The High Energy cosmic-Radiation Detector (HERD) Trigger System

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Executive summary

The High Energy cosmic-Radiation detector (HERD) facility has been proposed to be installed onboard the future China's Space Station (CSS) for about 10 years.

HERD will address major problems in fundamental physics and astrophysics with the precise measurement of charged cosmic-rays and gamma-rays from few GeV to PeV energies by means of a large acceptance detector based on an innovative concept.

HERD is composed of a 3D imaging calorimeter (CALO) surrounded by a scintillating fiber tracker (FIT), a plastic scintillator detector (PSD) and a silicon charge detector (SCD). In addition, a transition radiation detector (TRD) is placed on a lateral side to provide accurate energy calibration. HERD is designed to accept incident particles from both its top and four lateral faces thus providing an effective geometrical factor one order of magnitude larger than that of current experiments.

The large geometrical acceptance of the system requires detailed studies to define an efficient trigger system, which is able to identify the event samples for science and calibration purposes and keep the trigger rate to the level required by the acquisition system.

The HERD trigger strategy is designed to accomplish the scientific goals of the mission, and is based on trigger definitions that rely on the energy deposited in CALO and the PSD. The trigger performances in terms of acceptances and expected rates are evaluated using a detailed Monte Carlo simulation based on Geant4 that includes the latest HERD geometry.

In addition, the photodiode readout of the CALO crystals provides an additional opportunity for alternative trigger definitions based on simple programmable logic in terms of the event multiplicities. Dedicated sub-triggers for specific particle species and energy ranges have been proposed and investigated.