

Status of Primex Beam Position Monitor

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The Beam Position Monitor (BPM) is used to determine the vertical and horizontal position of the incident photon beam downstream of the Hycal detector. It consists of 2 modules and a remote controlled table. Scintillating fibers transmit light through fiber optic cables, that light is then detected by 4, 16 channel R5600-M16 Hamamatsu PMT's. The internal electronics module consists of 64 channels of amplifier and a preset voltage discriminator. The Anode signals are converted to ECL outputs and analog signals are available through the dynode outputs. I analyzed both the ECL and analog outputs and will present my data below.

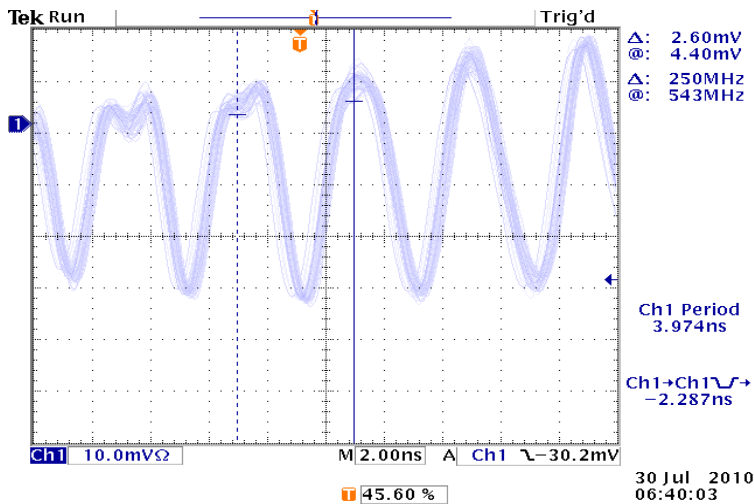
I will begin with the analog signals received on a 300 MHz digital oscilloscope.

Module 3

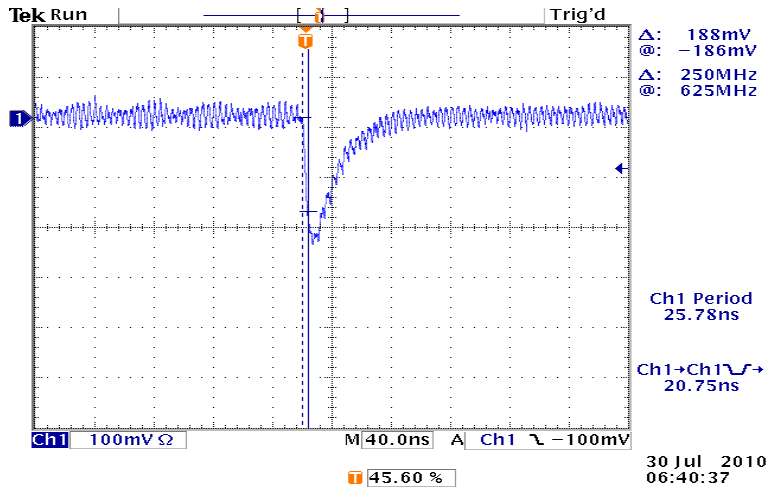
- Channel 1

~ 40 mV noise amplitude at 250 MHz

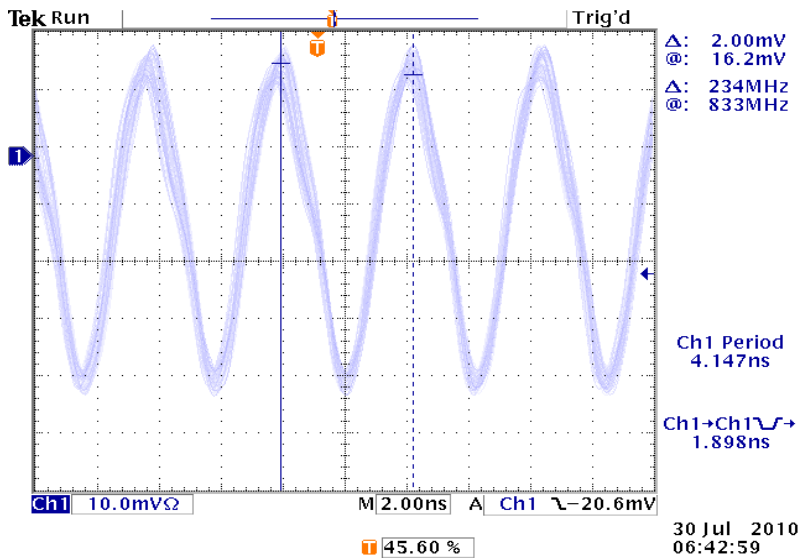
Possibly due to grounding issues within the electronics module



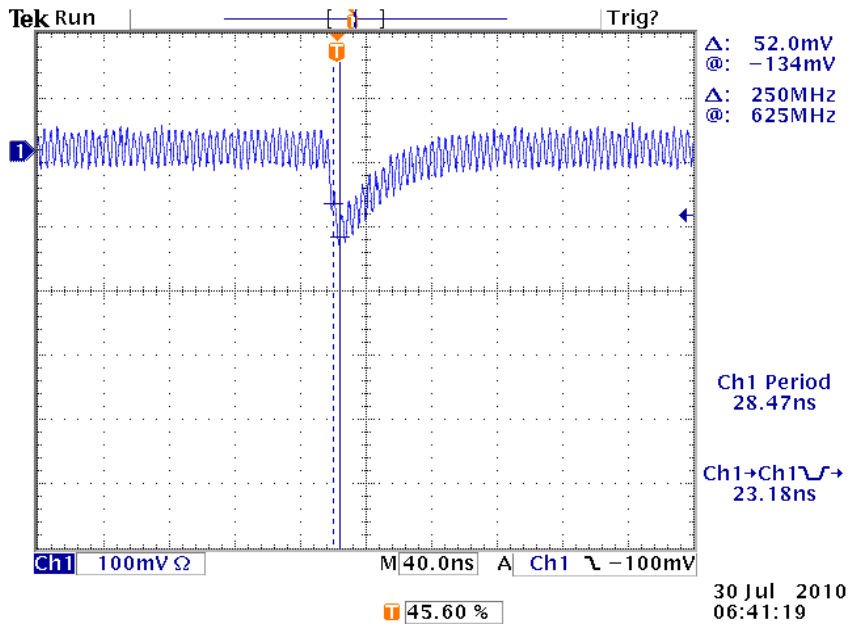
~200 mV pulse amplitude with a rise time of 20.75 ns.
Background noise is significant



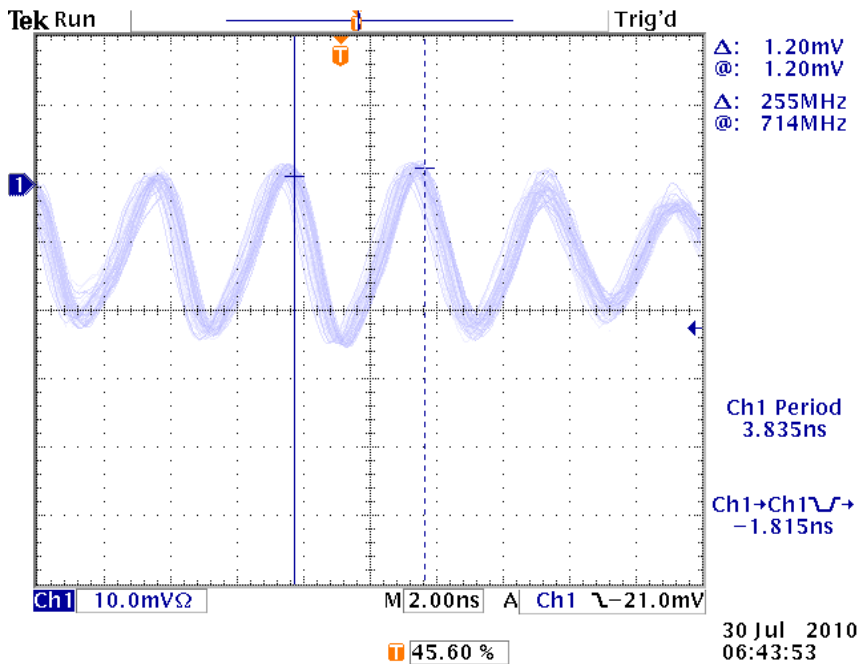
- Channel 2
~60 mV noise amplitude at 234 MHz



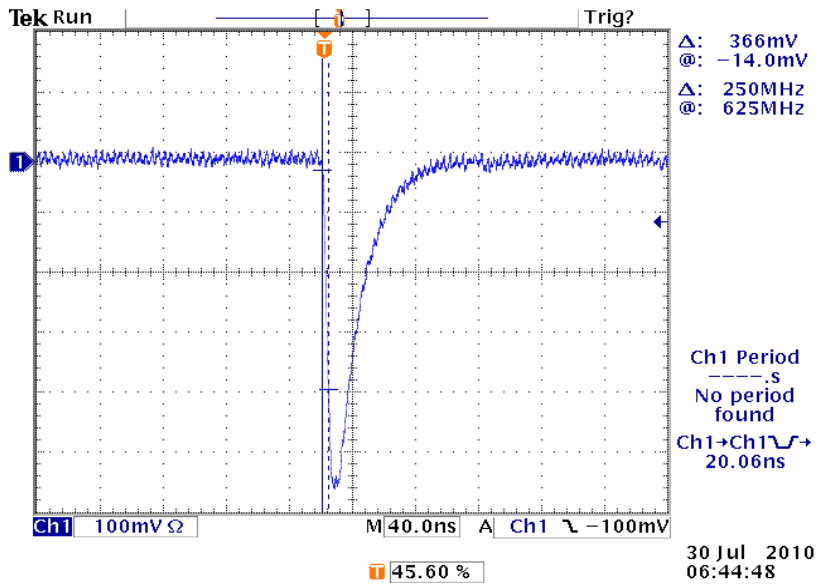
~140 mV pulse amplitude with a rise time of 23.18 ns
Background noise is significant



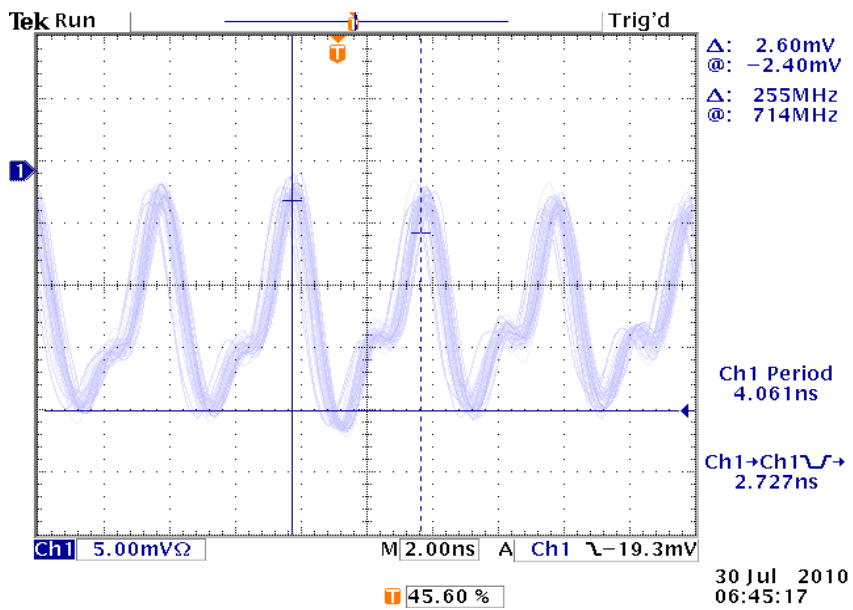
- Channel 3
~ 25 mV noise amplitude at 255 MHz



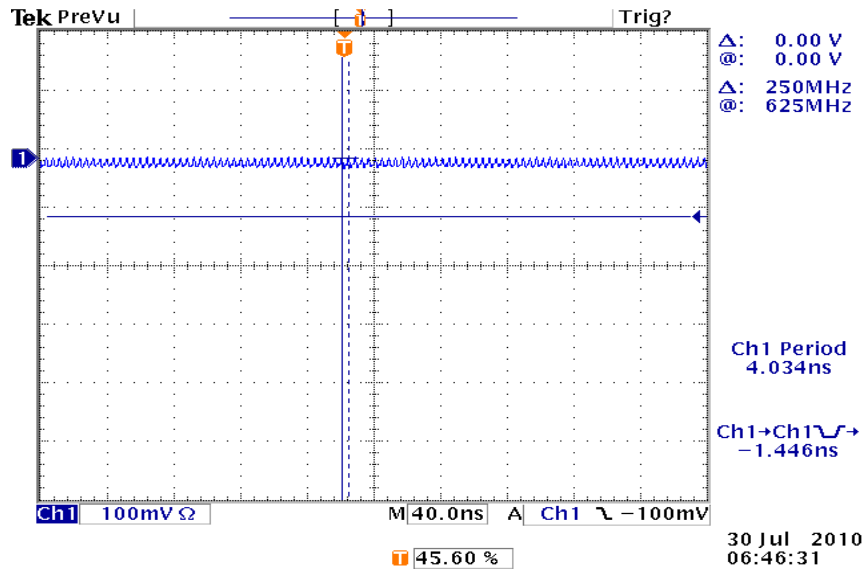
~550 mV pulse amplitude with a rise time of 20.06 ns
Background noise is significant



- Channel 4
~20 mV noise amplitude at 255 MHz

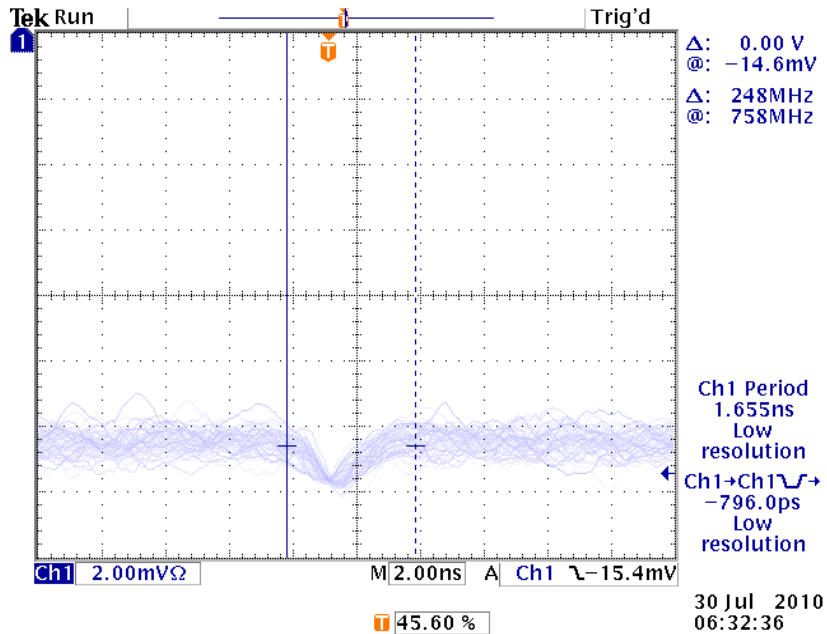


No pulse detected. Possibly a faulty PMT
Background noise significant

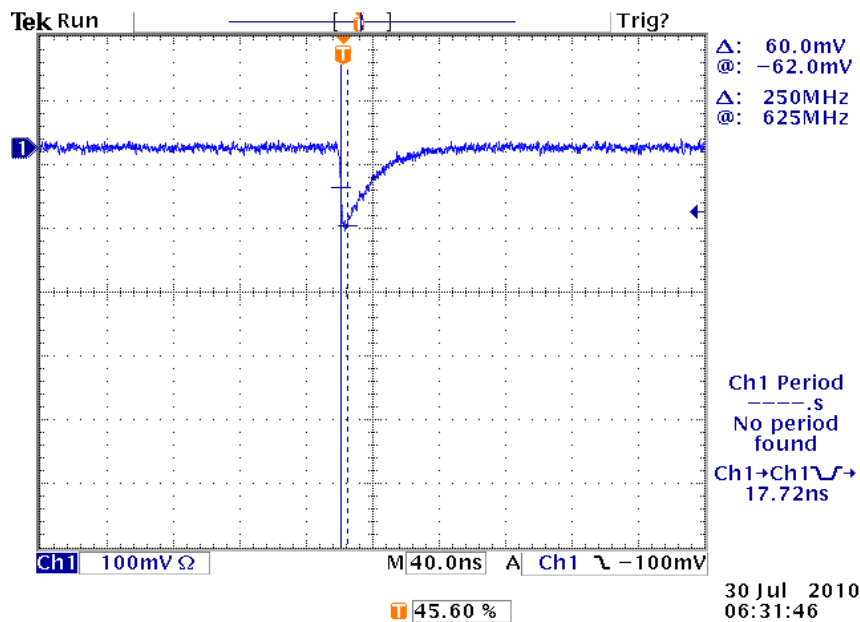


Module 4

- Channels 1 through 4 have similar signals
Clean signal



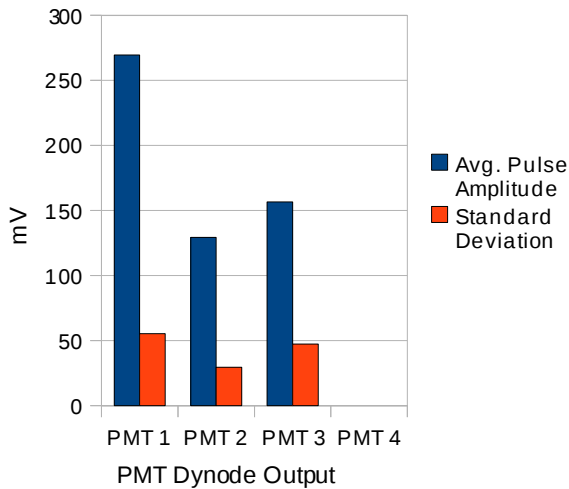
~140- 160 mV pulse amplitude with a rise time between 17.72 ns and 20.77 ns



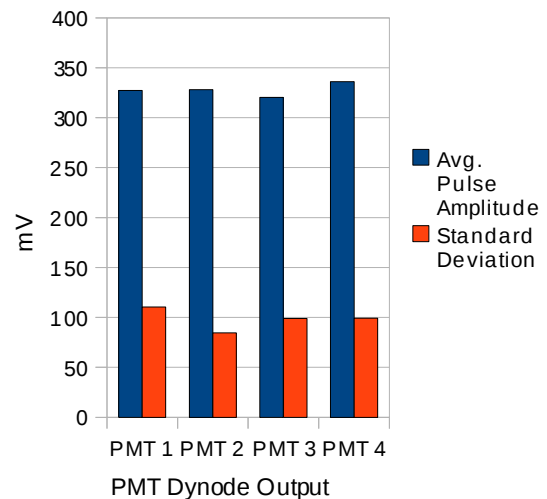
Voltage settings

- Module 3
 - PMT high voltage= -870 V
 - Low voltage power supply= +5 V, -5V, -2 V
- Module 4
 - PMT high voltage= -820 V
 - Low voltage power supply= +5 V, -5V, -2V

Module 3 Pulse Amplitude
(Average)



Module 4 Pulse Amplitude
(Average)



Analog Conclusion

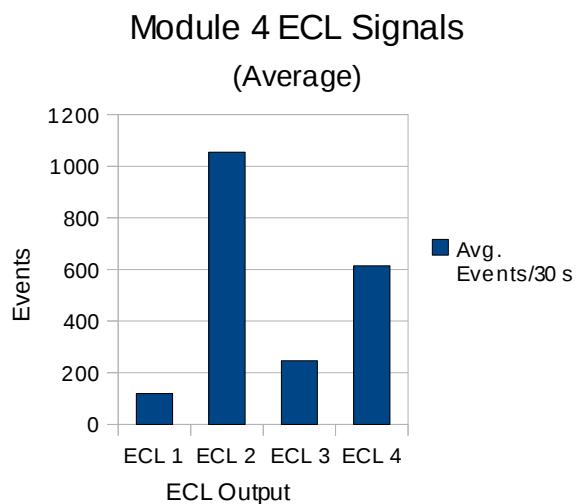
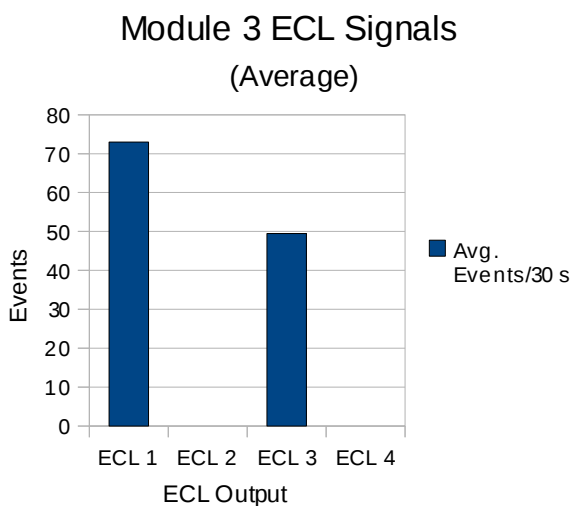
Module 3 appears to have relatively lower PMT gains on all 4 PMT's. This conclusion is supported by previous BPM analysis done by Dr. Liping Gan. The noise amplitude on all 4 channels of module 3 seems to imply that there is an internal grounding issue. Channel 4 on module 3 does not receive a pulse from its respective PMT. All channels on Module 4 are in good working condition. There were rare instances in which intermittent noise was detected on module 4 but there was no consistency and I was unable to retrieve that data.

ECL Signals

Each module has 4 ECL outputs. Mr. Fernando Barbosa e mailed me the following. "There is a pot on the module for this purpose but it is not accessible to the user, i.e., it is calibrated on the bench so that the discriminators do not trigger on noise (threshold is set above noise level). To see if the threshold is set appropriately, turn off the HV to the all the PMTs and look at the logic outputs. There should be little or no activity."

An extremely large count would imply that the discriminator threshold is not set properly or that the electronics module has a faulty circuit. Channels 1,2 and 3 on module 3 were all registering billions of events when the high voltage was turned off. Channel 4 on module 3 registered zero. All channels on module 4 registered zero with the high voltage turned off.

I connected the ECL output from the BPM module into a level translator module with NIM outputs. The NIM signals were then connected directly into a 100 MHz visual scalar. I recorded the number of counts per 30 seconds on all 64 channels for each module. Below are the average counts per ECL output. These counts are taken with the BPM powered by the original voltage settings.



Note: ECL 2 Mod 3 registers in the billions
ECL 4 Mod 3 registers zero or few

There were some discrepancies per channel, specifically channel 2 and 8 on ECL 3 module 3. These channels are very sensitive and occasionally switch between normal counts and billions of counts.

ECL Conclusion

The ECL data supports the analog data. There is an electronics problem in module 3 and possibly an offset discriminator. Further survey is required to determine the problem. Module 4 is in good working condition but the difference in events/channel is large and may need adjustment in order to obtain more exact data.

Other Observations

- Occasional distorted analog signals on channel 1 module 3 ,i.e., slow rise time and no defined peak
- ~50 mV afterpulsing within 50 to 80 ns of peak
- Occasional background noise occurs just after a peak and is sustained for a few seconds (Rare)
- No observable light pollution