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The trigger and calo DAQ of the HEPD-02 on CSES-02 satellite

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The High Energy Particle Detector (HEPD-02) onboard the second China Seismo-Electromagnetic Satellite (CSES)-02 is designed to measure cosmic rays, i.e., electrons and protons, along with light nuclei, in the energy range between a few MeV and a few hundreds of MeV. This high-precision instrument is composed by different subdetectors: a tracking system, a trigger system, a calorimeter made by a tower of plastic scintillators and an array of LYSO crystals, and a veto system.

The data acquisition of trigger, calo, and veto is performed by a single electronic board which relies on two Weeroc Citiroc ASICs. This board issues and manages the trigger signals for the whole apparatus and optimizes the acquisition of signals with different timing characteristics, such as those coming from plastic scintillators and LYSO.

Since particle fluxes span several orders of magnitude along the orbit of CSES-02, the trigger generation system must be extremely adaptable, and the data acquisition must guarantee the measurement of energy spectra with a high duty cycle.

The HEPD-02 trigger system features concurrent trigger configurations and prescaling capability to adjust the data acquisition scheme depending on the orbital zone and on the presence of impulsive events. Each trigger pattern is optimized to meet scientific requirements about the field of view and the nature of particles impinging in the detector, with prescaling settings suitably adjusted.

While still monitoring particle bursts, trigger configurations dedicated to gamma rays will be tracked on a time basis of 5 milliseconds, to measure photon fluxes in the MeV-tens of MeV energy range and provide sensitivity for rare events, such as Gamma Ray Bursts (GRB).

This contribution describes the design criteria and the architectural choices for the use in space. The performance of the trigger system, including results from laboratory and beam tests performed on the flight model of the HEPD-02, is also presented.

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