

PionLT EDTM Study # 2 Analysis

Jacob Murphy

2022/01/26

Total Live Times and EDTM Counts

Run	Current (uA)	Rate (Hz)	PS1	PS2	PS3	PS4	Scaler EDTM	Adj Sc EDTM	Acc EDTM	TLT	
13898	55	25			8		5	521970	34512	34595	1.002405
13899	55	25					5	319250	18779	18831	1.002769
13900	55	25			8			2138260	16575	15226	0.918612
13901	55	25		8		6		605430	22897	22967	1.003057
13902	55	50			8		5	549142	36308	35939	0.989837
13903	55	50			8		5	693106	45827	45295	0.988391
13905	55	100			8		5	693024	45822	48017	1.047903
13908	10	25			6		3	142543	31964	31794	0.994682
13912	10	25		6		3		115141	25819	25927	1.004183
13913	10	25			5			154171	9068	8990	0.991398
13914	10	25					1	56957	28478	28629	1.005302
13915	10	25					2	141398	47132	48248	1.023678
13916	10	50			5		2	92991	34643	34532	0.996796
13918	10	50			5		2	37704	14046	14314	1.01908
13919	10	100			5		2	164207	61175	61321	1.002387

Singe Arm TLT

Run	Current (uA)	PS2	PS4	TLT
13898	55	8	5	1.002405
13899	55		5	1.002769
13900	55	8		0.918612
13908	10	6	3	0.994682
13913	10	5		0.991398
13915	10		2	1.023678

At high rate, the SHMS TLT dropped compared to the HMS and combined.

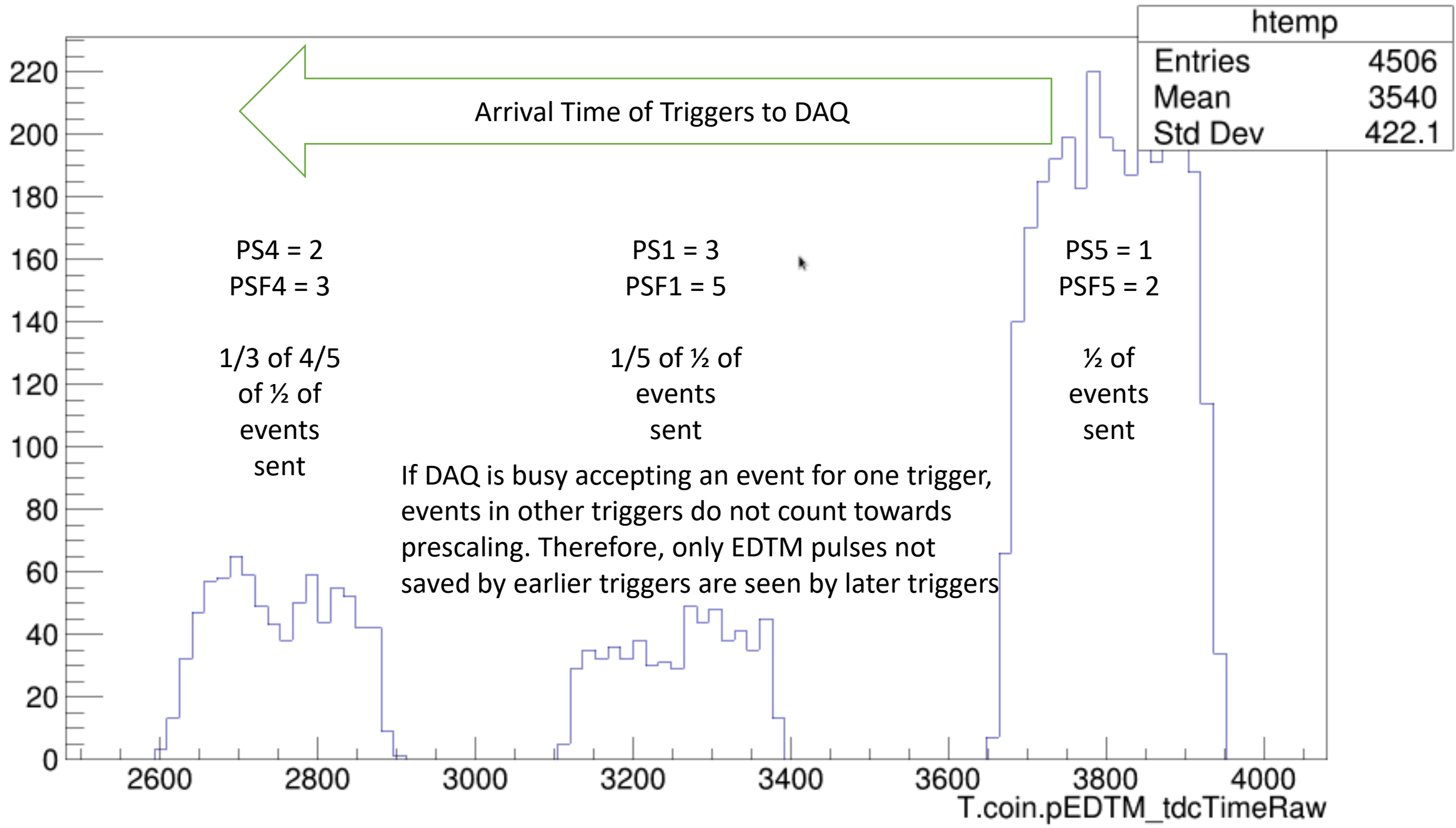
Increased Deadtime in Run 13899

- From Report Files:
 - At 10 μ A (Run 13908):
 - HMS EL_REAL Trigger rate: 3.275 kHz
 - SHMS EL_REAL Trigger rate: 24.836 kHz
 - At 55 μ A (Run 13898):
 - HMS EL_REAL Trigger rate: 16.549 kHz
 - SHMS EL_REAL Trigger rate: 126.268 kHz
- At higher current, the SHMS has a trigger rate an order of magnitude different from the HMS arm or either arm at lower current
 - I believe this is causing an increased electronic deadtime, but I will need to get the CPU LT to confirm this
- Following slides explain why TLT with both arms does not reflect this

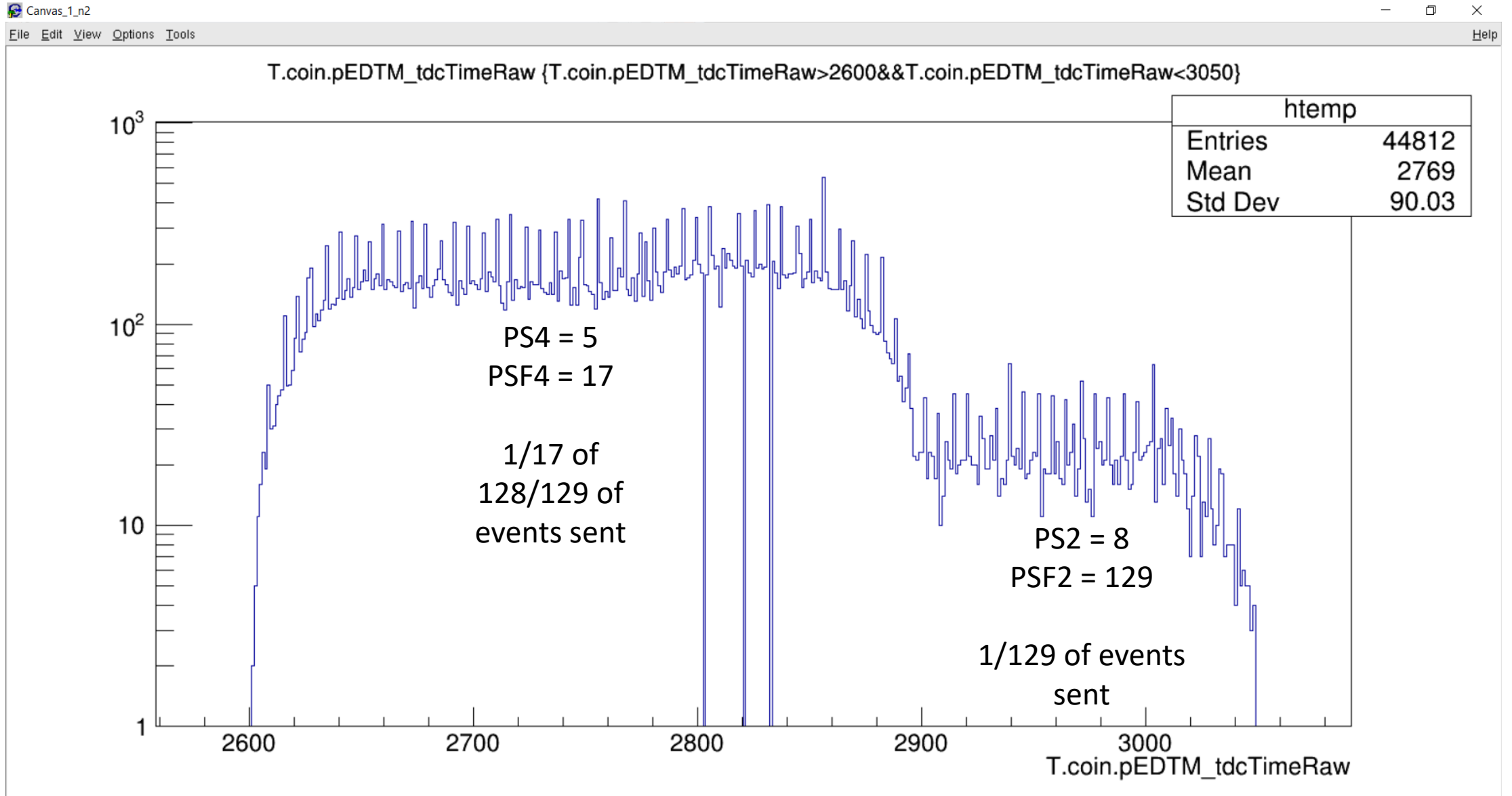
EDTM Rate to Disc

- Current EDTM GUI asks for desired nominal EDTM rate to disc
- Sets EDTM pulse clock to that rate * lowest prescale factor
 - $EDTM_{acc} = \frac{EDTM_{sent}}{PSF_{min}}$
 - For physics production runs, our coin trigger is always non-prescaled (PS=0), so The nominal rate accepted is the same as the pulse clock rate for EDTM
- In reality, the rate of EDTM events saved to disc is a function of all PS factors
 - $$\frac{EDTM_{acc}}{EDTM_{sent}} = \frac{EDTM_{sent}}{PSF_1} + \frac{EDTM_{sent}}{PSF_2} - \frac{EDTM_{sent}}{PSF_1 * PSF_2} + \frac{EDTM_{sent}}{PSF_3} - \frac{EDTM_{sent}}{PSF_1 * PSF_3} - \frac{EDTM_{sent}}{PSF_3 * PSF_2} + \frac{EDTM_{sent}}{PSF_1 * PSF_2 * PSF_3}$$
 - Note for two triggers, only the first 3 terms survive
 - This was confirmed by the first EDTM study

T.coin.pEDTM_tdcTimeRaw {T.coin.pEDTM_tdcTimeRaw>0}



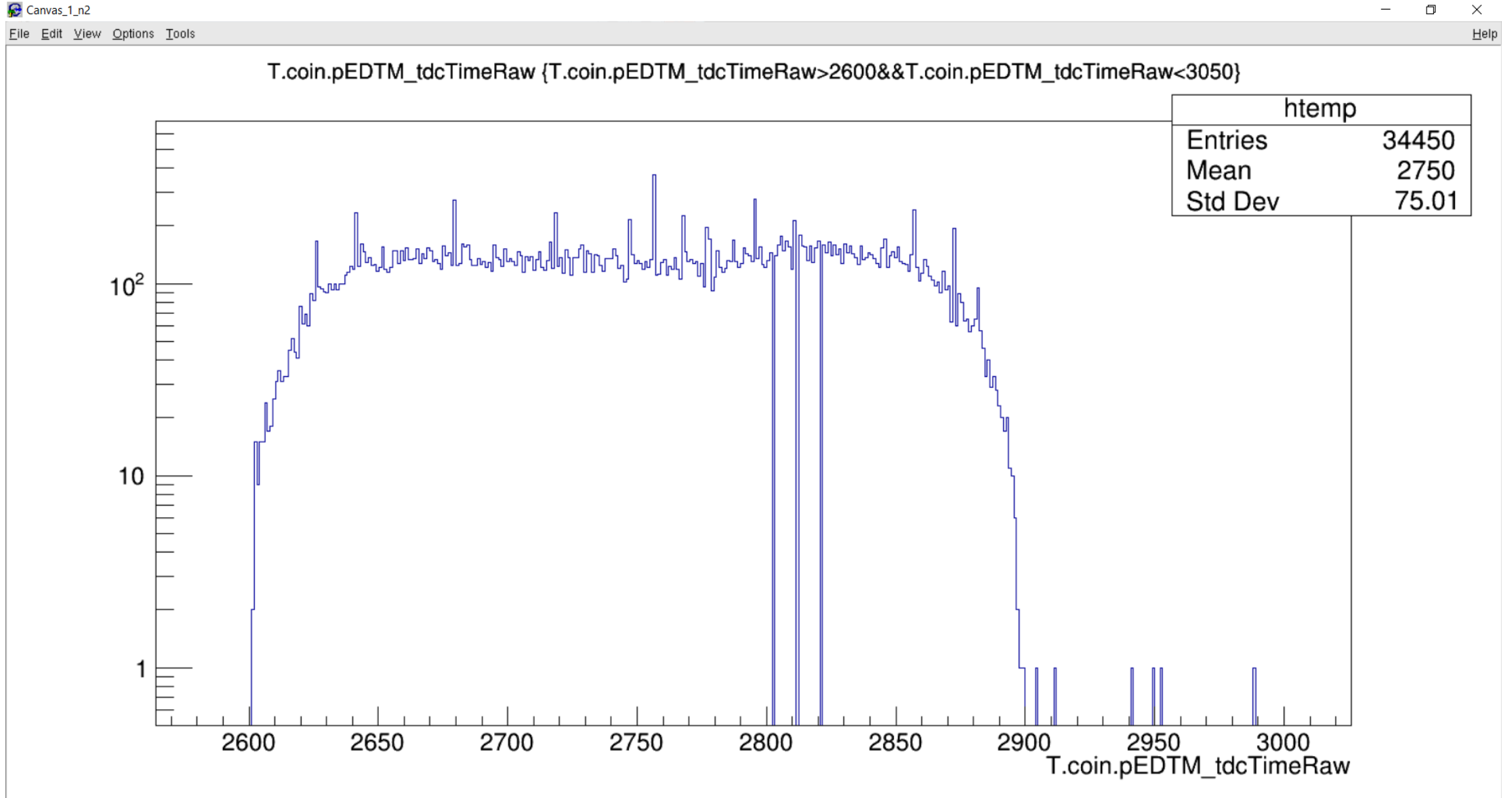
Run 13898 – Both Arms



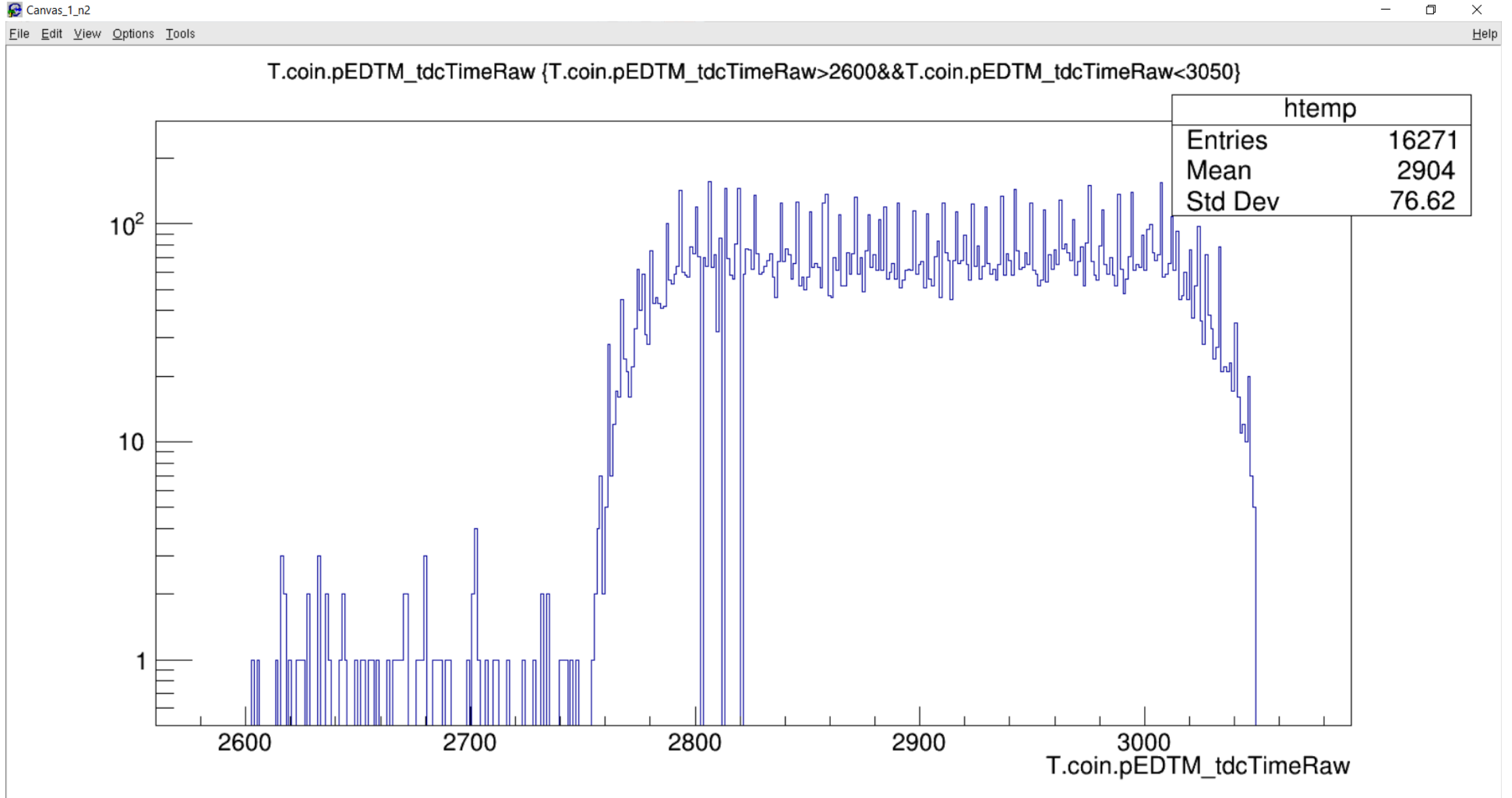
Weighted TLT

- ~522,000 scaler EDTM events are sent in run 13898
- Assuming the TLT in runs 13899 and 13900 are accurate
 - SHMS has TLT of ~92%
 - HMS has TLT of ~100%
- From the prescales, we expect ~4000 EDTM pulses to enter pTrig2
 - Accounting for deadtime, we expect ~3700 to be accepted
- From the prescales, we expect ~30500 EDTM pulses to enter pTrig4
 - Accounting for deadtime, we expect ~30500 EDTM pulses to be accepted
- In total, this is ~300 EDTM pulses rejected due to deadtime (8% of 4000)
 - This is 0.06% TDT, or ~100% TLT
- In the SHMS arm, the true TLT is 8% less than what EDTM calculates in the COIN DAQ

Run 13899 – HMS Only



Run 13900 – SHMS Only



$\frac{3}{4}$ Triggers TLT

Run	Current (uA)	PS1	PS2	PS3	PS4	TLT
13898	55	-1	8	-1	5	1.002405
13901	55	8	-1	6	-1	1.003057
13908	10	-1	6	-1	3	0.994682
13912	10	6	-1	3	-1	1.004183

Varied EDTM Rate TLT

Run	Current (uA)	EDTM Rate (Hz)	PS2	PS4	TLT
13898	55	25	8	5	1.002405
13902	55	50	8	5	0.989837
13903	55	50	8	5	0.988391
13905	55	100	8	5	1.047903
13908	10	25	6	3	0.994682
13916	10	50	5	2	0.996796
13918	10	50	5	2	1.01908
13919	10	100	5	2	1.002387

TLT at high physics and EDTM rate is higher

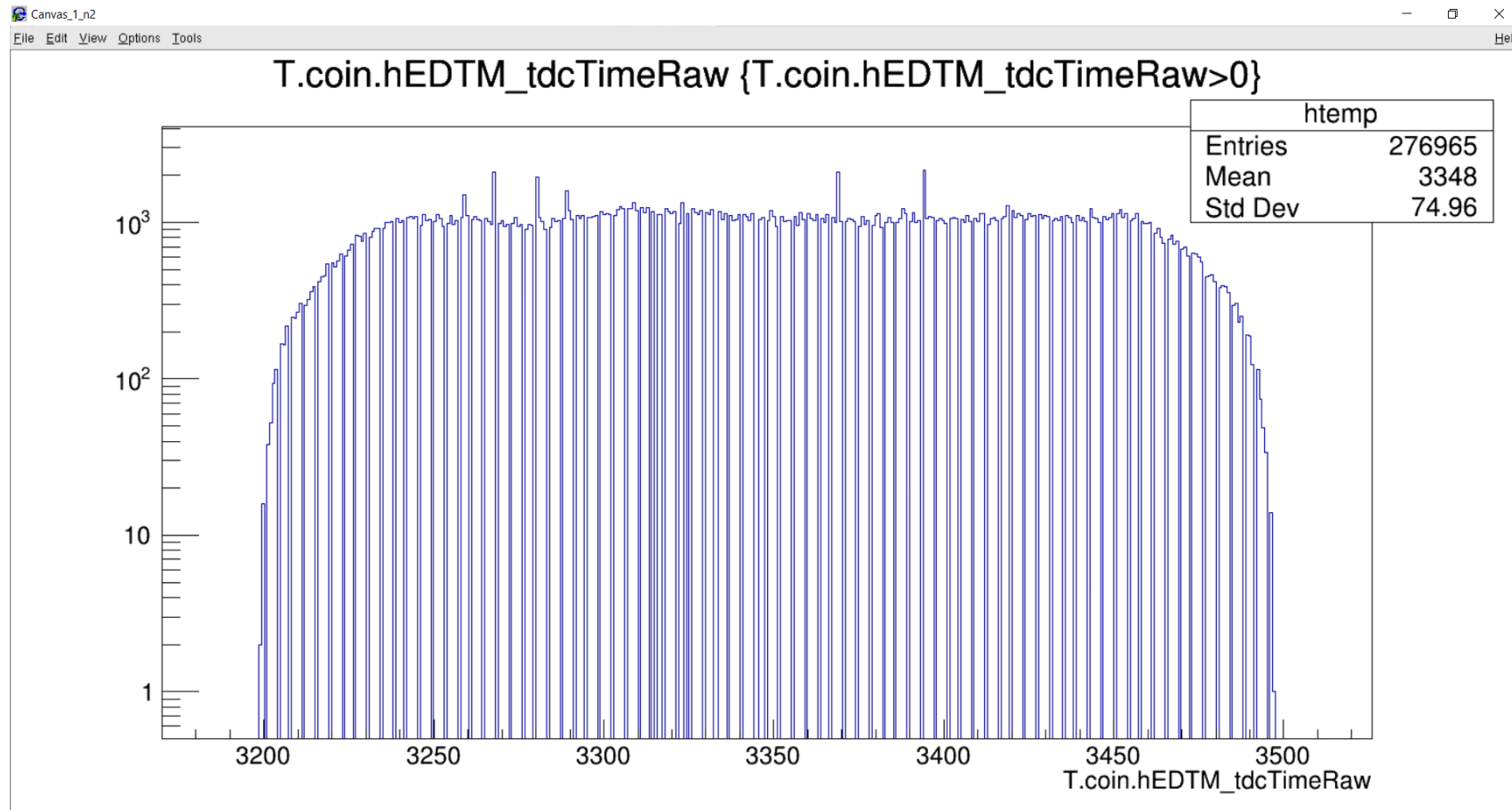
TLT > 1 Possible Explanations

- Badly defined cuts
 - Mismatch in current cuts between scaler and accepted, accepted cuts too wide
 - Found some inconsistencies, need to examine further
- Background in TDC spectrum from non-EDTM events
 - Should be seen in non-prescaled runs as well, where $TLT < 1$
- Double-Counting of EDTM Pulses
 - Again, should see this in non-prescaled runs
- Fluctuation in EDTM making it past prescaling
 - Only would be seen in runs with prescaled EDTM
 - BUT should see fluctuations both up and down
- EDTM interacts with prescaling in some not-understood way???
 - Consistently more EDTM get past prescaling than expected; Why? How best to account for this? Is this seen without beam? That is, is there a physics rate dependence?
 - Does a monte carlo simulation reflect the results we see?

A Look at Richard's EDTM Study (Study #3)

- All runs used PS3 only, varying the factor
- EDTM scaler rate aimed to be about 1kHz for following runs
- For hEDTM_tdcTimeRaw, PS3 triggers are from 3180-3480, roughly
 - All tdcTimeRaw triggers fall in channels of width 300

Run 14135



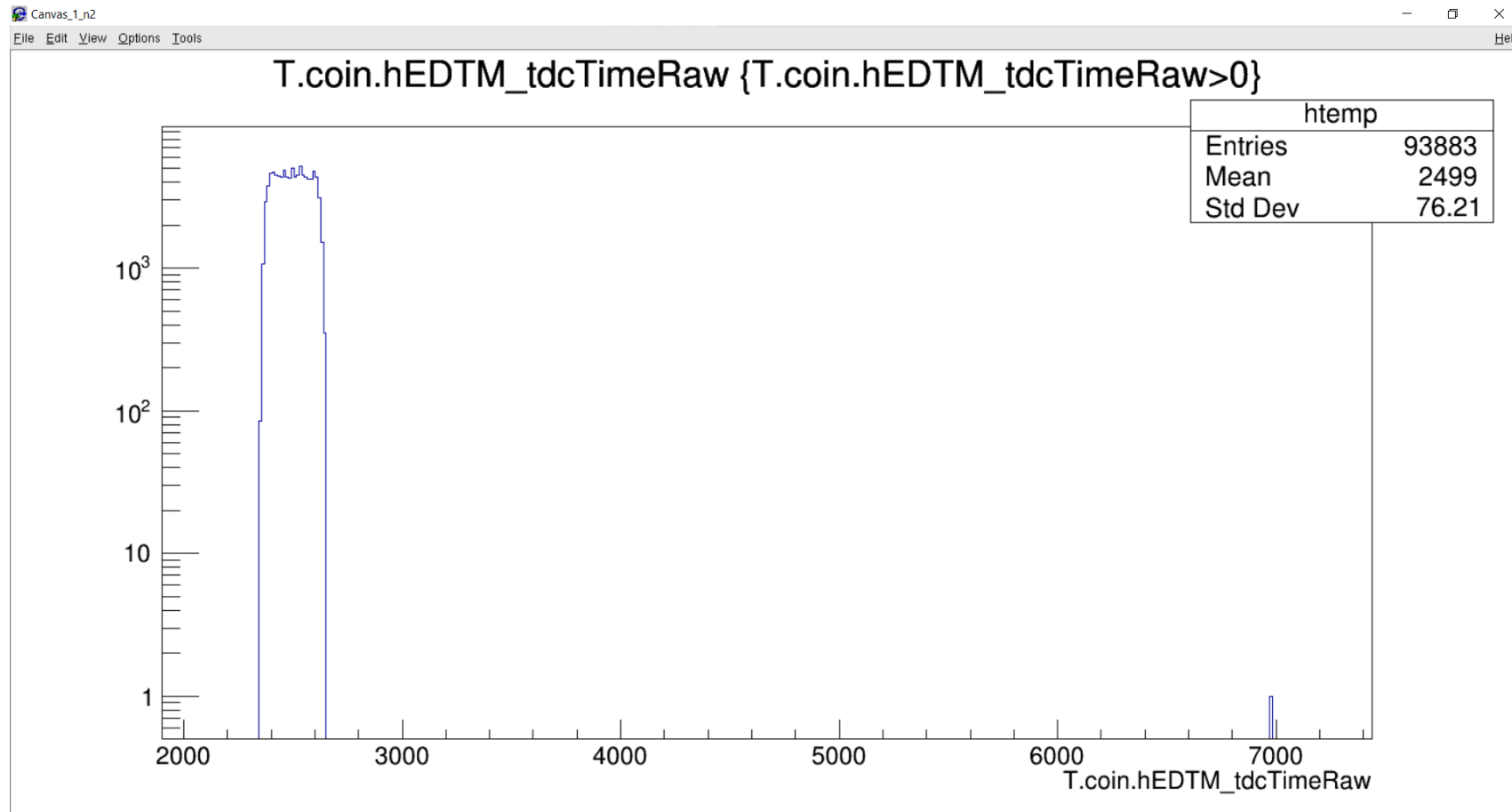
EDTM Scaler: 276992

PS3 = 0 (factor of 1)

EDTM Expected: 276992

TLT: 0.9999

Run 14139



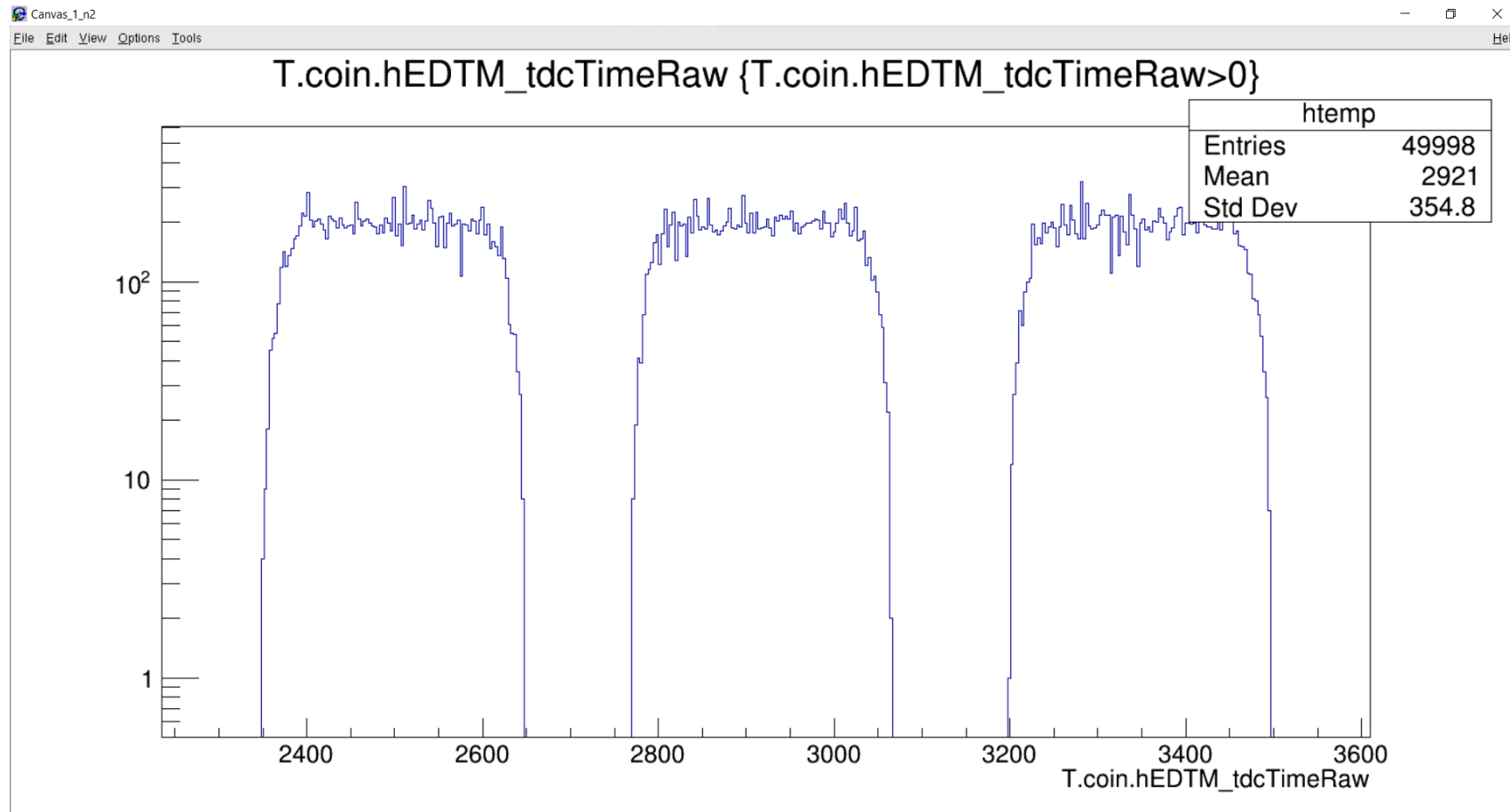
EDTM Scaler: 281640

PS3 = 4 (factor of 9)

EDTM Expected: 31293

$93883/3 = 31294$

Run 14140



EDTM Scaler: 283215

PS3 = 5 (factor of 17)

EDTM Expected: 16659

$49998/3 = 16666$

EDTM Pulses are triple-counted?

- Or 3x as many as expected are getting past pre-scaling?
- Richard and I plan to discuss more tonight