SimpleOpticsDetection

Bill Worstell

PicoRad -> MGH

10/30/2023

SPTR = 80ps sigma when using PETSYS readout

Seljak, A., Bračko, M., Dolenec, R., Križan, P., Lozar, A., Pestotnik, R. and Korpar, S., 2023. LAPPD operation using ToFPETv2 PETSYS ASIC. *Journal of Instrumentation*, *18*(02), p.C02007.

Perazzini, S., Ferrari, F., Vagnoni, V.M. and LHCb ECAL Upgrade-2 R&D Group, 2022. Development of an MCP-Based Timing Layer for the LHCb ECAL Upgrade-2. *Instruments*, *6*(1), p.7.

Dolenec, R., Korpar, S., Križan, P., Lozar, A., Pestotnik, R. and Seljak, A., 2023. Experimental results using large area picosecond photodetectors.

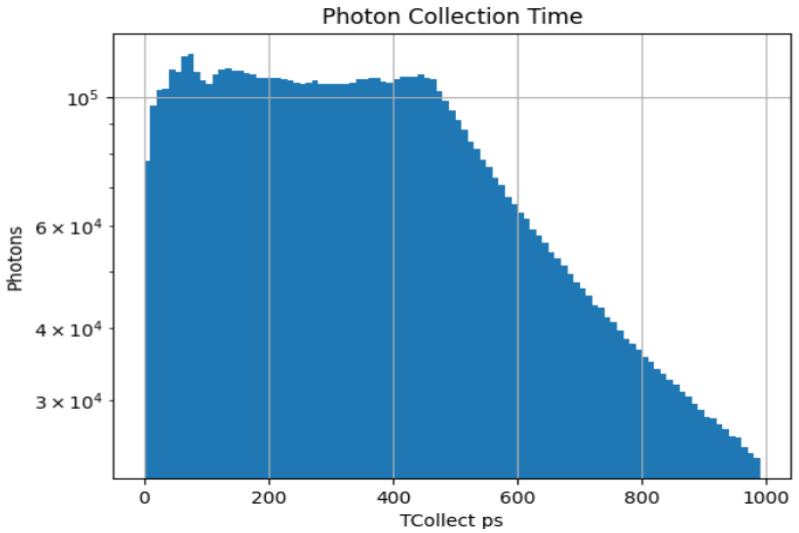
SPTR = 70ps sigma when using DRS4 readout

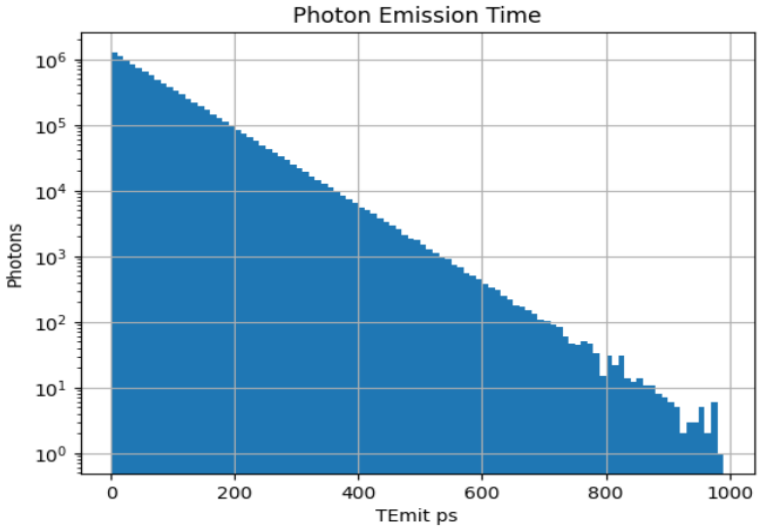
Shin, S., Aviles, M., Clarke, S., Cwik, S., Foley, M., Hamel, C., Lyashenko, A., Mensah, D., Minot, M., Popecki, M. and Stochaj, M., 2022. Advances in the Large Area Picosecond Photo-Detector (LAPPD): 8" x 8" MCP-PMT with Capacitively Coupled Readout. *arXiv preprint arXiv:2212.03208*.

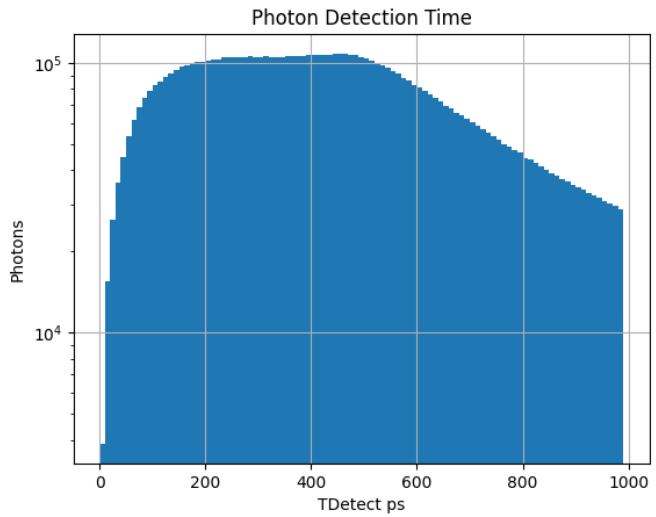
Shin, S., Aviles, M., Clarke, S., Cwik, S., Foley, M., Hamel, C., Lyashenko, A., Mensah, D., Minot, M., Popecki, M. and Stochaj, M., 2022. Advances in the Large Area Picosecond Photo-Detector (LAPPD): 8" x 8" MCP-PMT with Capacitively Coupled Readout. *arXiv preprint arXiv:2212.03208*.

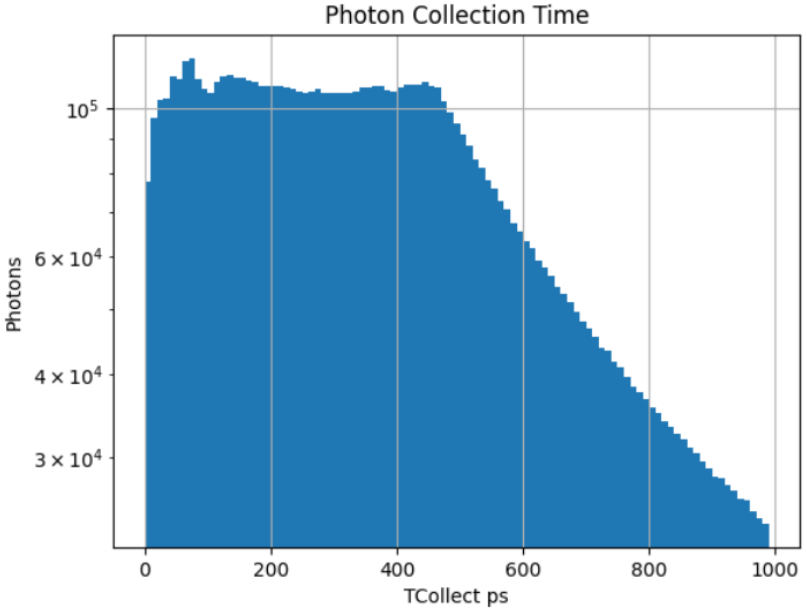
SimpleOpticsEmission.ipynb

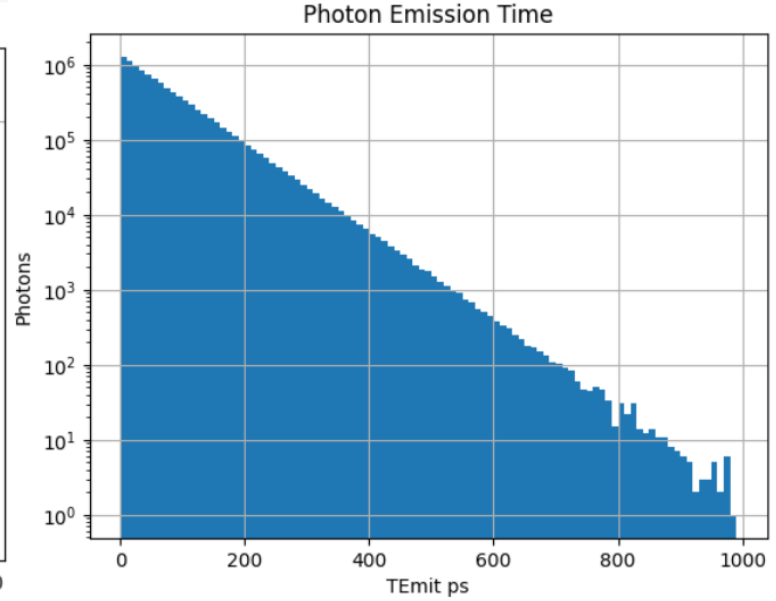
FASTEST ONLY: MeanNSurviveSample= 27

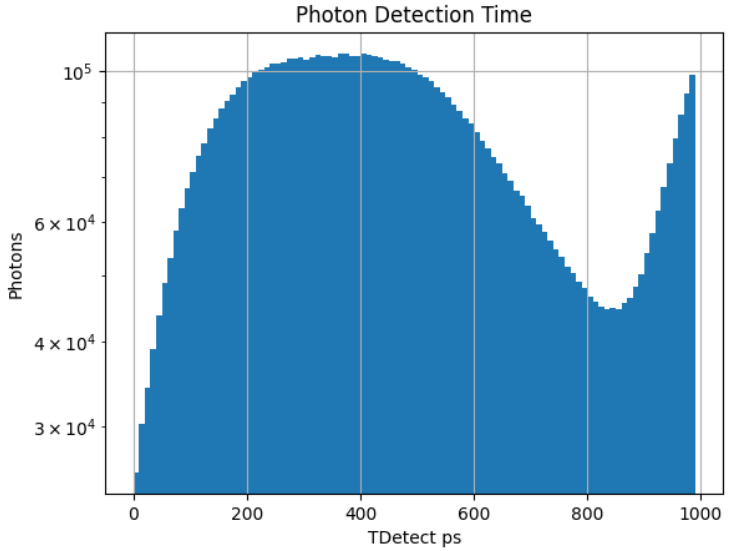








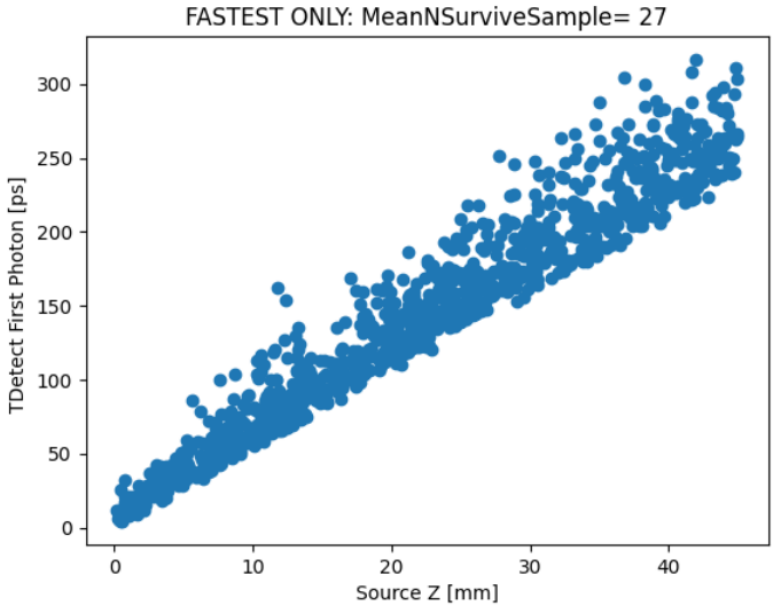


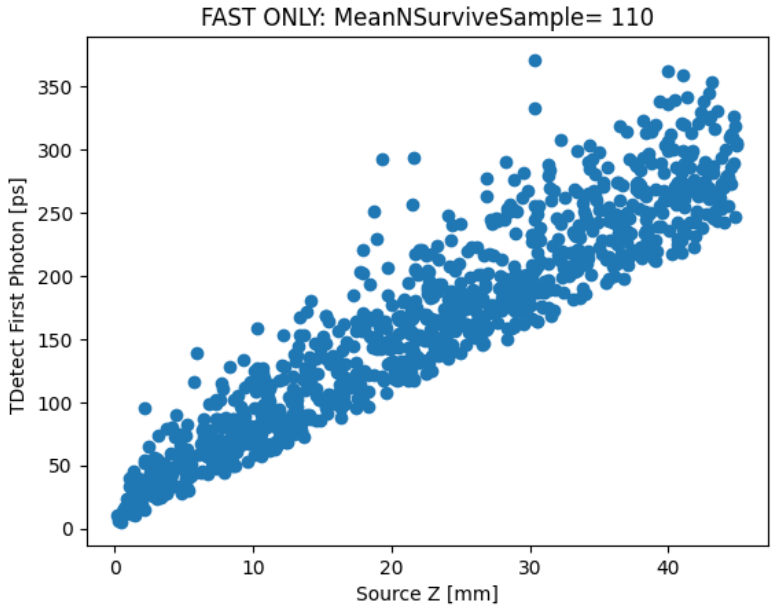


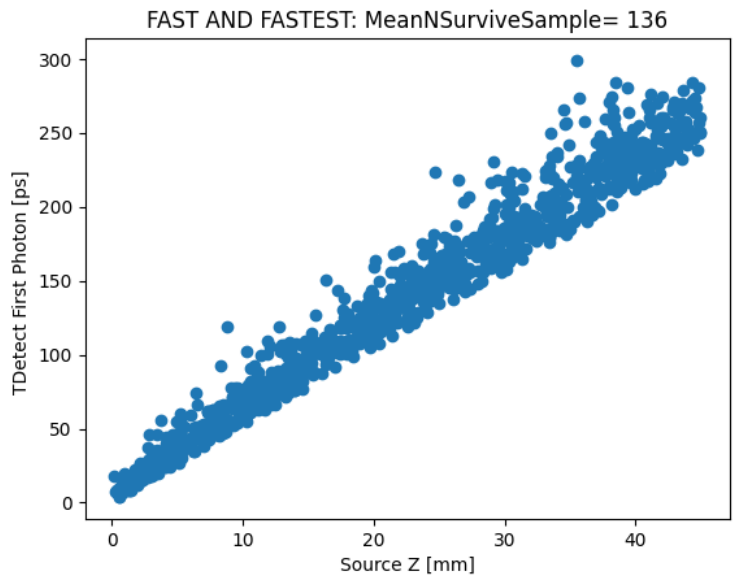
SimpleOpticsDetection.ipynb

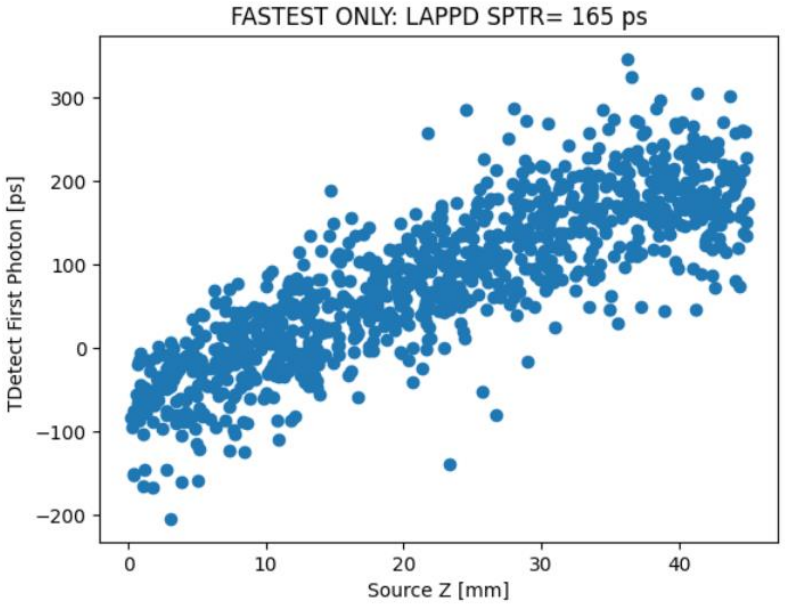
LAPPD SPTR= 165 ps

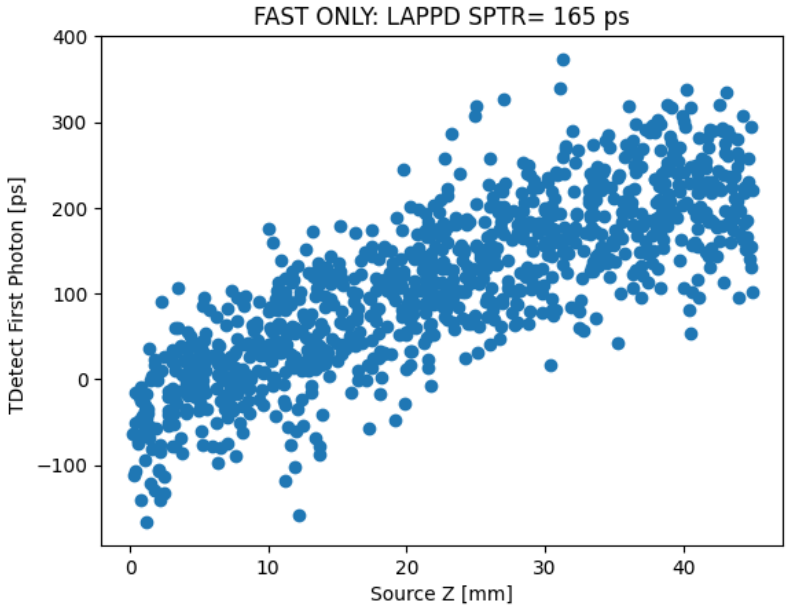
SimpleOpticsEmission.ipynb

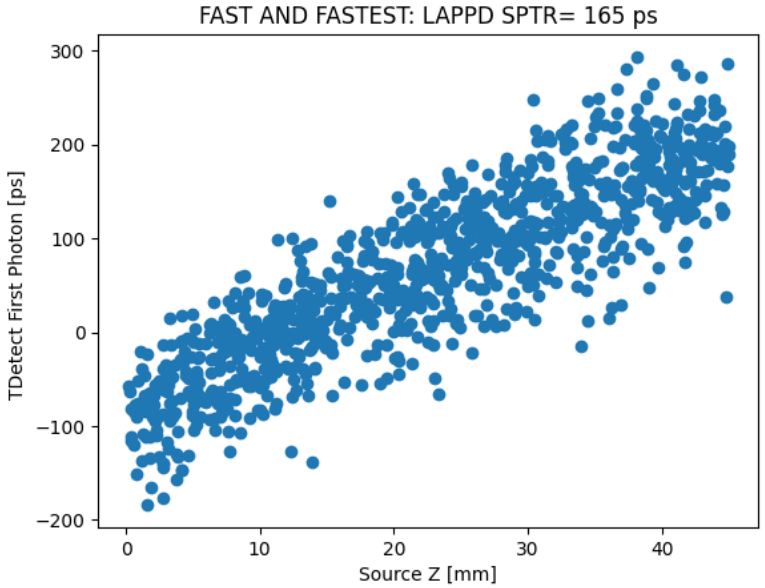












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LAPPD SPTR= 165 ps

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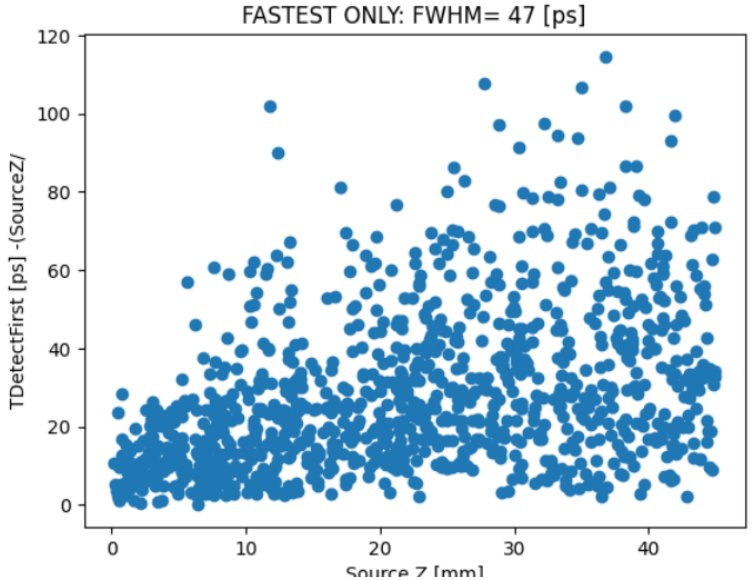
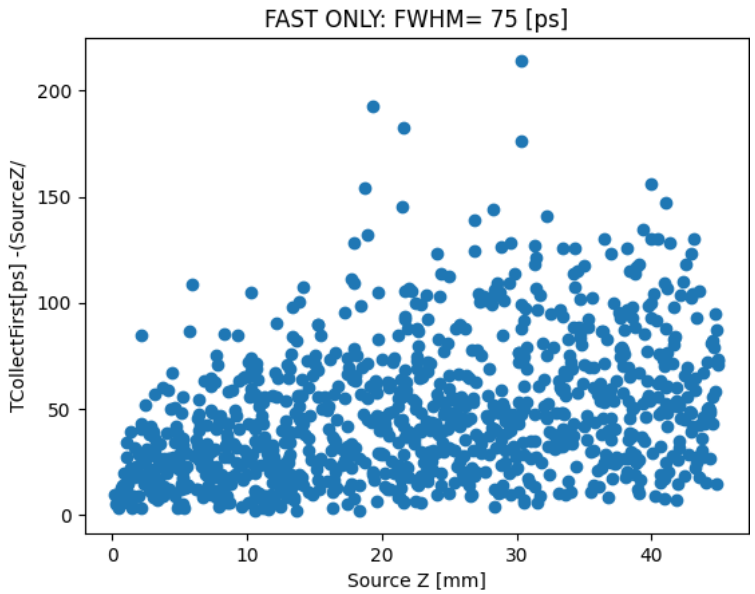
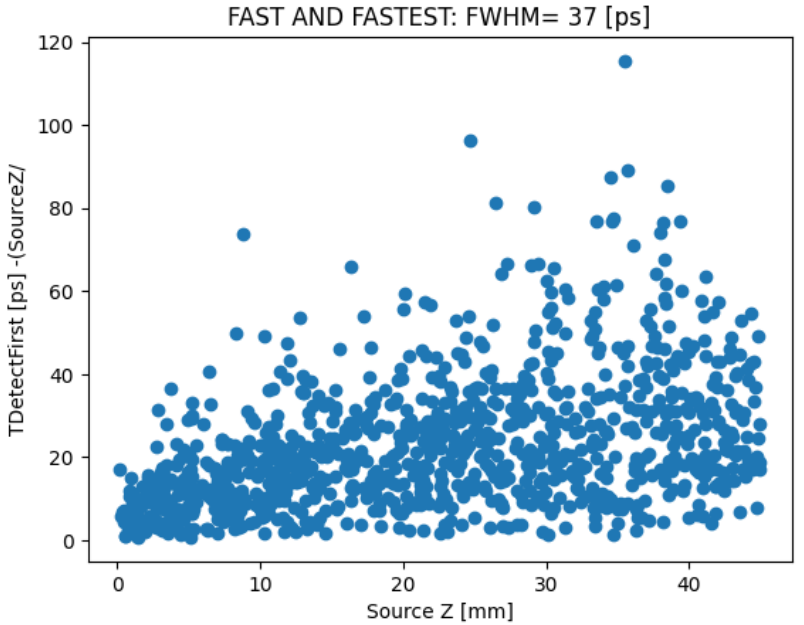
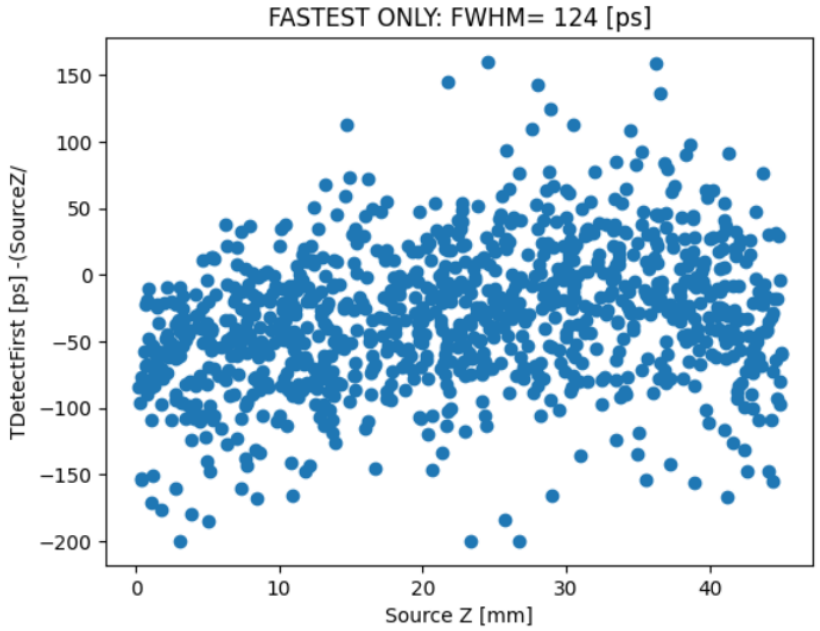
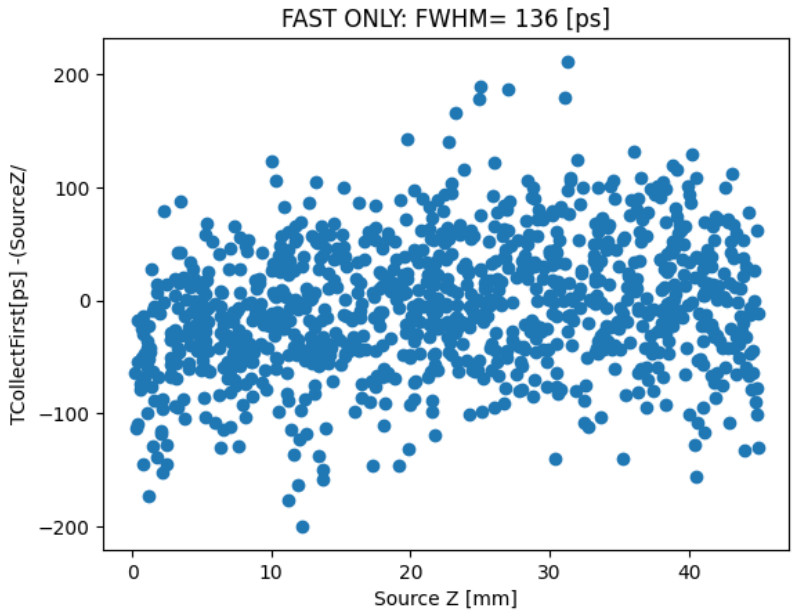
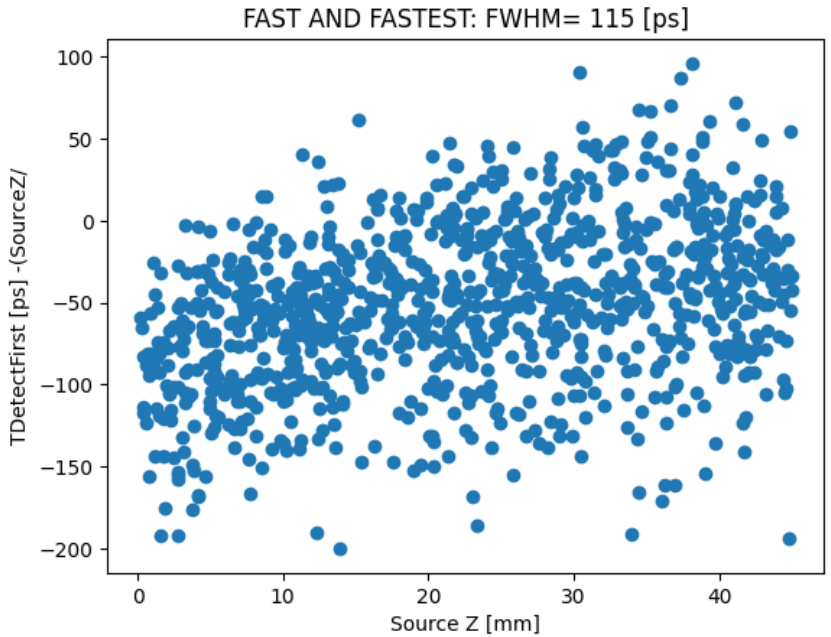






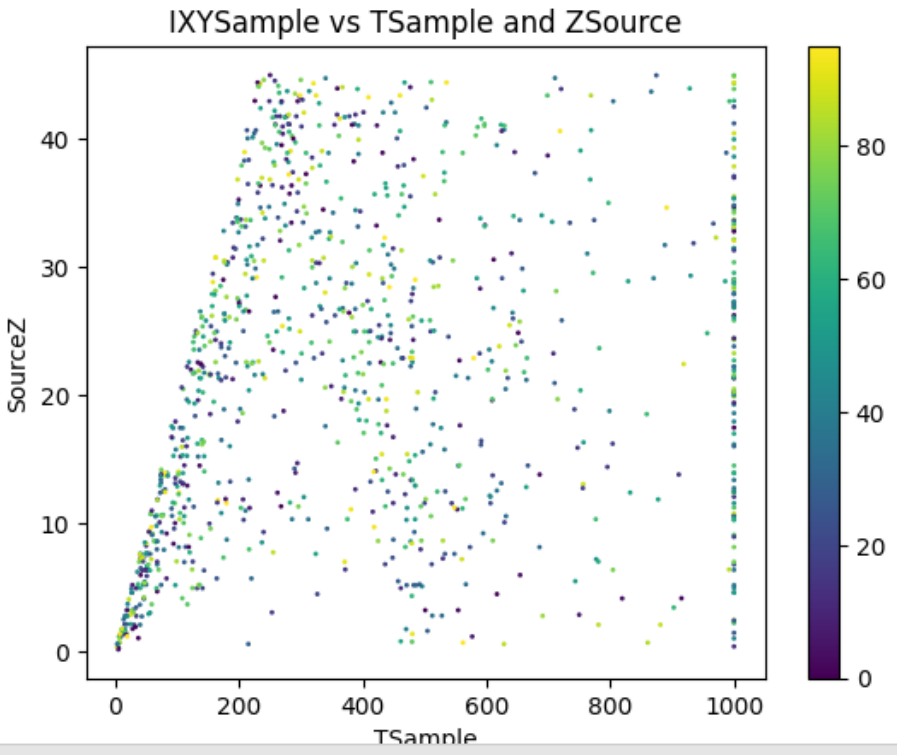






SimpleOpticsDetection.ipynb

LAPPD SPTR= 165 ps


IXYSample vs TSample and ZSource
SourceZ
TSample
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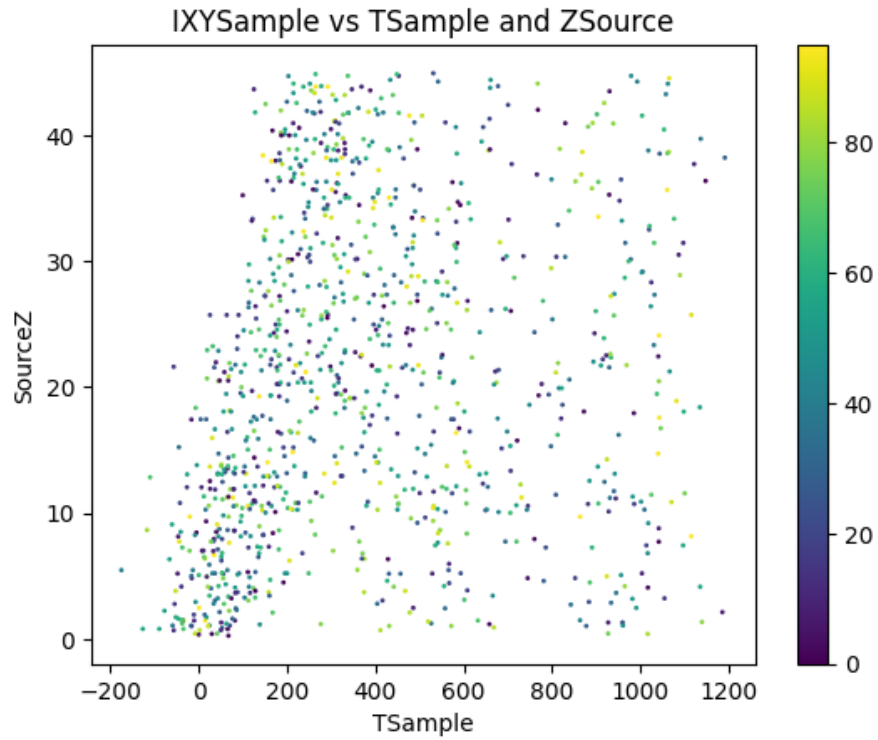
IXYSample vs TSample and ZSource
SourceZ
TSample
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Lehmann, A., Belias, A., Dzhygadlo, R., Gerhardt, A., Lehmann, D., Peters, K., Schepers, G., Schwarz, C., Schwiening, J., Traxler, M. and Schmitt, L., 2022, November. Latest Technological Advances with MCP-PMTs. In *Journal of Physics: Conference Series* (Vol. 2374, No. 1, p. 012128). IOP Publishing.

Table 1. Comparison of important performance parameters for the most recent MCP-PMTs.

Manufacturer	Photonis	Photonis	Photek	Photek	DIRC
serial number	9002192	9002193	A1200107	A3191220	specs
outer dimensions (mm^2)	58.8 × 58.8	58.8 × 58.8	61.4 × 61.9	60.3 × 61.8	58^2 to 62^2
active area ratio (%)	77	80	74	74	>72
TTS / RMS (-0.5 - 2.0 ns) time res. (ps)	26 / 109	27 / 109	28 / 215	36 / 199	≤50 / ≤200
gain loss (%) at 0.5 MHz/cm^2 @10^6 gain	5 - 8	5 - 7	8	0	<10
peak QE in % (@300 - 400 nm)	22.2	24.7	24.4	25.0	≥18
CE in % (≈10% uncertainty)	92	91	95	72	≥65
detective quantum efficiency DQE=QE*CE	20.4	22.5	23.2	17.9	≥12
QE uniformity (inner 2×2 pixels / full area)	1.00 / 1.28	1.01 / 1.35	1.02 / 1.92	1.04 / 8.33	<1.15 / <3
gain uniformity (full area)	4.2	3.1	7.7	12.5	<3
B-field gain ratio 0 T / 1 T (@ 0° tilt angle)	3.3	2.7	3.1	1.9	
B-field gain ratio 1 T / 2 T (@ 0° tilt angle)	9.1	6.1	2.2	2.3	
DCR at 0.5 p.e. threshold (Hz / cm^2)	24	183	263	69	<1000
afterpulse probability (%) @10^6 gain	1.74	0.79	0.14	0.49	<2

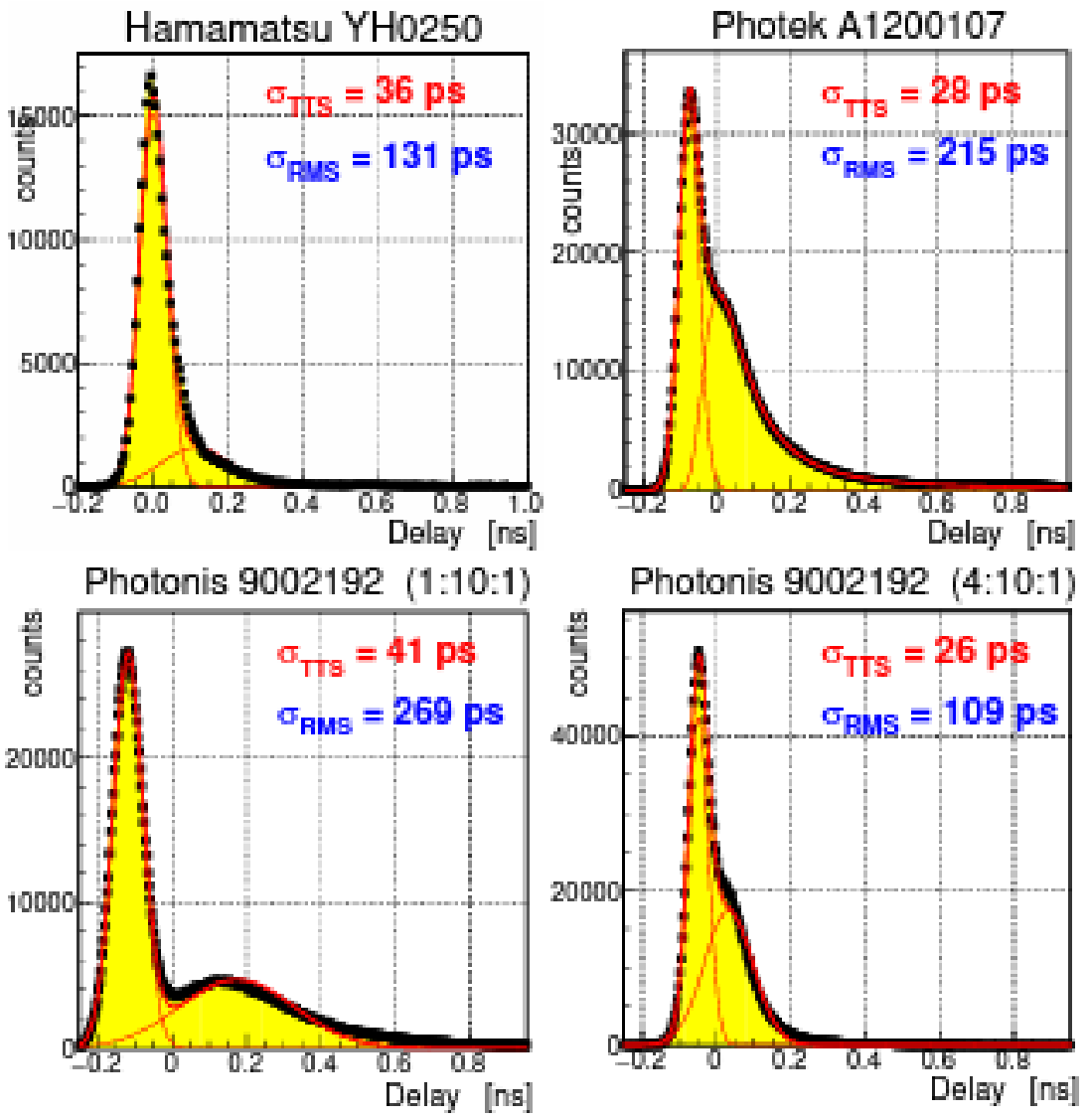
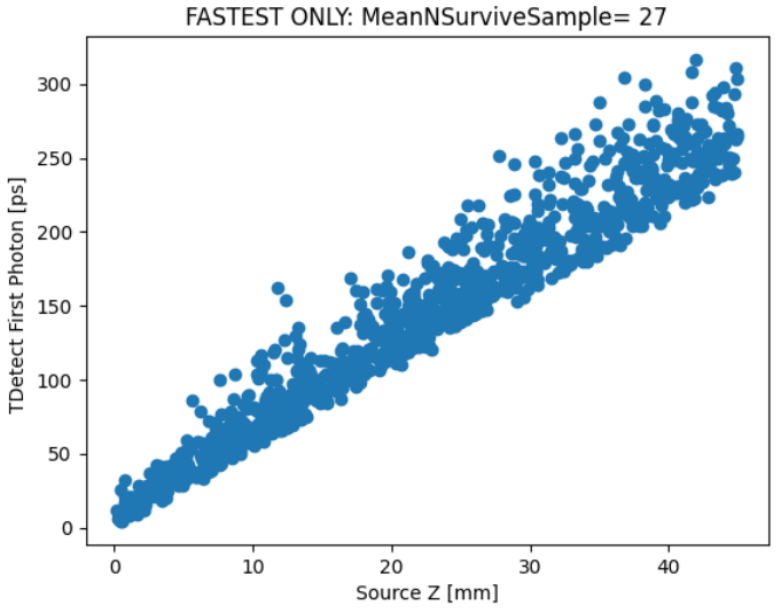
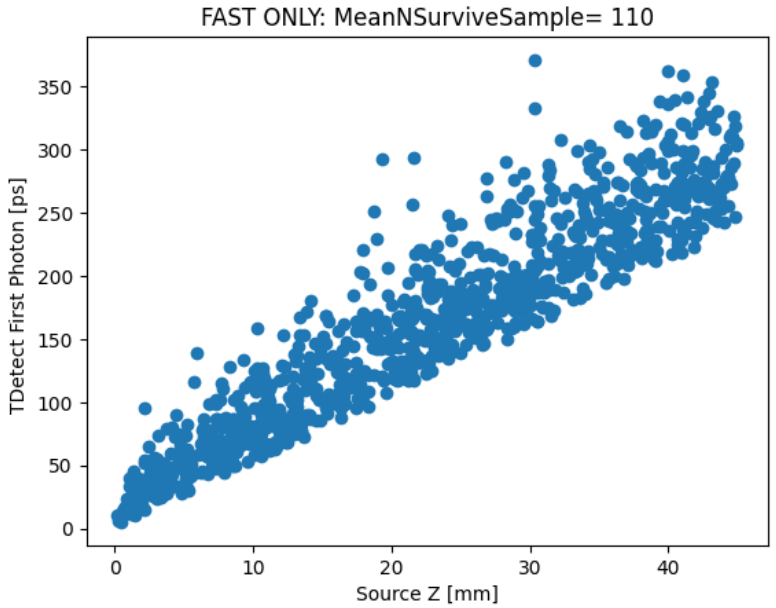
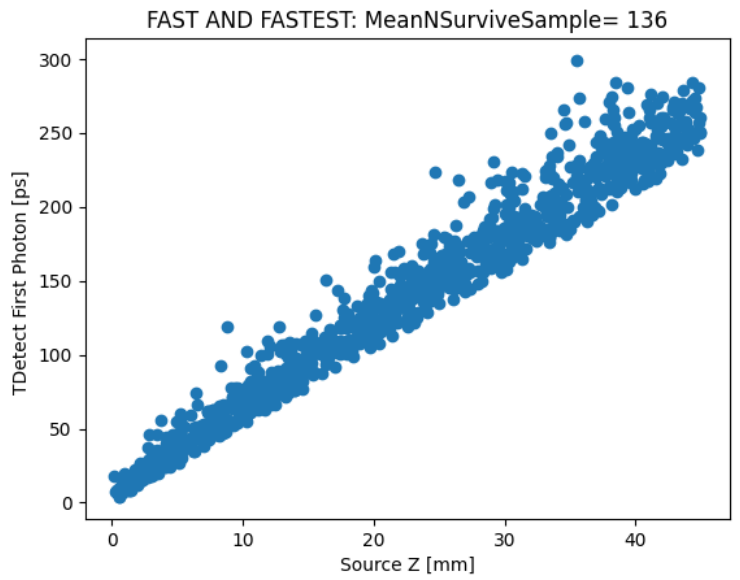


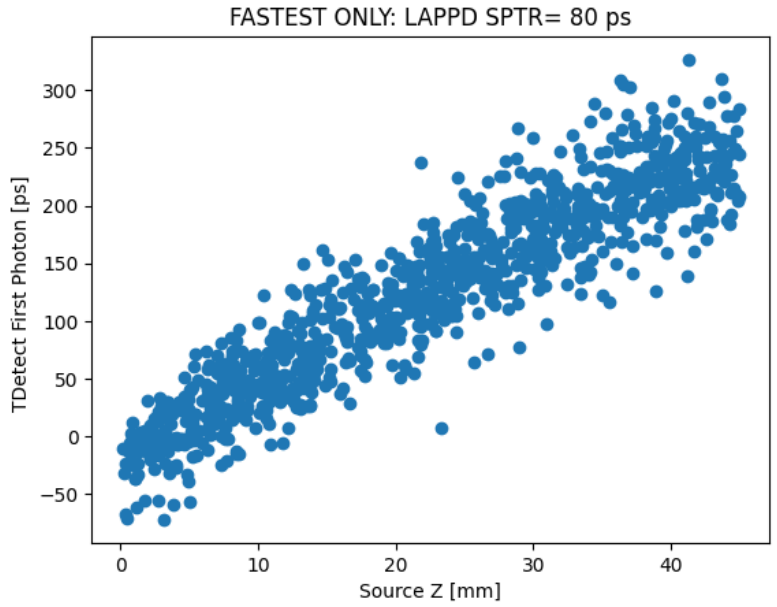
Figure 4. Time distribution (σ_{TTS}, σ_{RMS}) for various ALD MCP-PMTs

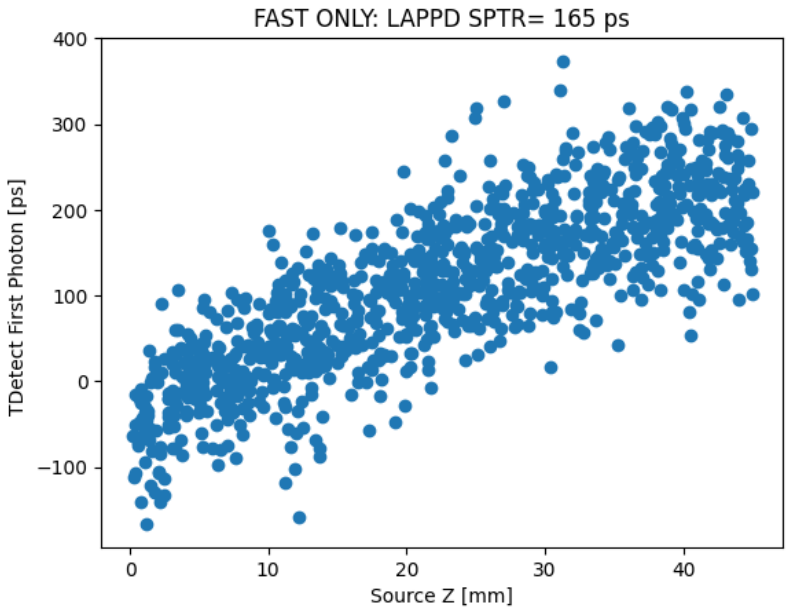
SimpleOpticsEmission.ipynb

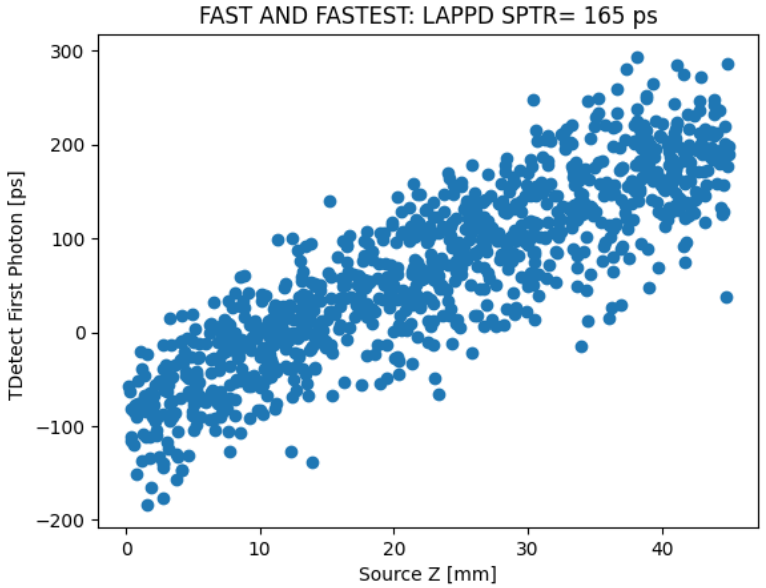








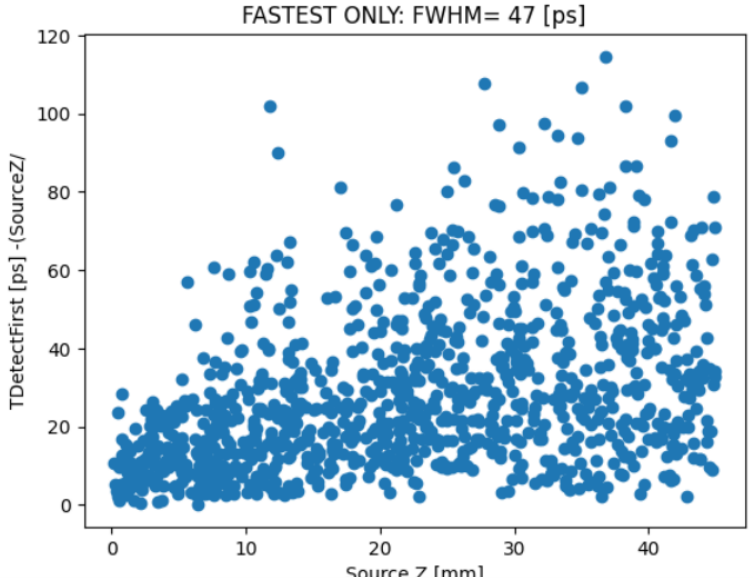


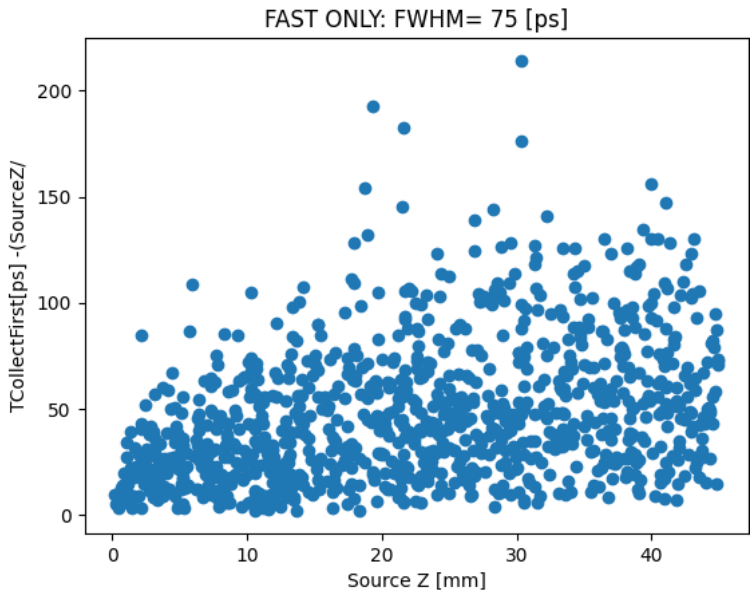


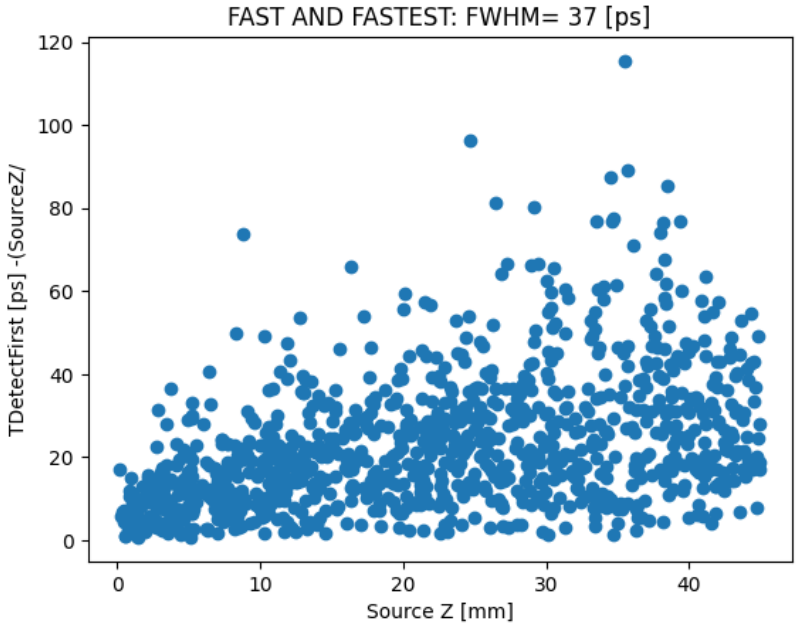
SimpleOpticsDetection.ipynb

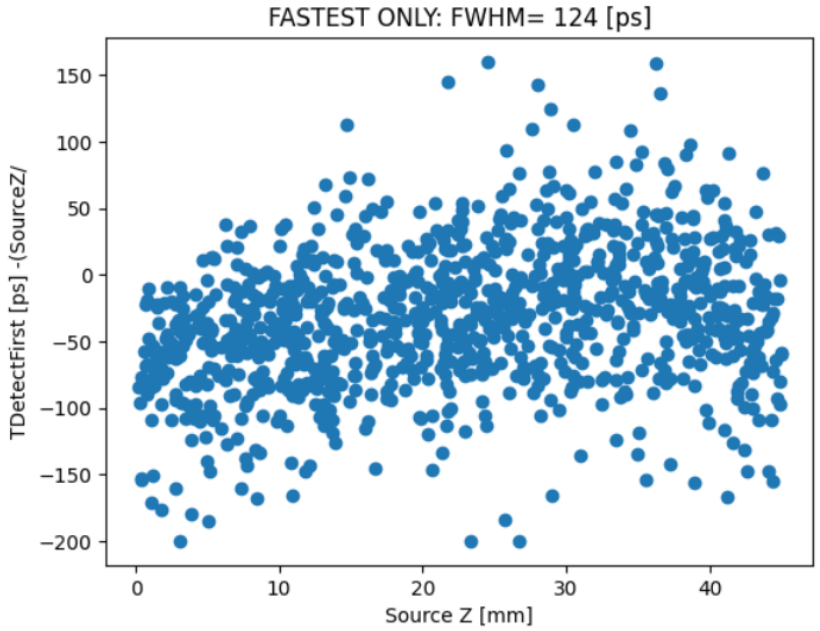
LAPPD SPTR= 165 ps

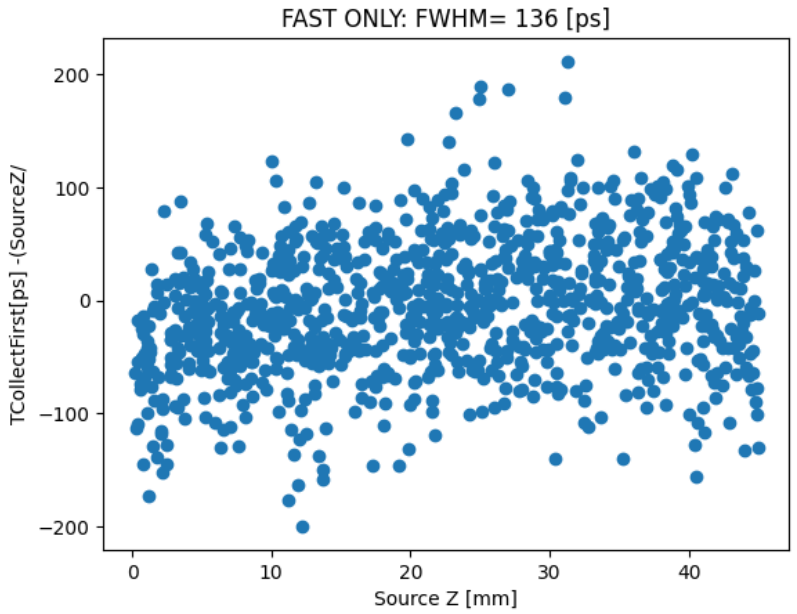
SimpleOpticsEmission.ipynb

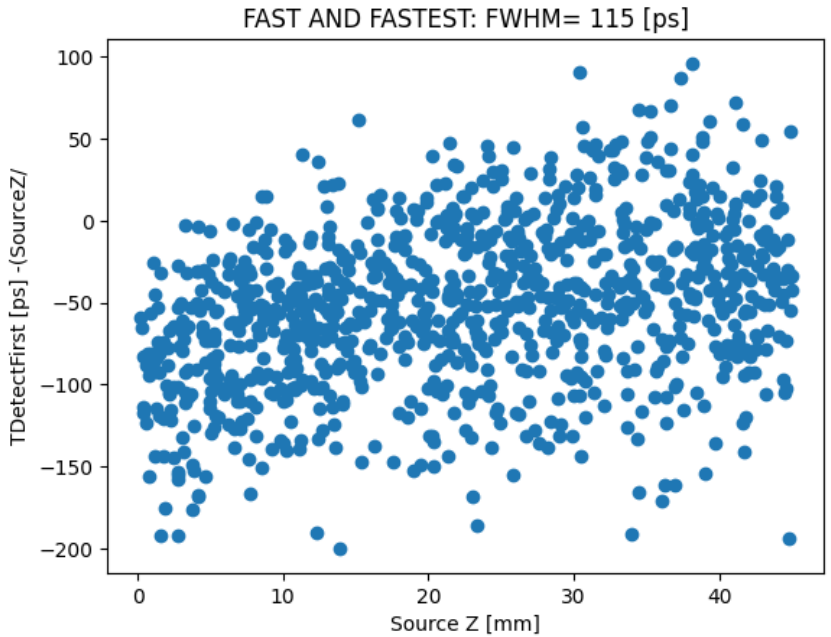








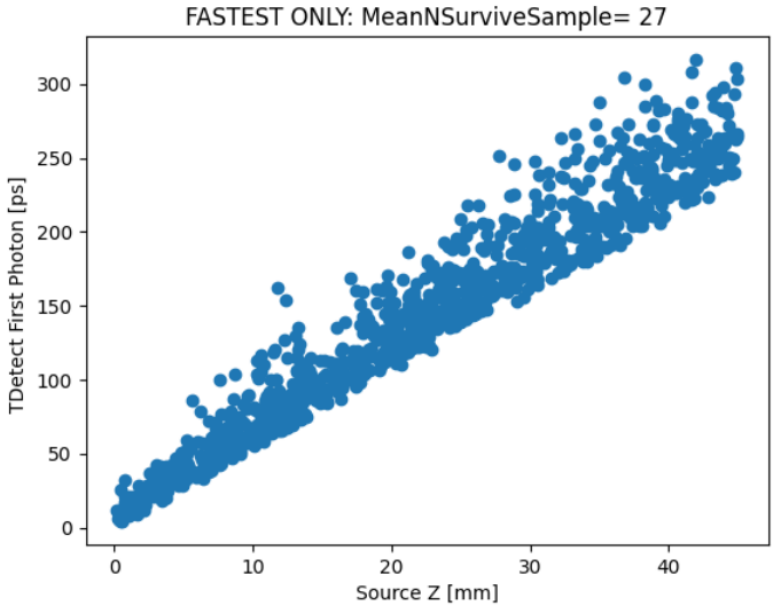


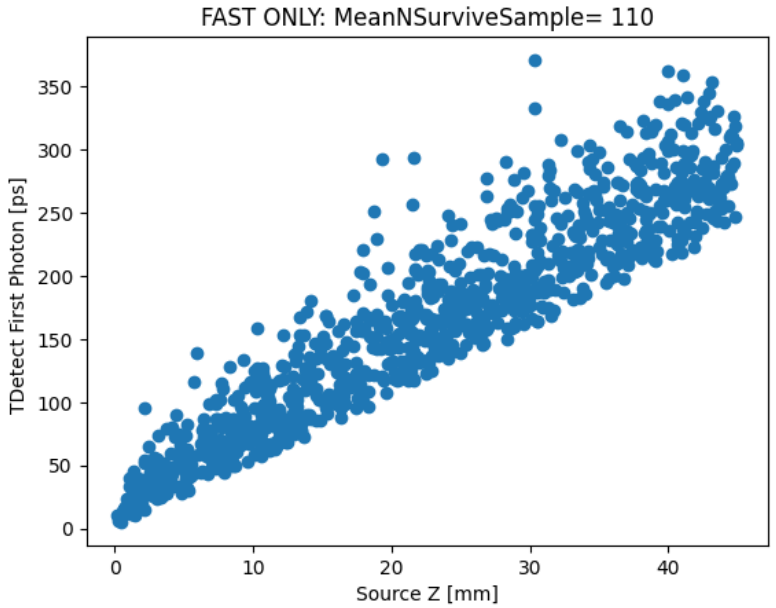


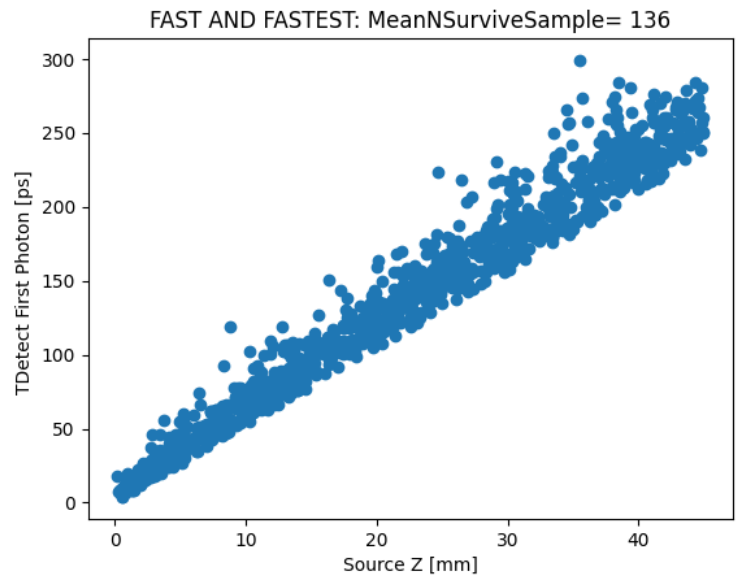
SimpleOpticsDetection.ipynb

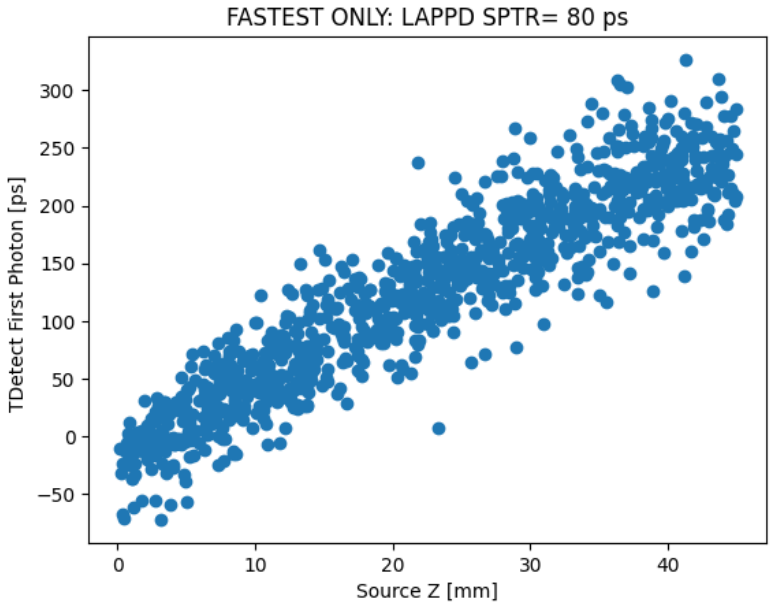
LAPPD SPTR= 165 ps

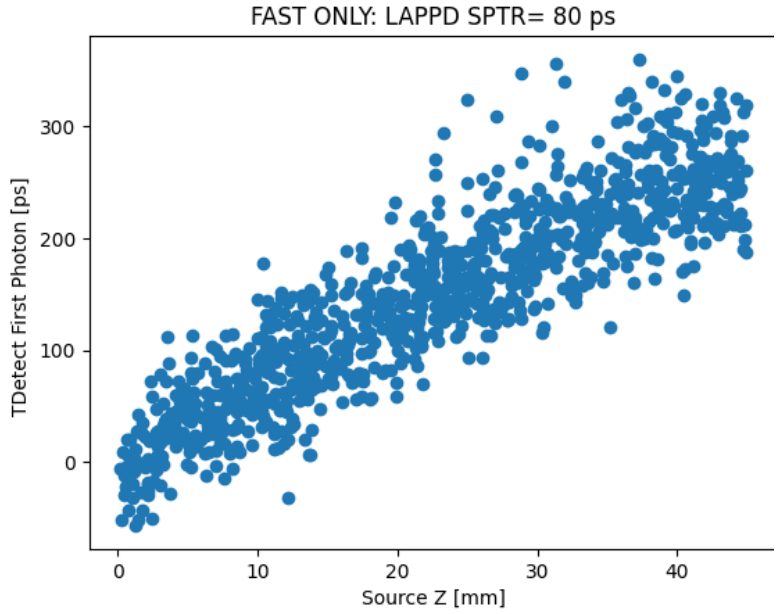
SimpleOpticsEmission.ipynb

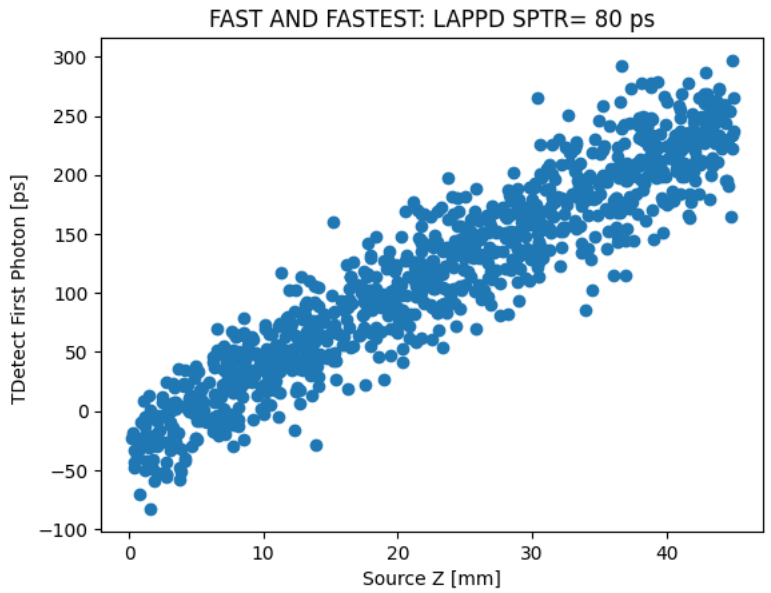








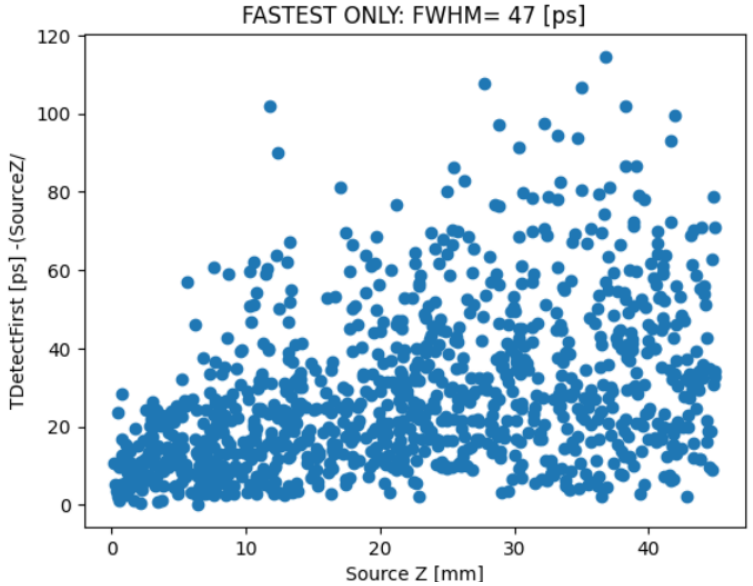


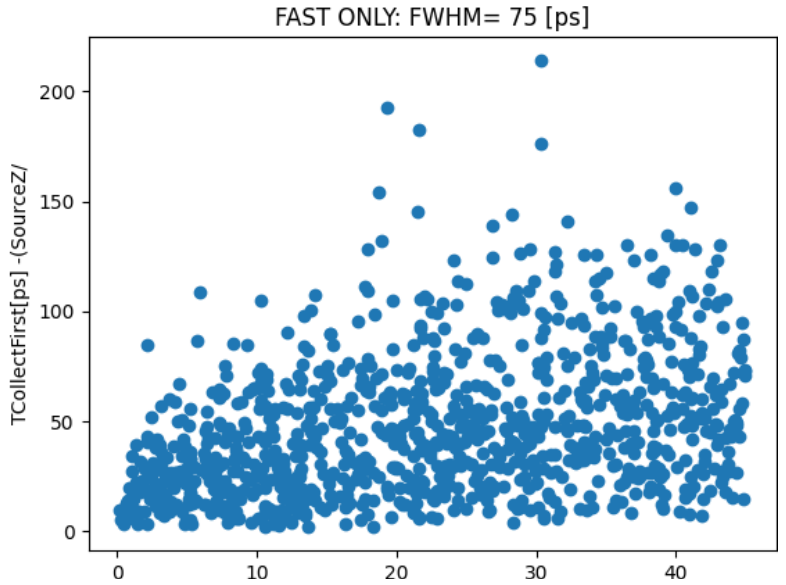


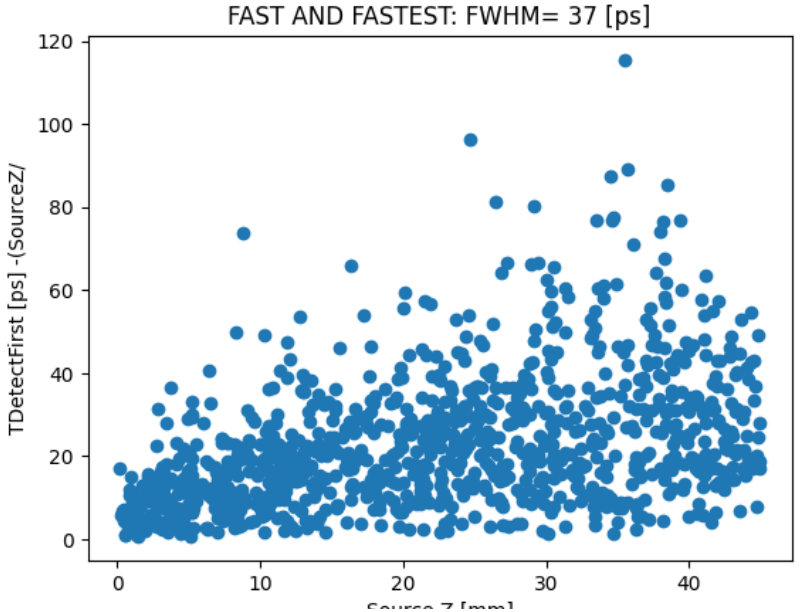
SimpleOpticsDetection.ipynb

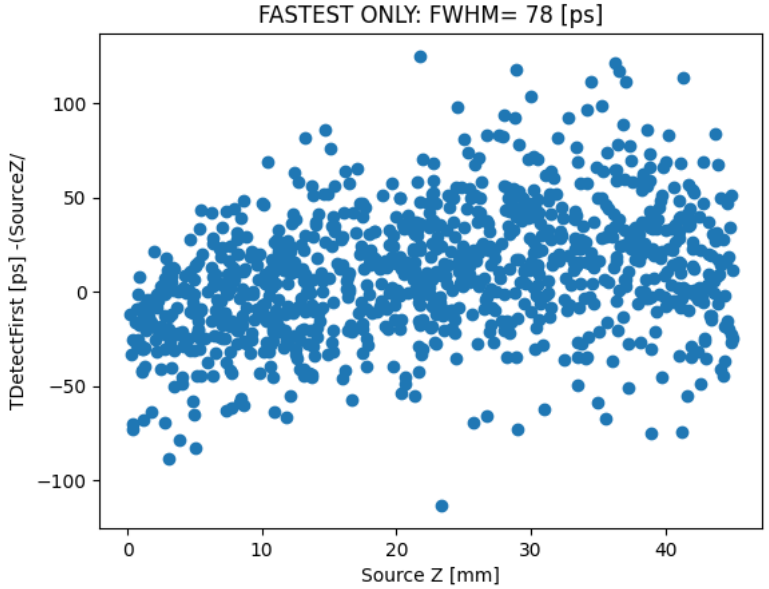
LAPPD SPTR= 80 ps

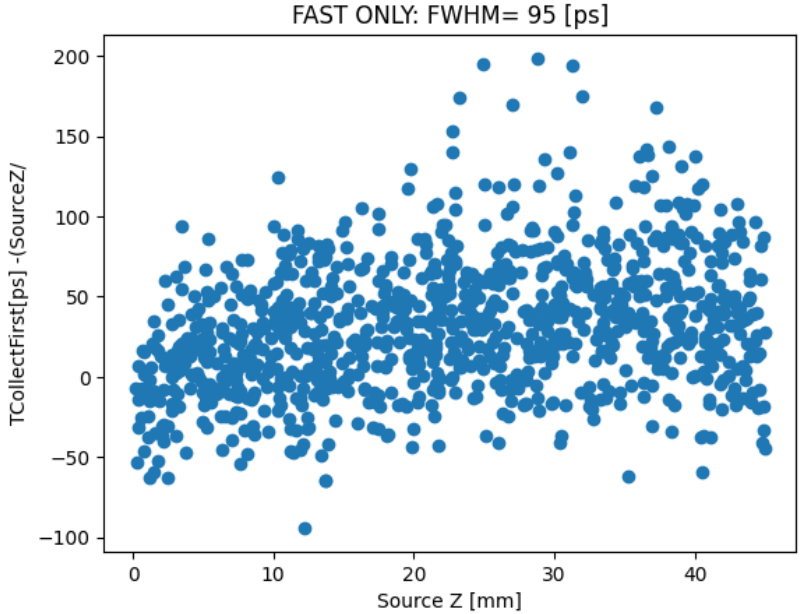
SimpleOpticsEmission.ipynb

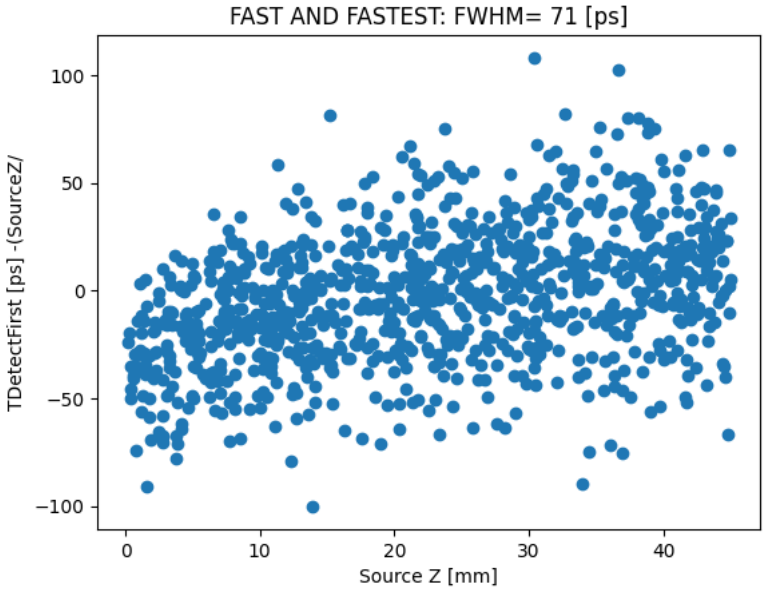












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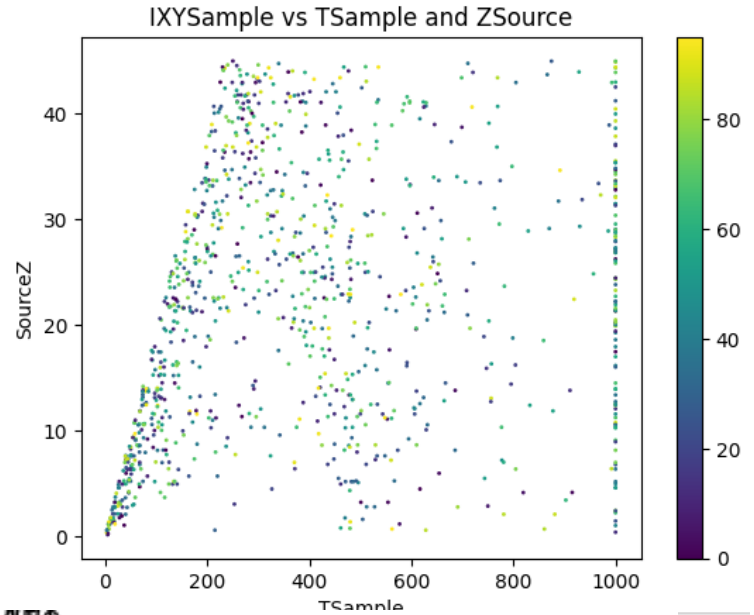

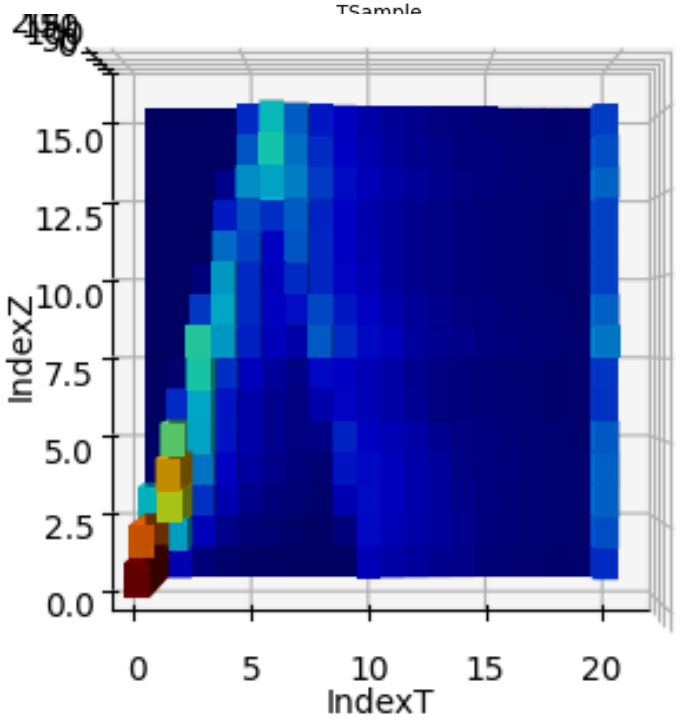

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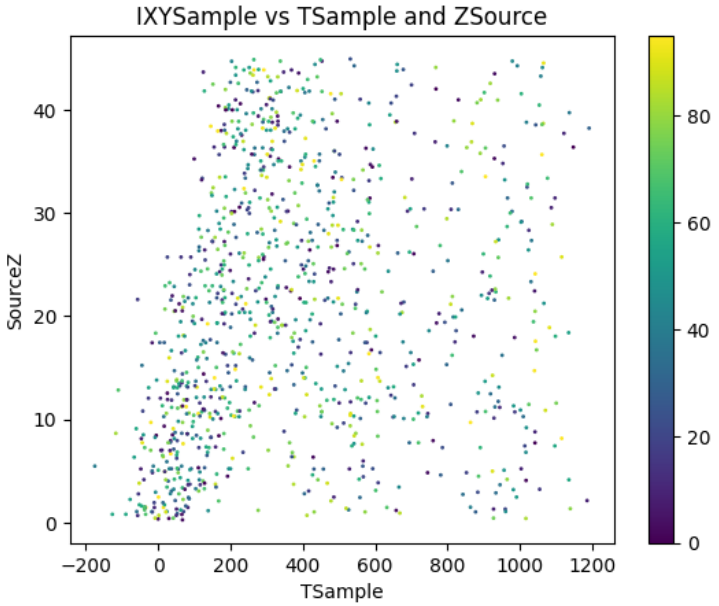

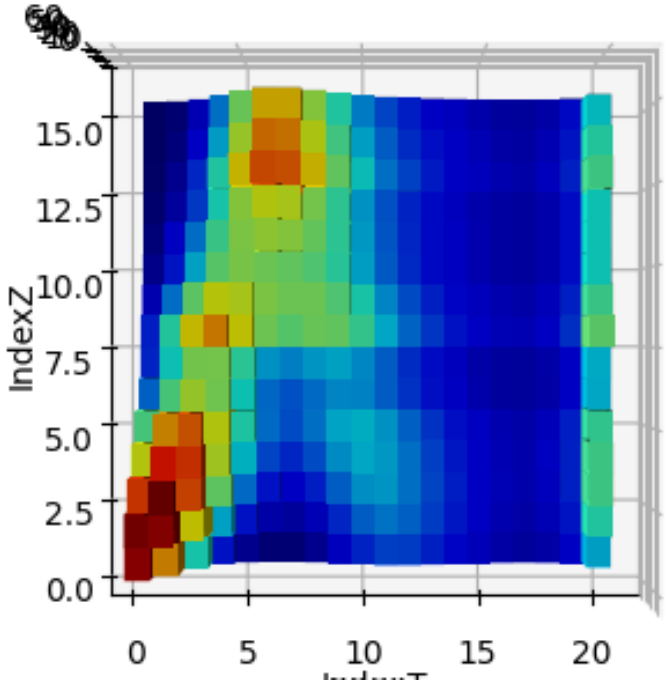

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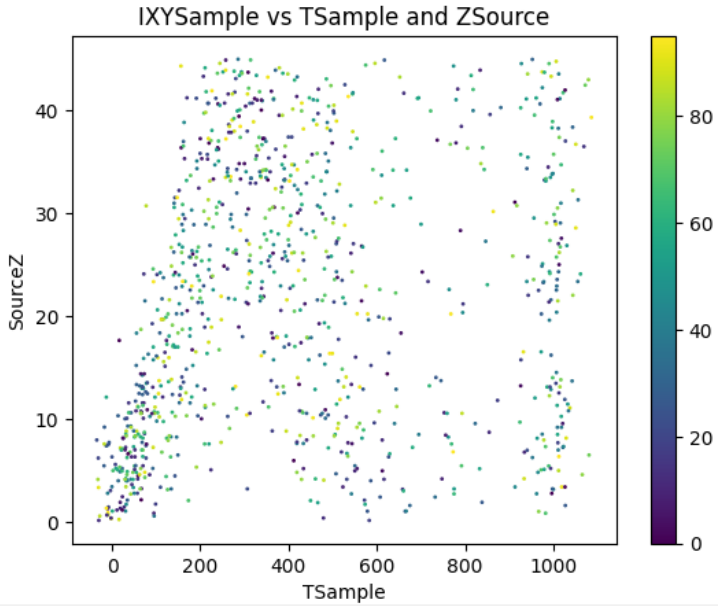

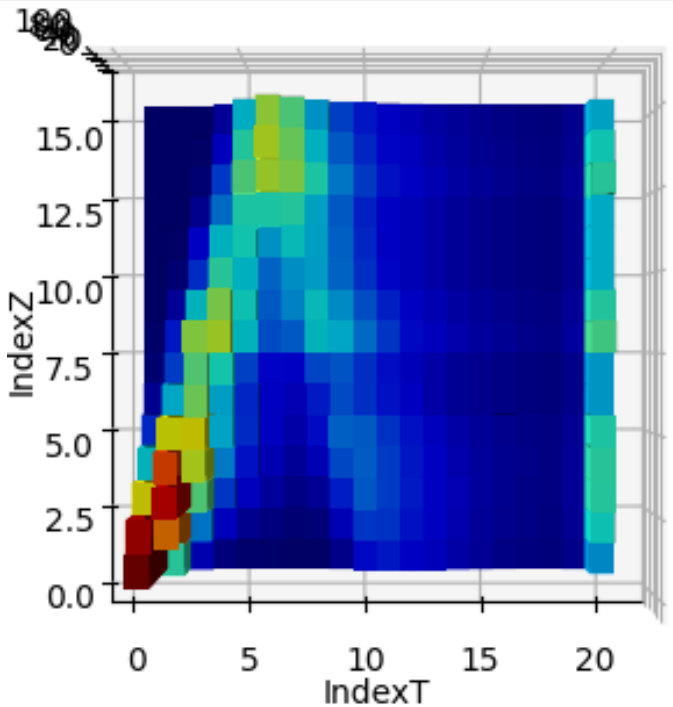

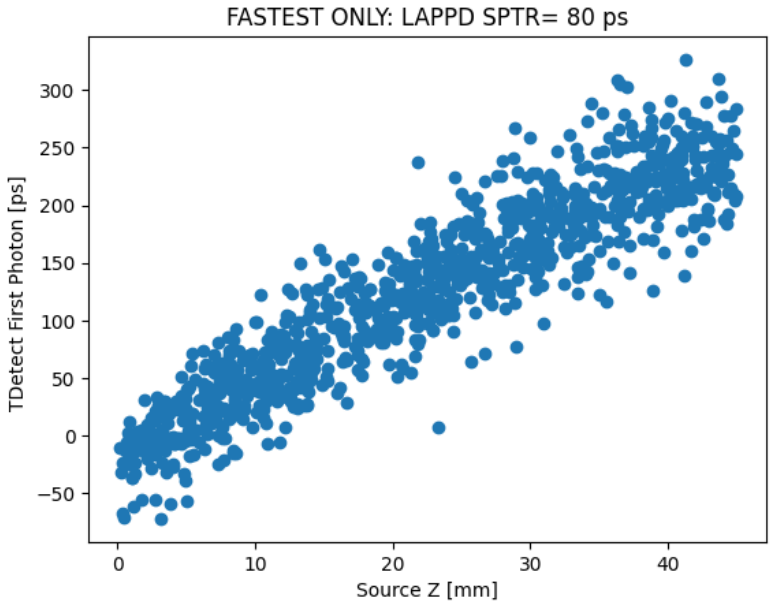

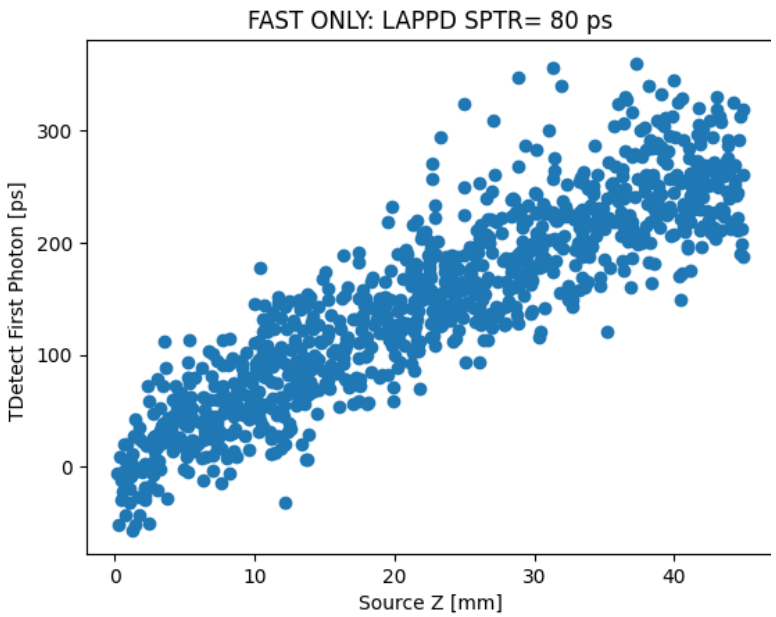

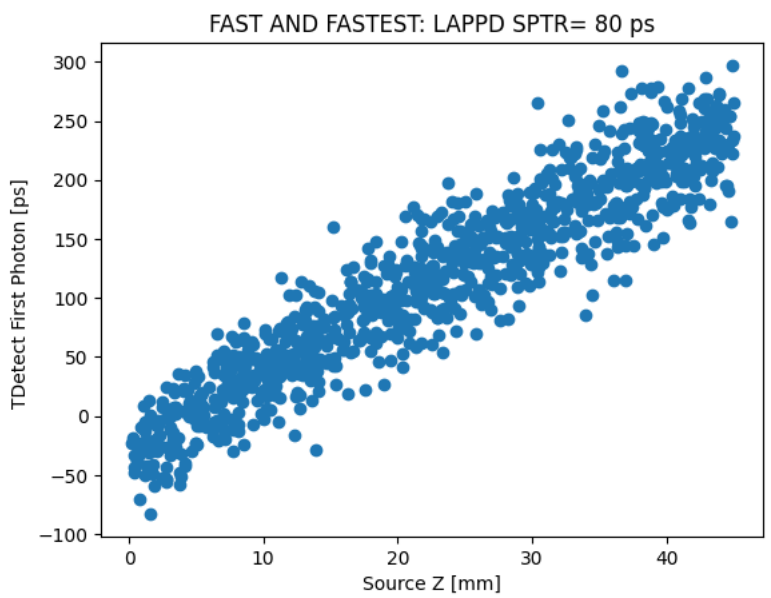

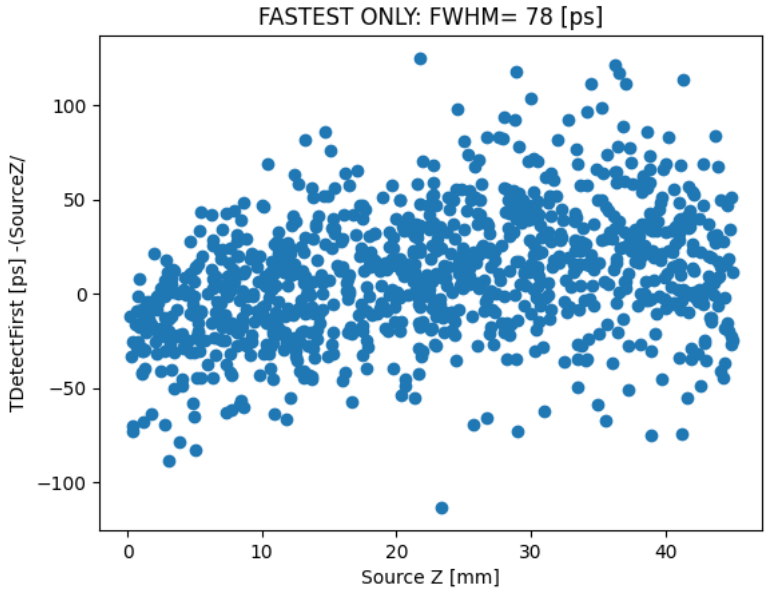

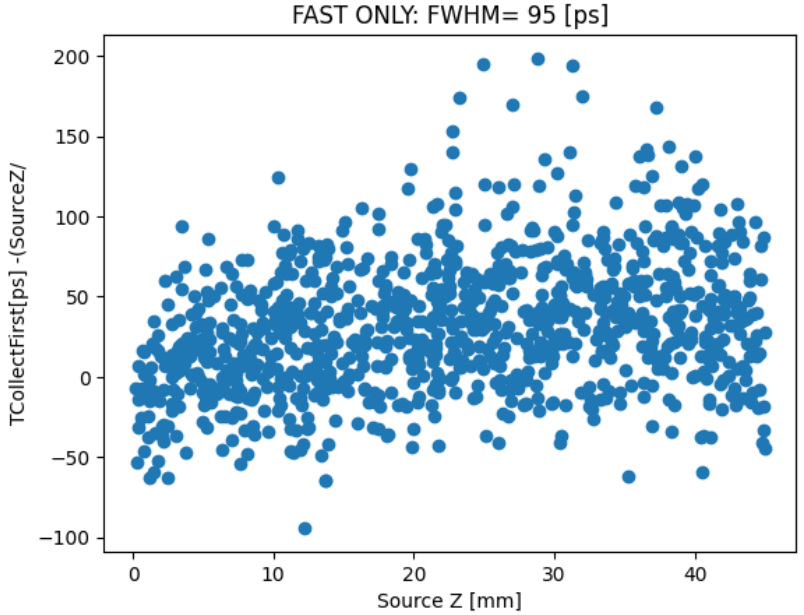

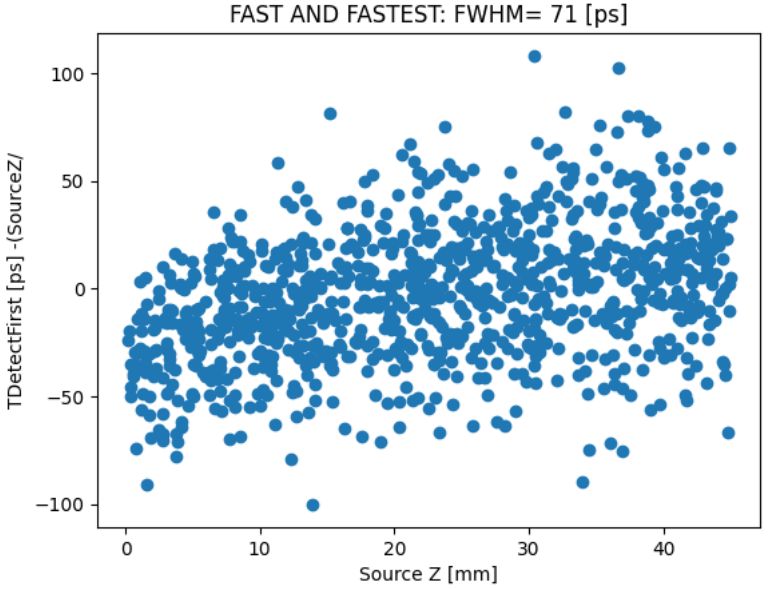

SimpleOpticsDetection.ipynb LAPPD SPTR= 80 ps