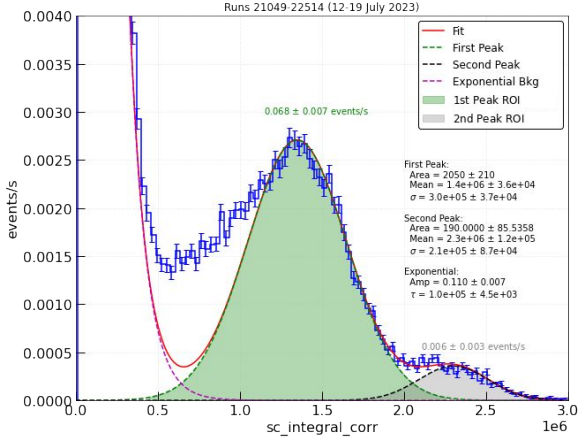


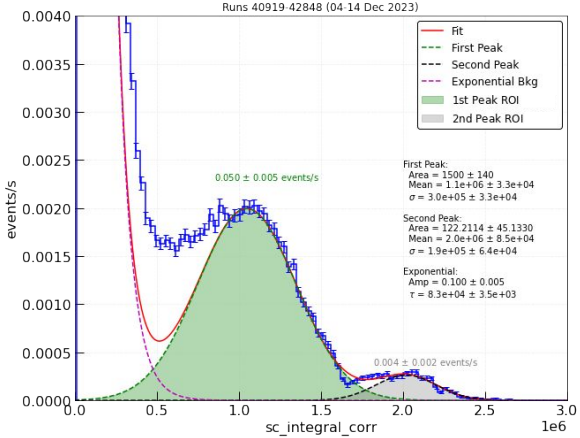


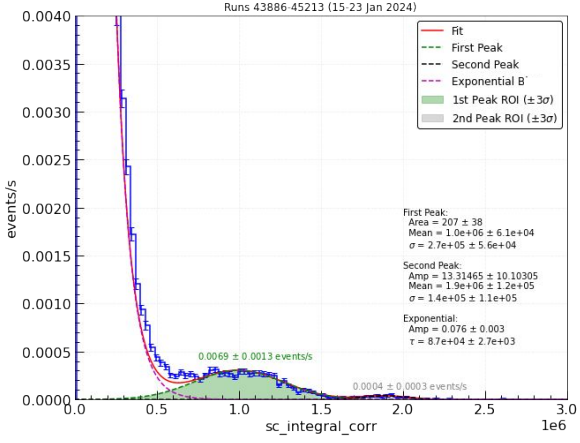


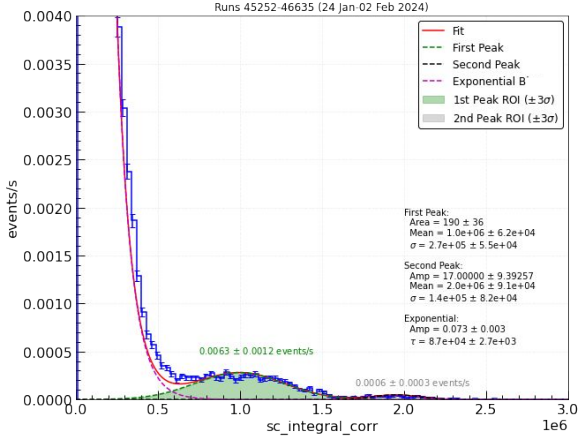
High energy events (plots with the same y-axis range)

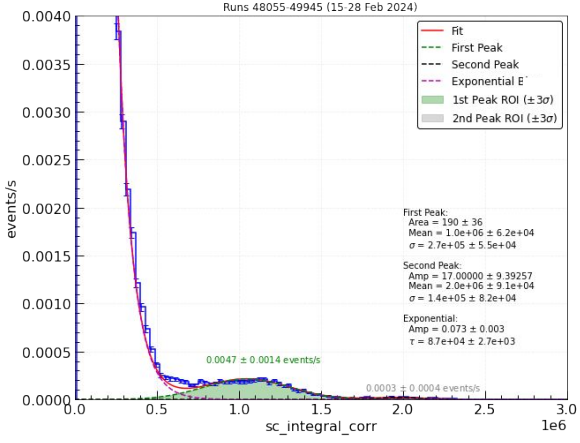




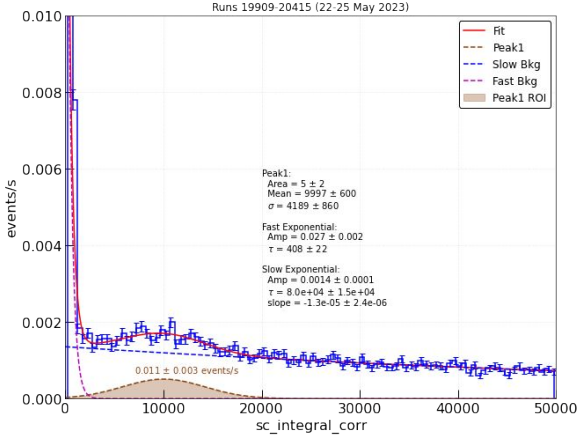


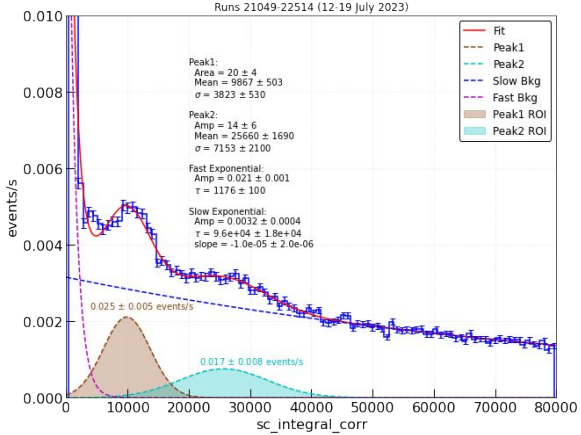


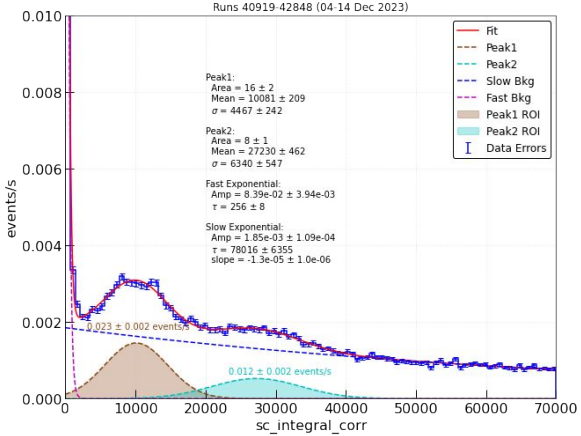


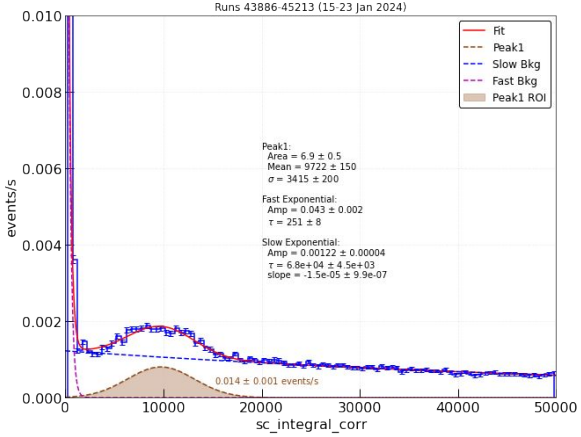


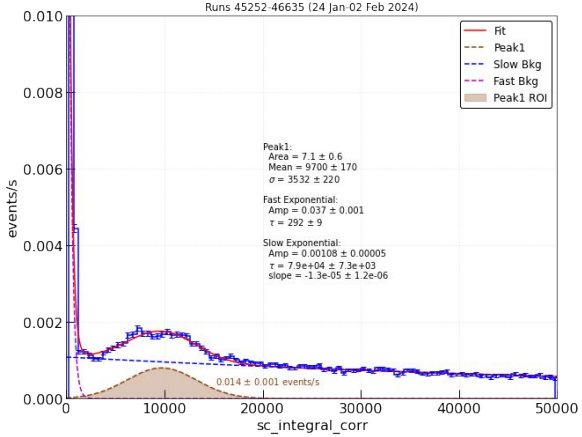
Low energy events (plots with the same y-axis range)

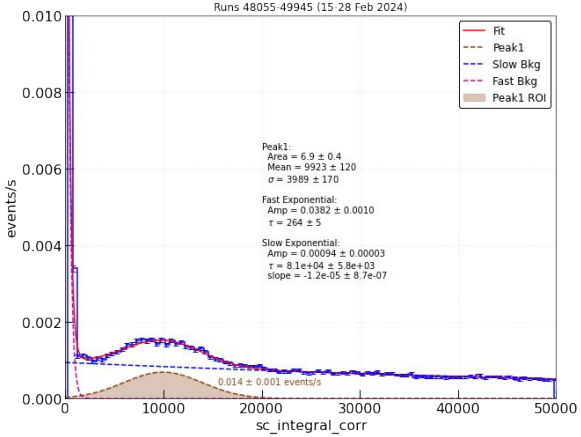








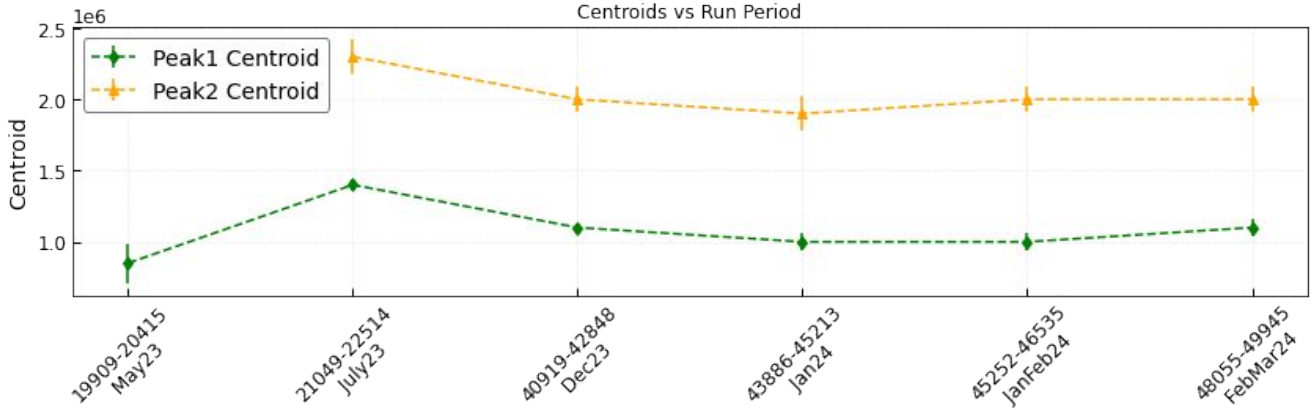


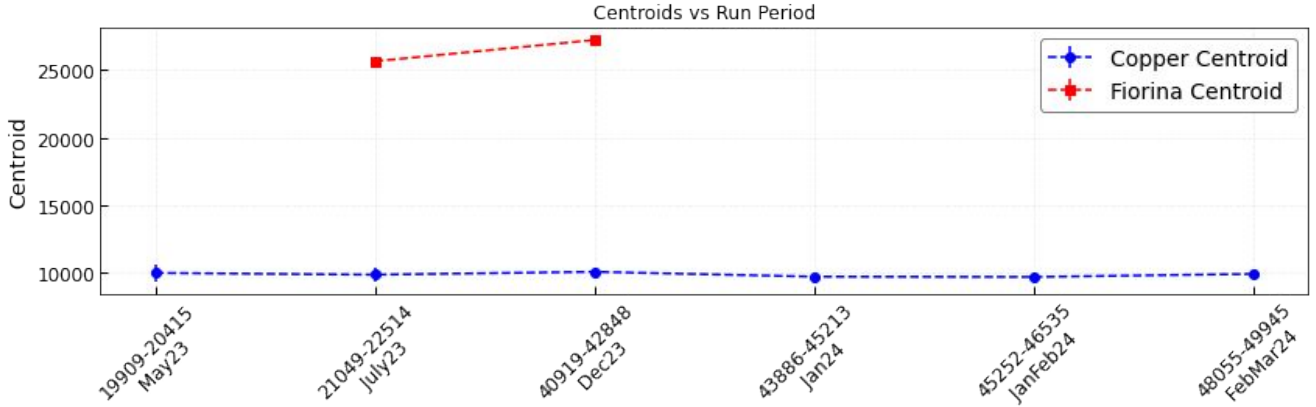


Data summary (Normalised Gaussian Method)

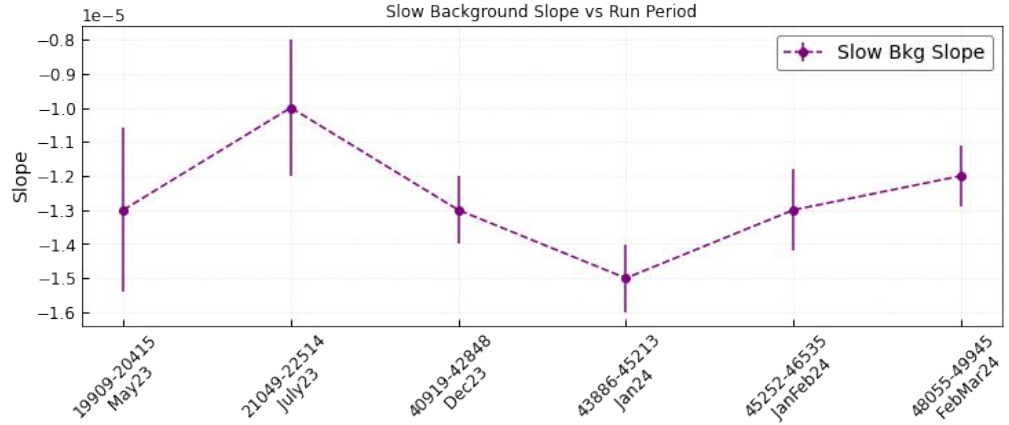
Run	Cu Peak		Fiorina Peak		Fast Exp. (low energy region plots)		Slow Exp. (low energy region plots)			Peak1 HiEn		Peak2 HiEn		Exponential (whole energy region plots)	
	μ	evt/s	μ	evt/s	A	τ	A	τ	Slope	μ	evt/s	μ	evt/s	A	τ
19909 - 20415 22-25 May 2023	9997 ± 600	0.011 ± 0.003	-	-	0.027 ± 0.002	408 ± 22	0.0014 ± 0.0001	8.0×10^{4} ± 1.5×10^{4}	-1.3×10^{-5} ± 2.4×10^{-6}	8.5×10^{5} ± 1.4×10^{5}	0.0062 ± 0.0019	-	-	0.083 ± 0.004	9.5×10^{4} ± 3.2×10^{3}
21049 - 22514 12-19 July 2023	9867 ± 503	0.025 ± 0.005	25660 ± 1690	0.017 ± 0.008	0.021 ± 0.001	1176 ± 100	0.0032 ± 0.0004	9.6×10^{4} ± 1.8×10^{4}	-1.0×10^{-5} ± 2.0×10^{-6}	1.4×10^{6} ± 3.6×10^{4}	0.068 ± 0.007	2.3×10^{6} ± 1.2×10^{5}	0.006 ± 0.003	0.110 ± 0.007	1×10^{5} ± 4.5×10^{3}
40919 - 42848 4-14 Dec 2023	10081 ± 209	0.023 ± 0.002	27230 ± 462	0.012 ± 0.002	8.39×10^{-2} ± 3.94×10^{-3}	256 ± 8	1.85×10^{-3} ± 1.09×10^{-4}	7.80×10^{4} ± 6.36×10^{3}	-1.3×10^{-5} ± 1.0×10^{-6}	1.1×10^{6} ± 3.3×10^{4}	0.050 ± 0.005	2.0×10^{6} ± 8.5×10^{4}	0.004 ± 0.002	0.100 ± 0.005	8.3×10^{4} ± 3.5×10^{3}
43886 - 45213 15-23 Jan 2024	9722 ± 150	0.014 ± 0.001	-	-	0.043 ± 0.002	251 ± 8	1.22×10^{-3} ± 4×10^{-5}	6.8×10^{4} ± 4.5×10^{3}	-1.5×10^{-5} ± 9.9×10^{-7}	1.0×10^{6} ± 6.1×10^{4}	0.0069 ± 0.0013	1.9×10^{6} ± 1.2×10^{5}	0.0004 ± 0.0003	0.076 ± 0.003	8.7×10^{4} ± 2.7×10^{3}
45252 - 46635 24Jan-2Feb 2024	9700 ± 170	0.014 ± 0.001	-	-	0.037 ± 0.001	292 ± 9	1.08×10^{-3} ± 5×10^{-5}	7.9×10^{4} ± 7.3×10^{3}	-1.3×10^{-5} ± 1.2×10^{-6}	1.0×10^{6} ± 6.2×10^{4}	0.0063 ± 0.0012	2.0×10^{6} ± 9.1×10^{4}	0.0006 ± 0.0003	0.073 ± 0.003	8.7×10^{4} ± 2.7×10^{3}
48055 - 49945 15-28 Feb 2024	9923 ± 120	0.014 ± 0.001	-	-	0.038 ± 0.001	264 ± 5	9.4×10^{-4} ± 3×10^{-5}	8.1×10^{4} ± 5.8×10^{3}	-1.2×10^{-5} ± 8.7×10^{-7}	1.1×10^{6} ± 3.3×10^{4}	0.0047 ± 0.0014	2.0×10^{6} ± 8.5×10^{4}	0.0003 ± 0.0004	0.100 ± 0.005	8.3×10^{4} ± 3.5×10^{3}

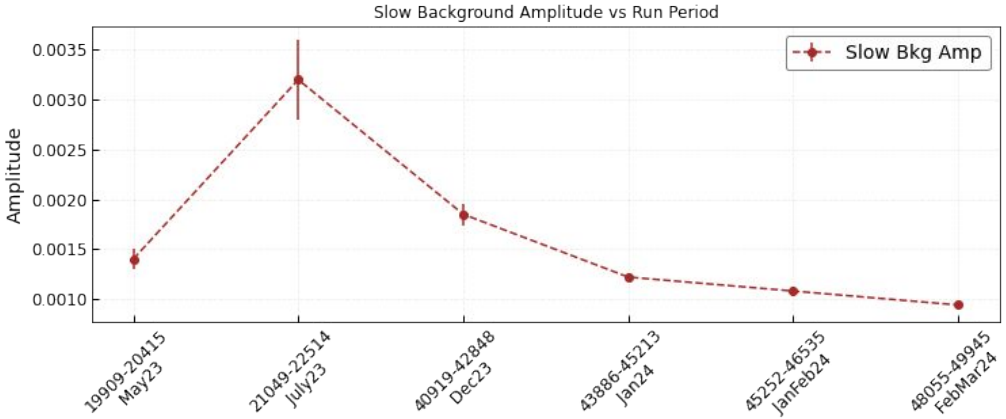
Data summary (Normalised Gaussian Method)



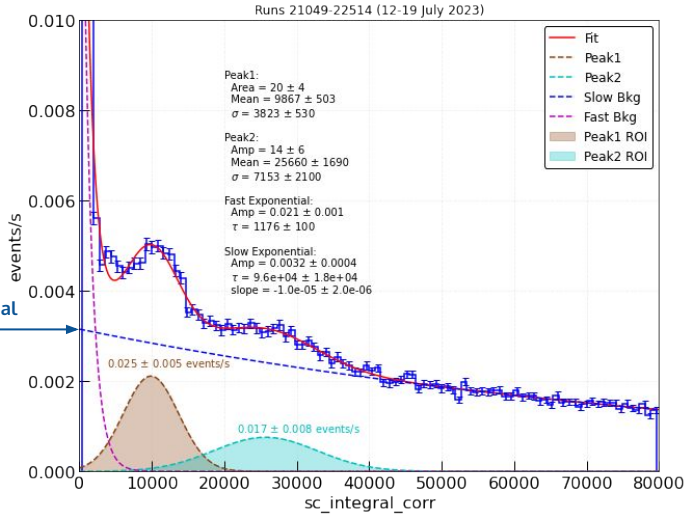


Data summary (Normalised Gaussian Method)

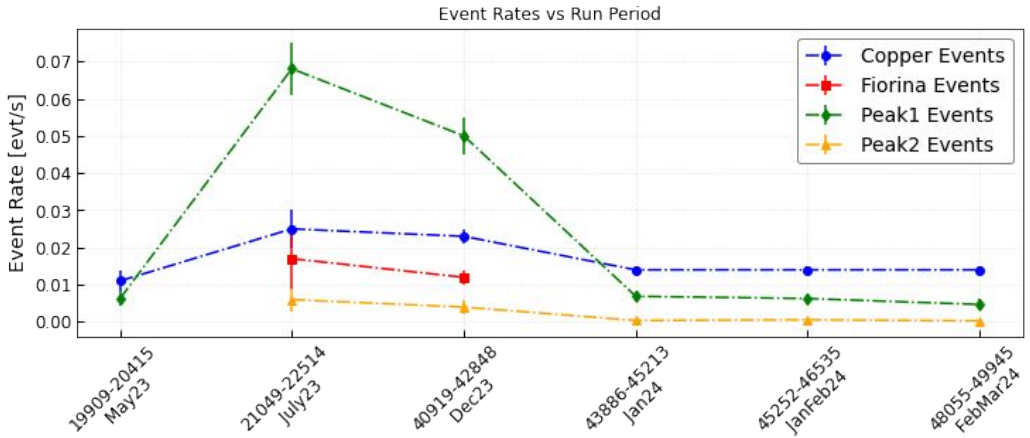




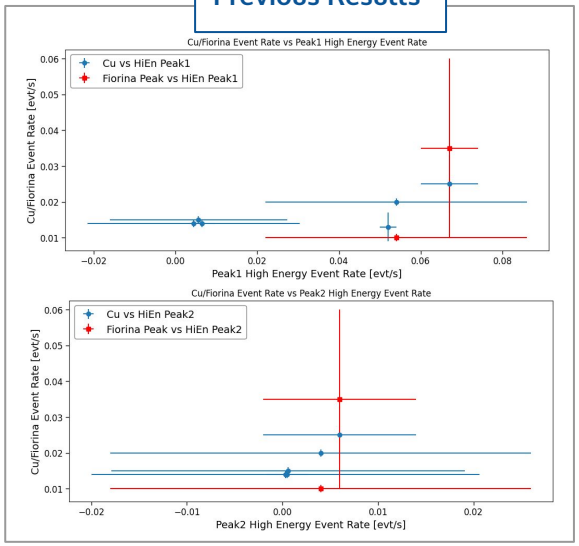
Slow Bkg Exponential

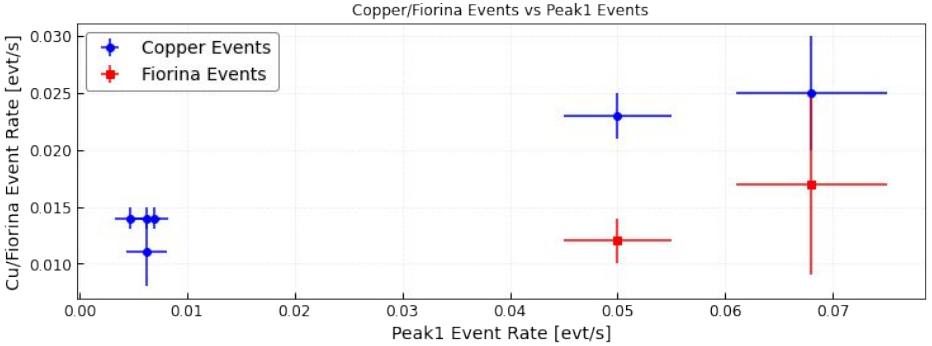


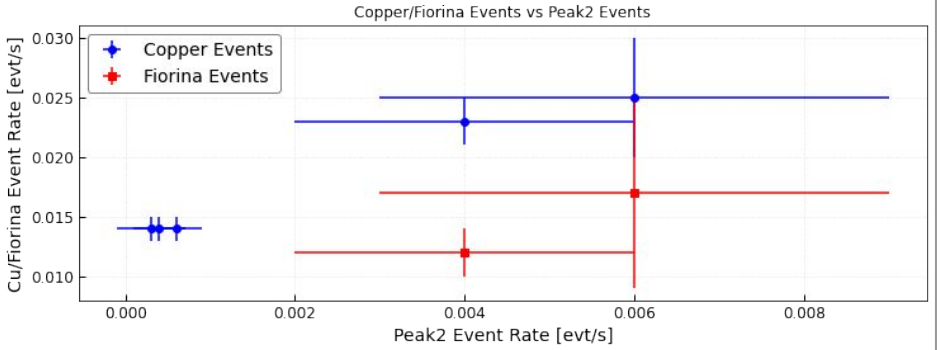
Data summary (Normalised Gaussian Method)



Previous Results





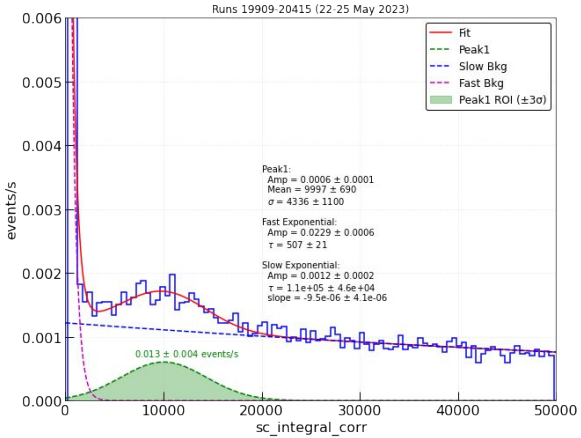


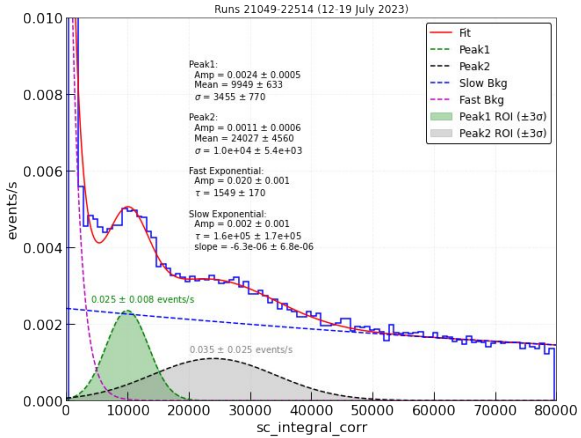
Backup

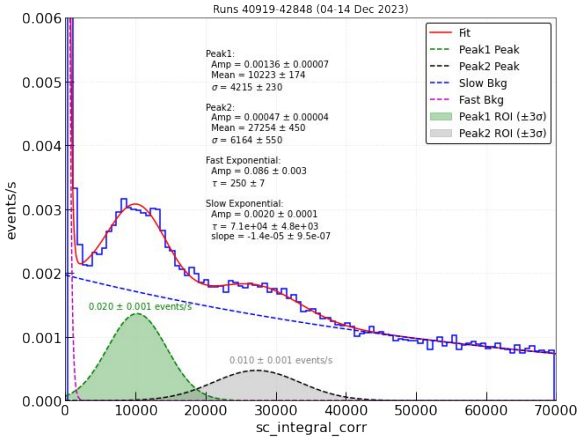
Previous results

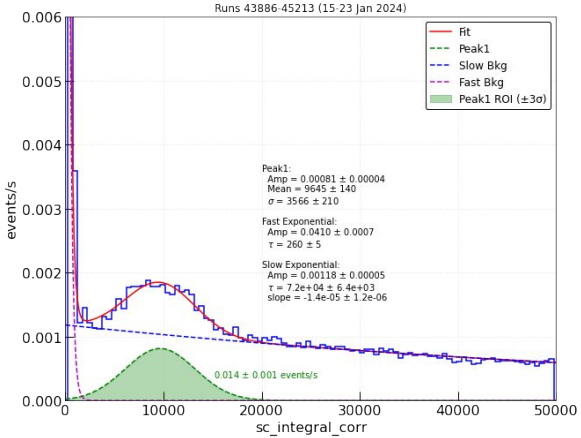
Gaussian values summed at bin centers to estimate the number of evt/s

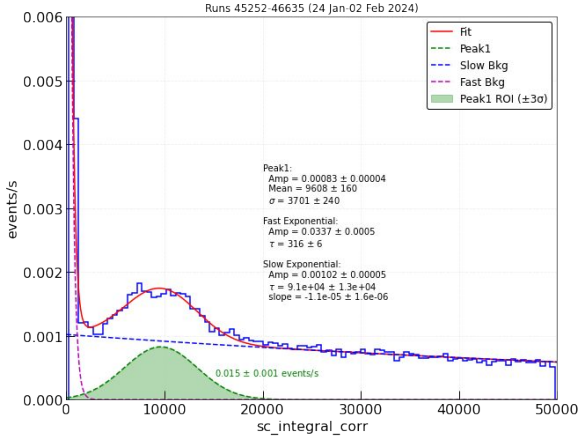
Low energy events

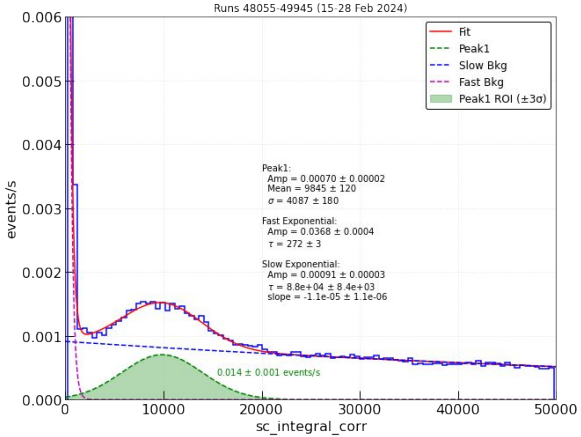






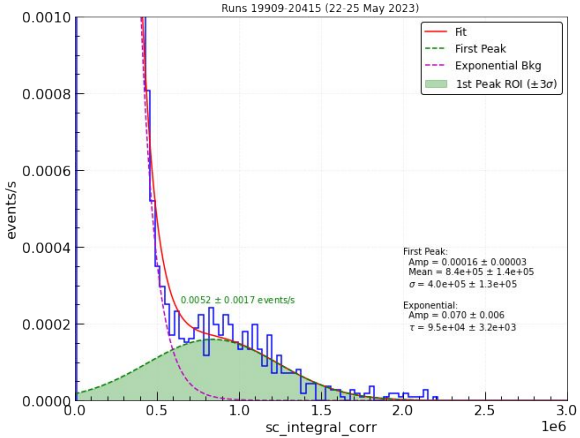


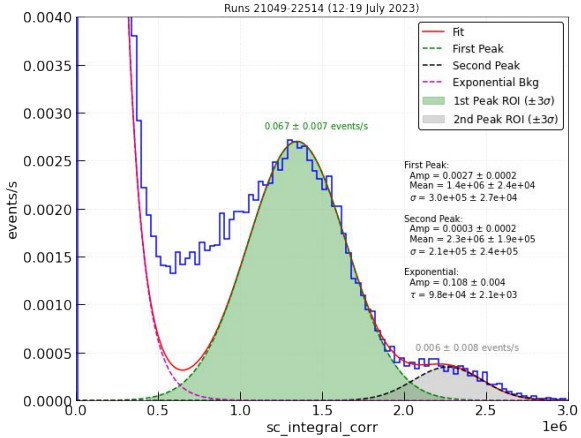


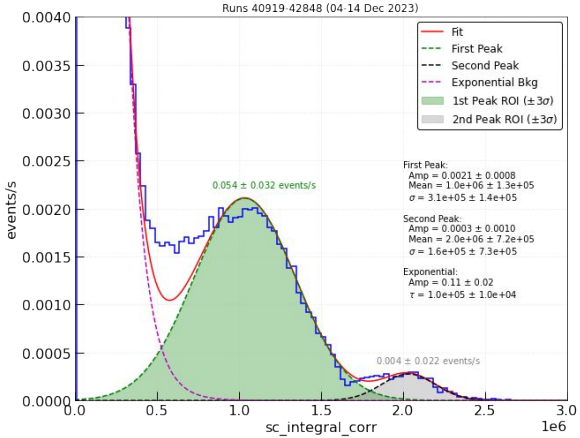


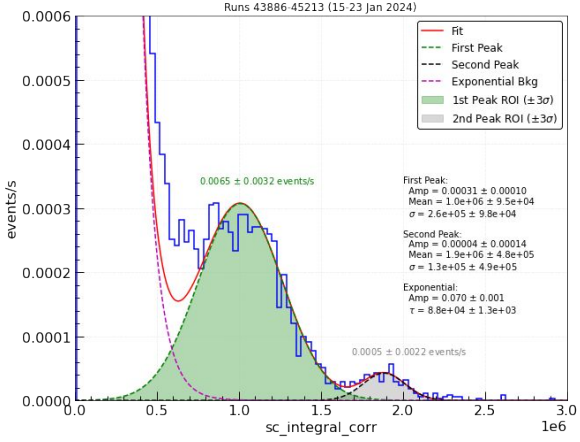
- **Total events/s for a peak**: centroid identified, ±3σ region selected, and Gaussian values summed at bin centers.

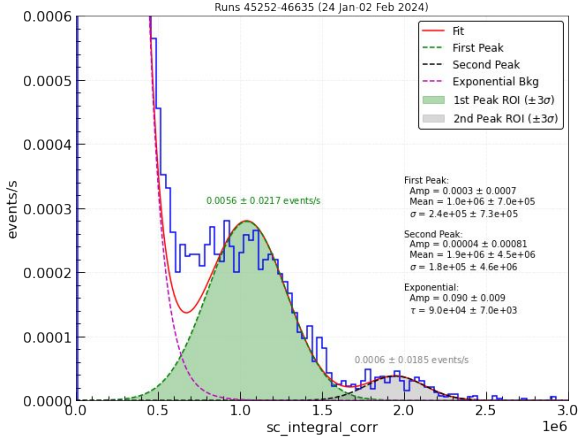
High energy events

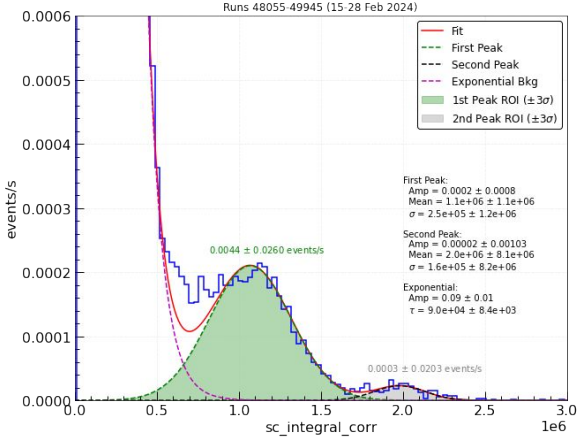










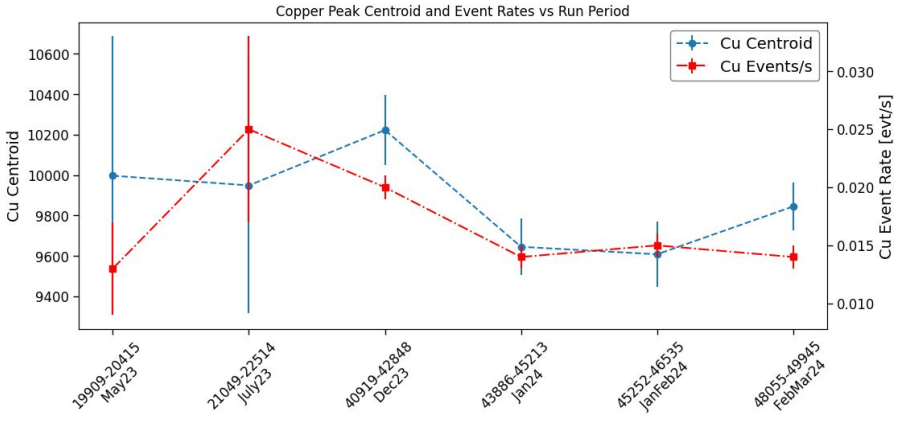


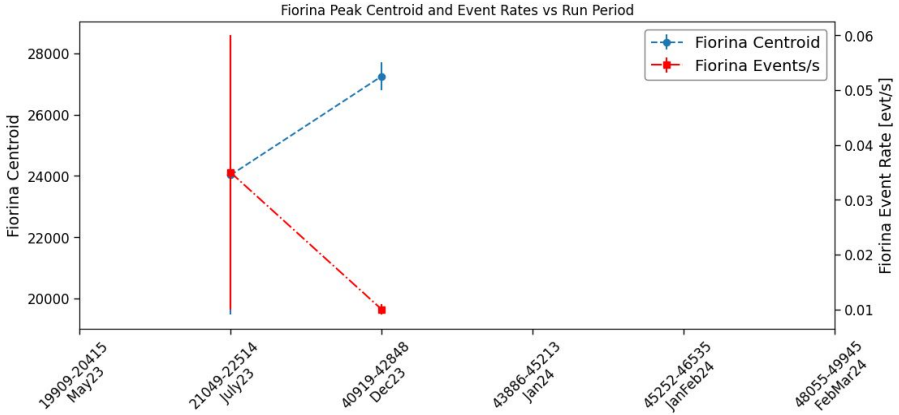
- **Total events/s for a peak**: centroid identified, ±3σ region selected, and Gaussian values summed at bin centers.

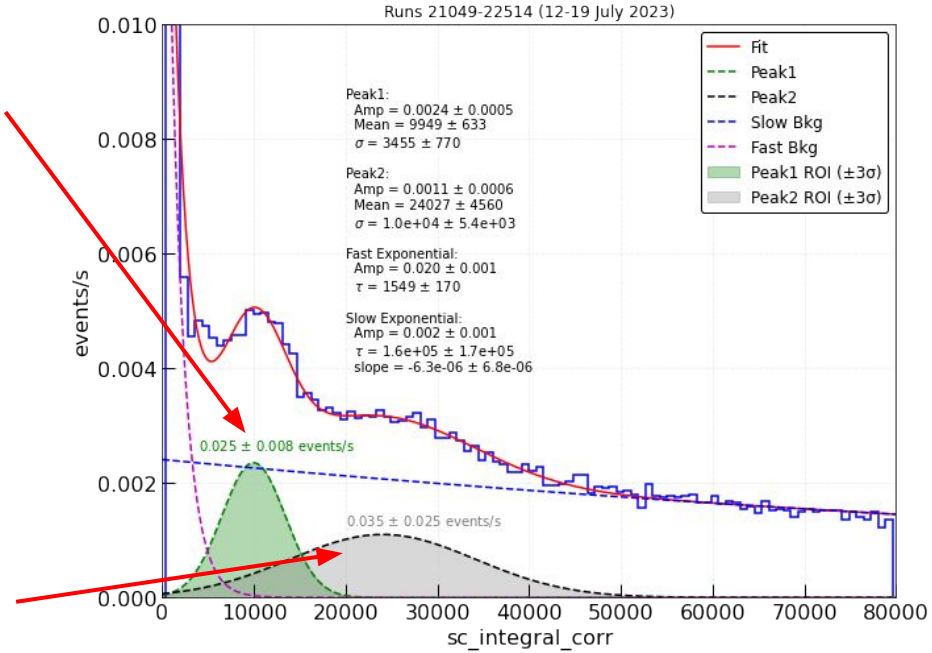
Data summary

Run	Cu Peak		Fiorina Peak		Fast Exp. (low energy region plots)		Slow Exp. (low energy region plots)			Peak1 HiEn		Peak2 HiEn		Exponential (whole energy region plots)	
	μ	evt/s	μ	evt/s	A	τ	A	τ	Slope	μ	evt/s	μ	evt/s	A	τ
19909 - 20415 22-25 May 2023	9997 ± 690	0.013 ± 0.004	-	-	0.0229 ± 0.006	507 ± 21	0.0012 ± 0.002	1.1×10^{5} ± 4.6×10^{4}	-9.5×10^{-6} ± 4.1×10^{-6}	8.4×10^{5} ± 1.4×10^{5}	0.052 ± 0.002	-	-	0.070 ± 0.006	9.5×10^{4} ± 3.2×10^{3}
21049 - 22514 12-19 July 2023	9949 ± 633	0.025 ± 0.008	24027 ± 4560	0.035 ± 0.025	0.002 ± 0.001	1549 ± 170	0.002 ± 0.001	1.6×10^{5} ± 1.7×10^{5}	-6.3×10^{-6} ± 6.8×10^{-6}	1.4×10^{6} ± 2.4×10^{4}	0.067 ± 0.007	2.3×10^{6} ± 1.9×10^{5}	0.006 ± 0.008	0.108 ± 0.004	9.8×10^{4} ± 2.1×10^{3}
40919 - 42848 4-14 Dec 2023	10223 ± 174	0.020 ± 0.001	27254 ± 450	0.010 ± 0.001	0.086 ± 0.003	250 ± 7	2×10^{-3} ± 1×10^{-4}	7.1×10^{4} ± 4.8×10^{3}	-1.4×10^{-5} ± 9.5×10^{-7}	1.0×10^{6} ± 1.3×10^{5}	0.054 ± 0.032	2.0×10^{6} ± 7.2×10^{5}	0.004 ± 0.022	0.11 ± 0.02	1.0×10^{5} ± 1.0×10^{4}
43886 - 45213 15-23 Jan 2024	9645 ± 140	0.014 ± 0.001	-	-	0.0410 ± 0.0007	260 ± 5	1.2×10^{-3} ± 5×10^{-5}	7.2×10^{4} ± 6.4×10^{3}	-1.4×10^{-5} ± 1.2×10^{-6}	1×10^{6} ± 9.5×10^{4}	0.0065 ± 0.0032	1.9×10^{6} ± 4.8×10^{5}	0.0005 ± 0.0022	0.070 ± 0.001	8.8×10^{4} ± 1.3×10^{3}
45252 - 46635 24Jan-2Feb 2024	9608 ± 160	0.015 ± 0.001	-	-	0.0336 ± 0.0005	316 ± 6	1.02×10^{-3} ± 5×10^{-5}	9.1×10^{4} ± 1.3×10^{4}	-1.1×10^{-5} ± 1.6×10^{-6}	1.0×10^{6} ± 7.0×10^{5}	0.0056 ± 0.0217	1.9×10^{6} ± 4.5×10^{6}	0.0006 ± 0.0185	0.009 0 ± 0.009	9.0×10^{4} ± 7.0×10^{3}
48055 - 49945 15-28 Feb 2024	9845 ± 120	0.014 ± 0.001	-	-	0.0368 ± 0.0004	272 ± 3	9.1×10^{-4} ± 3×10^{-5}	8.8×10^{4} ± 8.4×10^{3}	-1.1×10^{-5} ± 1.1×10^{-6}	1.1×10^{6} ± 1.1×10^{6}	0.0044 ± 0.0260	2.0×10^{6} ± 8.1×10^{6}	0.0003 ± 0.0203	0.09 ± 0.01	9.0×10^{4} ± 8.4×10^{3}

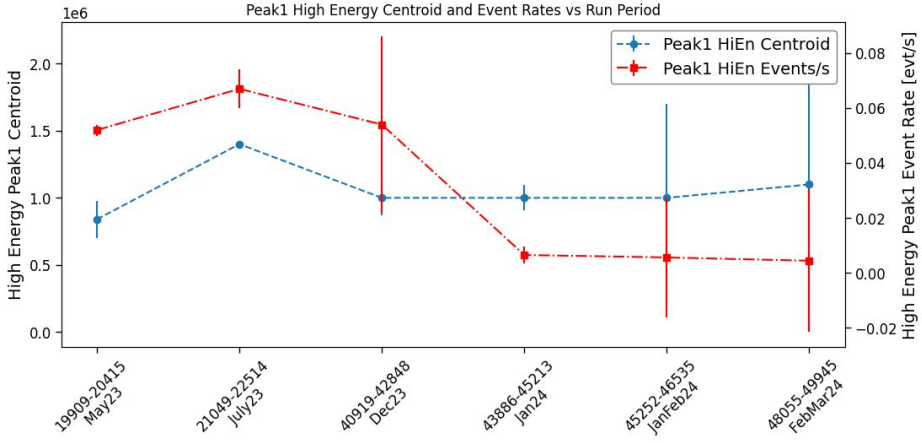
Data summary

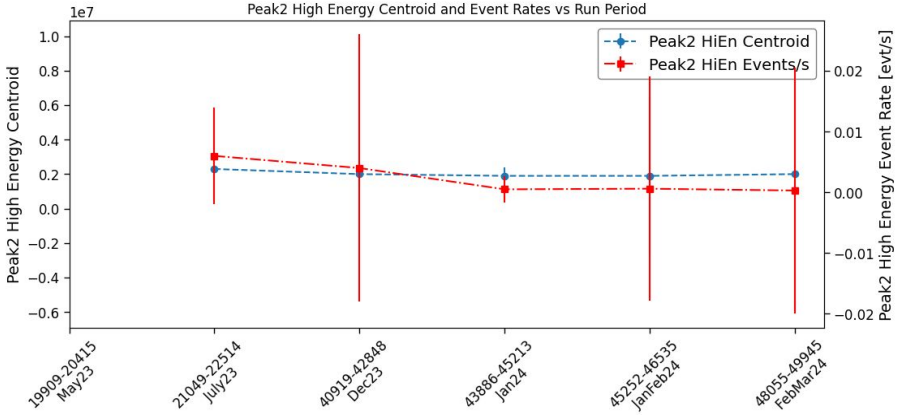


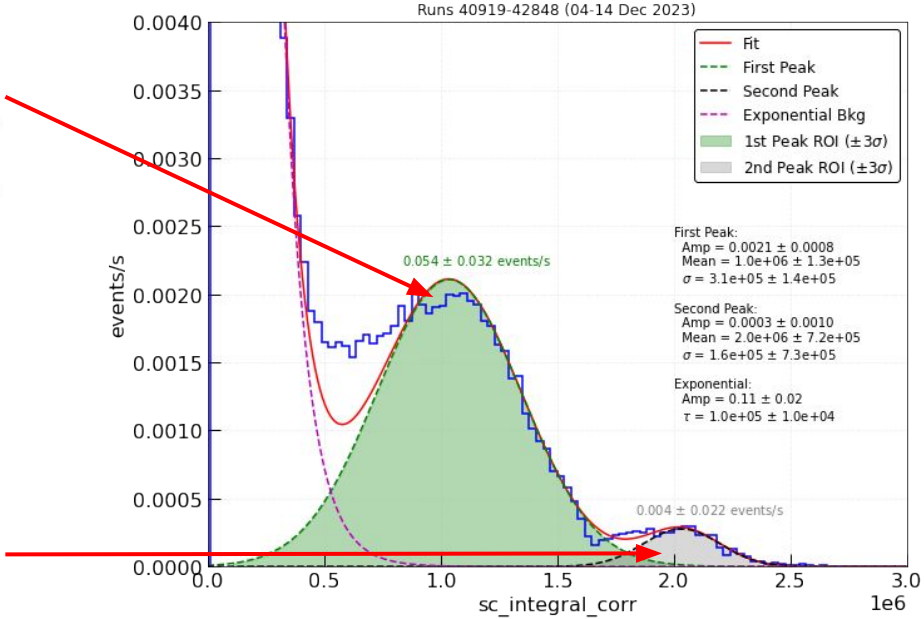




Data summary







Data summary