Jefferson Lab

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CDC Pre-Installation Tests

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The CDC is being readied for installation in Hall D by installing and testing its electronics components: HVBs, preamps, low voltage (LV) cabling, the high voltage (HV) cabling distribution and grounding. These cables were routed between the HVBs and close to the gas plenum to minimize the effect on the air flow necessary for cooling of the preamps and to provide access to the various components during maintenance. Figure 1 shows the final configuration on the upstream side of the detector.

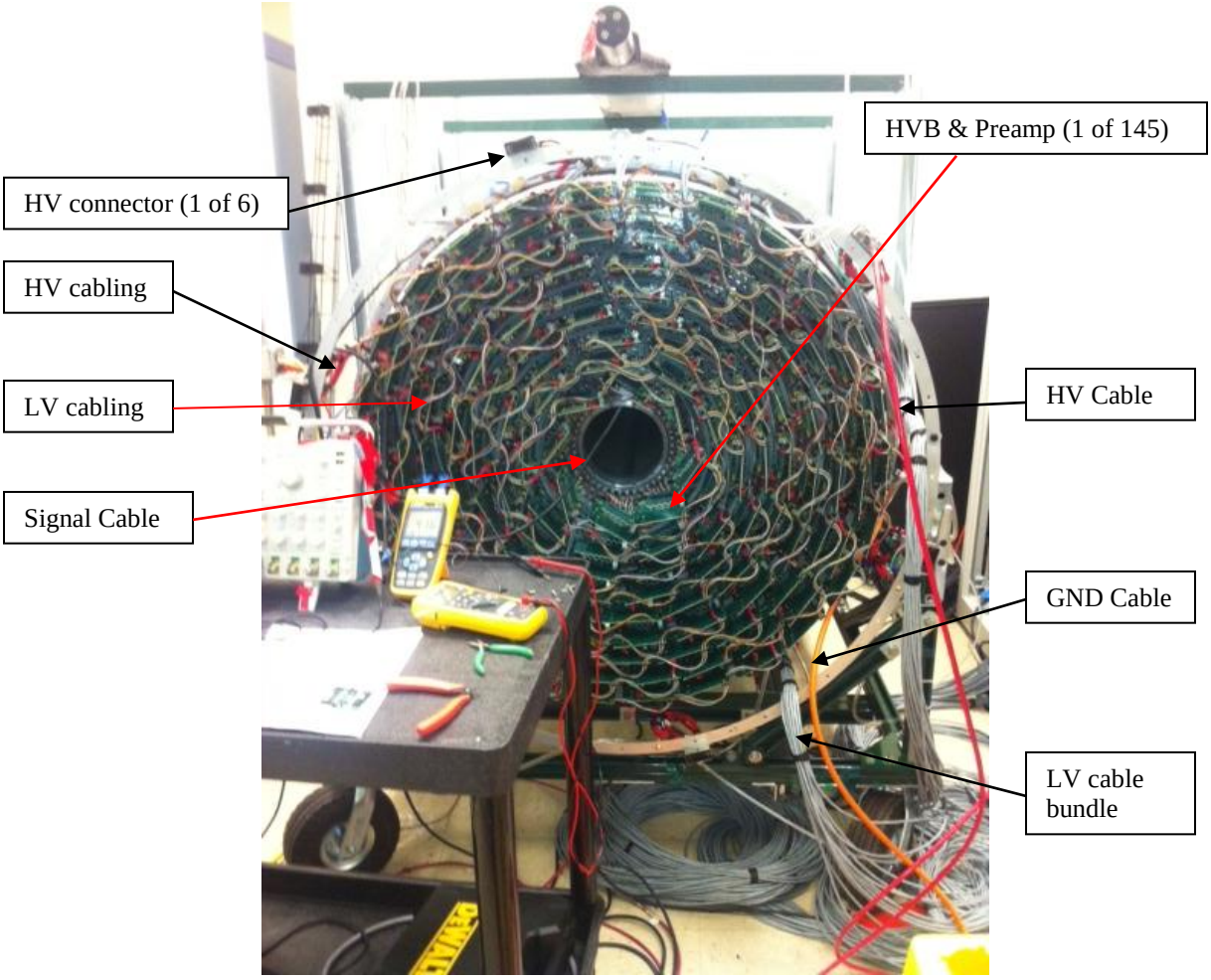

Fig 1. – The CDC ready for installation in Hall D

Tests were conducted in EEL 126, an electrically noisy environment due to conducted and radiated EMI from pumps, controls, motors, etc. There is, however, a dedicated "clean ground" connection to the building grounding grid. The CDC was grounded to this ground by means of a 2 AWG cable, shown in fig. 1. Grounding in the hall will be effected via a thicker 4/0 cable to the hall grounding grid. All the installed LV and HV cables will be moved with the CDC to the hall for final cable routing and connections; the HV (CAEN) and LV (Wiener MPOD) systems, including the LV distribution panels, were connected as specified for installation.

Noise Tests

An EMI survey of the room showed various frequency peaks, primarily radiated from wireless services (900 MHz, 1.8GHz); conducted interference components were observed but harder to characterize due to their intermittent nature (15KHz, 29KHz). Fig. 2 shows the noise at the output of the preamp (with a differential probe) before grounding (clean) and cabling. Only one preamp was powered from a bench supply, referenced to ground. The peak-to-peak noise of 80mvp-p occurs at multiples of 60Hz, likely from a UPS somewhere in the room; noise is predominantly under 40mVp-p, however.

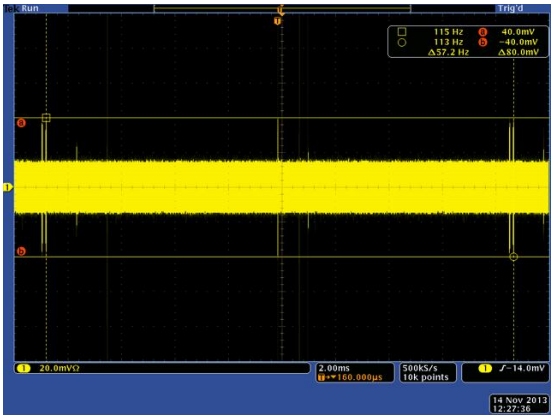

Fig. 2 – Noise, before, 20mV/div

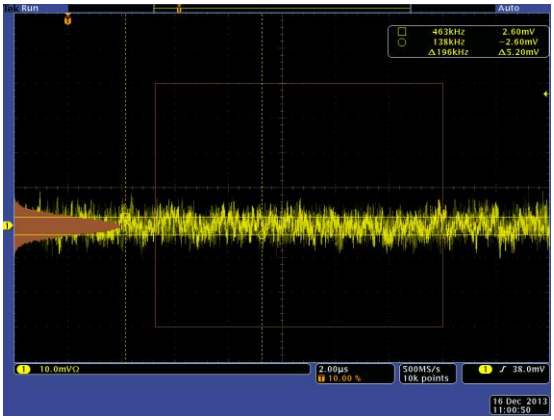

Fig. 3 – Noise, after, 10mV/div

Fig. 3 shows the noise at the output of the preamp (with a differential probe) after cabling and grounding to the room clean ground and with all 145 preamps powered from the MPOD supplies and LV distribution. Because of the intermittent nature of the conducted EMI observed, a histogram was used to measure the predominant noise (sigma of 2.6mV) at 5.2mVp-p; the total noise is still less than 10mVp-p.

Cosmics

The CDC was then connected to the CAEN supply and the sense wires were biased at +2kV, with the designated Argon-CO2 gas mixture. Figs. 4 – 6 show pulses with various amplitudes, all at 100 mV/div scale. The pulse in fig. 6 has an amplitude of 550mV which is at the top of the linear range of the preamp. A collection of pulses is also shown in fig. 7, still very clean and with no apparent saturation effects.

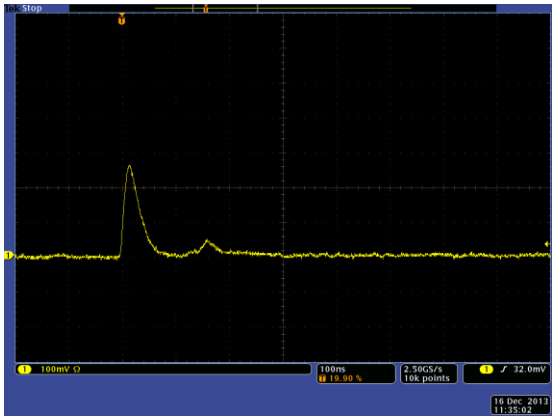

Fig. 4 – Two ionization clusters

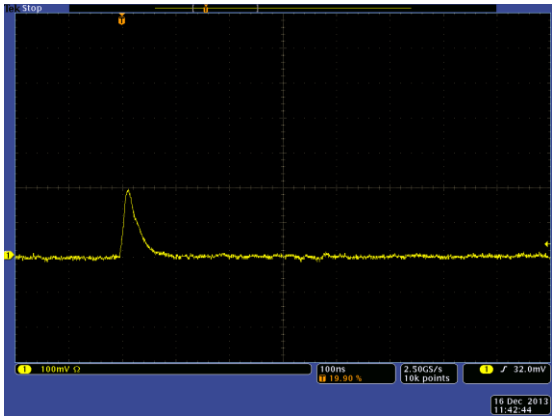

Fig. 5 – Single cluster

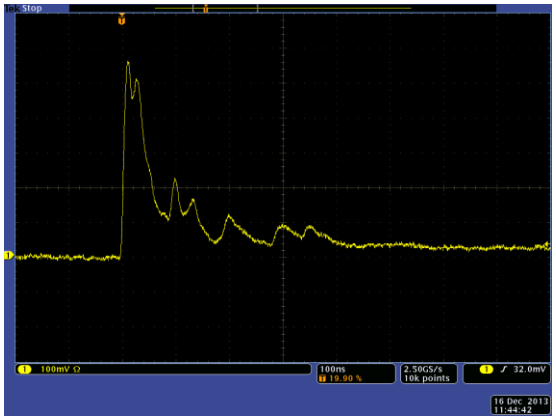

Fig. 6 – Multiple clusters

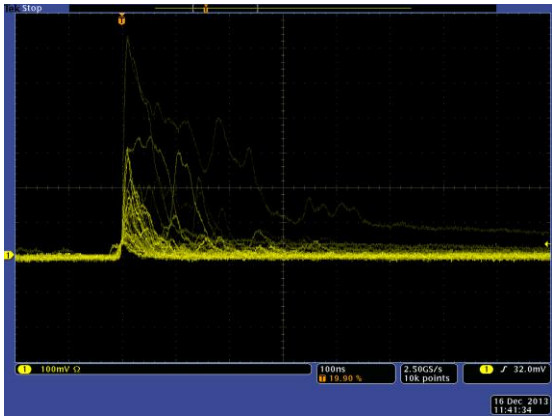

Fig. 7 – Collection of pulses

Temperature Measurements

The CDC was briefly operated during these measurements without any forced cooling on the electronics. A spare preamp was prepared with two thermo-couples glued onto two chips: ASIC and the voltage regulator, both on the bottom of the preamp card. These chips face the HVB when the preamp is inserted where cooling is primarily effected by conduction to the copper heatsink. The ambient temperature was 27°C.

Measurements have been taken at several places in each quadrant to obtain a baseline prior to installation in the hall with forced convection. The surface temperatures of the ASIC and of the voltage regulator never exceeded 60°C, resulting in junction temperatures of 70°C for the ASIC and 110°C for the voltage regulator, according to thermal simulations. We expect to operate the electronics in the hall with much lower junction temperatures for high reliability.

Noise Re-visited

Noise levels were monitored at the conclusion of the above tests with the HV off. During this period, the EMI levels decreased considerably, likely a result of equipment being turn off in the building. Fig. 8 shows that the predominant noise at the output of the preamp decreased to 5mVp-p. This result is to be compared with the noise observed in

fig. 3 (same scale). Considering the maximum signal excursion in the linear region, the SNR is about 1%, excellent indeed.

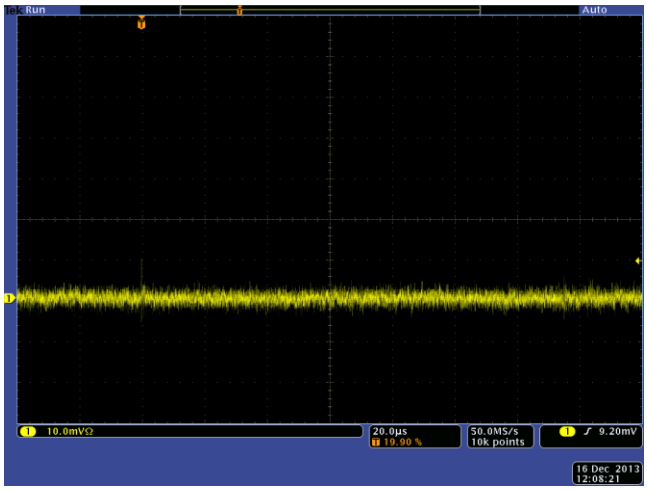

Fig. 8 – Noise at 5mVp-p (10mV/div)

Summary

The CDC is now ready for installation in the hall where optimization will be considered with respect to cabling, cooling of the electronics, grounding and the EMI environment in the hall.

Fig. 9 – Mike (left) and Nick readying the CDC for installation