MicroBooNE

Two High Voltage Monitoring Options

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Abstract

During recent tests we have identified
two new monitoring options
that may be of interest to the MicroBooNE HV system:

--a sensitive detector of small HV discharges
--a good resolution monitor of the DC drift cage current

We will show the performance of these two monitors
and discuss briefly a possible implementation

Pulse Current Transformer

At the top of the tank, a Ion Physics Wideband Pulse Current Monitor Transformer (Ion Physics Model CM-01-S, 1mV/A 500KHz)

The pulse current transformer in the test setup

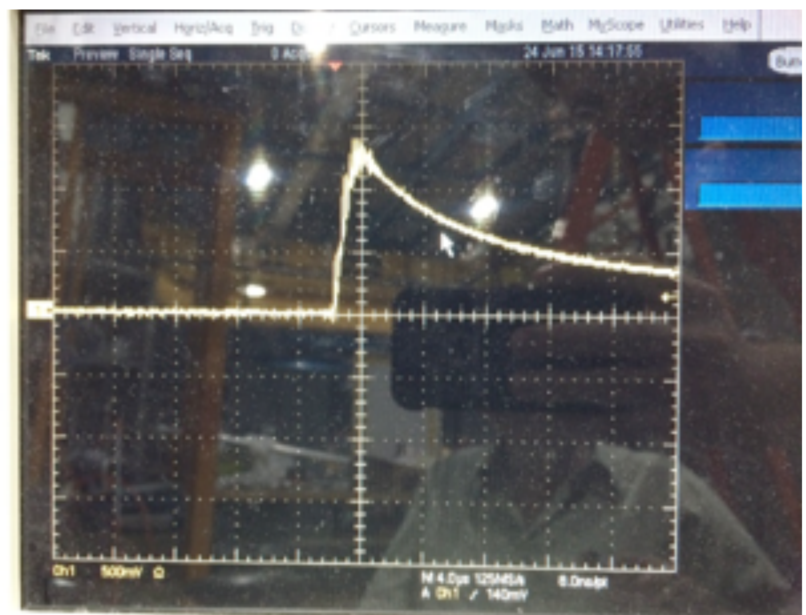
The Signal

The output of the current transformer was connected to a custom diode-and-RC Circuit.

The purpose of the RC Circuit is to extend the signal from the current transformer such that it can be read by the DAQ. The minimum desired time constant is 10 μs, such that the DAQ can trigger.

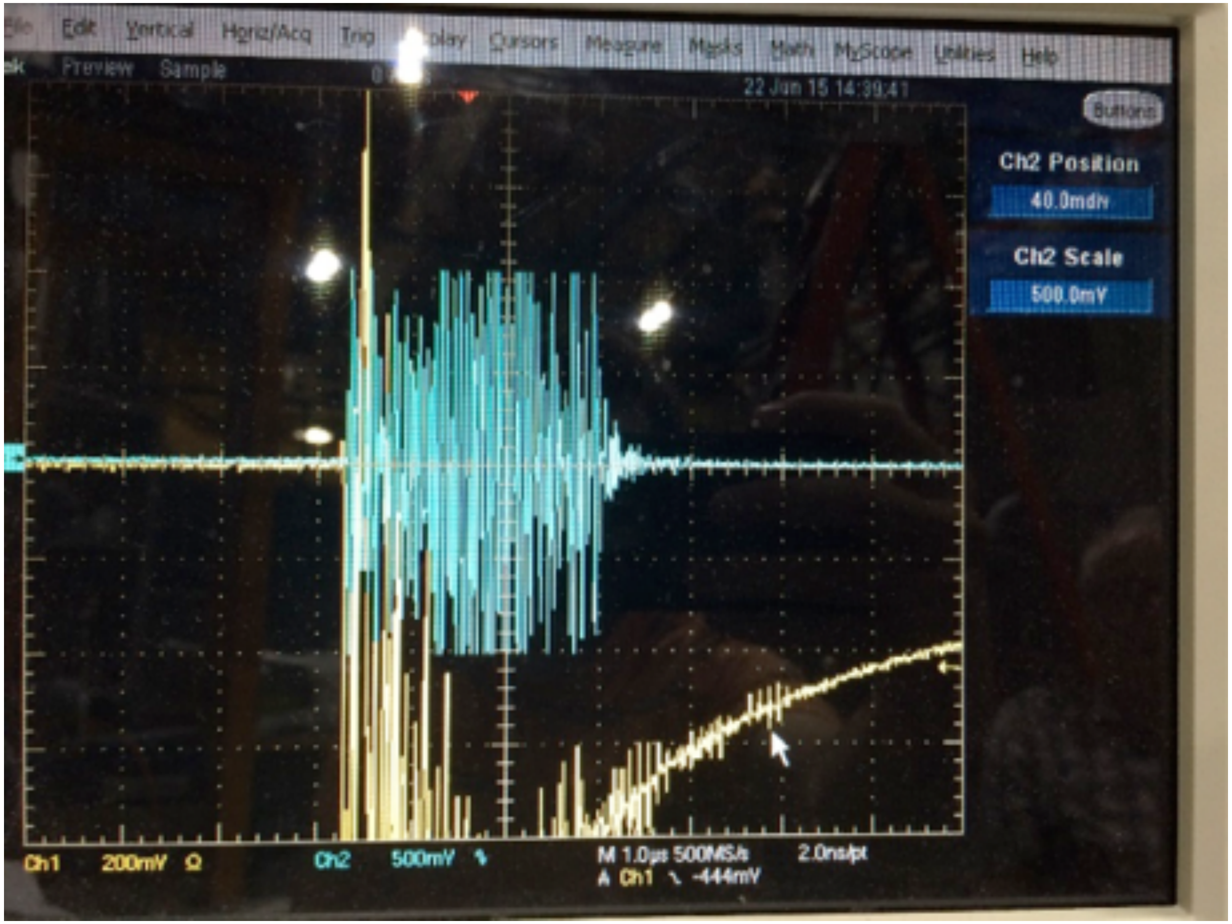
A 6 Volt Surge Protector was added to protect the scop

These readings show a peak voltage of 1.7 V, with a decay time constant of approximately 20 μs. The risetime is about 100 nsec



Verification

We installed a simple rod antenna in the cryostat to confirm that the signal is real:



Glassman Current Monitor

The Glassman Model LX150N12 high voltage power supply has analog output for current monitoring. It puts out 0-5 volts for the 0-12 mA current range of that model.

We tested the noise and stability of this monitor output.

To this purpose we shorted the HV after the 75 Mohm filter pot and varied the HV between zero and 10 kV.

We first tested with local control of the HVPS,

And found a DC offset of 6 microvolt,

and a random fluctuation of 6 microvolt across the HV range tested.

Test with Remote Control of the HVPS

We repeated the tests with the HPS under remote control.

This time we found a DC offset of the monitoring output of 5.9 mV,
1000x larger.

Upon measuring through the 0 to 10 kV range we found that this offset is stable, and that the fluctuation increased only modestly, to about 20 microvolts.

How well can we Monitor the DC Current?

Taking the calibration, 5 Volt/ 12 mA, we find that the 20 microvolts correspond to

(20 e-6) * (0.012/5) = 0.48 microamps.

This can be compared to the cage voltage divider current of about 10 microamps.

The instantaneous resolution if 5% of the current.

Averaging can improve it significantly

Implementation Options

With Linda Bagby’s assistance we had a very cursory look at how to get those signals into the MicrobooNE system.

Here is a brief summary:

The pulse current transformer output can be acquired with the existing bit-scope (sp.?) system.

The DC current monitor needs a DC voltage resolution of about 1 microvolt.

Any standard bench DMM can do that.

Interfacing would be easiest with a web-enabled DMM.

One can buy one from Keithley for a little under $ 4000.-

Another option is to use a GPIB –to-Ethernet adapter ($ 140.-) which has its own IP address.

(This is the limit of what I know)

Hardware for Implementation

We can use the existing cable and Pulse current transformer while building a replacement for the Blanche LDRD project

For the DC monitoring a DMM will be needed.