Tests of FNAL GPS Coincidence Board

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UMSL/PITT Quarknet/RET 2003

September 4, 2003

1 Abstract

Tests performed on the Fermilab Quarknet Board in summer 2003 at the Pitt/UMSL Quarknet/RET program are described. Problems and workarounds are discussed.

2 Context

The Quarknet board has been developed to be used in distributed cosmic ray detectors with the purpose to allow high schools to accumulate scintillator coincidences as part of a grid of such detectors. The hope is that if a grid of such detectors were implemented and continuously live, and with a GPS time stamp to allow coincident events from different schools to be compared, then the grid would be sensitive to the large showers originating from very high energy cosmic rays, above 10^{20} eV or so, which are not presently understood. Study of such high energy showers would be a significant scientific achievement. However, such showers occur only rarely. In addition to this potential scientific contribution, it is hoped that exposure to and participation in this project may interest some high school students, and that their scientific education may benefit from the many ways this project connects to technology and science education.

3 Framework of Tests

The board was received on approximately July 17, 2003, with only one week left for Gene Bender. Gene, and Dave Kraus, were able to get the board working to zero order before the end of Gene's work. Dave Kraus and Steve Grosland continued testing the board for about a week after Gene finished, and Dave Kraus, with computer analysis support from Julia Thompson, completed the tests described in this note.

The board was first set up with a PC interface vis mttty:. This worked immediately, and permitted the creation of ASCII files which could be used for analysis. This procedure allowed reliable communication with the board, except for the bit pattern problems noted below.

The trigger mask could be reliably set at some levels and not at others. We were able to run at "coincidence level 2", which required three counters, and at coincidence level 0 which requires only one input. We are now in Pittsburgh and our records in St. Louis, and thus we can not make more detailed statements about the modes of failure.

The on-board thermometer gave reasonable results. We did not calibrate the barometer.

The possibility of a LABVIEW interface via a serial port was considered but not pursued, in part because it was judged that external bit manipulation would be simpler in the context of a FORTRAN program.

Such a small FORTRAN program was written to study the records in more detail and test the data internally for consistency. The detailed description of the 16-word record is given in "QNET2 CPLD Code Updating" by Terry Kiper, 27 June, 2003.
The words as interpreted in our FORTRAN program are given in Table 1. The main difference in the two descriptions is that the FORTRAN program treats the records as an 18-word record. The pairs of words 1 and 2 (and words 11 and 12), as described in Table 1 are each one word in Kiper's description, but split for convenience in data handling. For the purposes of this study, the event second word (words 1 and 2 in the table) and the one second marker (words 11 and 12 in the table) are each treated as 2 words, with the high order 4 bits not used in the program (since 2**28 = 268,435,456, about 6 sec. of the nominal 41.666646 sec. clock counts).

Table 1: Words in the Fermilab board event record. Note that words 1 and 2 and words 11 and 12 in this table can also be treated as a single word, and are so described in the Kiper documentation.

Word	Representation	Interpretation
1 2	1 hex character 7 hex characters	Top 4 bits of event time Bot. 28 bits of event time
3 -10	begin, end time above thresh. (4 channels)	(two bytes/channel) subdividing the 25 ns clock period into 32 bins
11 12	1 hex character 7 hex characters	Top 4 bits of 1-second marker Bot. 28 bits of event time
13	decimal	Nom. GPStime at 1-sec. mark: hh:mm:ss.xxx
14	integer	dd:mm:yr (yr = 03 for us)
15	character	GPS status
16	integer	number of satellites used in this reading
17	1 hex character	error flag
18	integer	corr. (msec) to Nom. GPStime at 1-sec mark

In our experience the 2nd lowest bit in the error flag reliably corresponded to an indication that the following record will be a continuation of the current one. This was first tested over a smaller number of events in the pulser run, and then for the larger GPS comparison run, as described below.

4 Some Results, Successes, and Problems

4.1 Data and Interpretation

Four sets of data were taken:

1. position determination using the Oncore UT GPS averaging techniques. These tests established a sufficiently precise site location so that the UT could then be used in a mode which required only one satellite to do active time-keeping (as used in the time-keeping test described below).

2. comparison of triggers from a pair of scintillators, with timing information for the same events, digitized through a CAMAC system. (The time correlation of the two scintillator pulses indicated that the Fermilab board was selecting reasonable candidates for events; further analysis with detailed event by event comparison was not carried through for lack of time.)

3. short run with square 10nsec input pulses to confirm time-over-threshold digitization using the time-over-threshold feature of the KEK chip. (This yielded reasonable stable results as noted below for the pulses uses; large pulses were not tested.)

4. a run of approximately 2 hrs, to assess time-stamping performance by comparison of the Fermilab one second on board marker to an independent 1-sec time-mark generated by an 8-channel Motorola Oncore UT in time-keeping mode. The Motorola signal was used as an input to channel 3, with the majority logic set to 1. The advantage of this chip is that it has been developed specifically in order to produce reliable timing information. Once the position is found (by position averaging or other means) then only one satellite signal is required to give a timing signal. (A discussion of a two-hour run in this mode forms the bulk of this report.)

5 Comparison of Fermilab board triggers with CAMAC information

A qualitative comparison was made of results for data acquired using the fermilab board logic to generate a trigger which was used to drive a CAMAC system.
The anode signals from a stack of three scintillators were split and sent to the Fermilab board input lines, and to CAMAC ADC modules. Dynode signals were sent to stop CAMAC TDC channels. The trigger output generated by the Fermilab board was used to trigger the gatefor a CAMAC ADC. A scatterplot of the CAMAC TDC values showed the timing correlation expected if the triggers truly arose from coincident events. The data were not analyzed on an event by event basis due to lack of time.

6 Time above Threshold: Tests with Square Pulses

This run was used to gain familiarity with the data, and learn how to get the time above threshold for continuing events. A plot of the time above threshold (proportional to the amplitude) is shown in Figure 1. The time interval between counts of a 41.6MHz clock is approximately 25 ns. This period is further subdivided into 32 bins (so, overall timing of 25ns/32) by the time above threshold word, which takes up one byte in the record. The time seen, approximately 13 (* 25ns/32) corresponds to the width of the input pulse used.

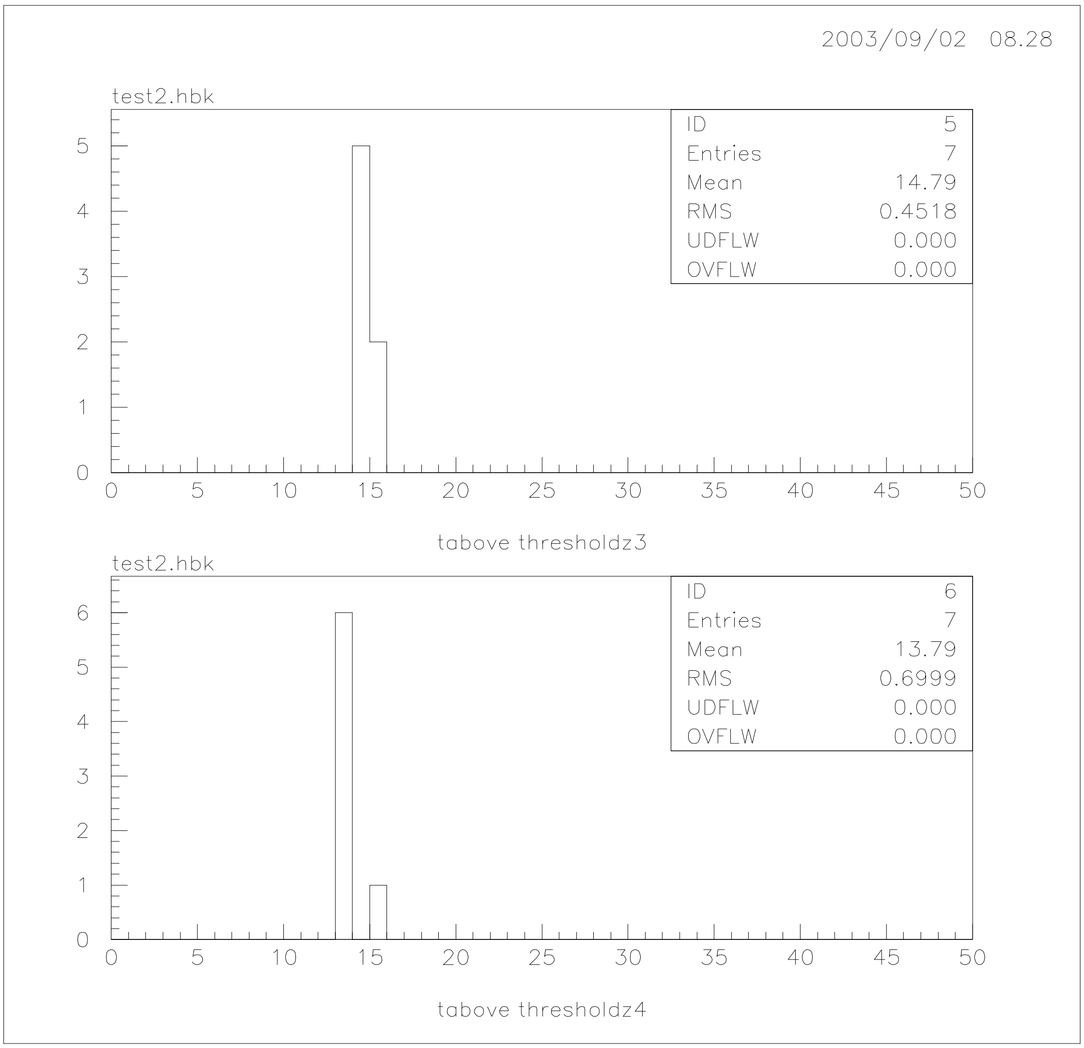

Figure 1: Time above threshold for channels 3 and 4

7 Comparison of FNAL board GPS to Motorola GPS

Next we began to analyze the 2 hour Motorola GPS run. This test was the most thoroughly analysed of our various tests. The 1 pps pulse from the Motorola is put through a discrimiantor to make an event pulse (what characteristics?). This discriminator output is then put into the FNAL gps board (channel 4).

7.1 Missing Bits

One problem which surfaced promptly was an apparent problem with missing bits. The problems appeared to be primarily in three pairs: (5,6), (13,14), (21,22), starting from bit 0 on the right, or lower end. The behavior appeared to be that if both should be there, both were. However, if one but not the other should be there, both were missing. If both should be missing, then both appeared to be missing. Routines were developed to correct for this error, in the current specialized case in which the event times should be reliably spaced either 1 clock count or 41,666,646 counts apart. If these times did not agree with expectations, both the input event time and the Fermilab one second GPS marker were treated as follows:

1. Either 2^{n1} or 2^{n2} (where $2^{n2} = 2\times^{n1}$ is added to the second event time, to make the difference closer either to 1 count (for a continuing event) or 41,666,646 counts (1 sec). The algorithm used is that if the event time differences were different by an amount which indicated that either bit (of the pair (n1,n2) might be missing, then 2^{n1} was added. This will shift the ones with the missing n1 bit into agreement and the ones with the missing n2 bit into the missing n1 bit position. The test (and correction, again both using 2^{n1}) were then repeated. In this way either 2^{n1} or 2^{n2} would be added (to both the event time and the Fermilab one second marker).

2. If the difference is higher than expected, by an amount which corresponds to the flaky bits, then 2^{n1} or 2^{n2} are subtracted from the event time. In principle, if the bits are always missing, this second step should not be required. However, an attempt to avoid it led to failures to fix the bits correctly. This could be due either to the possibility that an initial event had the bits mis-set, or that the bits in some cases were actually present when they should not be. We have not attempted to distinguish between these two possibilties, but simply gone ahead and allowed an adjustment either upward or downward corresponding to the troublesome bits. But in examination of individual events (without following the chain through completely) we did not find any instance in which the bits were erroneously present.

3. The procedure above was applied first for the (21,22) pair, then the (13,14) pair, and then the (5,6) pair. Figure 2 shows a histogram of occupied bits for all event times, before and after the corrections were applied.

The improvement is evident, although clearly some problems remain. There are undoubtedly remaining low level flaws in our bit corrections, but we judge that the bit correction is adequate to proceed, since it now gives no errors at more than 100 counts for the difference between two event times from the Oncore gps. And it is not useful to strain to correct the bits from the difference between the two Oncore gps time, since in general the Oncore gps time will not be available as a second marker, and even if it were, it would not come at the same time as the Fermilab board one second marker, and so the procedure used here could not be used to get reliable time differences between the event time and the one second marker. Clearly the missing bit problems must be solved before the board can be used in its intended application.

7.2 Error/Event Continuation Flag

Of 4151 events which had the event time (the Motorola GPS 1 sec marker pulses) differing by 1 clock count (indicating an event which carried over from one clock pulse to the next), all events had the 2 bit set in the error flag. Of the 265 events which had the carry bit set but did not have two event times differening by 1, 9 differed by 41.6Mhs and the rest had values differing by more than 20 from the last verified good event pulse. We have not studied all of these. 151 of them come from one spate of difficulty in which nonsense values of were appearing in the Oncore times. (upper left in Figure 3. Another indication of a problem is the difference between the event times and the fermilab time vs line in the input file shown in Figure 4. Most of the serious disagreements seem to be concentrated in a rather narrow range of data.

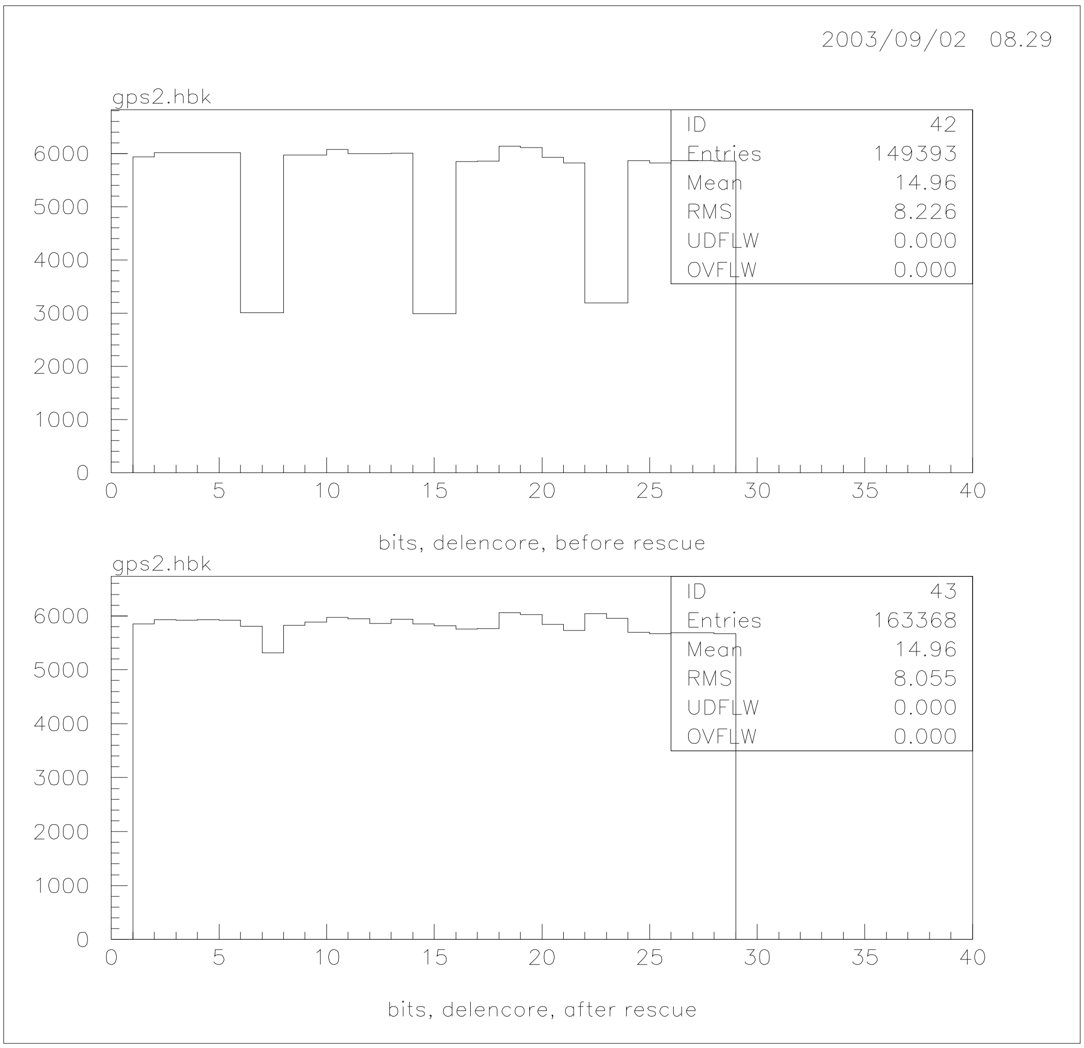

Figure 2: Bit occupancy patterns before (above) and after (below) the bit-rescue operation was applied.

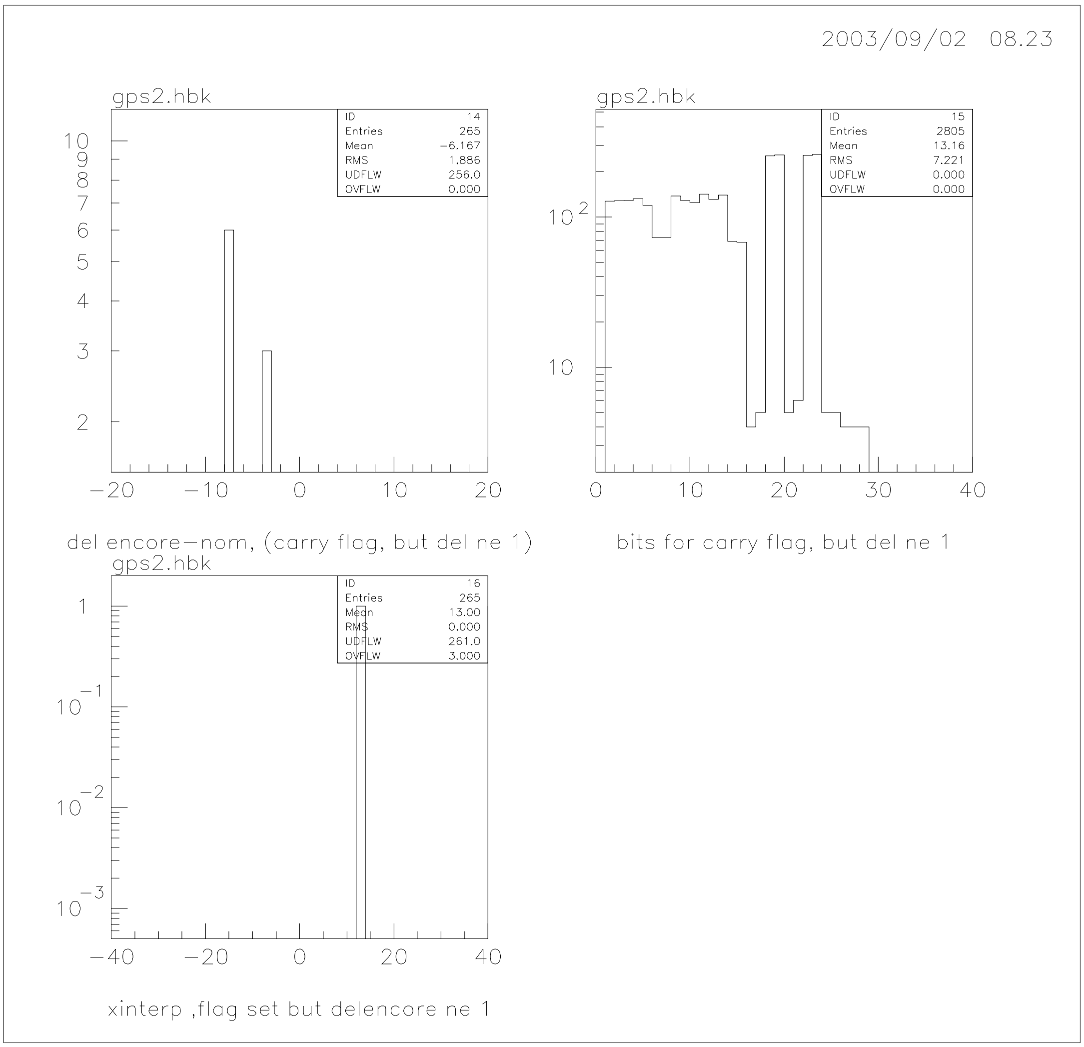

Figure 3: Events for which the difference between two successive event times (Motorola GPS) was not 1, although the "continuation flag bit" was set. Upper left: Difference between successive event times; upper right: bit occupancy patterns for the event time; lower left: difference between the event time and the Fermilab one second marker time

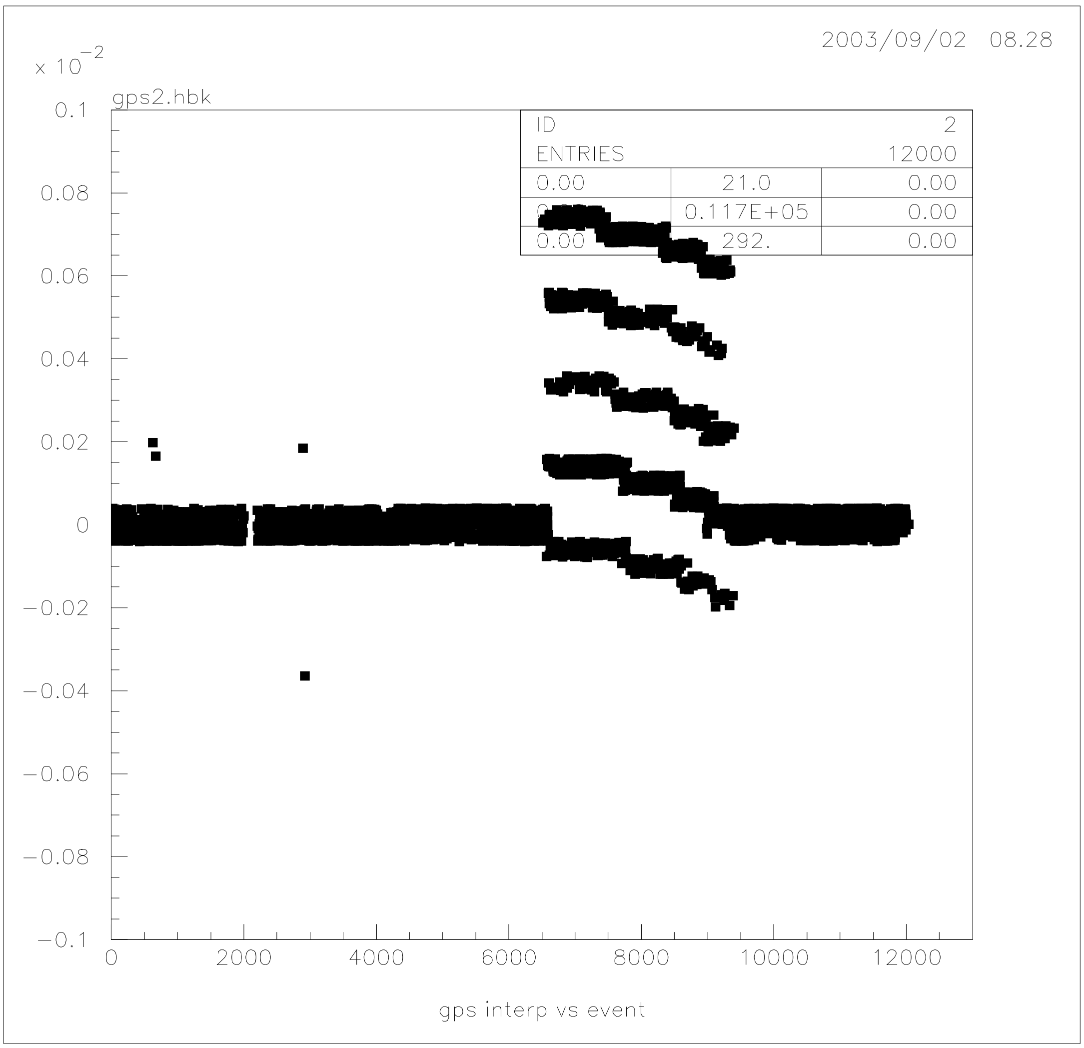

Figure 4: Difference (in seconds) between the Motorola GPS time and the FNAL board GPS one second time marker, as a function of record sequence number in the data file.

7.3 Bookkeeping of Events

The events examined began at 16:23:45.1 (16:23:45.9 after correction) and ended at 18:34:42.7 (18:34:42.9 after correction), thus with an elapsed time of 2 hrs, 10 min, 57 sec, we expected to find 7858 events (counting both the initial and ending event). Using the continuation flag bit to decide (7849) on whether or not a particular record was a "continuing event" (an event in which the event information stretches over two 41Mhz cycles), and adding the 10 events which have event times differing by 41.6Mhz but also have the continuation bit set (9 adjacent, and one pair separated by the string of 151 nonsense Oncore gps event times), we find 5282 events with Motorola - fnal differening by less than 16 counts, and 2576 differing by more than 16 counts $+10 = 7858$ events, as expected.

7.4 Samples with $\leq / \geq$ 16 counts between GPS and FNAL

Figures 5 and 6 show relevant distributions for the two samples in which the Motorola differs from the fnal gps time by less than (or more than) 16 counts. The bit patterns are reasonably flat in both groups. The "xinterp" plot is the Motorola - fnal times, in counts. Since a count is [1/(41.666646 M)] sec, the sigma of 6 for the less than 16 count sample implies a precision, at this point, with known problems removed, of about 100 nsec. The structure in the similar plot for the sample with bigger differences than 16 indicates some remaining bit-swapping problems. The xcorr plot shows the correction to the crude fnal board gps second time, from the board's own calculation. The negative xcorr values are shown in the section on synchronicity to be connected with time keeping glitches between the motorola and the fnal gps times.

Figure 7 shows the difference in Motorola Oncore event times for the two samples. The discrete distributions to each side of the main peak were not present until the events missing an overflow bit were rescued. (Previously they were outside the histogram). The structure is indicative of some remaining bit-swapping problems for events in which the high order bits roll over. Again, due to time constraints, this was not thoroughly investigated, but may be due to imperfections in the algorithm used for these cases.

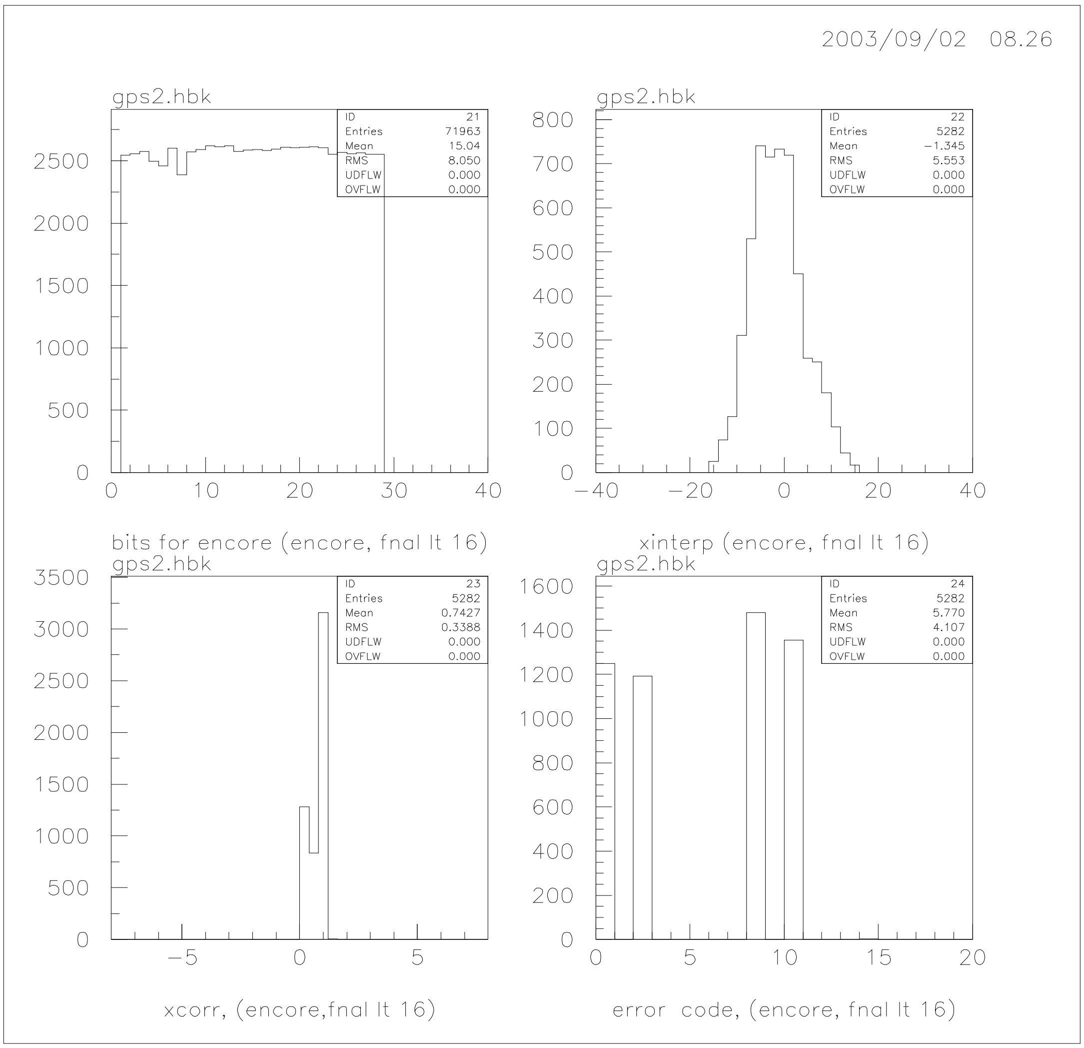

Figure 5: Plots of various quantities for the sample in which the Oncore time and the Fnal one second GPS time differ by less than 16 counts. Upper left: frequency of bits set (bit occupancy pattern); ;upper right: difference between Motorola and Fnal GPS time values; lower left: the correction to the crude one second (Fnal) GPS time in the record; and lower right: the error flags for these events.

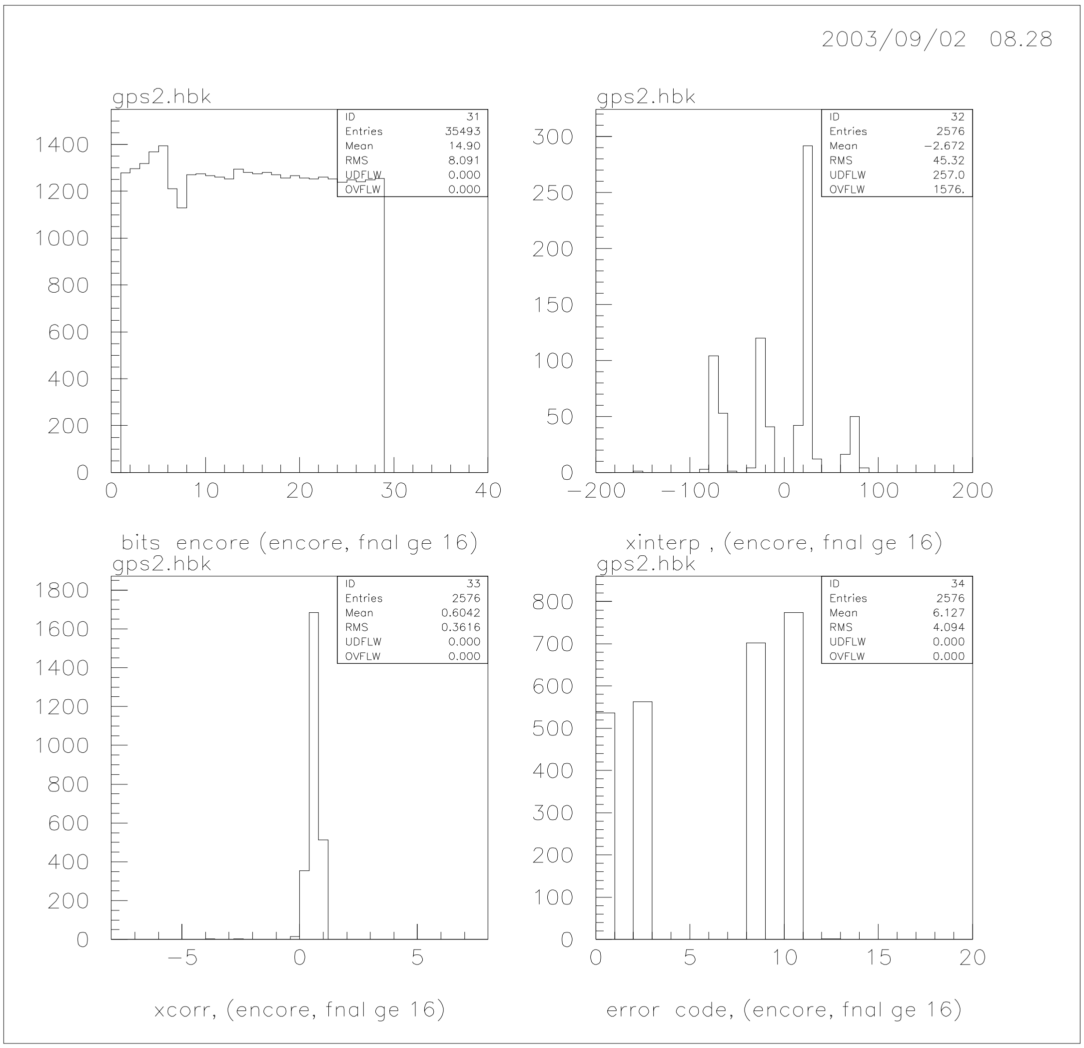

Figure 6: Events with the gps and fermilab times differing by more than 16 counts: Plots of various quantities (Upper left: bit frequency pattern; upper right: difference between Motorola and Fnal GPS time values; Lower left: the correction to the crude one second (Fnal) GPS time in the record; lower right: error flags for these events.

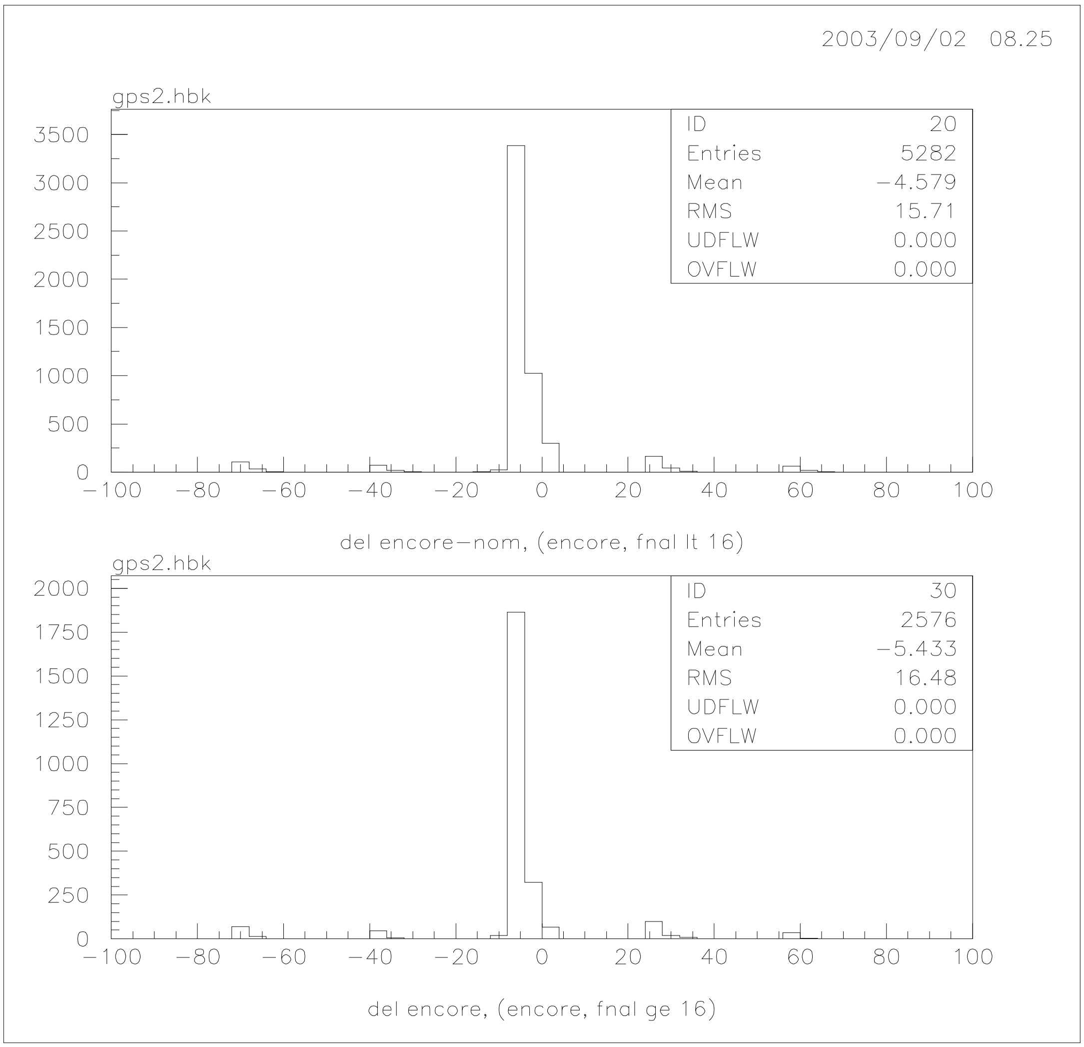

Figure 7: Difference between successive Motorola - Oncore pulses (with the nominal value of 41,666,646 subtracted). The difference is shown for the two samples: Motorola - fnal greater and less than 16 counts). Note that the variable in the FORTRAN program was erroneously spelled delencore rather than deloncore.

7.5 Test of One Second Advance and Synchronicity

At UMSL, already described:

```
1) bit -swapping, with before/after figure
2) use of error flag to identify continuing events.
3) 9 exceptions, pairs with event continuation flag set
     but  with delencore = 41.6 MHz
4) 1 exception, a pair separated by 151 junk Oncore events,
     but  with delencore = 41.6 MHz
5) combination of distinct events according to the flag, with the  10
exceptions to give
   7848+10 = 7858 events.

  Expected:
  (last studied: 18:34:42.9;
   first         16:23:45.8
-----------------------------
                  2:10:57.1

  or 7200
      600
       57
        1   (must also include first and last events, not just difference
 -----------
     7858
```

The two numbers agree. The correspondence runs off in some cases, but is relatively quickly restored, as shown in Figure 8, and discussed in the following subsection.

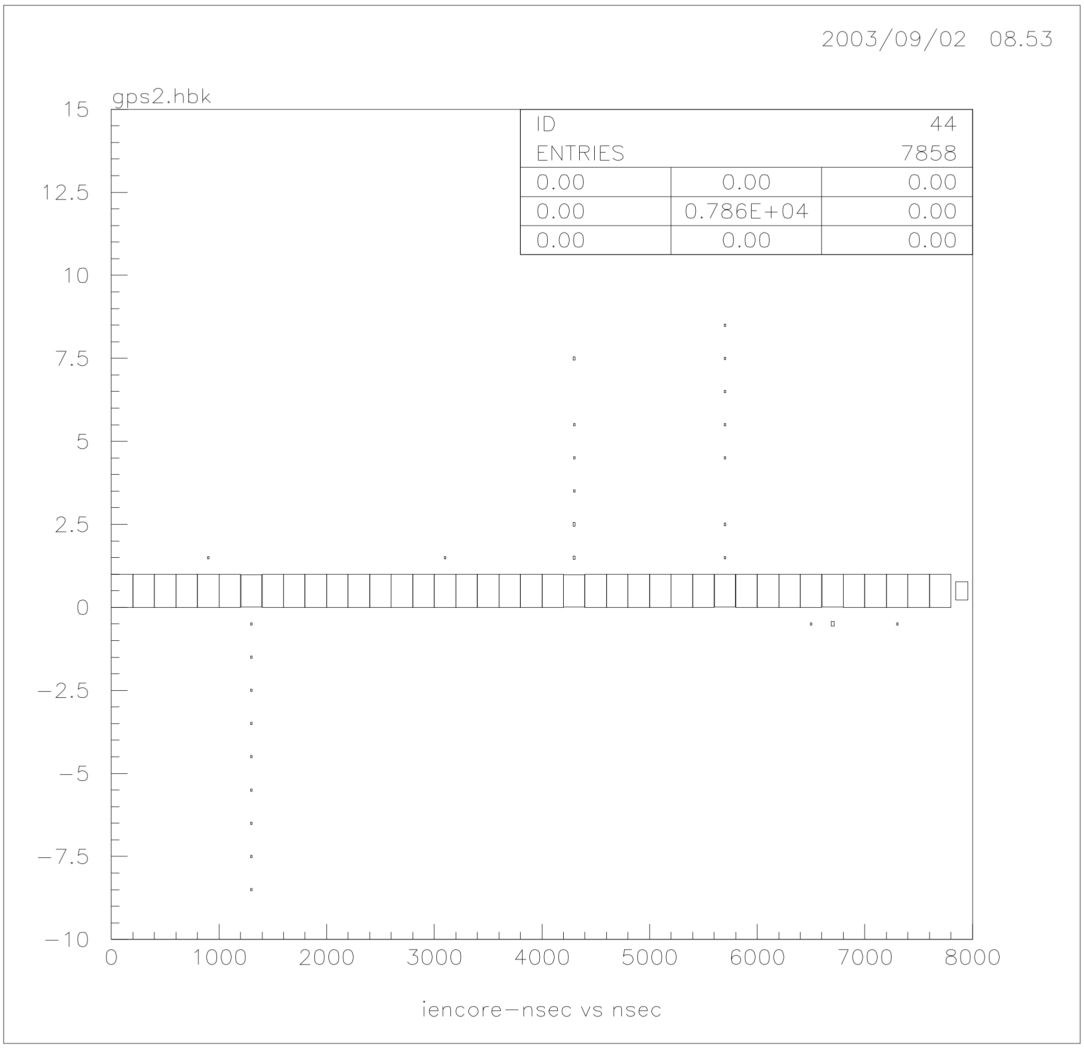

Figure 8: Difference between the Oncore event number (inferred by taking successive Motorola - Oncore pulses within 100 counts of the nominal value of 41,666,646) and the expected number of events inferred from the fnal board crude hour/min/time value provided. With some excursions during times when the crude time marker was clearly misbehaving, the two event markers agree exactly over most of the run.

7.6 Correspondence of events

With the tools developed in the previous sections, we now address the question of correspondence between Motorola Oncore (event time) gps seconds and the gps seconds suggested by the fnal board approximate time marker. Below we discuss the various glitches which were found. The corresponding raw event records are in Appendix A.

1. approx. gps sec/corection: 164007.018/-0.201 This negative correction throws off the fnal sequence, since the corrections to either side are numbers like 0.08, and the approximate second and the Motorola event time all progress normally. The number of Oncore events agrees with the elapsed time.

2. starting approx. 164443.001/+0.814 to 164554.000/-0.15, the Motorola times are garbage (increasing, but by small amounts, not zero, not 1, not 41.6M). All the garbage except for the first record is treated as a continuing event (error bit 2 set in the error flag), and so would not affect any data. The one garbage event is offset by one event with a continuation flag which has a difference of 41,666,608 with respect to the last good event. For the purposes of this test, we have included this event as real by simply ignoring events in which the flag would indicate a new event but the Oncore time differences are off by more than 1 million counts.

3. starting 164554.000/-0.15 through 164554.000/-0.15. Sequence of 10 events (9 time differences) with good differences in Motorola event times. The first event has a good difference with respect to the last good event. Overall we have problems over 10 sec and recover all of those events by using the Motorola event time properly and discarding the junk in between (in our case by not allowing distinct events to have a difference more than 1 million counts different from the nominal 41.6 million expected. These all still have a continuing event bit flag set.

4. 171401.918/-0.053 again causes a glitch in the fnal gps time sequence, with corrections of order 0.945 on either side.

5. 173424.858/1.110 through 173437.357/0.619. Series of negative corrections, some of multiple seconds. At the end, when things settle down, there are 12 missing fnal gps seconds (so 12 + 1 = 13 events) and 13 Motorola events, each differing from the last by a reasonable 41.6 million count difference.

6. 180010.282/0.689 (180011) through 180021.782/0.193 (180022) again first fnal gps time stalls at: 180011.282/0.685 (for two events), followed by series of negative correctgions. Thus we have a series of 12 events (11 intervals), some with negative corrections, which cause local glitches; but 180022 - 180010 predicts 22-11 + 1 = 12 events, in agreement with observation.

7. 181338.742/0.159 (181339) through 181401.741/0.160 (181402). This one is confused by the presence of new event codes not previously used (6,E,C); however, the continuing events are selected by the recognizable difference of 1 in the event record. Again, the total number of events agree with the expected number of elapsed second (string of 24 events, 23 intervals). Note that the subtraction here requires the understanding of the hh/mm/ss string of the crude time stamp: the string starts at 18:13:39 and finishes at 18:14:02, a difference of 23 (time intervals) and string of 24 seconds counting first and last.

8. 182407.712/1142 (182409) through 182411.711/0.170 (182412) . would expect 12-9 + 1 = 4 events in the string (3 intervals), and that is what is seen (the fnal board first gains, then drops the extra events. there is a glitch in one event because the corrections are flopping around from 1.1 to 0.1 sec.

The above numbers give an idea of how synchronicity is lost and regained.

8 Conclusions

The fermilab coincidence board with GPS time stamping was received, and some simple debugging carried out, leading to a brief discussion of errors in the data. We hope to receive a second module in fall 2003, and a complement of 5-7 for our planned workshop in 2004 (we anticipate 5 pairs of teachers, and would like to retain two for our own coincidence tests and finally (we hope) data collecting stations.. Work with the FNAL board will continue at a low level over the course of the fall, and we will continue similar work with the RET/Quarknet teachers in summer 2004.
In order for the board to be used as intended (with precise event time given by the difference between the event time and the GPS time marker, the current problems with missing bits must be addressed. This appears difficult to do in software at the user level, since the event times will not generally have the same bit patterns as the one second time markers (as was the case by design in this test of the board).

9 Appendix A: Raw data records

```
Here is the computer record of time-keeping glitches   j.


Here is an example where a negative correction causes the fnal
   approx. gps sec. to be wrong.

95941711 80 01 00 01 00 01 0E 1D 95941719 164004.018 070803 A 06 0 +0799

980F9F82 80 01 00 01 00 01 07 16 980F9F8B 164005.018 070803 A 06 0 +0800

9A8B87F3 80 01 00 01 00 01 07 17 9A8B888A 164006.018 070803 A 06 8 +0798

9D077008 80 01 00 01 00 01 0B 1B 9A8B888A 164007.018 070803 A 06 8 -0201

9F831899 80 01 00 01 00 01 03 13 9F831881 164008.017 070803 A 06 8 +0798

E21F00E9 80 01 00 01 00 01 1A 01 E21F00F3 164009.017 070803 A 06 A +0799
E21F00EA 00 01 00 01 00 01 01 09 E21F00F3 164009.017 070803 A 06 8 +0799

E49A891A 80 01 00 01 00 01 0D 1D E49A8905 164010.017 070803 A 06 8 +0799

Below is a sequence in which there appears to be a lot of garbage
in the event time.  If one followed the fnal approx. gps event
time and also used the continuing error flag, one would lose 9-10  events,
but the events would be (completely in time, or only approx?)
more or less recovered by the time the continuation flag allows one to
consider the event over.

1A868B06 80 01 00 01 00 01 13 01 1A868B14 164541.001 070803 A 05 A +0834
```

```
1A868B07 00 01 00 01 00 01 01 03 1A868B14 164541.001 070803 A 05 8 +0834

1D02939B 80 01 00 01 00 01 08 18 1D029386 164542.001 070803 A 05 0 +0822
```

Here starts one long nominally continuing event, with only small
differences between the event times (which nominally come from
the Motorola Oncore GPS module)

```
1F9E1BEC 80 01 00 01 00 01 04 13 1F9E1BF9 164543.001 070803 A 06 8 +0814
00661505 80 01 00 01 00 01 1F 01 1F9E1BF9 164543.001 070803 A 06 A +0814
00661506 00 01 00 01 00 01 01 0F 1F9E1BF9 164544.001 070803 A 06 A -0185
0066158D 80 01 00 01 00 01 10 01 1F9E1BF9 164544.001 070803 A 06 A -0185
0066158E 00 01 00 01 00 01 01 00 1F9E1BF9 164544.001 070803 A 06 A -0185
0066159F 80 01 00 01 00 01 00 10 1F9E1BF9 164544.001 070803 A 06 A -0185
0066158F 80 01 00 01 00 01 18 01 1F9E1BF9 164544.001 070803 A 06 A -0185
00661590 00 01 00 01 00 01 01 08 1F9E1BF9 164544.001 070803 A 06 A -0185
006615E4 80 01 00 01 00 01 1B 01 1F9E1BF9 164544.001 070803 A 06 A -0185
006615E5 00 01 00 01 00 01 1F 0A 1F9E1BF9 164544.001 070803 A 06 A -0185
006615E6 00 01 00 01 00 01 01 0E 1F9E1BF9 164544.001 070803 A 06 A -0185
00661612 80 01 00 01 00 01 04 14 1F9E1BF9 164544.001 070803 A 06 A -0185
0066160A 80 01 00 01 00 01 0D 1D 1F9E1BF9 164544.001 070803 A 06 A -0185
0066161F 80 01 00 01 00 01 09 19 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A03 80 01 00 01 00 01 09 19 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A0A 80 01 00 01 00 01 0D 1D 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A0B 00 01 00 01 00 01 11 01 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A0C 00 01 00 01 00 01 01 01 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A65 80 01 00 01 00 01 05 15 1F9E1BF9 164544.001 070803 A 06 A -0185
00661A66 00 01 00 01 00 01 0A 19 021A040B 164544.001 070803 A 06 A +0815
00661A7E 80 01 00 01 00 01 1F 01 021A040B 164544.001 070803 A 06 A +0815
00661A7F 00 01 00 01 00 01 01 0F 021A040B 164544.001 070803 A 06 A +0815
00661A97 80 01 00 01 00 01 1F 01 021A040B 164544.001 070803 A 06 A +0815
00661A98 00 01 00 01 00 01 01 0F 021A040B 164544.001 070803 A 06 A +0815
00661A88 80 01 00 01 00 01 04 14 021A040B 164544.001 070803 A 06 A +0815
00661AE6 80 01 00 01 00 01 01 11 021A040B 164544.001 070803 A 06 A +0815
00661AE7 00 01 00 01 00 01 05 15 021A040B 164544.001 070803 A 06 A +0815
00661B8A 80 01 00 01 00 01 0C 1C 021A040B 164544.001 070803 A 06 A +0815
00661C1D 80 01 00 01 00 01 0D 1D 021A040B 164545.001 070803 A 06 A -0185
00661C80 80 01 00 01 00 01 11 01 021A040B 164545.001 070803 A 06 A -0185
00661C81 00 01 00 01 00 01 01 01 021A040B 164545.001 070803 A 06 A -0185
00661C82 80 01 00 01 00 01 12 01 021A040B 164545.001 070803 A 06 A -0185
00661C83 00 01 00 01 00 01 01 02 021A040B 164545.001 070803 A 06 A -0185
00661CF1 80 01 00 01 00 01 01 11 021A040B 164545.001 070803 A 06 A -0185
00661CF2 00 01 00 01 00 01 05 14 021A040B 164545.001 070803 A 06 A -0185
00661D00 80 01 00 01 00 01 03 13 021A040B 164545.001 070803 A 06 A -0185
00661D01 00 01 00 01 00 01 08 17 021A040B 164545.001 070803 A 06 A -0185
00661D15 80 01 00 01 00 01 1A 01 021A040B 164545.001 070803 A 06 A -0185
00661D16 00 01 00 01 00 01 1E 0A 021A040B 164545.001 070803 A 06 A -0185
00661D17 00 01 00 01 00 01 01 0E 021A040B 164545.001 070803 A 06 A -0185
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00661D95 80 01 00 01 00 01 01 11 021A040B 164545.001 070803 A 06 A -0185
00661D96 00 01 00 01 00 01 05 15 021A040B 164545.001 070803 A 06 A -0185
00661DE4 80 01 00 01 00 01 04 14 021A040B 164545.001 070803 A 06 A -0185
00661DE5 00 01 00 01 00 01 09 18 021A040B 164545.001 070803 A 06 A -0185
00661E03 80 01 00 01 00 01 1B 01 021A040B 164545.001 070803 A 06 A -0185
00661E04 00 01 00 01 00 01 1F 0B 0495EC9B 164545.001 070803 A 06 A +0815
00661E05 00 01 00 01 00 01 01 0F 0495EC9B 164545.001 070803 A 06 A +0815
00661F8C 80 01 00 01 00 01 04 14 0495EC9B 164545.001 070803 A 06 A +0815
00661F8D 00 01 00 01 00 01 09 18 0495EC9B 164545.001 070803 A 06 A +0815
0066001D 80 01 00 01 00 01 04 14 0495EC9B 164545.001 070803 A 06 A +0815
0066001E 00 01 00 01 00 01 09 18 0495EC9B 164545.001 070803 A 06 A +0815
00660087 80 01 00 01 00 01 12 01 0495EC9B 164545.001 070803 A 06 A +0815
00660088 00 01 00 01 00 01 17 02 0495EC9B 164545.001 070803 A 06 A +0815
00660089 00 01 00 01 00 01 01 06 0495EC9B 164545.001 070803 A 06 A +0815
00660104 80 01 00 01 00 01 04 13 0495EC9B 164546.001 070803 A 06 A -0185
00660105 00 01 00 01 00 01 08 18 0495EC9B 164546.001 070803 A 06 A -0185
0066019F 80 01 00 01 00 01 10 01 0495EC9B 164546.001 070803 A 06 A -0185
00660180 00 01 00 01 00 01 01 00 0495EC9B 164546.001 070803 A 06 A -0185
00660272 80 01 00 01 00 01 19 01 0495EC9B 164546.001 070803 A 06 A -0185
00660273 00 01 00 01 00 01 01 09 0495EC9B 164546.001 070803 A 06 A -0185
0066031A 80 01 00 01 00 01 16 01 0495EC9B 164546.001 070803 A 06 A -0185
0066031B 00 01 00 01 00 01 01 06 0495EC9B 164546.001 070803 A 06 A -0185
006603EE 80 01 00 01 00 01 02 12 0495EC9B 164546.001 070803 A 06 A -0185
0066040C 80 01 00 01 00 01 18 01 0495EC9B 164546.001 070803 A 06 A -0185
0066040D 00 01 00 01 00 01 01 08 0495EC9B 164546.001 070803 A 06 A -0185
00660499 80 01 00 01 00 01 1E 01 0495EC9B 164546.001 070803 A 06 A -0185
0066049A 00 01 00 01 00 01 01 0E 0495EC9B 164546.001 070803 A 06 A -0185
00660513 80 01 00 01 00 01 1E 01 0495EC9B 164546.001 070803 A 06 A -0185
00660514 00 01 00 01 00 01 01 0E 0495EC9B 164546.001 070803 A 06 A -0185
00660584 80 01 00 01 00 01 0B 1B 0495EC9B 164546.001 070803 A 06 A -0185
00660619 80 01 00 01 00 01 01 11 0495EC9B 164546.001 070803 A 06 A -0185
0066069D 80 01 00 01 00 01 19 01 071194ED 164546.001 070803 A 06 2 +0815
0066069E 00 01 00 01 00 01 01 09 071194ED 164546.001 070803 A 06 2 +0815
00660702 80 01 00 01 00 01 12 01 071194ED 164546.001 070803 A 06 2 +0815
00660703 00 01 00 01 00 01 01 02 071194ED 164546.001 070803 A 06 2 +0815
00660800 80 01 00 01 00 01 0A 1A 071194ED 164546.001 070803 A 06 2 +0815
0066088A 80 01 00 01 00 01 08 18 071194ED 164546.001 070803 A 06 2 +0815
00660914 80 01 00 01 00 01 14 01 071194ED 164546.001 070803 A 06 2 +0815
00660915 00 01 00 01 00 01 01 04 071194ED 164546.001 070803 A 06 2 +0815
006609E2 80 01 00 01 00 01 19 01 071194ED 164547.001 070803 A 06 2 -0185
006609E3 00 01 00 01 00 01 01 09 071194ED 164547.001 070803 A 06 2 -0185
00660A6B 80 01 00 01 00 01 1A 01 071194ED 164547.001 070803 A 06 2 -0185
00660A6C 00 01 00 01 00 01 01 0A 071194ED 164547.001 070803 A 06 2 -0185
00660AF8 80 01 00 01 00 01 18 01 071194ED 164547.001 070803 A 06 2 -0185
00660AF9 00 01 00 01 00 01 01 08 071194ED 164547.001 070803 A 06 2 -0185
00660B86 80 01 00 01 00 01 19 01 071194ED 164547.001 070803 A 06 2 -0185
00660B87 00 01 00 01 00 01 01 09 071194ED 164547.001 070803 A 06 2 -0185
00660C18 80 01 00 01 00 01 19 01 071194ED 164547.001 070803 A 06 2 -0185
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00660C19 00 01 00 01 00 01 01 08 071194ED 164547.001 070803 A 06 2 -0185
00660C99 80 01 00 01 00 01 08 18 071194ED 164547.001 070803 A 06 2 -0185
00660D0C 80 01 00 01 00 01 0A 1A 071194ED 164547.001 070803 A 06 2 -0185
00660D80 80 01 00 01 00 01 12 01 071194ED 164547.001 070803 A 06 2 -0185
00660D81 00 01 00 01 00 01 01 02 071194ED 164547.001 070803 A 06 2 -0185
00660E19 80 01 00 01 00 01 0A 1A 071194ED 164547.001 070803 A 06 2 -0185
00660EEF 80 01 00 01 00 01 12 01 071194ED 164547.001 070803 A 06 2 -0185
00660EF0 00 01 00 01 00 01 01 01 071194ED 164547.001 070803 A 06 2 -0185
00660F86 80 01 00 01 00 01 0F 1F 098D7D1E 164547.001 070803 A 06 2 +0815
00661019 80 01 00 01 00 01 0D 1D 098D7D1E 164547.001 070803 A 06 2 +0815
0066108C 80 01 00 01 00 01 1A 01 098D7D1E 164547.001 070803 A 06 2 +0815
0066108D 00 01 00 01 00 01 01 09 098D7D1E 164547.001 070803 A 06 2 +0815
00661108 80 01 00 01 00 01 0A 1A 098D7D1E 164547.001 070803 A 06 2 +0815
006611E4 80 01 00 01 00 01 17 01 098D7D1E 164547.001 070803 A 06 2 +0815
006611E5 00 01 00 01 00 01 01 07 098D7D1E 164547.001 070803 A 06 2 +0815
00661277 80 01 00 01 00 01 09 19 098D7D1E 164547.001 070803 A 06 2 +0815
00661315 80 01 00 01 00 01 04 14 098D7D1E 164547.001 070803 A 06 2 +0815
006613EB 80 01 00 01 00 01 00 10 098D7D1E 164548.001 070803 A 06 2 -0186
00661490 80 01 00 01 00 01 12 01 098D7D1E 164548.001 070803 A 06 2 -0186
00661491 00 01 00 01 00 01 01 02 098D7D1E 164548.001 070803 A 06 2 -0186
0066156C 80 01 00 01 00 01 0A 1A 098D7D1E 164548.001 070803 A 06 2 -0186
0066156D 00 01 00 01 00 01 0F 1E 098D7D1E 164548.001 070803 A 06 2 -0186
00661608 80 01 00 01 00 01 13 01 098D7D1E 164548.001 070803 A 06 2 -0186
00661609 00 01 00 01 00 01 01 03 098D7D1E 164548.001 070803 A 06 2 -0186
0066168A 80 01 00 01 00 01 03 13 098D7D1E 164548.001 070803 A 06 2 -0186
00661709 80 01 00 01 00 01 1D 01 098D7D1E 164548.001 070803 A 06 2 -0186
0066170A 00 01 00 01 00 01 01 0D 098D7D1E 164548.001 070803 A 06 2 -0186
006617E2 80 01 00 01 00 01 15 01 098D7D1E 164548.001 070803 A 06 2 -0186
006617E3 00 01 00 01 00 01 01 05 098D7D1E 164548.001 070803 A 06 2 -0186
0066187D 80 01 00 01 00 01 13 01 098D7D1E 164548.001 070803 A 06 2 -0186
0066187E 00 01 00 01 00 01 01 03 098D7D1E 164548.001 070803 A 06 2 -0186
00661902 80 01 00 01 00 01 0D 1D 098D7D1E 164548.001 070803 A 06 2 -0186
00661988 80 01 00 01 00 01 19 01 098D7D1E 164548.001 070803 A 06 2 -0186
00661989 00 01 00 01 00 01 01 09 098D7D1E 164548.001 070803 A 06 2 -0186
00661A6E 80 01 00 01 00 01 0D 1D 0C090591 164548.001 070803 A 06 A +0813
00661A6F 00 01 00 01 00 01 12 01 0C090591 164548.001 070803 A 06 A +0813
00661A70 00 01 00 01 00 01 01 02 0C090591 164548.001 070803 A 06 A +0813
00661B00 80 01 00 01 00 01 0B 1B 0C090591 164548.001 070803 A 06 A +0813
00661B82 80 01 00 01 00 01 16 01 0C090591 164548.001 070803 A 06 A +0813
00661B83 00 01 00 01 00 01 01 06 0C090591 164548.001 070803 A 06 A +0813
00661C0A 80 01 00 01 00 01 0D 1D 0C090591 164548.001 070803 A 06 A +0813
00661CF1 80 01 00 01 00 01 12 01 0C090591 164548.001 070803 A 06 A +0813
00661CF2 00 01 00 01 00 01 01 02 0C090591 164548.001 070803 A 06 A +0813
00661E04 80 01 00 01 00 01 13 01 0C090591 164549.001 070803 A 05 A -0181
00661E05 00 01 00 01 00 01 01 03 0C090591 164549.001 070803 A 05 A -0181
00661E93 80 01 00 01 00 01 0E 1D 0C090591 164549.001 070803 A 05 A -0181
00661F13 80 01 00 01 00 01 0C 1C 0C090591 164549.001 070803 A 05 A -0181
00661F9B 80 01 00 01 00 01 0D 1D 0C090591 164549.001 070803 A 05 A -0181
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00660085 80 01 00 01 00 01 1A 01 0C090591 164549.001 070803 A 05 A -0181
00660086 00 01 00 01 00 01 01 0A 0C090591 164549.001 070803 A 05 A -0181
0066010C 80 01 00 01 00 01 00 0F 0C090591 164549.001 070803 A 05 A -0181
00660195 80 01 00 01 00 01 01 11 0C090591 164549.001 070803 A 05 A -0181
0066027A 80 01 00 01 00 01 10 01 0C090591 164549.001 070803 A 05 A -0181
0066027B 00 01 00 01 00 01 01 00 0C090591 164549.001 070803 A 05 A -0181
0066031E 80 01 00 01 00 01 03 12 0C090591 164549.001 070803 A 05 A -0181
0066038B 80 01 00 01 00 01 13 01 0C090591 164549.001 070803 A 05 A -0181
0066038C 00 01 00 01 00 01 01 03 0C090591 164549.001 070803 A 05 A -0181
00660479 80 01 00 01 00 01 18 01 0C090591 164549.001 070803 A 05 A -0181
0066047A 00 01 00 01 00 01 01 08 0C090591 164549.001 070803 A 05 A -0181
00660505 80 01 00 01 00 01 06 16 0C090591 164549.001 070803 A 05 A -0181
00660594 80 01 00 01 00 01 1F 01 0E850DE3 164549.001 070803 A 05 2 +0818
00660595 00 01 00 01 00 01 01 0E 0E850DE3 164549.001 070803 A 05 2 +0818
00660596 00 01 00 01 00 01 04 13 0E850DE3 164549.001 070803 A 05 2 +0818
00660680 80 01 00 01 00 01 07 17 0E850DE3 164549.001 070803 A 05 2 +0818
00660715 80 01 00 01 00 01 1C 01 0E850DE3 164549.001 070803 A 05 2 +0818
00660716 00 01 00 01 00 01 01 0B 0E850DE3 164549.001 070803 A 05 2 +0818
006607E6 80 01 00 01 00 01 0F 1F 0E850DE3 164549.001 070803 A 05 2 +0818
0066089F 80 01 00 01 00 01 0A 1A 0E850DE3 164549.001 070803 A 05 2 +0818
0066099A 80 01 00 01 00 01 10 01 0E850DE3 164550.001 070803 A 05 2 -0183
0066099B 00 01 00 01 00 01 01 00 0E850DE3 164550.001 070803 A 05 2 -0183
00660A69 80 01 00 01 00 01 00 10 0E850DE3 164550.001 070803 A 05 2 -0183
00660B1D 80 01 00 01 00 01 1A 01 0E850DE3 164550.001 070803 A 05 2 -0183
00660B1E 00 01 00 01 00 01 01 09 0E850DE3 164550.001 070803 A 05 2 -0183
00660B82 80 01 00 01 00 01 0F 1F 0E850DE3 164550.001 070803 A 05 2 -0183
00660D0A 80 01 00 01 00 01 08 18 0E850DE3 164550.001 070803 A 05 2 -0183
00660DF4 80 01 00 01 00 01 10 01 0E850DE3 164550.001 070803 A 05 2 -0183
00660DF5 00 01 00 01 00 01 01 00 0E850DE3 164550.001 070803 A 05 2 -0183
00660F1B 80 01 00 01 00 01 0F 1F 0E850DE3 164550.001 070803 A 05 2 -0183
00660F81 80 01 00 01 00 01 0C 1C 0E850DE3 164550.001 070803 A 05 2 -0183
00661197 80 01 00 01 00 01 00 10 0E850DE3 164550.001 070803 A 05 2 -0183
0066126B 80 01 00 01 00 01 1D 01 0E850DE3 164550.001 070803 A 05 2 -0183
0066126C 00 01 00 01 00 01 01 0C 0E850DE3 164550.001 070803 A 05 2 -0183
00661303 80 01 00 01 00 01 1B 01 0E850DE3 164550.001 070803 A 05 2 -0183
00661304 00 01 00 01 00 01 01 0B 0E850DE3 164550.001 070803 A 05 2 -0183
0066141D 80 01 00 01 00 01 07 17 0E850DE3 164550.001 070803 A 05 2 -0183
00661500 80 01 00 01 00 01 06 16 11009614 164550.001 070803 A 05 2 +0817
0066159A 80 01 00 01 00 01 1F 01 11009614 164550.001 070803 A 05 2 +0817
0066159B 00 01 00 01 00 01 01 0F 11009614 164550.001 070803 A 05 2 +0817
00661617 80 01 00 01 00 01 12 01 11009614 164550.001 070803 A 05 2 +0817
00661618 00 01 00 01 00 01 01 02 11009614 164550.001 070803 A 05 2 +0817
0066170F 80 01 00 01 00 01 0B 1B 11009614 164550.001 070803 A 05 2 +0817
00661796 80 01 00 01 00 01 0B 1B 11009614 164550.001 070803 A 05 2 +0817
0066181C 80 01 00 01 00 01 1B 01 11009614 164550.001 070803 A 05 2 +0817
0066181D 00 01 00 01 00 01 01 0B 11009614 164550.001 070803 A 05 2 +0817
0066190A 80 01 00 01 00 01 1A 01 11009614 164551.001 070803 A 03 2 -0162
0066190B 00 01 00 01 00 01 01 0A 11009614 164551.001 070803 A 03 2 -0162
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00661A12 80 01 00 01 00 01 00 10 11009614 164551.001 070803 A 03 2 -0162
00661A9F 80 01 00 01 00 01 0A 1A 11009614 164551.001 070803 A 03 2 -0162
00661B8C 80 01 00 01 00 01 02 12 11009614 164551.001 070803 A 03 2 -0162
00661C17 80 01 00 01 00 01 1B 01 11009614 164551.001 070803 A 03 2 -0162
00661C18 00 01 00 01 00 01 01 0A 11009614 164551.001 070803 A 03 2 -0162
00661CE3 80 01 00 01 00 01 1F 01 11009614 164551.001 070803 A 03 2 -0162
00661CE4 00 01 00 01 00 01 01 0F 11009614 164551.001 070803 A 03 2 -0162
00661D96 80 01 00 01 00 01 01 11 11009614 164551.001 070803 A 03 2 -0162
00661E9B 80 01 00 01 00 01 02 12 11009614 164551.001 070803 A 03 2 -0162
00661F6A 80 01 00 01 00 01 09 19 11009614 164551.001 070803 A 03 2 -0162
00666019 80 01 00 01 00 01 00 0F 11009614 164551.001 070803 A 03 2 -0162
00666096 80 01 00 01 00 01 1E 01 11009614 164551.001 070803 A 03 2 -0162
00666097 00 01 00 01 00 01 01 0D 11009614 164551.001 070803 A 03 2 -0162
00666098 00 01 00 01 00 01 02 12 11009614 164551.001 070803 A 03 2 -0162
0066618B 80 01 00 01 00 01 0E 1E 11009614 164551.001 070803 A 03 2 -0162
00666216 80 01 00 01 00 01 05 15 137C9E86 164551.001 070803 A 03 2 +0838
0066631A 80 01 00 01 00 01 08 18 137C9E86 164551.001 070803 A 03 2 +0838
0066631B 00 01 00 01 00 01 0D 1D 137C9E86 164551.001 070803 A 03 2 +0838
006663E0 80 01 00 01 00 01 0E 1E 137C9E86 164551.001 070803 A 03 2 +0838
006663E1 00 01 00 01 00 01 12 01 137C9E86 164551.001 070803 A 03 2 +0838
006663E2 00 01 00 01 00 01 01 02 137C9E86 164551.001 070803 A 03 2 +0838
00666483 80 01 00 01 00 01 0F 1F 137C9E86 164551.001 070803 A 03 2 +0838
00666564 80 01 00 01 00 01 1A 01 137C9E86 164551.001 070803 A 03 2 +0838
00666565 00 01 00 01 00 01 01 0A 137C9E86 164552.001 070803 A 03 2 -0150
0066660E 80 01 00 01 00 01 16 01 137C9E86 164552.001 070803 A 03 2 -0150
0066660F 00 01 00 01 00 01 01 06 137C9E86 164552.001 070803 A 03 2 -0150
006666F7 80 01 00 01 00 01 16 01 137C9E86 164552.001 070803 A 03 2 -0150
006666F8 00 01 00 01 00 01 1C 06 137C9E86 164552.001 070803 A 03 2 -0150
006666F9 00 01 00 01 00 01 01 0B 137C9E86 164552.001 070803 A 03 2 -0150
0066678D 80 01 00 01 00 01 12 01 137C9E86 164552.001 070803 A 03 2 -0150
0066678E 00 01 00 01 00 01 01 02 137C9E86 164552.001 070803 A 03 2 -0150
00666887 80 01 00 01 00 01 1E 01 137C9E86 164552.001 070803 A 03 2 -0150
00666888 00 01 00 01 00 01 01 0E 137C9E86 164552.001 070803 A 03 2 -0150
00666889 00 01 00 01 00 01 02 12 137C9E86 164552.001 070803 A 03 2 -0150
00666912 80 01 00 01 00 01 1D 01 137C9E86 164552.001 070803 A 03 2 -0150
00666913 00 01 00 01 00 01 01 0C 137C9E86 164552.001 070803 A 03 2 -0150
00666A04 80 01 00 01 00 01 06 16 137C9E86 164552.001 070803 A 03 2 -0150
00666A80 80 01 00 01 00 01 04 14 137C9E86 164552.001 070803 A 03 2 -0150
00666B18 80 01 00 01 00 01 19 01 137C9E86 164552.001 070803 A 03 2 -0150
00666B19 00 01 00 01 00 01 01 09 137C9E86 164552.001 070803 A 03 2 -0150
00666C05 80 01 00 01 00 01 17 01 137C9E86 164552.001 070803 A 03 2 -0150
00666C06 00 01 00 01 00 01 1C 07 15F86697 164552.001 070803 A 03 A +0849
00666C07 00 01 00 01 00 01 01 0B 15F86697 164552.001 070803 A 03 A +0849
00666CE0 80 01 00 01 00 01 08 18 15F86697 164552.001 070803 A 03 A +0849
00666DE5 80 01 00 01 00 01 0F 1F 15F86697 164552.001 070803 A 03 A +0849
00666E88 80 01 00 01 00 01 16 01 15F86697 164552.001 070803 A 03 A +0849
00666E89 00 01 00 01 00 01 01 06 15F86697 164552.001 070803 A 03 A +0849
00666F7E 80 01 00 01 00 01 1E 01 15F86697 164552.001 070803 A 03 A +0849
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00666F7F 00 01 00 01 00 01 01 0E 15F86697 164552.001 070803 A 03 A +0849
00666F80 00 01 00 01 00 01 03 12 15F86697 164553.001 070803 A 03 A -0149
00667012 80 01 00 01 00 01 0A 1A 15F86697 164553.001 070803 A 03 A -0149
00667013 00 01 00 01 00 01 0F 1F 15F86697 164553.001 070803 A 03 A -0149
00667104 80 01 00 01 00 01 1C 01 15F86697 164553.001 070803 A 03 A -0149
00667105 00 01 00 01 00 01 01 0C 15F86697 164553.001 070803 A 03 A -0149
006671EF 80 01 00 01 00 01 0A 1A 15F86697 164553.001 070803 A 03 A -0149
006671F0 00 01 00 01 00 01 0E 1E 15F86697 164553.001 070803 A 03 A -0149
0066728E 80 01 00 01 00 01 12 01 15F86697 164553.001 070803 A 03 A -0149
0066728F 00 01 00 01 00 01 16 02 15F86697 164553.001 070803 A 03 A -0149
00667290 00 01 00 01 00 01 01 06 15F86697 164553.001 070803 A 03 A -0149
0066738B 80 01 00 01 00 01 06 16 15F86697 164553.001 070803 A 03 A -0149
00667496 80 01 00 01 00 01 12 01 15F86697 164553.001 070803 A 03 A -0149
00667497 00 01 00 01 00 01 16 02 15F86697 164553.001 070803 A 03 A -0149
00667498 00 01 00 01 00 01 01 05 15F86697 164553.001 070803 A 03 A -0149
00667590 80 01 00 01 00 01 09 19 15F86697 164553.001 070803 A 03 A -0149
00667698 80 01 00 01 00 01 0C 1B 15F86697 164553.001 070803 A 03 A -0149
00667699 00 01 00 01 00 01 10 1F 15F86697 164553.001 070803 A 03 A -0149
00667794 80 01 00 01 00 01 0C 1C 15F86697 164553.001 070803 A 03 B -0149
00667795 00 01 00 01 00 01 11 01 18740F10 164553.001 070803 A 03 A +0850
00667796 00 01 00 01 00 01 01 00 18740F10 164553.001 070803 A 03 A +0850
00667869 80 01 00 01 00 01 1E 01 18740F10 164553.001 070803 A 03 A +0850
0066786A 00 01 00 01 00 01 01 0E 18740F10 164553.001 070803 A 03 A +0850
0066798A 80 01 00 01 00 01 0F 1F 18740F10 164553.001 070803 A 03 A +0850
0066798B 00 01 00 01 00 01 13 01 18740F10 164553.001 070803 A 03 A +0850
0066798C 00 01 00 01 00 01 01 03 18740F10 164553.001 070803 A 03 A +0850

This event is still peculiar but will form the basis for a string
which is ok.
021A041C 80 01 00 01 00 01 11 01 18740F10 164554.000 070803 A 03 A -0150
021A041D 00 01 00 01 00 01 01 00 18740F10 164554.000 070803 A 03 A -0150

0495EC91 80 01 00 01 00 01 10 01 18740F10 164554.000 070803 A 03 A -0150
0495EC92 00 01 00 01 00 01 01 00 18740F10 164554.000 070803 A 03 A -0150

071194E2 80 01 00 01 00 01 08 17 18740F10 164554.000 070803 A 03 A -0150

098D7D12 80 01 00 01 00 01 15 01 18740F10 164554.000 070803 A 03 A -0150
098D7D13 00 01 00 01 00 01 01 05 18740F10 164554.000 070803 A 03 A -0150

0C090587 80 01 00 01 00 01 11 01 18740F10 164554.000 070803 A 03 A -0150
0C090588 00 01 00 01 00 01 01 01 18740F10 164554.000 070803 A 03 A -0150

0E850D98 80 01 00 01 00 01 02 11 18740F10 164554.000 070803 A 03 A -0150

11009608 80 01 00 01 00 01 10 01 18740F10 164554.000 070803 A 03 A -0150
11009609 00 01 00 01 00 01 01 00 18740F10 164554.000 070803 A 03 A -0150
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137C9E7D 80 01 00 01 00 01 09 19 18740F10 164554.000 070803 A 03 A -0150

15F8668D 80 01 00 01 00 01 18 01 18740F10 164554.000 070803 A 03 A -0150
15F8668E 00 01 00 01 00 01 01 07 18740F10 164554.000 070803 A 03 A -0150

18740F1D 80 01 00 01 00 01 1F 01 18740F10 164554.000 070803 A 03 A -0150
18740F1E 00 01 00 01 00 01 01 0E 18740F10 164554.000 070803 A 03 8 -0150
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Now we pick up regularly again, after these 9 events.

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1AEFF772 80 01 00 01 00 01 1D 01 1AEFF782 164554.000 070803 A 03 2 +0849
1AEFF773 00 01 00 01 00 01 01 0D 1AEFF782 164554.000 070803 A 03 0 +0849

1D6B9F83 80 01 00 01 00 01 05 14 1D6B9F94 164555.000 070803 A 03 0 +0850

1FE78813 80 01 00 01 00 01 0F 1F 1FE78805 164556.000 070803 A 03 0 +0850

02631068 80 01 00 01 00 01 06 15 02631076 164557.000 070803 A 05 8 +0845
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Here again a negative correction gives an apparent problem in the sequence.

```
96090306 80 01 00 01 00 01 1F 01 96090300 171359.918 070803 A 03 A +0936
96090307 00 01 00 01 00 01 01 0E 96090300 171359.918 070803 A 03 8 +0936

98850B1C 80 01 00 01 00 01 1B 01 98850B13 171400.918 070803 A 03 2 +0945
98850B1D 00 01 00 01 00 01 01 0A 98850B13 171400.918 070803 A 03 0 +0945

9B00938D 80 01 00 01 00 01 1E 01 98850B13 171401.918 070803 A 03 2 -0053
9B00938E 00 01 00 01 00 01 01 0E 98850B13 171401.918 070803 A 03 0 -0053

9D9C9BFF 80 01 00 01 00 01 0F 1E 9D9C9BF8 171402.918 070803 A 03 8 +0947

80186410 80 01 00 01 00 01 16 01 8018640A 171403.917 070803 A 03 A +0947
80186411 00 01 00 01 00 01 01 06 8018640A 171403.917 070803 A 03 8 +0947
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again, problem...?

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787A9394 80 01 00 01 00 01 1F 01 787A9396 173424.858 070803 V 00 2 +1110
787A9395 00 01 00 01 00 01 01 0E 787A9396 173424.858 070803 V 00 0 +1110

7AF69C06 80 01 00 01 00 01 12 01 7AF69C09 173425.858 070803 V 00 2 +1107
7AF69C07 00 01 00 01 00 01 01 02 7AF69C09 173425.858 070803 V 00 0 +1107

7D726478 80 01 00 01 00 01 01 10 7D050110 173426.858 070803 V 00 8 +1033

7FEE0C8A 80 01 00 01 00 01 04 14 7D050110 173426.858 070803 V 00 8 +1033

8269F51B 80 01 00 01 00 01 11 01 7D050110 173428.000 070803 V 00 A -1439
```

```
8269F51C 00 01 00 01 00 01 01 01 7D050110 173428.000 070803 V 00 8 -1439

84E59D71 80 01 00 01 00 01 1B 01 7D050110 173428.999 070803 V 00 A -2439
84E59D72 00 01 00 01 00 01 01 0B 7D050110 173428.999 070803 V 00 8 -2439

87618583 80 01 00 01 00 01 11 01 7D050110 173429.999 070803 V 00 A -3441
87618584 00 01 00 01 00 01 01 01 7D050110 173429.999 070803 V 00 8 -3441

899D0E15 80 01 00 01 00 01 0B 1B 7D050110 173430.999 070803 V 00 8 -4518

8C191666 80 01 00 01 00 01 1D 01 7D050110 173431.999 070803 V 00 A -5451
8C191667 00 01 00 01 00 01 01 0D 7D050110 173431.999 070803 V 00 8 -5451

8E949E98 80 01 00 01 00 01 09 19 8D1C818B 173432.999 070803 V 00 8 -0020

91108709 80 01 00 01 00 01 17 01 8F9869FE 173433.999 070803 V 00 A -0024
9110870A 00 01 00 01 00 01 01 06 8F9869FE 173433.999 070803 V 00 8 -0024

938C6F1B 80 01 00 01 00 01 02 12 92141210 173436.357 070803 V 00 0 -0371

9608178C 80 01 00 01 00 01 1A 01 96081785 173437.357 070803 V 00 A +0619
9608178D 00 01 00 01 00 01 01 09 96081785 173437.357 070803 V 00 8 +0619

new problem?

75868A01 80 01 00 01 00 01 12 01 75869FED 180010.282 070803 V 00 2 +0689
75868A02 00 01 00 01 00 01 01 02 75869FED 180010.282 070803 V 00 0 +0689

78029213 80 01 00 01 00 01 12 01 78026803 180011.282 070803 V 00 A +0685
78029214 00 01 00 01 00 01 01 02 78026803 180011.282 070803 V 00 8 +0685

7A7E1A85 80 01 00 01 00 01 18 01 78026803 180011.282 070803 V 00 A +0685
7A7E1A86 00 01 00 01 00 01 01 08 78026803 180011.282 070803 V 00 8 +0685

7CFA02F8 80 01 00 01 00 01 00 0F 78026803 180012.000 070803 V 00 8 -1793

7F75EB09 80 01 00 01 00 01 1C 01 78026803 180012.999 070803 V 00 A -2793
7F75EB0A 00 01 00 01 00 01 01 0B 78026803 180012.999 070803 V 00 8 -2793

81F1939C 80 01 00 01 00 01 06 15 78026803 180013.999 070803 V 00 8 -3793

846D7BEE 80 01 00 01 00 01 09 18 78026803 180013.999 070803 V 00 8 -3793

86E90400 80 01 00 01 00 01 08 18 78026803 180015.999 070803 V 00 8 -5805

89650C92 80 01 00 01 00 01 09 19 889A9C1B 180015.999 070803 V 00 8 +0979

8BE094E3 80 01 00 01 00 01 1C 01 8BE09517 180019.782 070803 V 00 A +0190
```

```
8BE094E4 00 01 00 01 00 01 01 0C 8BE09517 180019.782 070803 V 00 8 +0190

8E1C9D16 80 01 00 01 00 01 04 14 8E1C7587 180020.782 070803 V 00 8 +0193

90986587 80 01 00 01 00 01 1A 01 90981D9B 180021.782 070803 V 00 A +0193
90986588 00 01 00 01 00 01 01 09 90981D9B 180021.782 070803 V 00 8 +0193
```

now problem again.

```
0C170C0F 80 01 00 01 00 01 0F 1E 0C170C08 181338.742 070803 A 03 0 +0159

0E929481 80 01 00 01 00 01 02 11 0E92949A 181338.742 070803 A 03 0 +1160

110E9CF2 80 01 00 01 00 01 1E 01 110E9CEC 181340.742 070803 A 03 6 +1159
110E9CF3 00 01 00 01 00 01 01 0E 110E9CEC 181340.742 070803 A 03 0 +0159

138A6504 80 01 00 01 00 01 13 01 138A651E 181340.742 070803 A 03 A +1159
138A6505 00 01 00 01 00 01 01 02 138A651E 181341.742 070803 A 03 8 +0158

16060D96 80 01 00 01 00 01 06 16 16060D8F 181341.742 070803 A 03 8 +1158

1881F5E8 80 01 00 01 00 01 00 0F 1881F5E1 181342.742 070803 A 03 0 +1159

1B1D9E19 80 01 00 01 00 01 11 01 1B1D9E13 181344.742 070803 A 03 E +1159
1B1D9E1A 00 01 00 01 00 01 01 01 1B1D9E13 181344.742 070803 A 03 8 +0159

1D99868B 80 01 00 01 00 01 08 18 1D998685 181345.742 070803 A 03 8 +0159

60150E9C 80 01 00 01 00 01 14 01 60150E97 181346.742 070803 A 03 A +0159
60150E9D 00 01 00 01 00 01 01 03 60150E97 181346.742 070803 A 03 8 +0159

6291170E 80 01 00 01 00 01 06 15 62911707 181346.742 070803 A 03 8 +1159

650C9F7F 80 01 00 01 00 01 1D 01 650C9F79 181348.742 070803 A 03 2 +0178
650C9F80 00 01 00 01 00 01 01 0C 650C9F79 181348.742 070803 A 03 0 +0178

67888791 80 01 00 01 00 01 18 01 6788878B 181349.742 070803 A 03 E +1179

67888792 00 01 00 01 00 01 01 07 6788878B 181349.742 070803 A 03 8 +0159

6A047003 80 01 00 01 00 01 0A 19 6A04701C 181350.742 070803 A 03 C +1159

6C801874 80 01 00 01 00 01 1F 01 6C80186E 181351.742 070803 A 03 2 +0160
6C801875 00 01 00 01 00 01 01 0E 6C80186E 181351.742 070803 A 03 0 +0160

6EFC0086 80 01 00 01 00 01 1A 01 6EFC0080 181352.742 070803 A 03 A +0159
6EFC0087 00 01 00 01 00 01 01 0A 6EFC0080 181352.742 070803 A 03 8 +0159
```

```
71778918 80 01 00 01 00 01 05 14 71778912 181352.742 070803 A 03 8 +1160

73F39169 80 01 00 01 00 01 1A 01 73F39164 181354.742 070803 A 03 2 +0159
73F3916A 00 01 00 01 00 01 01 0A 73F39164 181354.742 070803 A 03 0 +0159

766F199B 80 01 00 01 00 01 06 15 766F1994 181355.742 070803 A 03 0 +0159

78EB020C 80 01 00 01 00 01 18 01 78EB0206 181356.741 070803 A 03 A +0159
78EB020D 00 01 00 01 00 01 01 07 78EB0206 181356.741 070803 A 03 8 +0159

7B66EA1E 80 01 00 01 00 01 06 15 7B66EA18 181357.741 070803 A 03 8 +0159

7DE29290 80 01 00 01 00 01 00 0F 7DE29289 181358.741 070803 A 03 0 +0159

801E7B01 80 01 00 01 00 01 01 10 801E7AFA 181359.741 070803 A 03 C +1160

829A0312 80 01 00 01 00 01 1D 01 829A030C 181400.741 070803 A 03 A +0160
829A0313 00 01 00 01 00 01 01 0D 829A030C 181400.741 070803 A 03 8 +0160

85160B84 80 01 00 01 00 01 00 10 85160B9E 181401.741 070803 A 03 0 +0160


temporary fnal glitch below. (from corrections)

6896059C 80 01 00 01 00 01 17 01 6896058A 182407.712 070803 A 04 2 +1142
6896059D 00 01 00 01 00 01 01 07 6896058A 182408.712 070803 A 04 0 +0142

6B118E13 80 01 00 01 00 01 1F 01 6B118E1C 182409.711 070803 A 04 E +1142
6B118E14 00 01 00 01 00 01 01 0E 6B118E1C 182409.711 070803 A 03 8 +0160

6D8D9666 80 01 00 01 00 01 10 01 6D8D966E 182410.711 070803 A 03 2 +0171
6D8D9667 00 01 00 01 00 01 01 00 6D8D966E 182410.711 070803 A 03 0 +0171

70091E98 80 01 00 01 00 01 1C 01 70091E80 182411.711 070803 A 03 A +0170

now continues normally to end.
```

9.1 Appendix B:Instructions to run small Fortran program

1. Make a file on the NAL GPS computer.
2. Transfer it to the cosray/coswork/2003/fermilab directory on kaon. (use commands mdir, mcopy,mdelete to mimic dos commands)
3. edit testGPS.for (or other small Fortran program) to achieve aims of this analysis
4. edit inputfnal file to give events desired

5. clgcern testGPS ¿ testGPS.log to run the job

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