

1 BigBite Timing Hodoscope OSP

The timing hodoscope of BigBite (BB) (Fig.1) electron-arm spectrometer provides an event reference time, which can be correlated with RF beam buckets from the CEBAF accelerator, and with signals from the SBS hadron arm for time of flight determination in (e,e'N) experiments. It consists of an array of 90, EJ-200 plastic scintillators, each of dimensions 600 x 25 x 25 mm, which are stacked in a vertical “ladder”, sandwiched between the preshower and shower arrays of the BB electromagnetic calorimeter.

Scintillation light from each bar is read out at each end, through acrylic light guides, glued to the scintillator using UV-cure, optical epoxy. Two type ET-9142, 29 mm diameter photomultipliers (PMT) collect the scintillation light. They are clamped in position at the end of the light guide by an assembly (Fig. 2) which encloses the PMT, along with its custom-built voltage-divider base chain, and incorporates mu-metal shielding from stray magnetic fields. Anode signals from the PMTs are output from MCX coaxial connectors on the HV base and fed, via ~ 2 m of RG179 cable to amplifier-discriminator cards based on the NINO chip. The latter, mounted close to the PMTs, provide amplified anode signals for pulse amplitude measurement and LVDS logic signals for timing measurements. The typical mean-time resolution for a hodoscope bar is around 150 ps.

The PMTs are operated typically at voltages of -1000 V to -1200 V. HV is supplied over shielded cable and the PMT bases are encased in a plastic jacket which insulates internal base terminals from the outer Al PMT container. The PMTs themselves are supplied with an integral mu-metal shield and outer insulating plastic jacket. Thus the PMT cathode at ~ -1 kV is insulated from any potential contact with the Al outer case. A more substantial mu-metal shield fits outside of the Al case and provides most of the shielding from stray magnetic fields.

The PMT base chain draws a current of around 200 mA and operates without the need for forced cooling. In the event that an over-current condition is detected the current-limited HV supply will power down. The amplifier/discriminator cards operate from a +5 V power supply and each 16-channel card draws a current of ~ 1.25 A. A common LV supply will power (~ 15 A total current) the 12 cards required to read out 180 PMTs. This will be current limited and will have individual fuses on the supply lines to each card.

2 Readiness of Equipment

The timing hodoscope will be one element of the stack of detectors instrumenting the BB spectrometer. It will be fitted between preshower and shower components of the electromagnetic calorimeter with a minimum of free space in the sandwich. All elements of the detector stack will require careful fitting together, which means that the support frame must be carefully designed and engineered. Final assembly of the hodoscope will not take place until the frame is ready,

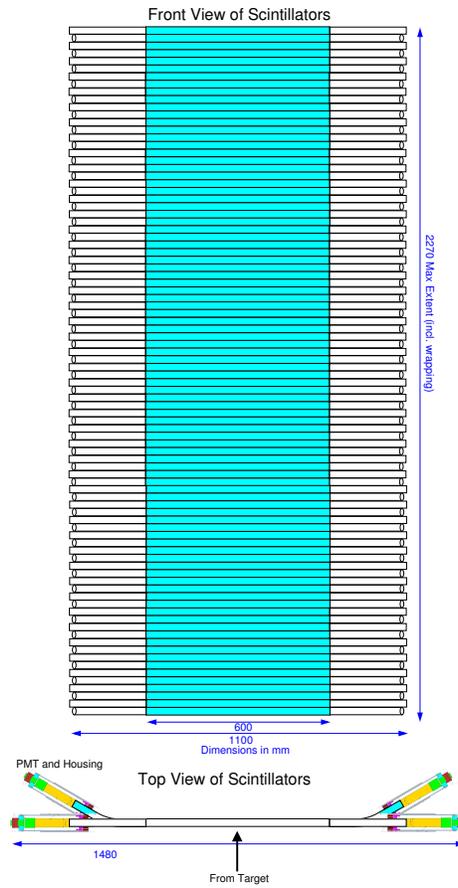


Figure 1: BB Timing Hodoscope

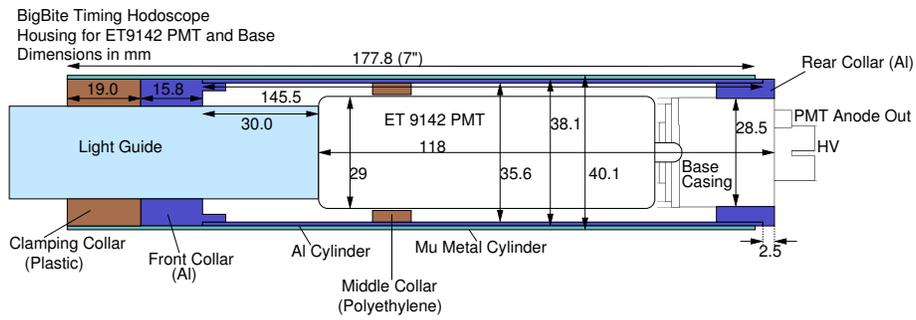


Figure 2: BB Timing Hodoscope: PMT and outer case assembly

but individual elements can be assembled and tested prior to final assembly. The status of various components is as follows:

1. Light guides have been epoxied to the scintillator bars and are stored at JLab. Wrapping to exclude external light remains to be done.
2. 200 ET-9142 PMTs have been procured and will be shipped to JLab before wrapping commences.
3. 200 custom base chains have been manufactured and are under test in Glasgow. They will be shipped along with the PMTs.
4. 180 light-guide clamp and PMT protective case assemblies have been produced. Since they were produced we have decided to use ET-9142 PMTs instead of the ET-9125 originally proposed. The 9142 is much faster than the 9125 and although they have the same diameter the 9142 is shorter. Thus the Al cylinder of the PMT case (Fig. 2) requires to be shortened, the rear collar bored out to accommodate the PMT base assembly and a middle collar machined to hold the PMT firmly within the case.
5. 200 MCX/RG179 cables have been manufactured to connect the PMT anode to the NINO card.
6. 15 (12 + 3 spare) NINO cards have been produced for the hodoscope

Modification of the PMT cases will require machine-shop time. A test modification has been performed successfully for one case assembly and we are now ready to work on the rest of the cases. It is anticipated that this will take place in the spring of 2017. Subject to the availability of laboratory space, we expect to perform the wrapping and testing of scintillator bars in the summer of 2017. They will then be ready for incorporation into the BigBite detector stack. Testing will include HV and LV power supplies and the NINO amplifier/discriminator cards.