VME based DAQ for Hodoscope characterization

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Introduction

The hodoscope at NPD-BARC has been designed to perform experiments with RPCs and cosmic muons [1, 2]. It has 9 shelves. Shelf #9 and shelf #2 contain 8 large area scintillator paddles each. The scintillator paddles are 180 cm × 18 cm × 1 cm in dimension. Each of them are coupled to two photomultipiers at opposite ends along the length. The total area covered by the scintillators on one plane is 2.6 m^2. The other racks are used to house the gas gaps and RPCs. The Electronic system composed of both VME and NIM standards, is capable of operating and characterizing a couple of RPCs at the same time.

Electronics

The photomultipliers are from Electron Tubes Ltd. (Mod. 9814B). They are powered by the CAEN SY2527 Power Supply to a voltage of ~ -1.8 kV. Their signals are brought to the NIM Modules through 10.5 m cables to ensure equal delay. There are three NIM bins of which, one is used for the signals from the top plane, one for the bottom plane and the other for processing the signals to be fed to VME. These crates contain suitable disciminators, scaler-counters and Logic Modules. Processing crate contains ECL-NIM/NIM-ECL translator.

VME

VME Crate is CAEN Mod. 8100 of the VME64/64X 21 Slot 8U Crate Series. The controller is CAEN Mod. V2718. It communicates to the PC through an Optical Link Bridge. It can generate a clock of 40 MHz and is used to synchronize the TDCs.

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TDC

The TDC (Multihit) we are using is CAEN Mod. V1190A having 128 Channels. Its Max. resolution is 100 ps. There are 3 such TDCs. It accepts either ECL or LVDS signals. Input to the TDC comes from the NIM-ECL translator through flat cables.

As with many TDCs, the V1190A can be operated with the trigger in the common start and stop modes. However, it can also be operated in the so called '*straddling*' mode [3]. In the straddling mode, the trigger window width is straddled around the trigger, so that events occurring both before, and after the trigger are recorded; provided they are within the window width. Fig. 1 illustrates the straddling mode. The trigger matching mode can be decided or

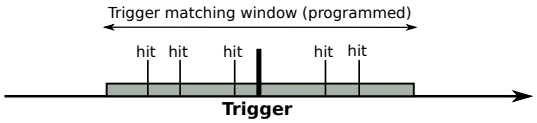

FIG. 1: Straddling Mode.

set by setting the different programmable parameters [3]. The TDCs are being operated in the straddling mode.

RPCs

The hodoscope rack has one endcap CMS bakelite RPC and one square glass RPC (1 m × 1 m). The gas mixture of the RPCs was Freon-R134a (96 %) and Isobutane (4 %) with ∼40 % Relative Humidity. The resistance of the bakelite gaps vary with humidity.

Trigger and Data acquisition

The coincidence of the top and bottom plane scintillator signals is used as the trigger. The way the trigger is generated is illustrated in the block diagram in Fig. 2. Each scintillator is coupled to two photomultipliers.

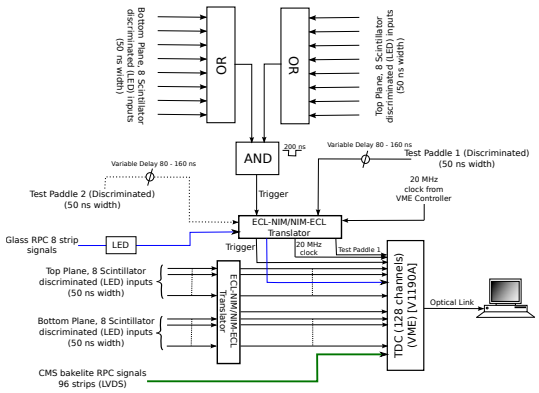

FIG. 2: Block diagram of the setup.

The OR of the two photomultiplier signals after discrimination forms the scintillator signal. We will have 8 such signals from both the top and bottom planes. The 8-fold OR of signals in one plane forms the plane signal. Therefore we will have two signals: one from the bottom plane and one from the top plane. The AND of these two signals forms the trigger. The individual scintillator signals are also fed to the TDC.

The software for the DAQ was developed at CERN. It is being modified and upgraded so that, the parameters like cluster size, strip profile and efficiency of the RPC can be monitored easily.

Observations and Conclusions

The coincidence pattern observed for 100 000 triggers (valid cosmic ray muon events) is shown in Fig. 3. The pattern peaks along the diagonal. This is expected as the cosmic muon flux is not uniform over the zenith angles. Fig. 4 shows the timing distribution of signals from scintillator paddles and RPCs with respect to the trigger. The straddling mode operation can be noticed from the distribution. The CMS and Glass RPCs lie above the bottom plane scintillators of the hodoscope. So their signals would appear earlier than the trigger. Scintillator signals are brought to the electronics by equal length cables. They will appear after the trigger.

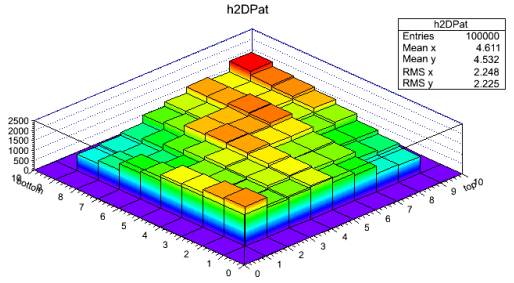

FIG. 3: Coincidence pattern of scintillator paddles.

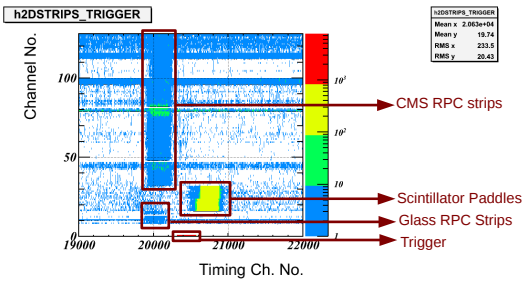

FIG. 4: Timing distribution of signals.

Acknowledgments

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References

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[3] V1190 A/B, VX1190 A/B, Technical Information manual, Revision n. 11, 11 November 2011.