THE TRIGGER SYSTEM OF THE TELESCOPE ARRAY DETECTOR

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This paper describes the trigger system of the Telescope Array detector and its performance from the prototype tests. The trigger system is controled by the combination of signal finder (SF) and track finder (TF) modules totally with software on digital signal processors (DSP). The parameters characterized from signal from each PMT, such as starting time (t1), ending time (t2) of the signal duration, and its signal-to-noise ratio (S/N), are recognized maximizing the S/N as a function of t1 and t2 by on-flight software on the DSP attached to each input channel after ADC chip every seach window time-interval of 25.6 μs. The SF module sends out found parameters from all DSP for signal finding on the module every 25.6 μs to the TF module via high-speed serial communication lines. The TF module gathers the signal characteristic parameters from many SF modules and make pretrigger at input DSP, which is responsible for each 2 SF modules, using 2-dimensional pattern recognition and very low trigger threshold. The set of signal parameters which survive the pretriggers are transfered into 4-port dual access memory on the TF module, which is surrounded by three high-speed DSP, which can efficiently perform the pipelined treatment of data to calculate the significance of track-like correlation between the found signal time and the position of the corresponding PMT. The TF module sends back the data aquisition (DAQ) request for the appropriate regions of data memory on SF DSPs to the SF module via the serial communication. The trigger system allows as the excellent detection sensitivity for air-showers without any strong trigger biases for or against a certain kinematics of cosmic rays. It is based so fully on software control that we can estimate the performance of complicated trigger efficiency and some biases exactly using computer simulation once we handle the input analog signals and also can improve the trigger scheme step by step after experiences understanding the detector and environments.