

RHIC BPM SYSTEM APEX WORKSHOP 2009

Rob Hulsart, P. Cerniglia, J. DeCicco, C. Degen,
R. Michnoff, M. Minty, R. Olsen, T. Satogata

November 12 – 13 2009

New Features

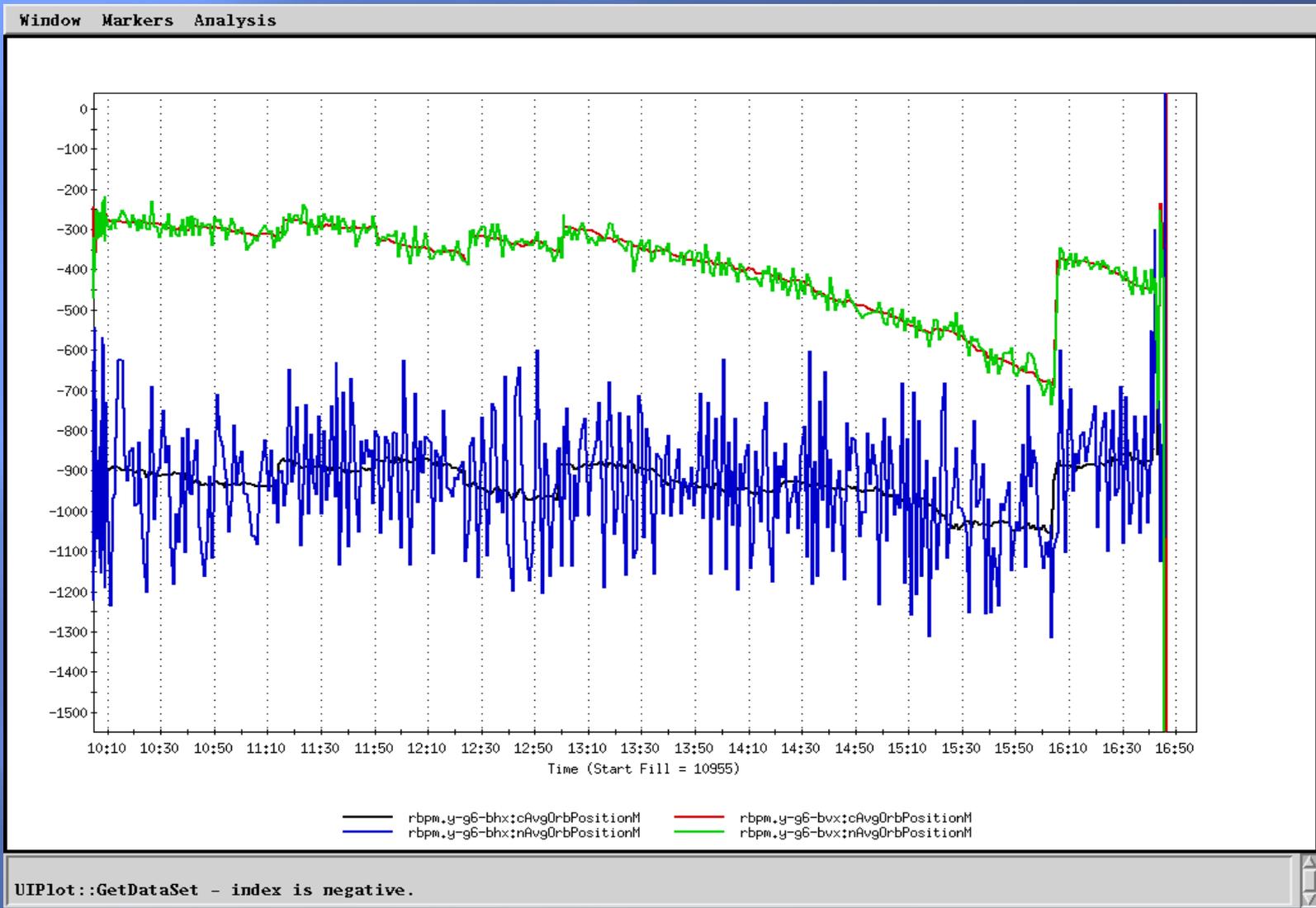
- ▣ Continuous Average Orbit Position
 - ▣ Data Integrity and Correlation
 - ▣ Million Turn Measurement
 - ▣ Fixed-Trigger Timing Mode
 - ▣ System Reliability Upgrades
-
- ▣ 17 Versions of DSP code from Dec. 08' to June 09'
 - ▣ Loaded all 722 IFE modules each time!



Continuous Average Orbit

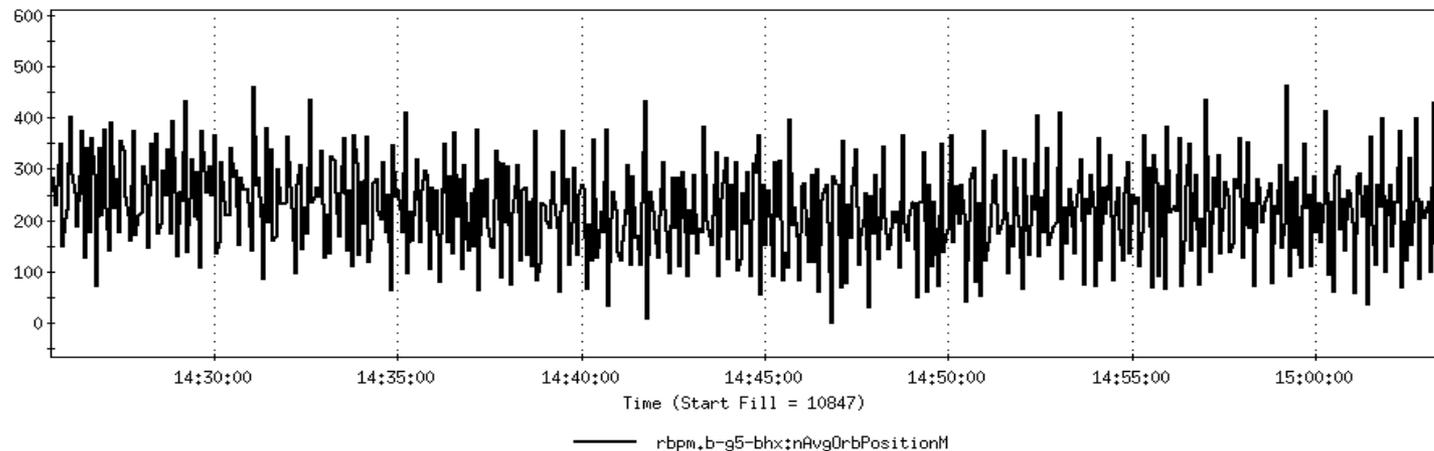
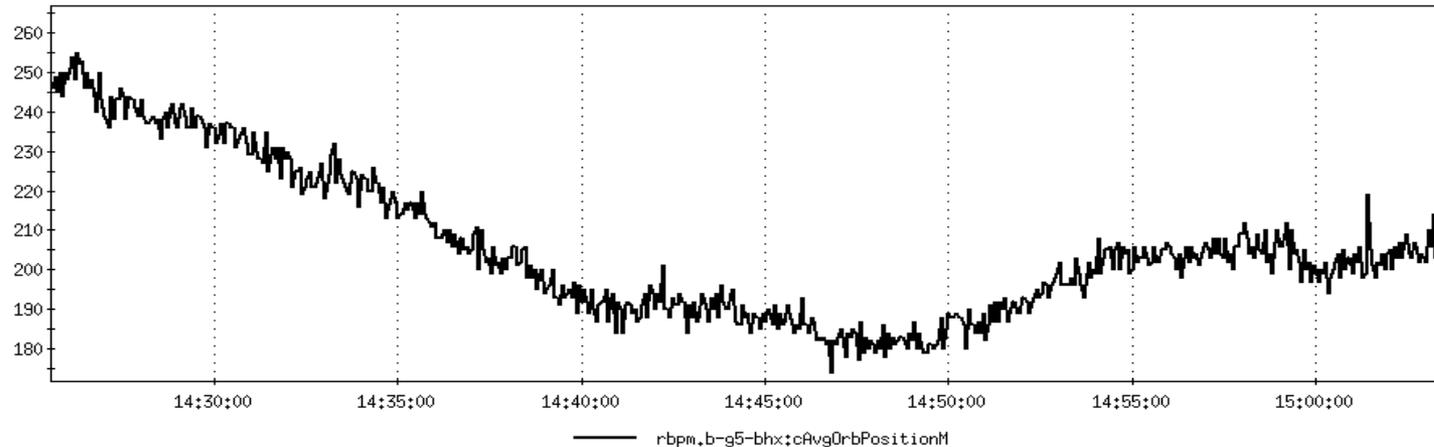
- ▣ First test with beam in Run9
- ▣ DSP is capable of processing every 6th turn
- ▣ Comparison with n-turn average shows about an order of magnitude less noise
- ▣ Filter divide factor chosen as compromise between noise and step-response ($2^{13} = 8192$)
- ▣ Longer period / small amplitude position changes can now be seen

Fill 10955 (6/19) y-g6-bhx/bvx



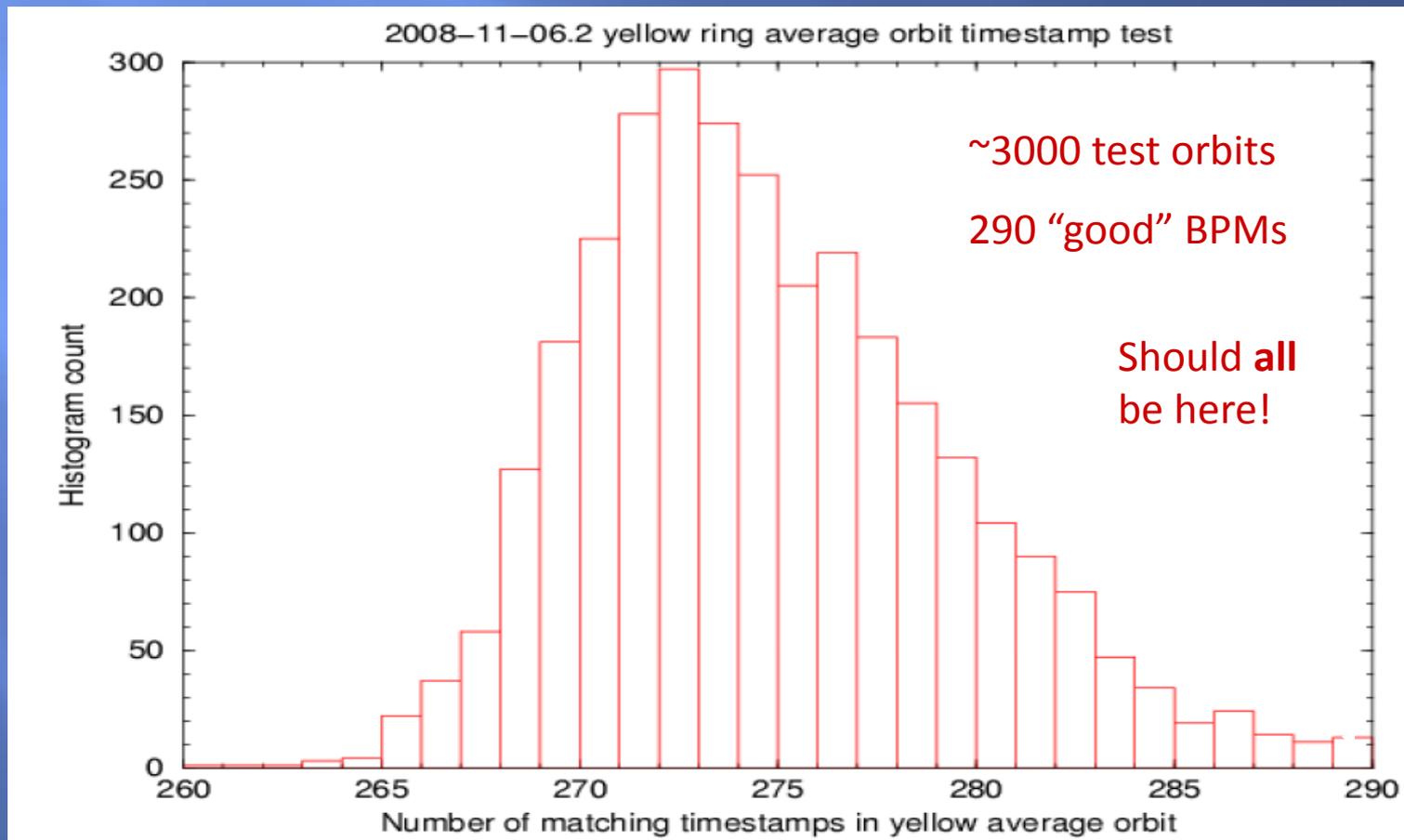
300 μm pk-pk n-turn vs. 10 μm cAvg

Window Markers Analysis



From Todd's Presentation 11/17/2008

- Discovered while investigating gaps in ORM
BPM timestamps used for correlation are sometimes wrong
BPM system timestamps: unix "slow" time + turn count "fast" time



Data Correlation and Integrity: Timestamp Issues

- ▣ RTDL + 78KHz fast timestamps on delivered data
- ▣ There have been many causes of timestamp errors:
 - Missing pullup resistor on interrupt line - 'extra triggers'
 - Race conditions between ADO and DSP handling of RTDL
 - Fire wire bus transmission errors and dropped data
- ▣ Before startup, script-driven testing showed success

- ▣ Early in Run9 data was still getting dropped
 - A lengthy investigation found bugs in DSP code that caused data corruption - only when a 1s. status update coincided with events

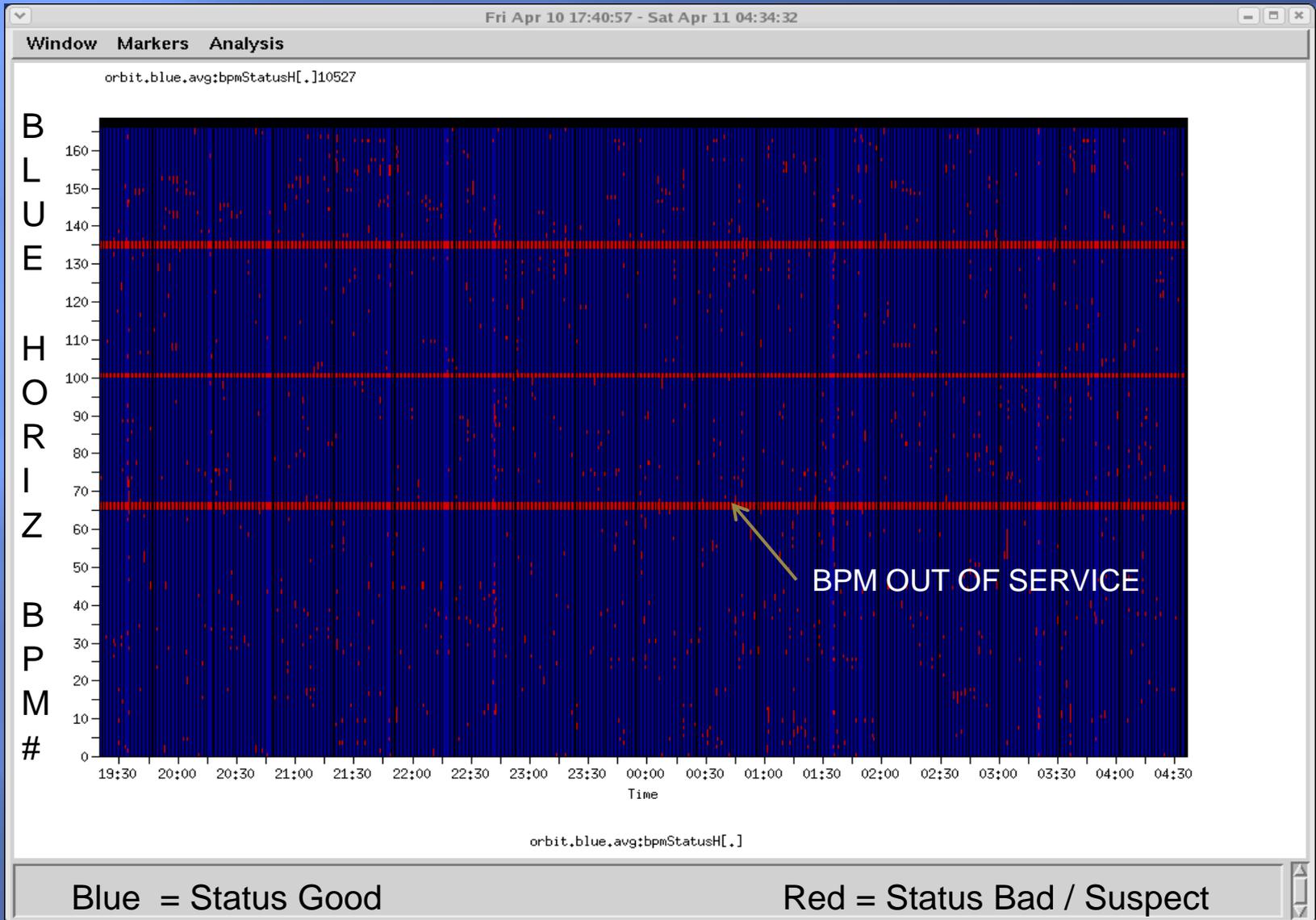
- ▣ By the end of May timestamp issues were resolved

Data Correlation and Integrity: Status Bits and Auto-Gain

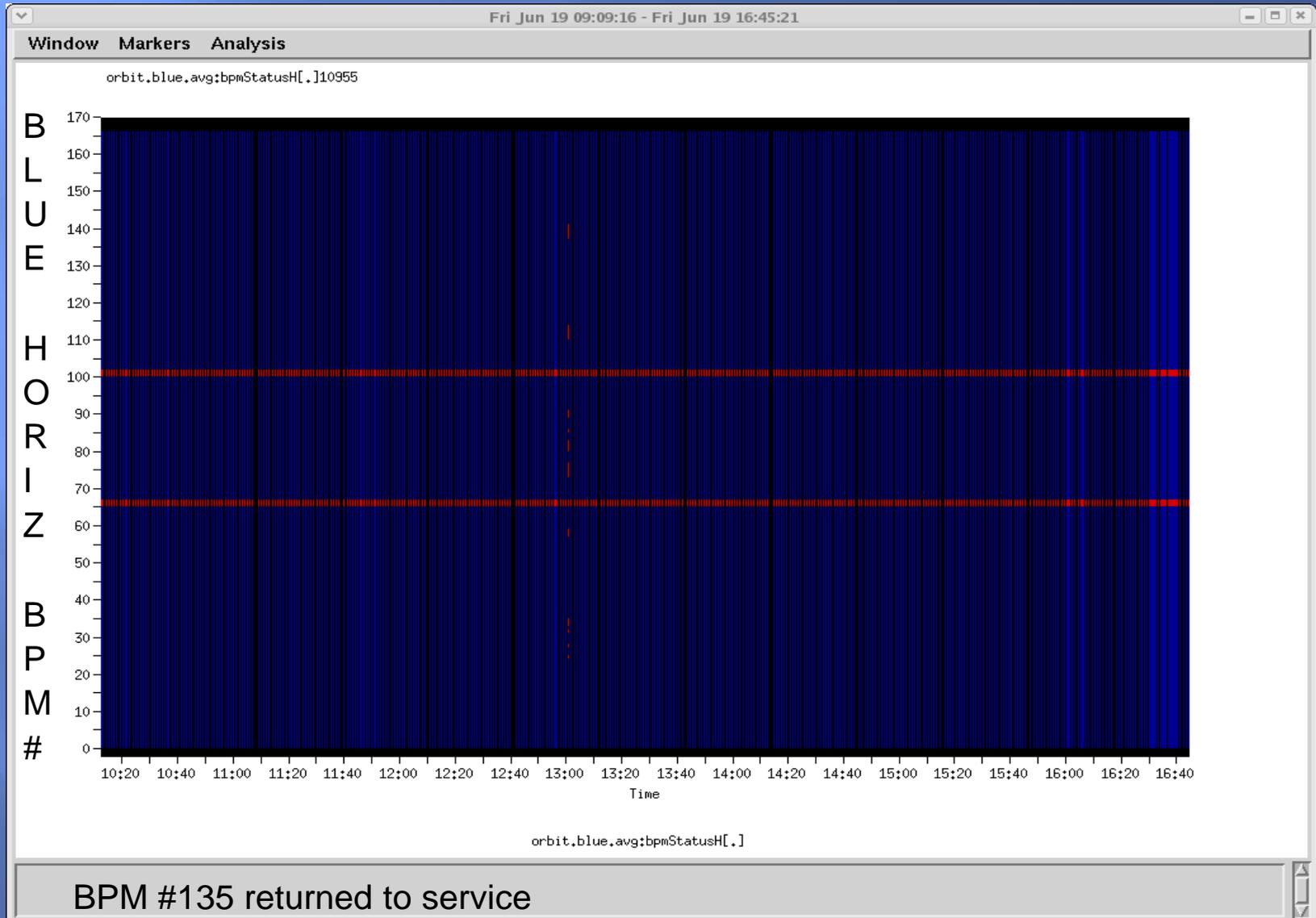
- ▣ New status bits on data also caused data drops
- ▣ This worked as expected, raw counts were too low or saturated high, setting the error bits
- ▣ Manager then drops BPM data

- ▣ Only 2 gain modes on IFE – x1 and x10
 - As intensity drops we need to increase gain
- ▣ Rob M. and Todd S. implemented auto-gain switching in the ADO to solve this problem

April 10-11 2009 / Fill 10527



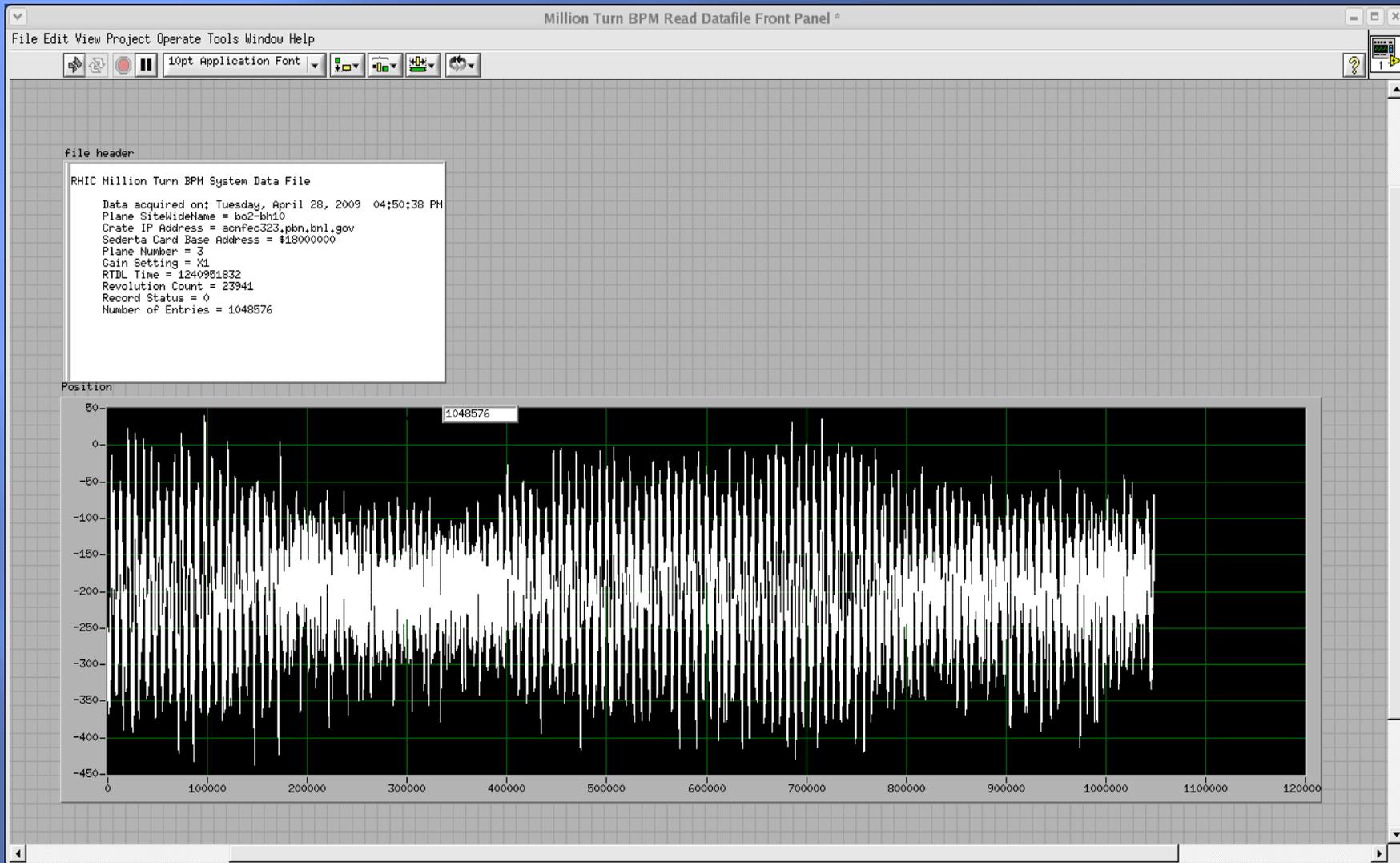
June 19 2009 / Fill 10955



Million Turn Mode

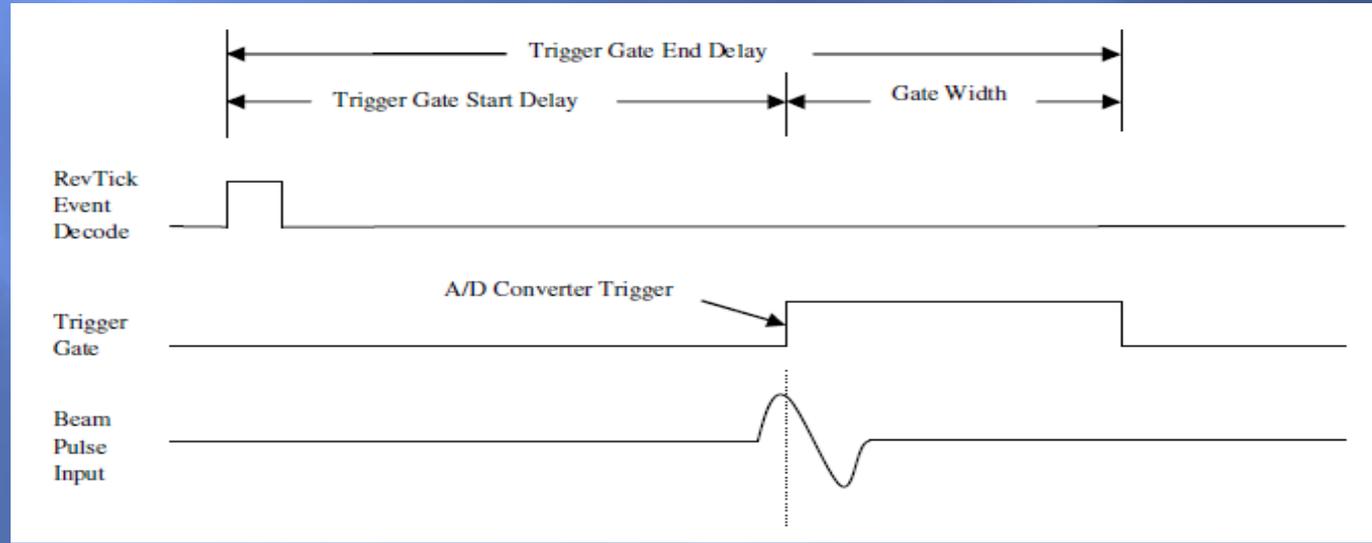
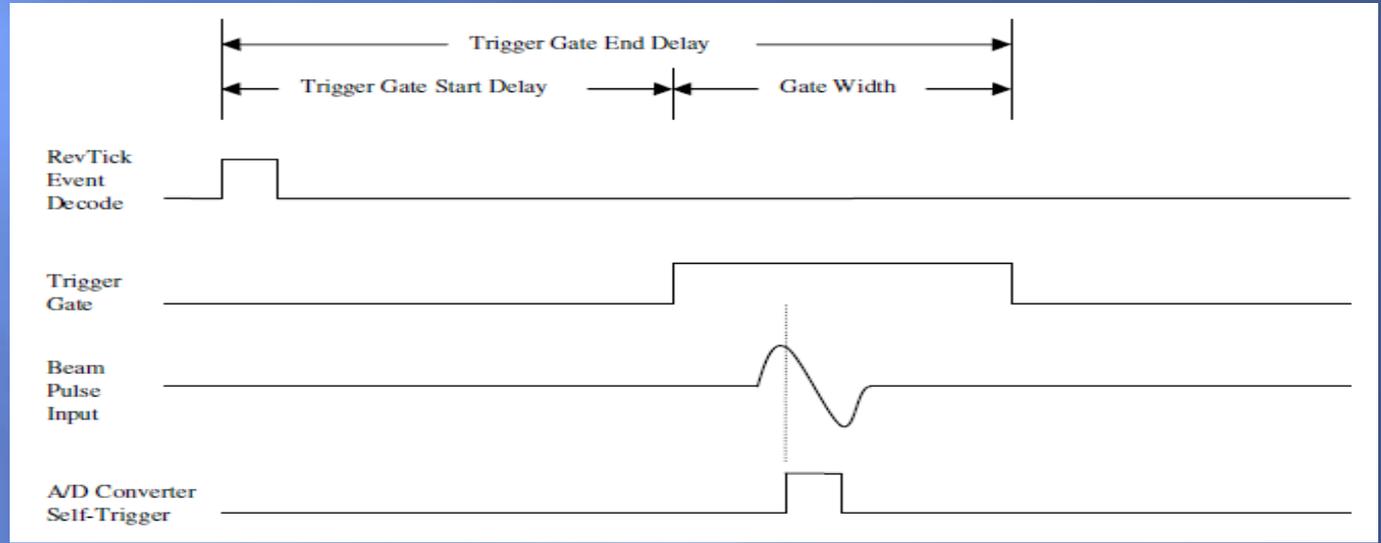
- ▣ 8 BPM Planes have this capability (32MB RAM)
 - Blue at 2:00 (2H/2V) and Yellow at 7:00 (2H/2V)
- ▣ MTM version of DSP code was out of date (06')
- ▣ New code allows normal operation and MTM
 - MTM beam sync event triggers acquisition
 - 64K - 1M+ Turns can be stored
 - The DSP waits (forever) for the VI on MTM event
 - An on/off switch on the pet page disables this wait

1M Turn Acquisition bo2-bh10



Self vs. Fixed Trigger Timing

Self
Trigger
Mode



Fixed
Trigger
Mode

Fixed Trigger Challenges

- ▣ Self trigger is problematic with dynamic beam
- ▣ Fixed trigger is more accurate but trigger point needs to be manually configured
- ▣ Todd S. wrote script to do this at high-level with some success in Run9 – still lots of manual work for 722 BPM's
- ▣ AFT mode has been added to DSP code to automate this process for Run10 – hopefully we will have a 'pushbutton' solution

Automatic Fixed Timing in DSP

Temp A...

Page PPM Device Data Tools Buffer

Heartbeat		170
bucket	1	65522
triggerSource	3	3
triggerThreshold	1948	1948

	Timestamp	Position	Status
Avg	[1258051852 52788]		-4
Cavg			-4
tbt	[1258083940 46843]	[-21 -8 -10 -1 24. [1026 1026 1026 1	
Profile		[-58 -58 -59 -60.. [0 0 0 0 0 0 0 0	
Cal		[]	[]

	BuffPtr	BuffPtrAtSync	BuffStart
Avg	0xc0000	0xc0000	0xc
tbt	0x4720	0x2710	0

	Geo Delay	picoDelayAtInj	picoDelay
Setting	11	84900	
Readback	11		8

(26,4) rbpm.919a-bpm1.0d7:picoDelayAtInjS

Thu Nov 12 22:45:15 2009: Get and Async requests complete.
Thu Nov 12 22:45:41 2009: Value sent for (26,4)

Stop

File PPM Setup Logging Diagnostics

Thu Nov 12 22:42:29 2009, cycle 1258083745

picoDelayAtInj = 50000

— rbpm.919a-bpm1.0d7;prof0rbBCorrM:value[*] — rbpm.919a-bpm1.0d7;prof0rbBCorrM:value[*]

tmp/rbpm.919a-bpm1.0d7.ado

Page PPM Device Data Tools Buffer Help

profileMaxValueM	16483
profileMaxIndexM	1
picoDelayFromProfileM	84900

(136,2) "text" Nudge: 0 366

entry ID specified
Thu Nov 12 22:45:15 2009: Get and Async requests complete.

Terminal

File Edit View Terminal Tabs Help

```
[1] + Done labview
acnuser01.pbn.bnl.gov 216:adoIf bsy-tbtstart triggerChannel
Trigger
adoIf bsy-tbtstart triggerChannel Trigger
adoIf bsy-tbtstart triggerChannel Trigger
acnuser01.pbn.bnl.gov 217:adoIf bsy-tbtstart triggerChannel Trigger
adoIf bsy-tbtstart triggerChannel Trigger
adoIf bsy-tbtstart triggerChannel Trigger
acnuser01.pbn.bnl.gov 218:[]
```

File PPM Setup Logging Diagnostics

Thu Nov 12 22:45:50 2009, cycle 1258083946

picoDelayAtInj = 84900

— rbpm.919a-bpm1.0d7;prof0rbBCorrM:value[*] — rbpm.919a-bpm1.0d7;prof0rbBCorrM:value[*]

System Integrity Upgrades

- ▣ AC Reset Fix – ‘sedertaHappyFlag’
 - Checks RTDL updates to see if they are reasonable
 - If RTDL difference is $>12s$, do not use received data
 - Wait until RTDL updates again, and recheck
- ▣ Spares – we had a few left coming out of Run9
 - Thanks to Joe D. we now have >40 spare IFE’s

System Integrity Upgrades

- ▣ Sederta Reset Upgrades
 - Majority of BPM 'hangs' are due to Sederta Card
 - These can sometimes be recovered from without rebooting the whole FEC, taking many more BPM's offline in the process
 - New tools for operations will be available

- ▣ Calibration
 - Efforts are ongoing to characterize the resolution and accuracy of the system, and how each IFE's calibration parameters can be optimized