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Trigger system for a large area RPC TOFtracker

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The TOFtracker concept, the simultaneous measurement of accurate time and bi-dimensional space coordinates in a single gaseous detector, has been previously demonstrated [1]. The small detector yielded a time accuracy of 77 ps along with a bi-dimensional position accuracy of 38 um over a full active area of 60 x 60 mm2.

Recently, a large area, 1550x1250 mm2, RPC detector has been constructed for the same purpose. Signals are induced in metallic strips located in each side of the plastic box and coupled to both charge-sensitive and timing circuits.

In this work, the architecture and performance of the trigger and control system of the detector is reported. The system is based on off-the-shelf available modules. A Raspberry Pi2 running Linux is used as a control and logging computer. The trigger algorithms are described in VHDL and implemented using a Xilinx XC6LX45-2 FPGA housed in module TE0600 from Trenz Electronic GmbH. Communications between the FPGA and Raspberry Pi2 are made using the SPI protocol.

Actually 12 time channels are being used to generate the data acquisition coincidence trigger signal. Several different trigger strategies can be used. And trigger and Or trigger signals can be programmed, and also a mix of And and Or trigger can be chosen. Each time channel can be selected to join any of the possible trigger groups. Trigger generation takes less than 30 ns since the detection of coincidence between the different time channels according to the mode of operation chosen. The width of the trigger signal can also be programmed, and work is being done to optimize its duration according to the restrictions of the physical process and data acquisition system.

The trigger system is also used to routinely control the operation of the detector. Events on every time channel are processed and counted, as are all trigger signals generated. Information on system dead time is available, as a distinction is made between triggers generated internally and triggers effectively sent to the data acquisition system. The control software running on Raspberry Pi2 initiates periodically the process of counting the events during a certain amount of time and logs results, which are used to automatically check if the detector is operating as expected.

[1] A. Blanco, P. Fonte, L. Lopes, P. Martins, J. Michel, M. Palka, M. Kajetanowicz, G. Korcyl, M. Traxler and R. Marques, “TOFtracker: gaseous detector with bidimensional tracking and time-of-flight capabilities”, 2012 JINST 7 P11012

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