Update on EDTM Studies

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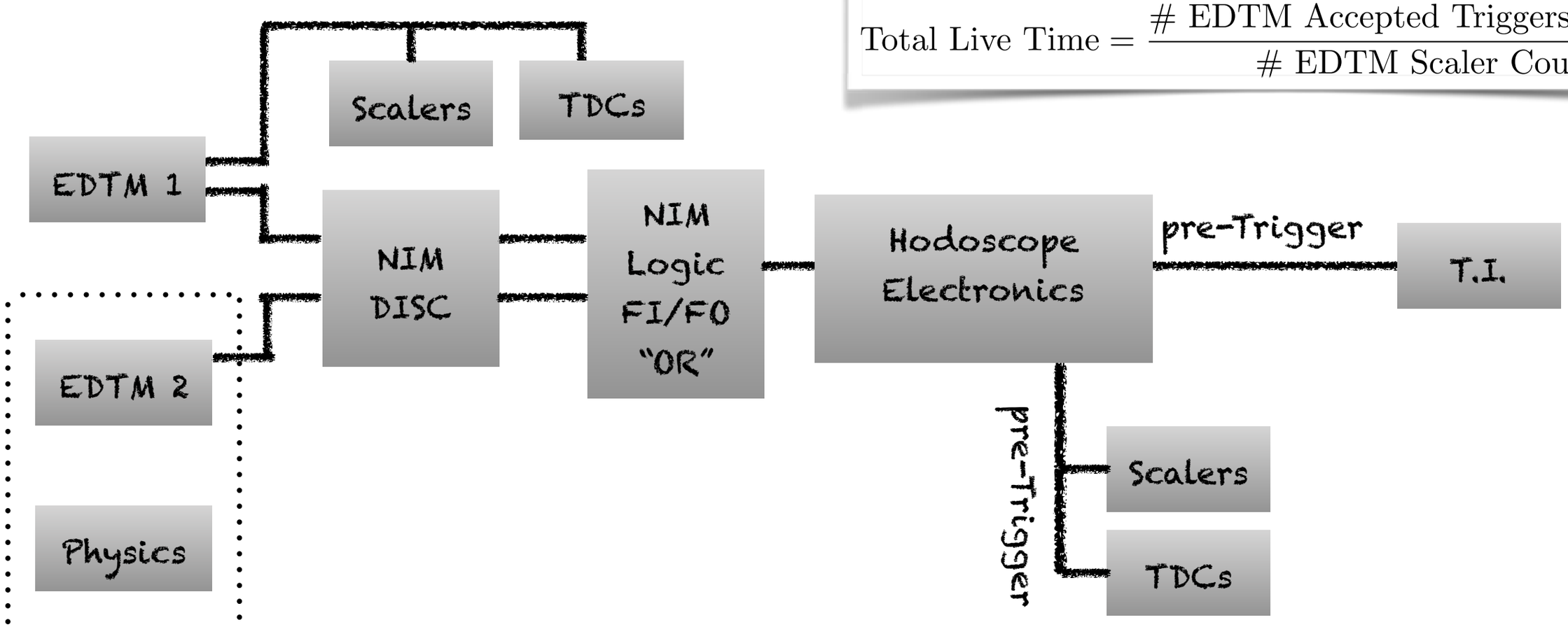
09/06/17

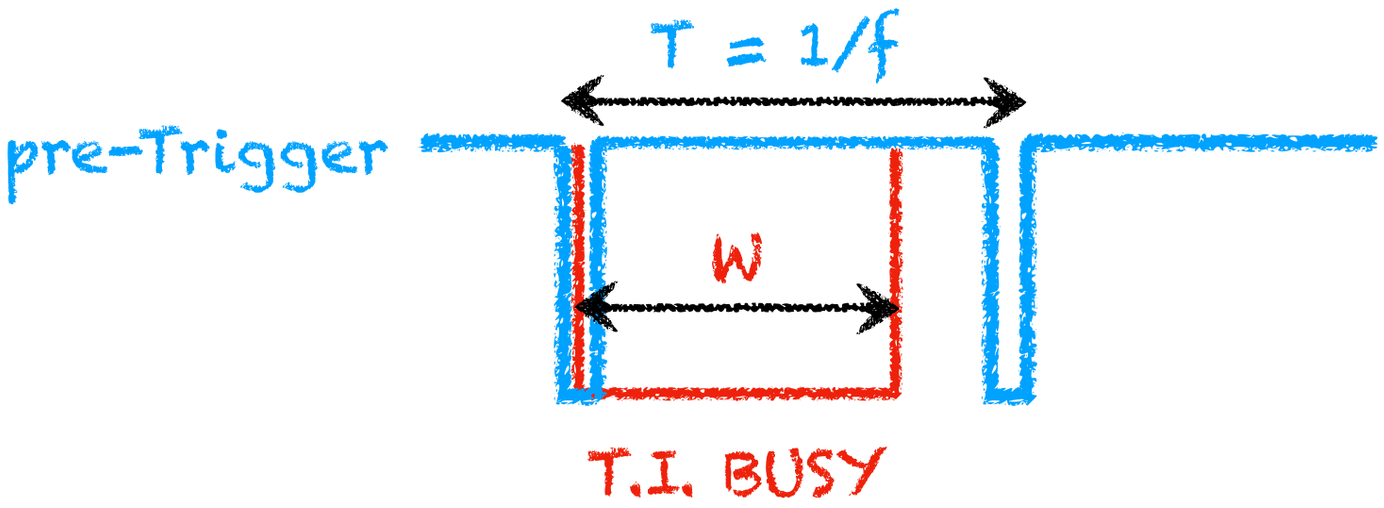
EDTM Electronics Diagram



$$\text{Total Live Time} = \frac{\#\text{ EDTM Accepted Triggers, TDC}\neq 0}{\#\text{ EDTM Scaler Counts}}$$

$$\text{Computer Live Time} = \frac{\#\text{ Accepted Triggers}}{\#\text{ pre-Trigger Scaler Counts}}$$

Some Useful Concepts

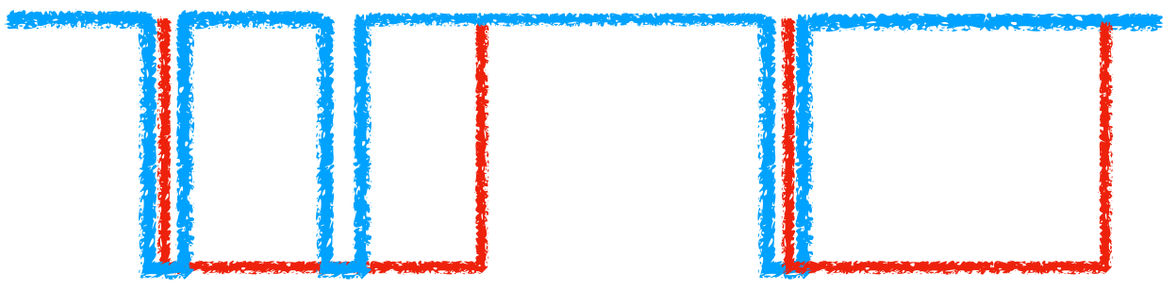


Case 1: T > w (or f < 1/w):
Live Time = 100%

Case 2: T = w (or f = 1/w):
Live Time ~ 50%

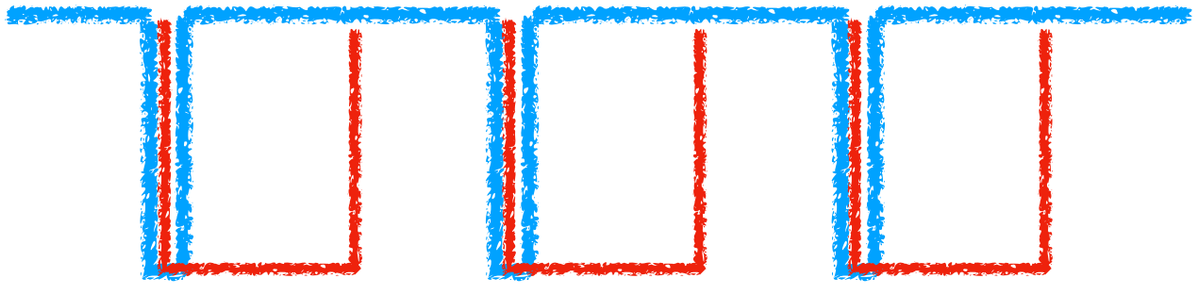
Case 3: T < w (or f > 1/w):
Live Time < 50%

Physics
(Poisson)



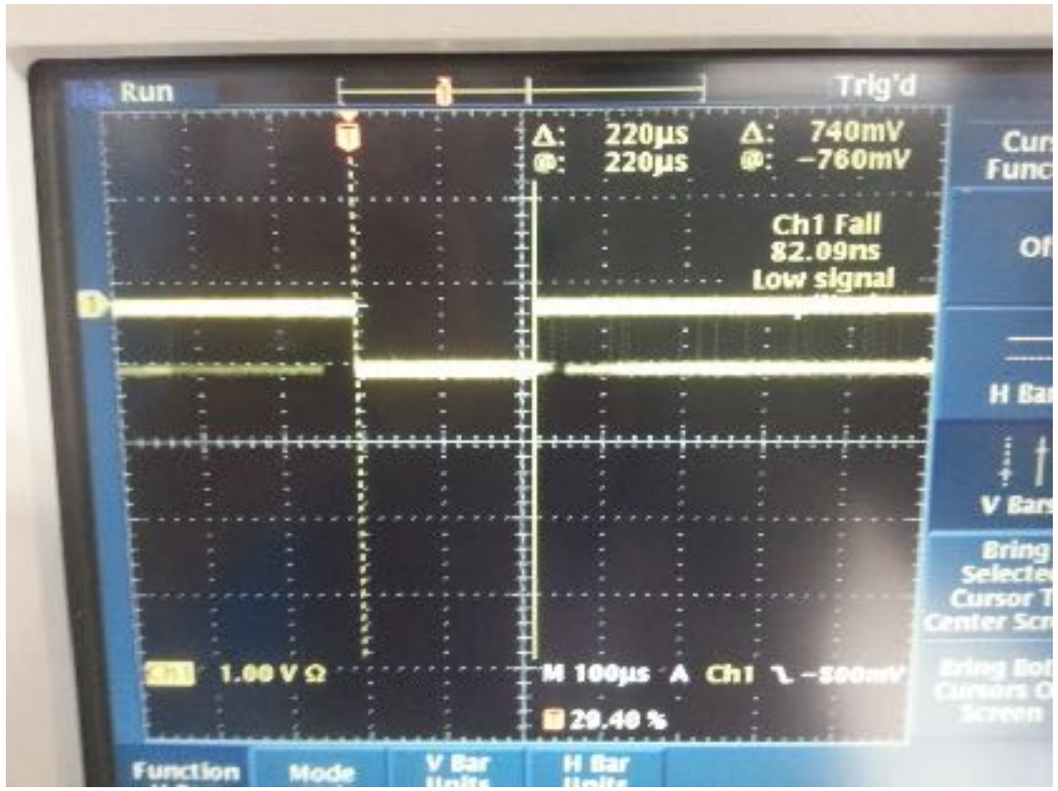
Due to randomness,
Live Time will NEVER
be 100%

EDTM
(Clock)



Due to periodicity,
Live Time should
ALWAYS be 100% (T>w)

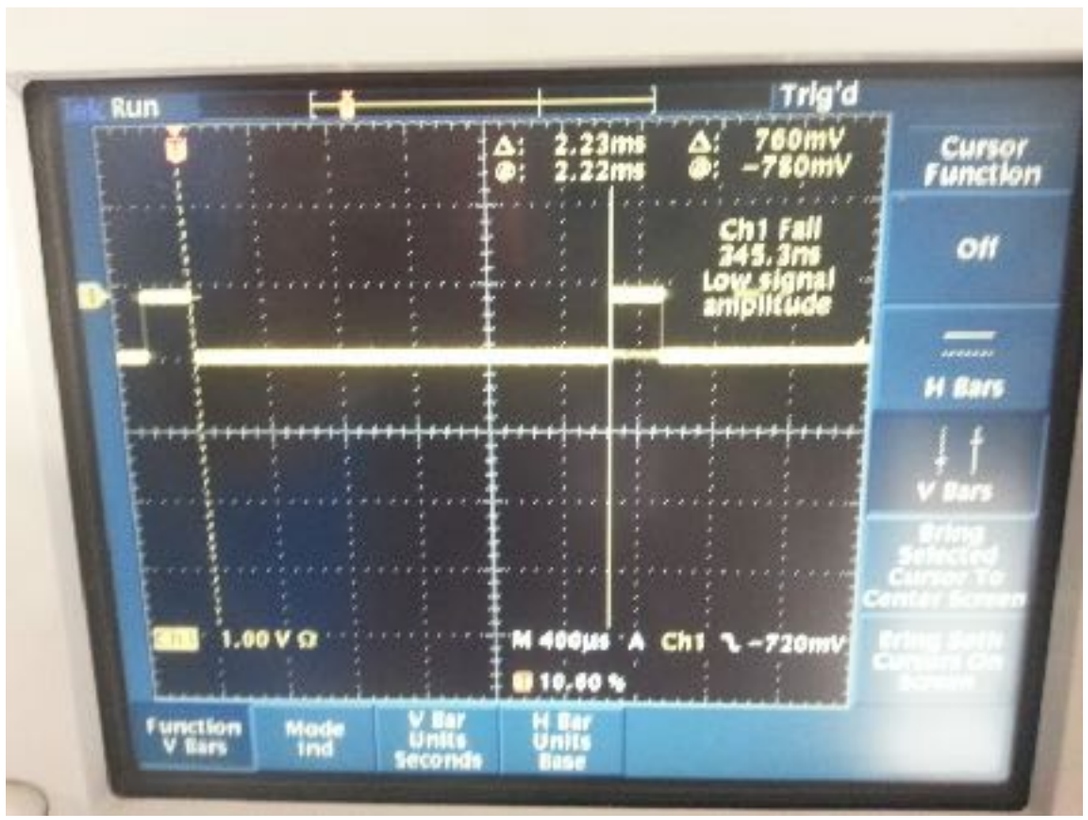
Measured BUSY from SHMS/HMS



SHMS BUSY Output = 220 us

EDTM pre-Trigger Rates

f < 4.545 kHz. ⟶ 100% Live Time

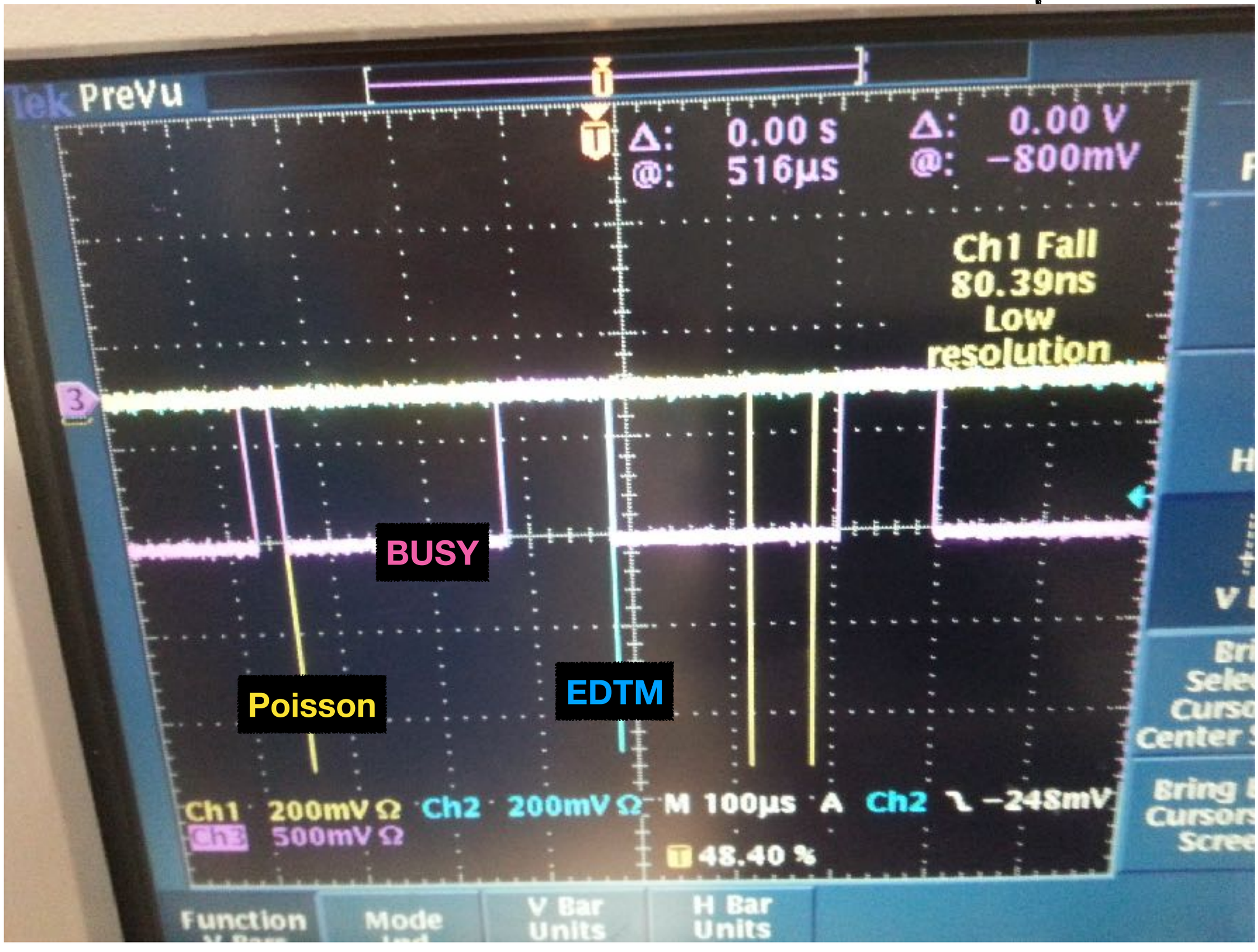


HMS BUSY Output = 2.22 ms !!!

EDTM pre-Trigger Rates

f < 450 Hz. ⟶ 100% Live Time

SHMS Dead time as seen on O'scope



SHMS:
EDTM 1 < 1 kHz
EDTM 2 < 1 kHz

Run #	EDTM 1 (Hz)	EDTM 2 (Hz)	$\frac{\text{EDTM 1 Acc.}}{\text{EDTM 2 Acc.}}$	Computer Live Time
1069	100	100	1.00	93.1%
1070	200	100	2.05	95.6%
1072	301	100	3.15	95.4%
1073	401	100	4.31	95.6%
1074	501	100	5.53	95.6%
1075	601	100	6.78	94.1%
1076	701	100	8.13	95.0%
1077	800	100	9.43	93.7%

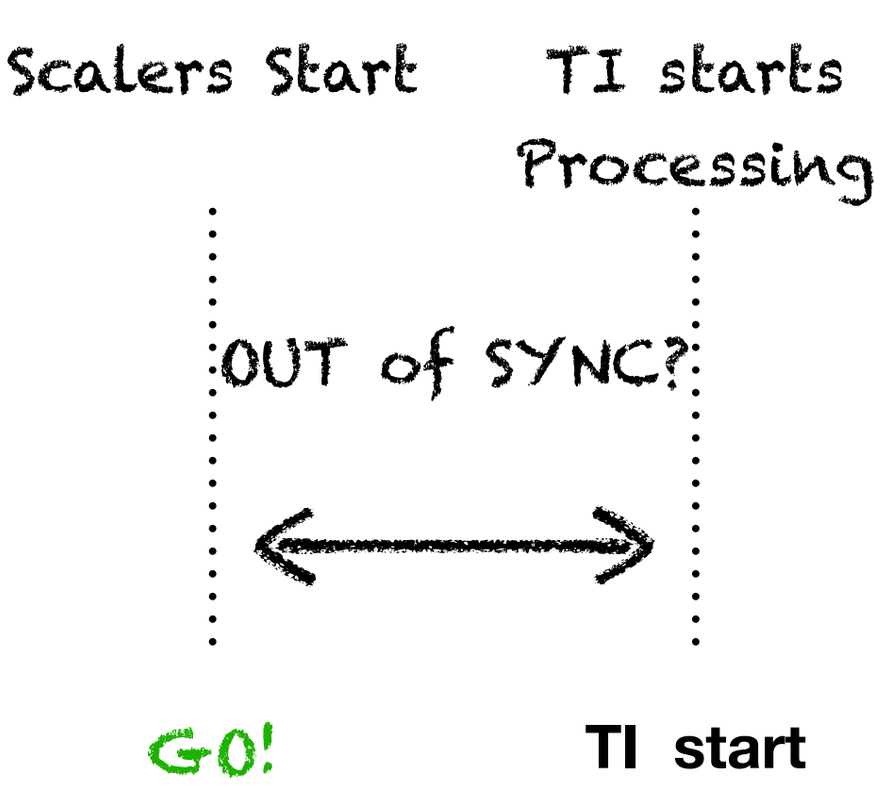
*Rates are well below the SHMS BUSY output width
*Computer live time should be at 100%

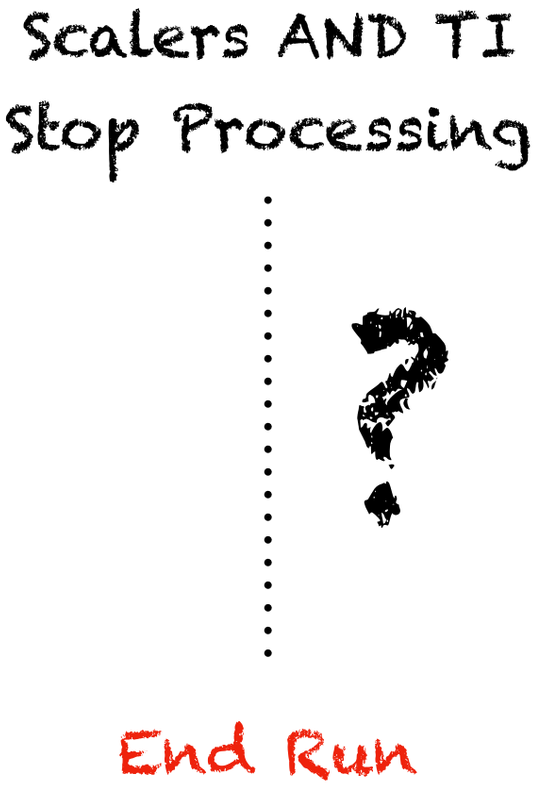
Why is Computer Live Time NOT 100%?

* the pre-Triggers and accepted triggers were fed to a digital scaler
  (Most direct measure of counts)

Results: pre-Trigger Counts = Trigger Counts (100% Live Time)

Are the SCALERS in SYNC with the TI?



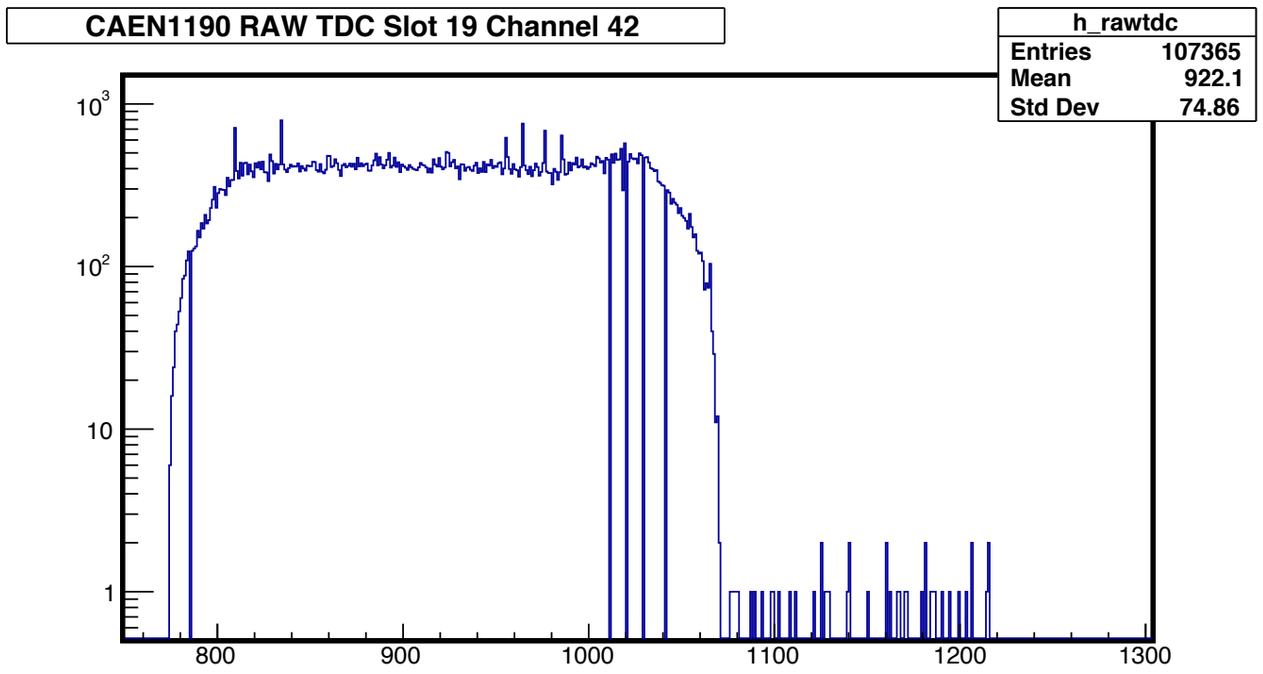


SHMS:
EDTM 1 > 1 kHz
EDTM 2 = 1 kHz

Run #	EDTM 1 (kHz)	EDTM 2 (kHz)	$\frac{\text{EDTM 1 Acc.}}{\text{EDTM 2 Acc.}}$	Computer Live Time
1078	1	1	0.993	75.1%
1079	2	1	2.25	68.3%
1080	3	1	8.09	71.7%
1081	4	0.999	33.6	64.5%
1082	5	0.997	2.60	42.4%
1083	6	0.996	14.2	41.5%
1084	7	0.996	8.13	39.2%
1085	8	0.997	34.09	37.9%
1088	9	0.997	72.1	35.6%
1089	10	0.996	9.13	27.7%

*Unpredictable behavior beyond ~ 4 kHz edtm rate
*observation: edtm rate approaches BUSY output width (220 us)

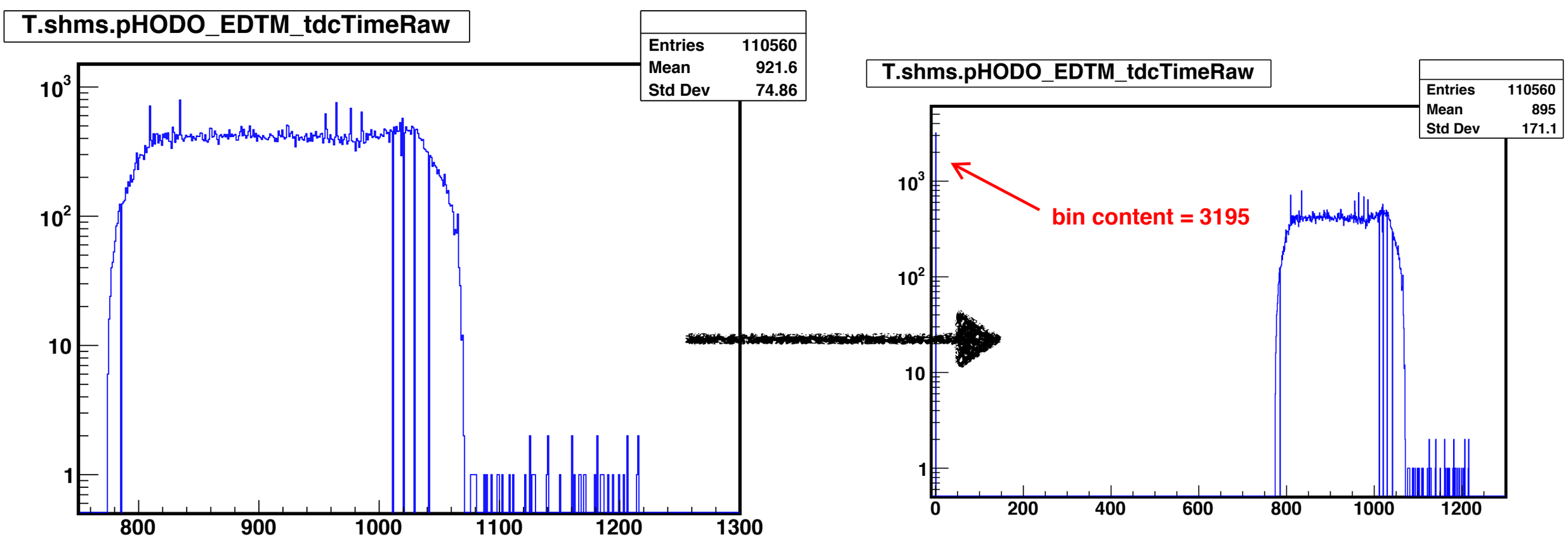
Software Issue ?



* Is hallc_replay over counting EDTM hits?

Cross-check with tst1190_main.C script shows agreement in counts

hallc_replay software is OK!



SHMS:
EDTM < 1 kHz
Physics <= 1 kHz

Run #	EDTM (kHz)	Physics (kHz)	$\frac{\text{Physics Acc.}}{\text{EDTM Acc.}}$	Computer Live Time
1091	0.101	0.095	0.901	92.5%
1093	0.101	0.501	4.56	76.7%
1094	0.101	1.00	9.14	75.0%

SHMS:
EDTM < 1 kHz
Physics > 1 kHz

Run #	EDTM (kHz)	Physics (kHz)	$\frac{\text{Physics Acc.}}{\text{EDTM Acc.}}$	Computer Live Time
1095	0.101	1.407	12.8	68.2%
1096	0.101	2.000	18.4	63.8%
1097	0.101	2.438	22.4	59.1%
1098	0.101	3.052	28.1	54.3%
1099	0.101	4.631	41.8	46.8%
1100	0.101	5.252	48.8	42.5%
1101	0.101	5.988	52.7	38.7%

SHMS:
EDTM >= 1 kHz
Physics ~ 1 kHz

Unpredictable ratios at high EDTM rates

Run #	EDTM (kHz)	Physics (kHz)	$\frac{\text{EDTM Acc.}}{\text{Physics Acc.}}$	Computer Live Time
1103	1.00	0.940	1.37	69.9%
1104	2.00	0.965	3.56	59.2%
1105	3.00	0.964	9.33	71.6%
1106	4.00	0.948	34.25	68.0%
1107	5.00	0.974	6.40	43.8%
1108	6.00	0.935	10.17	41.3%

SHMS:
EDTM = 1 kHz
Physics >=1 kHz

Run #	EDTM (kHz)	Physics (kHz)	Physics Acc/ EDTM Acc.	Computer Live Time
1109	1.00	1.024	0.772	69.4%
1110	1.00	1.961	1.55	60.3%
1111	1.00	2.958	2.40	52.1%
1112	1.00	4.032	3.27	43.3%
1113	0.999	4.790	4.08	40.1%
1114	1.00	6.112	5.22	36.2%

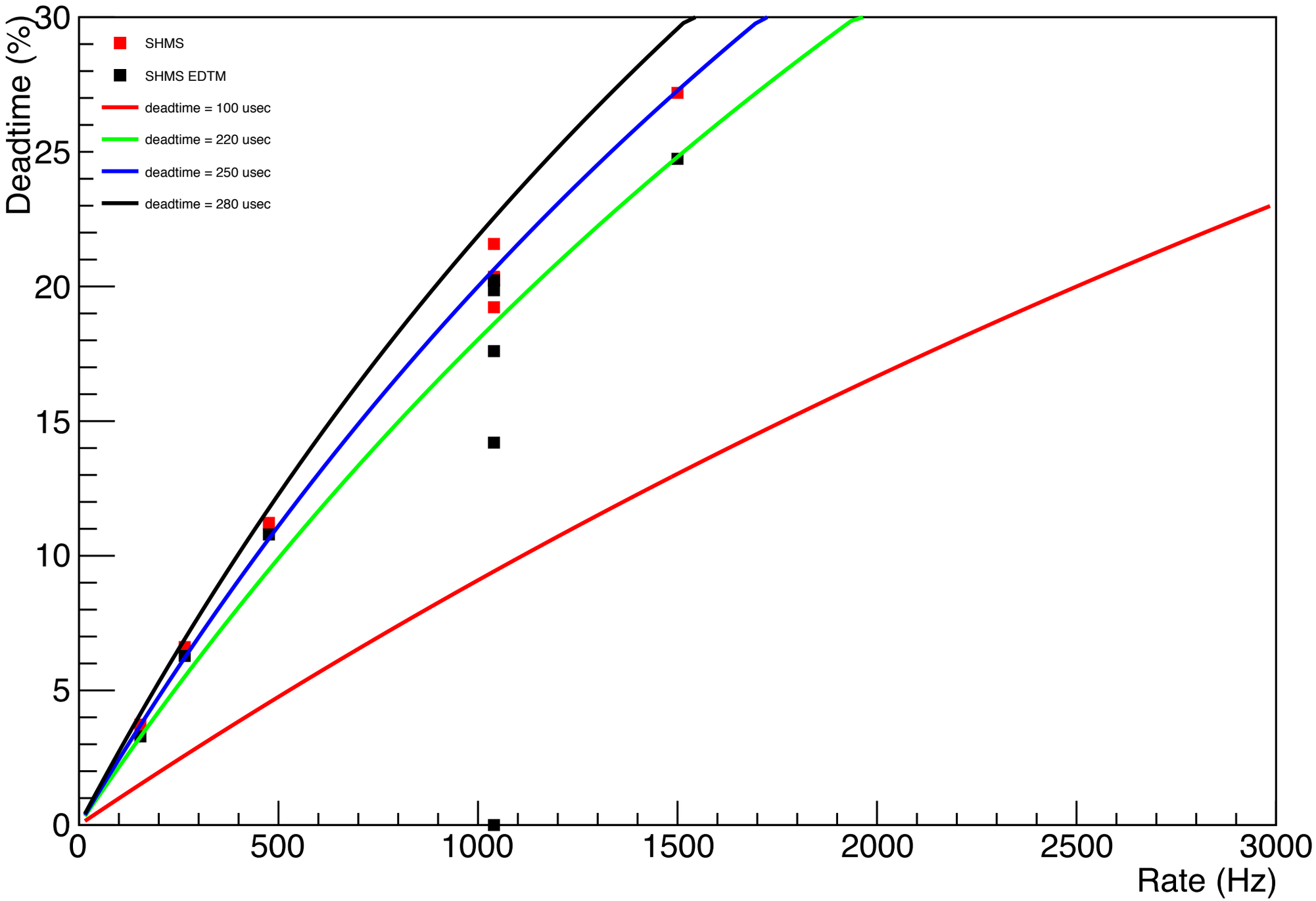
HMS Live Time Studies

HMS:
EDTM 1 > 1 kHz
EDTM 2 = 1 kHz

Run #	EDTM 1 (kHz)	EDTM 2 (kHz)	$\frac{\text{EDTM 1 Acc.}}{\text{EDTM 2 Acc.}}$	Computer Live Time
490	1.00	1.00	1.00	18.4%
491	2.00	1.00	2.90	13.0%
492	3.00	1.00	9.08	10.6%
493	4.00	1.00	68.5	8.86%
494	5.00	0.998	2.99	7.06%
495	6.00	1.00	879.6	6.11%

HMS long BUSY of 2.2 ms is reflected on the small live times measured

Deadtime vs. Total Rate Measurements for SHMS



Plot made by: Mark Jones