50 MHz Time 1.0

J. Orrell, J. Wilkerson

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1 Motivation and Methods

1.1 Introduction

The 50 MHz clock was originally intended to serve as the relative time basis for event-to-event timing. That is, triggers are latched on the 20 nanosecond ticks of the 50 MHz clock. (Please see the *The SNO Trigger System* document for more information. SNO-STR-97-035) Due to the 43 bits allocated for the 50 MHz clock record, the 50 MHz clock "rolls over" approximately every 2 days. The intention was to allow this to happen since the 10 MHz clock was to keep "absolute time" over the duration of the experiment. The 10 MHz clock is our "absolute time" because it is compared to the GPS time standard at periodic intervals.

Certainly the 50 MHz clock can do more than this and there is ample reason to do so. Simple calculations tell us exactly how to account for 50 MHz clock roll over, so long as we can correctly identify the point *of* roll over. The intent of this paper is to provide run durations based on the 50 MHz clock and assess their accuracy and/or validity. Once done, the 50 MHz clock can then be compared to the 10 MHz clock. There are a number of reasons to make this comparison. The foremost reason is to determine if the 10 MHz clock and the 50 MHz clock give the same or comparable run durations. If the 10 MHz and 50 MHz are in close agreement, then the 50 MHz clock can become a secondary time standard. A secondary time standard is extremely useful in situations where the 10 MHz clock has failed, the GPS communication is down or unavailable, or there are other uncertainties in the validity of the time stamps supplied by the 10 MHz clock.

1.2 50 MHz Records

The 50 MHz clock "tick" is stored in a 43 bit word. This 43 bit word can thus store 8796093022207 ticks. The 43 bits of this word correspond to a clock which can record sequential times up to 175921 seconds, 860444 microseconds, and 140 nanoseconds. This is equivalent to 2 days, 52 minutes, 1 second, 860444 microseconds, and 140 nanoseconds. The 50 MHz clock is termed to "roll over", but in reality this roll over is simply a limitation enforced by the finite size of our 43 bit storage allocation.

1.3 Calculating the 50 MHz Time Stamp

The 50 MHz time stamp for a selected event is output into an n-tuple from SNOMAN via the Derived Quantity Function (DQF) called NTIME. The NTIME DQF has a special form, as noted in the *SNOMAN Companion*, which outputs the 50 MHz clock's time stamp. The data is output in the form of 4 numbers:

- Minus processed event number
- Universal seconds
- Universal microseconds
- Universal nanoseconds

I have convinced myself (via Occam's Razor) that this special form of the NTIME DQF does in fact produce 50 MHz clock ticks. That is, the upper limit seen for the Universal seconds variable is exactly the same as the calculated upper limit based on the 43 bit word size.

The algorithm for the correction of 50 MHz time stamps is:

- Corrected Universal seconds = Universal seconds + 175921 * # of Previous Roll Overs
- Corrected Universal microseconds = Universal microseconds + 860444 * # of Previous Roll Overs
- Corrected Universal nanoseconds = Universal nanoseconds + 140 * # of Previous Roll Overs

This algorithm is intended for use *within a single run*. This algorithm then gives the correct 50 MHz time stamp for all events after the first event, and is, thus, *relative to* that first event's 50 MHz time stamp. It is obvious that this algorithm is easily extendible beyond individual runs. For the task at hand, however, this is not necessary.

1.4 A Simple Definition of the Events of Interest

Most simply, a run's duration is generated by subtracting the run's first event's 50 MHz time stamp from the run's last event's 50 MHz time stamp. Thus, in any run duration calculation the time stamps of events at the beginning and the end of the run should be scrutinized. As already noted, this run duration calculation is complicated because of the 50 MHz clock's approximately 2 day roll over time. Knowing the details of the 50 MHz record allows for accurate 50 MHz time stamp "reconstruction" for runs where a roll over occurs. In other words, it is possible to monitor the roll over of the 50 MHz clock and then correct all later events' 50 MHz time stamps for this roll over.

1.5 Event Selection

I select a fraction of events from each run, from which I extract time stamps. I have extracted the complete time information from (tested in the following order) each Pulse GT event, a large number of events at the beginning and end of each run, and each Soft GT event. It is worth mentioning that I eliminate all ORPHAN events since they do not have time stamps. I select the Pulse GT events and the Soft GT events by their respective triggers. I have used the first GTID and last GTID information, provided for each run by SNORE, to create "windows" of selected events at the beginning and end of each run. I select all events which have a GTID less than the first GTID + 100. I also select all events which have a GTID greater than the last GTID - 1000.

This sort of event selection allows me to monitor for 50 MHz roll over (via PGTs) as well as closely interrogating all event times at the beginning and end of runs. There are two disadvantages to this technique. The first disadvantage is the significant amount of time required to generate and then analyze the selected time stamps for each run. The second disadvantage is if there are any non-PGT event in the middle of a run which have time stamps either *earlier* or *later* than any of my selected events, then my analysis misses these *important* (time-wise) events. This last disadvantage may seem silly since the situation should never occur. However, if such events *were* found in a run it would be a signal of a serious problem. I'm merely trying to accurately characterize my method's inability to test for such problems.

2 Run Durations via the 50 MHz clock

2.1 Run Durations

I have compiled the run durations for all selected neutrino runs. Here I simply tabulate the run durations calculated from the 50 MHz clock. Each run's duration is given as a number of seconds plus microseconds plus nanoseconds. I have chosen to present the "Last - First" run durations (this is explained below). This choice is not the livetime committee's decided upon definition of a run's duration, namely, that of "Late - Early". However, I have shown that for selected neutrino runs this distinction only affects a small fraction of the run durations. I have added an additional table which specifies any runs where the "Last - First" run duration is not equal to the "Late - Early" run duration. I also include a histogram of the run durations for the selected neutrino runs.

2.2 Run Duration Distinctions

There has been some disagreement as to which events should be used to calculate a run's duration. Suggestions have been to use either the First event or the Earliest event to determine the start time for the run. A third category might be the Soft GT event. Similarly, should we use the Last event or the Latest event in a run as the stop time. I have calculated the run durations for two possible combinations of these possible starting event and stopping event criterion. Namely, I have calculated run durations for the Last event's time minus the First event's time ("Last - First") as well as the Latest event's time minus the Earliest event's time ("Late - Early"). As already mentioned, I tabulate the run durations for the "Last - First" events. I have also compiled a table of runs whose run duration changes depending on the specific choice of events for the start and stop time stamps.

2.3 Analysis

There are a number of comments worth making about the run durations, upon close inspection of the results. However, since a major purpose of this exercise is to make a comparison to the run durations calculated via the 10 MHz clock, I will save my analysis and conclusions. The analysis and my conclusions are found in the *Comparison of Run Durations: 10 MHz vs. 50 MHz* section of this document.

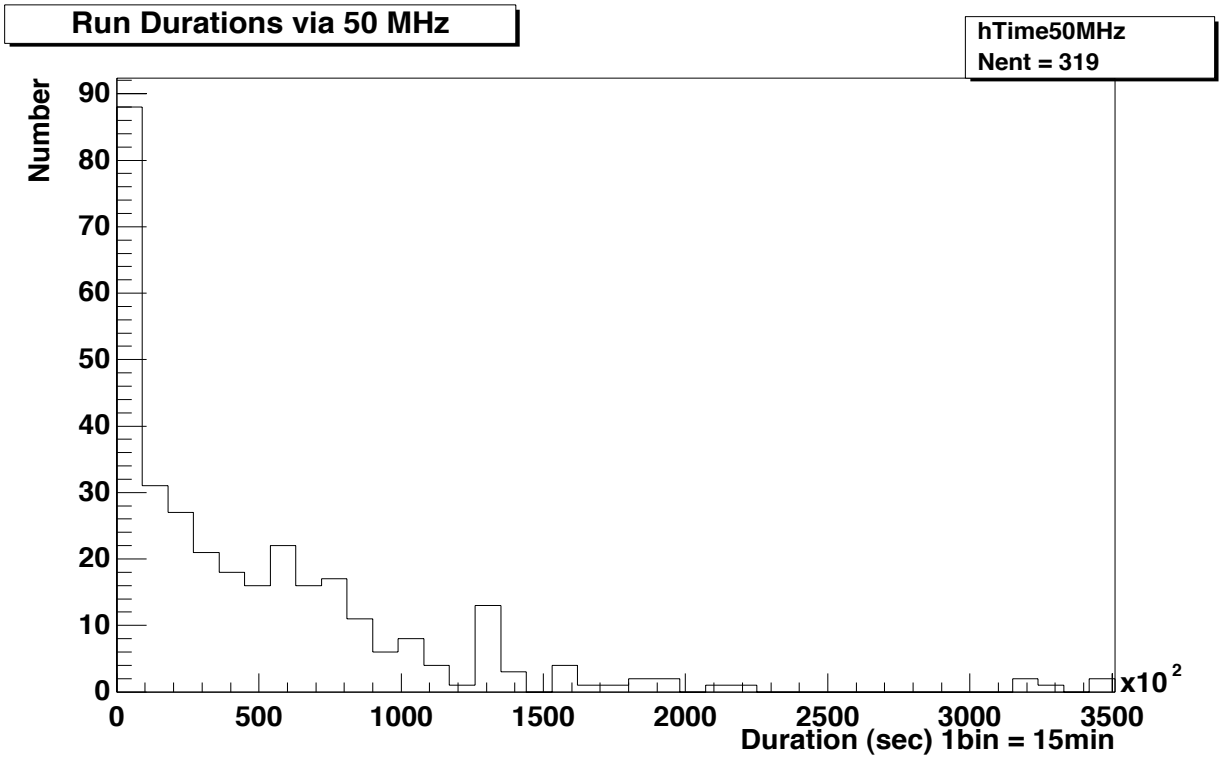

Figure 1: Histogram of the run durations (via 50 MHz) for all 319 selected runs.

Run	Seconds	Microseconds	Nanoseconds
10000	27906	688999	940
10002	2050	952483	640
10003	25300	987227	900
10005	3758	692680	120
10008	52234	55463	340
10015	23902	872518	0
10020	3727	452529	740
10023	2202	255220	800
10025	2565	263347	440
10030	8393	447882	80
10031	29349	483063	40
10034	30785	992276	760
10035	3371	867756	280
10036	10541	48406	220
10038	101871	839797	420
10040	126938	12337	900
10124	1899	961250	840
10125	52798	566200	220
10127	5843	13156	740
10129	5613	413584	940
10130	6365	306205	200
10133	78891	818692	100
10141	24289	862185	860
10142	58216	582045	40
10149	42195	211995	860
10161	27911	197477	580
10162	28360	813282	80
10163	4700	326803	800
10169	69239	548868	200
10170	11099	970242	940
10171	2662	214265	920
10172	59490	814844	160
10174	167145	383705	240
10177	77550	979954	300
10189	57997	416513	280
10190	3587	656906	720
10197	26252	682268	620
10219	4511	761489	780
10221	18807	588357	760
10224	26882	662448	660
10236	10019	416663	180
10237	213142	480657	680
10534	21941	382677	80
10536	31473	814031	760
10549	37085	818970	400

Table 1: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
10551	110436	886039	800
10554	37230	177319	760
10555	23968	225134	520
10638	2587	807110	220
10649	49342	87480	240
10650	3519	330784	0
10651	12225	738769	660
10655	116765	234747	640
10675	7391	471895	260
10677	15410	549579	260
10678	10346	740755	560
10680	36439	658624	140
10686	69517	146296	600
10687	83079	429167	360
10700	68562	757450	420
10701	5804	857936	320
10704	2175	447398	580
10705	129629	827672	0
10706	110009	107371	660
10708	10041	215528	940
10709	129618	788601	580
10710	2746	710944	80
10714	18428	446009	660
10734	5458	285467	380
10735	129599	373036	60
10736	11441	119524	300
10737	2050	608745	920
10738	129613	523983	400
10739	129596	738527	420
10740	8729	204284	720
10741	8119	588595	600
10742	8794	814233	580
10743	3776	613831	520
10744	7235	4099	660
10747	29518	631635	420
10748	129600	613961	640
10749	28684	172550	700
10756	39206	943725	980
10762	74829	428626	900
10770	21149	259983	20
10773	3204	51120	440
10775	75991	318623	620
10776	5019	614614	660
10779	75197	667745	140
10781	87327	168594	20

Table 2: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
10782	5533	454294	960
10783	18731	417321	640
10784	55016	435198	760
10797	73268	180952	240
10801	88902	636493	480
10803	129601	721063	860
10804	20641	820317	120
10805	4749	223061	700
10806	7523	19936	680
10811	71909	78859	160
10813	2238	75004	120
10815	68139	842299	920
10821	64841	502195	620
10826	75214	779834	400
10828	15942	604182	620
10836	35355	975353	160
10841	3442	290992	640
10843	45586	161466	880
10869	7488	612830	320
10871	50761	788705	840
10873	4592	911888	380
10876	5227	976728	840
10878	8912	698257	240
10879	57645	690871	880
10881	7498	414762	740
10882	2898	965159	180
10883	5313	218891	520
10884	23186	118677	540
10885	129598	942358	600
10886	49498	585461	20
10887	122263	135365	720
10891	3486	711346	40
10894	47618	301012	60
10922	58649	299035	100
10923	25359	760809	60
10924	3162	536330	500
10925	26658	14471	960
10927	29557	863264	380
10932	5693	261460	660
10933	3439	980737	820
10935	11514	945957	700
10936	4069	5015	200
10938	28015	793864	160
10939	12935	622695	500
10942	3163	12666	860

Table 3: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
10943	3407	559162	880
10944	11131	694250	320
10946	62547	892721	800
10948	129578	690398	200
10949	19455	52058	140
10950	3629	12448	780
10951	8152	868076	480
10953	2241	399218	80
10954	3058	555047	160
10955	20324	345796	440
10956	59050	849920	580
10959	9661	568597	420
10961	104799	33670	600
10962	5432	739970	720
10963	47988	860681	380
10970	36126	640613	40
10972	37716	299123	960
10975	129591	249411	660
10976	108832	564489	640
11269	65780	258291	600
11271	2211	668555	160
11272	4650	862202	180
11281	8171	417056	220
11286	3299	742415	740
11289	55596	955460	660
11291	69166	726675	240
11303	60694	75790	60
11310	72862	80598	860
11312	103561	543936	60
11313	47607	714011	940
11347	35047	812865	280
11366	93209	653187	960
11368	76634	847961	160
11371	216094	741827	380
11377	2916	936768	940
11381	21229	478821	180
11383	4893	410249	300
11384	104635	604780	720
11389	57549	100950	260
11390	10963	1060	920
11393	87231	978635	960
11397	25398	187693	920
11399	345599	46950	540
11400	73792	89712	900
11402	51418	15174	720

Table 4: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
11406	11510	894831	640
11407	73809	817545	340
11415	68390	341392	500
11417	98142	854958	680
11429	98388	142320	760
11431	154209	146264	540
11433	84731	748507	360
11436	321224	238667	500
11437	181373	764770	940
11443	14195	858837	520
11444	15158	474099	500
11446	23172	484858	100
11462	84608	432092	640
11466	65412	100936	740
11474	100338	554029	540
11479	173914	265077	140
11481	44308	67078	120
11489	13347	109180	40
11490	55422	908869	540
11493	45387	713555	460
11498	19211	213102	60
11502	6190	412067	260
11504	1923	611742	320
11506	7692	77685	180
11508	4627	611930	560
11510	101222	748720	900
11512	32918	764053	80
11525	64197	950154	220
11528	71451	413819	320
11530	11457	885694	100
11531	57860	453181	440
11532	2937	257543	80
11533	16990	931321	500
11537	55777	659886	980
11539	81345	64698	940
11541	54266	754555	680
11543	10039	442911	880
11544	18814	204160	900
11549	4402	200000	0
11550	2707	220653	540
11553	14657	412768	460
11554	64804	202716	240
11561	57050	814205	280
11568	20496	414997	880
11570	57466	14757	760

Table 5: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
11575	197428	921679	100
11579	140314	468753	300
11582	62770	959856	0
11591	45273	605162	660
11621	135750	122027	520
11650	60063	815624	160
11652	3605	17002	320
11655	35159	812062	780
11657	33151	192545	960
11676	11001	812832	860
11679	2672	30031	380
11681	317236	859238	100
11682	42228	15596	780
11730	8075	468909	80
11732	32168	812599	740
11733	12243	866842	800
11748	5376	968783	180
11764	64193	977921	800
11783	33747	232419	180
11802	77791	150212	40
11805	4156	999017	780
11816	90576	21450	240
11819	107727	213440	480
11820	6698	127647	640
11824	77975	838101	60
11828	41007	510982	680
11829	8226	299684	860
11831	5108	885140	140
11859	29873	813978	300
11864	44386	697426	460
11867	32671	374850	860
11875	4158	727877	700
11890	49593	460971	760
11899	17811	107557	380
11901	2449	555737	980
11903	2844	800000	0
11911	326237	119540	340
11915	155396	527674	320
11919	79222	195109	440
11924	3005	632104	720
11925	85653	531031	860
11976	187229	51171	60
11977	8750	415359	960
11978	157624	545572	720
11985	39648	927598	220

Table 6: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
11988	29744	613617	960
11990	26099	70865	720
11991	99098	213644	440
12038	43236	813306	960
12054	8103	128339	860
12059	47636	413935	40
12082	63768	677774	260
12150	60821	13052	820
12157	19946	460896	560
12159	10717	902725	880
12162	36334	448048	100
12167	72467	149392	520
12168	79594	134264	520
12172	96282	814822	980
12173	11930	970673	860
12178	44138	493837	660
12181	130050	98977	800
12183	74469	317246	280
12187	195205	447185	320
12190	2304	354186	560
12197	43998	12083	200
12207	86149	196900	540
12222	13241	121880	440
12224	5335	12323	60
12226	83930	812812	120
12227	1858	885014	640
12229	155252	978352	120
12233	345601	260356	0
12234	10912	582158	260
12237	25763	176439	60
12238	2949	464669	180
12240	130552	480222	40
12243	7334	195299	280
12257	63427	408454	700
12289	40581	421065	440
12290	21237	646171	780
12329	6222	846939	600
12330	48207	871922	20
12506	94975	412303	660
12568	51670	614286	800
12571	10148	414493	200
12575	4908	213484	660
12576	41172	96481	140
12577	143900	800000	0
12590	27354	12338	860

Table 7: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
12598	59268	538430	520
12614	17371	819050	720
12615	55811	746066	240
12618	89066	670891	600

Table 8: "Last - First" run durations based on the 50 MHz clock.

Run	Seconds	Microseconds	Nanoseconds
11474	0	6	800
12187	1	747100	940

Table 9: Runs where the "Late - Early" is not equal to "Last - First" run durations. To calculate the "Late - Early" run duration for a given run, simply add the numbers in this table, respectively, onto the numbers listed in the "Last - First" tables.

3 Comparison of Run Durations: 10 MHz vs. 50 MHz

3.1 50 MHz vs. 10 MHz

The most important point of calculating run durations via the 50 MHz clock is to make a comparison to the run durations calculated via the 10 MHz clock. The 10 MHz clock (with GPS synchronization) is our "experiment length" clock from which we derive time stamps. A comparison of the 50 MHz to the 10 MHz run durations can tells us about our clocks' stability and whether the 50 MHz clock can be used to calculate 10 MHz time stamps for periods when there are known 10 MHz clock problems.

I have tabulated the 10 MHz and 50 MHz run durations (in seconds only) for all selected neutrino runs. I have also calculated the difference in seconds of the 10 MHz derived run duration and the 50 MHz derived run duration. I have calculated several statistics which are included and discussed. I also include histograms of the difference in seconds between the two clocks' calculated run durations. The run durations determined via the 10 MHz clock were provided by the ECG group.

3.2 Analysis

Upon comparison of the run durations calculated from the 50 MHz clock and those calculated from the 10 MHz clock, excellent agreement is found. Table 10 shows the pertinent statistics. In the following, T_{10} and T_{50} are the total durations calculated from the 10 MHz and 50 MHz clocks respectively.

Data Set	T_{10} (hrs)	T_{50} (hrs)	$(T_{10} - T_{50})/T_{10}$
10000 to 12618	4451.44	4451.09	.0000782

Table 10: Statistics for run durations from the selected neutrino runs.

Figure 2 shows the distribution of the run duration differences. Clearly three runs are "outstanding" and contribute the majority of the .00782% fractional difference listed in table 10. During my analysis I found several other "anomalous" runs. I will detail these outstanding and anomalous runs in another section. However, I wish to calculate the spread of the distribution around zero. Thus I will calculate statistics for two data sets: The whole data set and an Alternative data set which excludes the outstanding runs. The Alternative data set allows us to make some insightful generalizations.

In table 11 I show some statistics concerning the distribution of run duration differences for my two data sets. Table 11 shows that the 50 MHz clock is, on average, slower than the 10 MHz clock. This is

Data Set	Mean Δt (sec)	σ (sec)
10000 to 12618	3.42	32.4
Alternative Set	0.528	1.84

Table 11: Statistics for run duration differences from the selected neutrino runs.

not a problem however, if it can be shown that the 50 MHz clock actually runs stably at, say, 49.9...MHz. Operationally, we verify that the 10 MHz clock is, in the long term, stable by continually comparing it to the GPS time standard and making corrections if necessary. A future study of the 50 MHz clock should address the issue of its stability and its actual rate. I'll quickly mention that the Alternative set shows that the distribution is actually quite narrow around zero (in comparison to the size of the run durations considered in the *Run Durations* document). This narrow width, while gratifying, may not even be the correct measure since the one second binning used can add round off errors. The distribution for the Alternative set is shown in figure 3.

3.3 The Anomalous Runs

During my analysis I found a small number of runs which I consider anomalous. Due to my curiosity, I investigated these runs. As already mentioned there are three runs (10680, 10955, and 11549) which

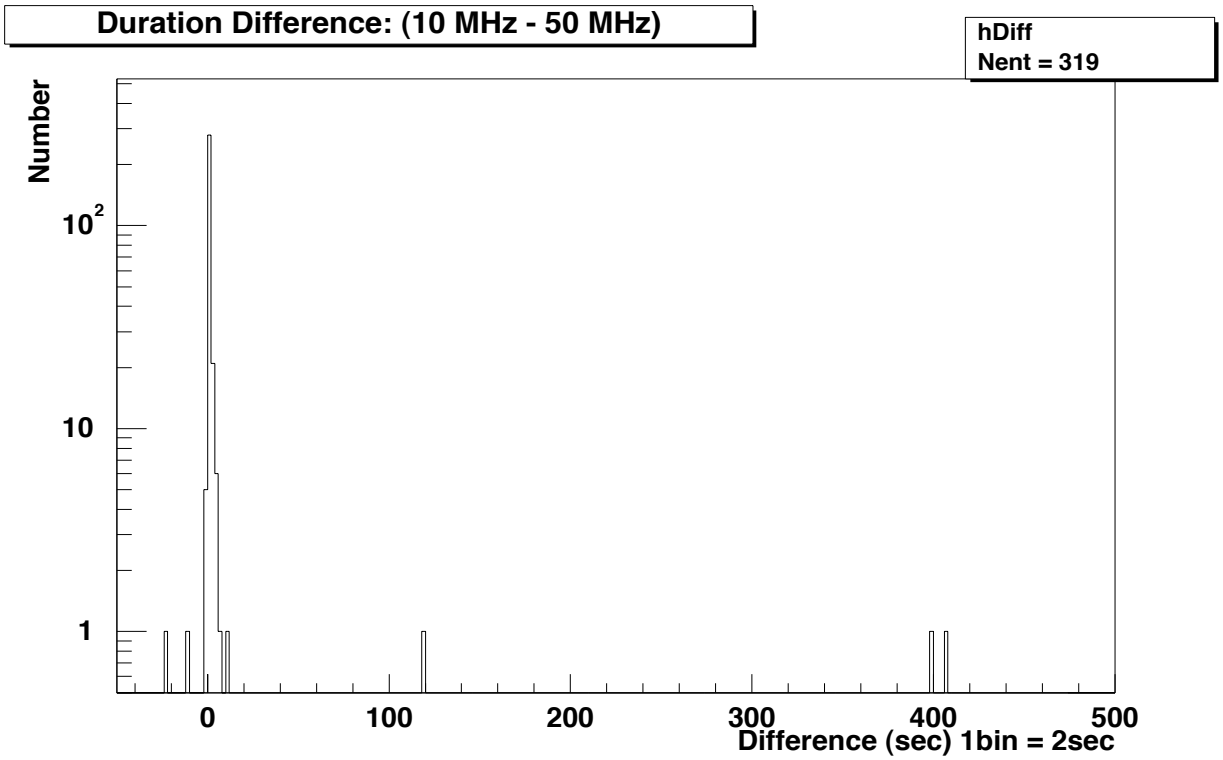

Figure 2: Histogram of the run duration differences (10 MHz - 50 MHz) for all 319 selected runs.

contribute the largest proportion of the total run duration difference between the 10 MHz calculations and the 50 MHz calculations. Looking at these runs' shift reports I have found that both run 10680 and 10955 were "auto-started" by the GPS task after a period of 10 MHz clock problems. This GPS task auto-start is implemented so that when the 10 MHz clock time and the GPS time disagree, the 10 MHz clock is corrected and a new run is started. This procedure lessens the amount of data taken with questionable 10 MHz time stamps. These occurrences actually suggest that the 50 MHz clock gives a more accurate run duration for these two runs. Run 11549 appears fine upon inspection of the shift reports, though the SHaRC Run Log does note a difference of 406.5 seconds between the two clocks. The run continues for approximately another 30 minutes after this.

Another interesting thing I noted was that runs 11903 and 12577 both have run durations where the microseconds equal 800000 and the nanoseconds equal 000. I was surprised to find so many zeros lined up together and in exactly the same way in two runs. I have no idea if this is merely a coincidence or indicative of something else.

Run 11384 is peculiar in two respects. The first is that several thousand of the last events in the run are either ORPHANs or have no PMTs contained within them. The second is that the last GTID in the run is 1902990 while every non-ORPHAN event before this has a GTID of 1884446 or less. Despite this irregularity, it appears the run duration calculation (as currently envisioned) is not compromised since this last event is only a few thousand microseconds later than previous events.

I still need to scan three more anomalous runs, namely, 10000, 10638, and 10655. These three runs showed peculiar event selection statistics, but in such a way that I am confident that the run duration calculations are correct.

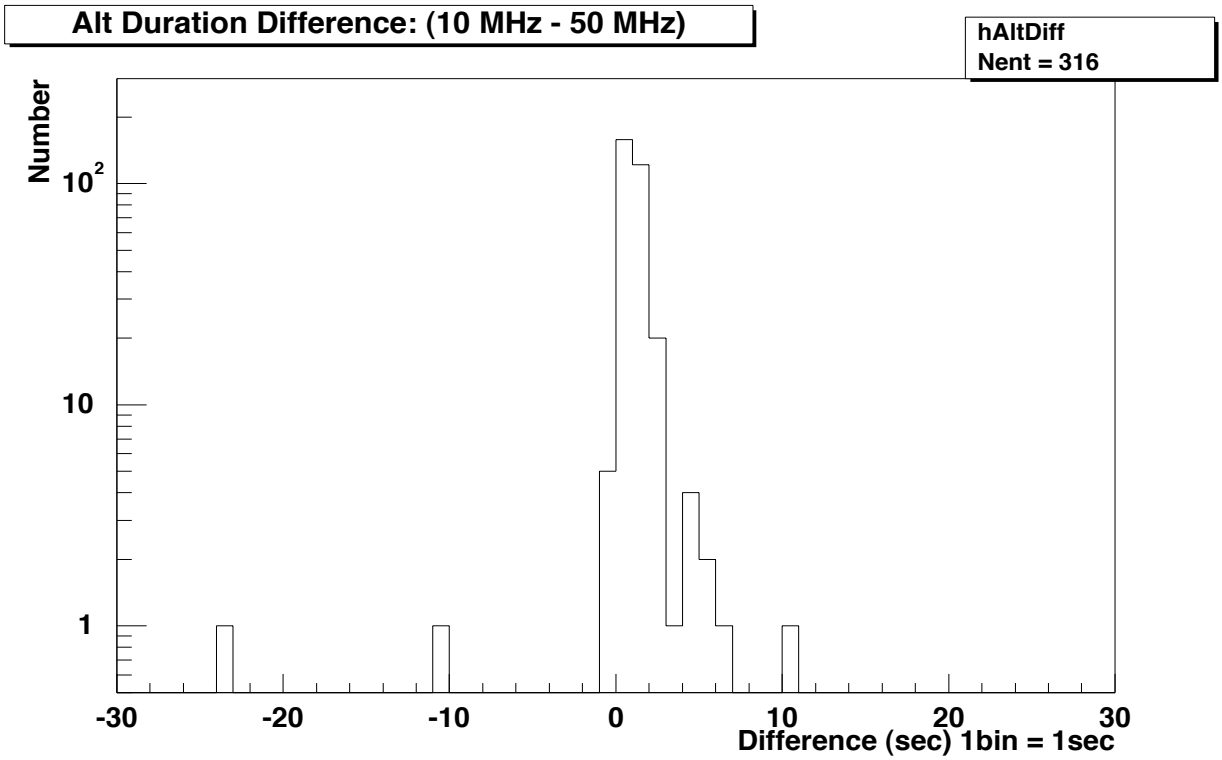

Figure 3: Histogram of the run duration differences (10 MHz - 50 MHz) for 316 selected runs. The Alternative data set.

Run	10 MHz Sec	50 MHz Sec	Difference
10000	27907	27907	0
10002	2051	2051	0
10003	25301	25301	0
10005	3758	3759	-1
10008	52235	52234	1
10015	23903	23903	0
10020	3728	3727	1
10023	2203	2202	1
10025	2565	2565	0
10030	8393	8393	0
10031	29350	29349	1
10034	30786	30786	0
10035	3372	3372	0
10036	10541	10541	0
10038	101873	101872	1
10040	126940	126938	2
10124	1900	1900	0
10125	52799	52799	0
10127	5843	5843	0
10129	5613	5613	0
10130	6365	6365	0
10133	78893	78892	1
10141	24290	24290	0
10142	58217	58217	0
10149	42195	42195	0
10161	27912	27911	1
10162	28361	28361	0
10163	4700	4700	0
10169	69240	69240	0
10170	11101	11100	1
10171	2662	2662	0
10172	59491	59491	0
10174	167147	167145	2
10177	77552	77551	1
10189	57998	57997	1
10190	3588	3588	0
10197	26253	26253	0
10219	4512	4512	0
10221	18808	18808	0
10224	26883	26883	0
10236	10020	10019	1
10237	213144	213142	2
10534	21942	21941	1
10536	31474	31474	0
10549	37086	37086	0

Table 12: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
10551	110438	110437	1
10554	37230	37230	0
10555	23969	23968	1
10638	2588	2588	0
10649	49342	49342	0
10650	3520	3519	1
10651	12226	12226	0
10655	116766	116765	1
10675	7392	7391	1
10677	15411	15411	0
10678	10347	10347	0
10680	36846	36440	406
10686	69518	69517	1
10687	83080	83079	1
10700	68564	68563	1
10701	5805	5805	0
10704	2175	2175	0
10705	129631	129630	1
10706	110010	110009	1
10708	10042	10041	1
10709	129620	129619	1
10710	2747	2747	0
10714	18428	18428	0
10734	5458	5458	0
10735	129601	129599	2
10736	11441	11441	0
10737	2051	2051	0
10738	129615	129614	1
10739	129598	129597	1
10740	8729	8729	0
10741	8120	8120	0
10742	8795	8795	0
10743	3777	3777	0
10744	7235	7235	0
10747	29519	29519	0
10748	129602	129601	1
10749	28684	28684	0
10756	39208	39207	1
10762	74831	74829	2
10770	21149	21149	0
10773	3204	3204	0
10775	75992	75991	1
10776	5020	5020	0
10779	75199	75198	1
10781	87328	87327	1

Table 13: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
10782	5534	5533	1
10783	18732	18731	1
10784	55017	55016	1
10797	73269	73268	1
10801	88903	88903	0
10803	129603	129602	1
10804	20642	20642	0
10805	4749	4749	0
10806	7523	7523	0
10811	71910	71909	1
10813	2238	2238	0
10815	68140	68140	0
10821	64842	64842	0
10826	75215	75215	0
10828	15943	15943	0
10836	35356	35356	0
10841	3442	3442	0
10843	45587	45586	1
10869	7489	7489	0
10871	50763	50762	1
10873	4593	4593	0
10876	5228	5228	0
10878	8913	8913	0
10879	57646	57646	0
10881	7499	7498	1
10882	2899	2899	0
10883	5313	5313	0
10884	23187	23186	1
10885	129600	129599	1
10886	49500	49499	1
10887	122264	122263	1
10891	3487	3487	0
10894	47619	47618	1
10922	58649	58649	0
10923	25361	25360	1
10924	3163	3163	0
10925	26658	26658	0
10927	29559	29558	1
10932	5693	5693	0
10933	3440	3440	0
10935	11515	11515	0
10936	4069	4069	0
10938	28016	28016	0
10939	12935	12936	-1
10942	3164	3163	1

Table 14: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
10943	3407	3408	-1
10944	11132	11132	0
10946	62548	62548	0
10948	129580	129579	1
10949	19455	19455	0
10950	3639	3629	10
10951	8142	8153	-11
10953	2242	2241	1
10954	3059	3059	0
10955	20443	20324	119
10956	59027	59051	-24
10959	9662	9662	0
10961	104800	104799	1
10962	5433	5433	0
10963	47990	47989	1
10970	36127	36127	0
10972	37716	37716	0
10975	129593	129591	2
10976	108833	108833	0
11269	65781	65780	1
11271	2212	2212	0
11272	4651	4651	0
11281	8172	8171	1
11286	3299	3300	-1
11289	55598	55597	1
11291	69167	69167	0
11303	60695	60694	1
11310	72863	72862	1
11312	103563	103562	1
11313	47609	47608	1
11347	35048	35048	0
11366	93211	93210	1
11368	76636	76635	1
11371	216097	216095	2
11377	2917	2917	0
11381	21230	21229	1
11383	4894	4893	1
11384	104637	104636	1
11389	57550	57549	1
11390	10963	10963	0
11393	87232	87232	0
11397	25399	25398	1
11399	345603	345599	4
11400	73793	73792	1
11402	51418	51418	0

Table 15: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
11406	11511	11511	0
11407	73811	73810	1
11415	68391	68390	1
11417	98144	98143	1
11429	98389	98388	1
11431	154211	154209	2
11433	84733	84732	1
11436	321228	321224	4
11437	181376	181374	2
11443	14196	14196	0
11444	15159	15158	1
11446	23173	23172	1
11462	84610	84608	2
11466	65413	65412	1
11474	100340	100339	1
11479	173916	173914	2
11481	44309	44308	1
11489	13347	13347	0
11490	55424	55423	1
11493	45388	45388	0
11498	19211	19211	0
11502	6191	6190	1
11504	1924	1924	0
11506	7692	7692	0
11508	4628	4628	0
11510	101223	101223	0
11512	32920	32919	1
11525	64199	64198	1
11528	71452	71451	1
11530	11458	11458	0
11531	57861	57860	1
11532	2937	2937	0
11533	16992	16991	1
11537	55779	55778	1
11539	81345	81345	0
11541	54268	54267	1
11543	10040	10039	1
11544	18814	18814	0
11549	4800	4402	398
11550	2708	2707	1
11553	14658	14657	1
11554	64805	64804	1
11561	57052	57051	1
11568	20496	20496	0
11570	57467	57466	1

Table 16: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
11575	197431	197429	2
11579	140316	140314	2
11582	62771	62771	0
11591	45274	45274	0
11621	135751	135750	1
11650	60065	60064	1
11652	3605	3605	0
11655	35160	35160	0
11657	33151	33151	0
11676	11002	11002	0
11679	2672	2672	0
11681	317241	317237	4
11682	42228	42228	0
11730	8076	8075	1
11732	32169	32169	0
11733	12244	12244	0
11748	5377	5377	0
11764	64194	64194	0
11783	33747	33747	0
11802	77792	77791	1
11805	4157	4157	0
11816	90577	90576	1
11819	107728	107727	1
11820	6698	6698	0
11824	77977	77976	1
11828	41008	41008	0
11829	8227	8226	1
11831	5109	5109	0
11859	29874	29874	0
11864	44387	44387	0
11867	32671	32671	0
11875	4159	4159	0
11890	49594	49593	1
11899	17812	17811	1
11901	2450	2450	0
11903	2845	2845	0
11911	326240	326237	3
11915	155398	155397	1
11919	79224	79222	2
11924	3006	3006	0
11925	85654	85654	0
11976	187231	187229	2
11977	8750	8750	0
11978	157627	157625	2
11985	39649	39649	0

Table 17: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
11988	29745	29745	0
11990	26099	26099	0
11991	99100	99098	2
12038	43237	43237	0
12054	8104	8103	1
12059	47637	47636	1
12082	63770	63769	1
12150	60822	60821	1
12157	19947	19946	1
12159	10718	10718	0
12162	36335	36334	1
12167	72468	72467	1
12168	79595	79594	1
12172	96284	96283	1
12173	11931	11931	0
12178	44139	44138	1
12181	130051	130050	1
12183	74470	74469	1
12187	195209	195205	4
12190	2304	2304	0
12197	43998	43998	0
12207	86150	86149	1
12222	13241	13241	0
12224	5335	5335	0
12226	83931	83931	0
12227	1859	1859	0
12229	155255	155253	2
12233	345606	345601	5
12234	10912	10913	-1
12237	25763	25763	0
12238	2949	2949	0
12240	130554	130552	2
12243	7334	7334	0
12257	63428	63427	1
12289	40582	40581	1
12290	21238	21238	0
12329	6229	6223	6
12330	48208	48208	0
12506	94976	94975	1
12568	51671	51671	0
12571	10149	10148	1
12575	4909	4908	1
12576	41172	41172	0
12577	143903	143901	2
12590	27359	27354	5

Table 18: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.

Run	10 MHz Sec	50 MHz Sec	Difference
12598	59270	59269	1
12614	17372	17372	0
12615	55812	55812	0
12618	89067	89067	0

Table 19: Run durations (rounded to seconds) from the 10 MHz clock and the 50 MHz clock.