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Highly segmented electromagnetic Calorimeter prototype

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A prototype of a highly segmented electromagnetic calorimeter has been developed. The detector tower is made of 24 layers of PHASE2/MIMOSA23 silicon sensors sandwiched between tungsten plates, with 4 sensors per layer, resulting in 39 MPixels in total. A detector readout and control system was developed, containing two Spartan 6 and one Virtex 6 FPGA, and running embedded Linux. In 550 ms 4 Gbytes of data is read from the detector and shipped to the DAQ system after readout via Gigabit ethernet.

Summary

A prototype of a compact, highly segmented electromagnetic calorimeter has been developed. It consists of a tower of 24 layers of silicon sensors sandwiched between tungsten plates. The active layers are composed of pixel sensors: 96 PHASE2/MIMOSA23 sensors (4 per layer) which have a pixel pitch of 30um, resulting in 39 MPixels in total. The sensors are controlled and read out by two boxes, each containing two Spartan 6 and one Virtex 6 FPGA. As the sensors work in continuous rolling shutter readout, the readout system has also to manage the trigger information. Each sensor multiplexes the data on to 4 pairs of LVDS signals running at 160 MHz which gives a total data throughput of 61 Gbit/s. Automatic phase detection and delay adjustments are used to ensure correct sampling of the input data over the distance of 10 m from the readout electronics to the detector front end. The Linux distribution PetaLinux is used on an embedded Microblaze processor for control and configuration of the front end electronics.
Up to 4 Gbytes of data (corresponding to 830 sensor frames of the whole detector) can be read out continuously before shipping to the DAQ system via Gigabit Ethernet. The prototype system has recorded data successfully in beamtests at the CERN PS and DESY. The readout system is described, results of the beamtests and prototype performance are presented.

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