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Performance of the Read-out Electronics of the Qualification Model of DAMPE BGO Calorimeter in Environmental Tests and CERN Beam Experiment

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The DAMPE (DArk Matter Particle Explorer) is a scientific satellite mainly aimed at indirectly searching for dark matter in space. One critical sub-detector of the DAMPE payload is an electromagnetic calorimeter, which consists of 308 BGO (Bismuth Germanate Oxid) crystal bars and 616 PMTs (photomultiplier tubes), for precisely measuring the energy of cosmic rays from 5 GeV to 10 TeV. The calorimeter, with 1848 readout channels and a dynamic range of 2×10^5 for each crystal bar, is equipped with a complex readout system which contains 16 front-end electronics boards (FEE) with a total power consumption of 26 W. The qualification model of the BGO calorimeter, as well as its readout electronics, has been constructed and passed a series of environmental tests, such as EMC (Electromagnetic Compatibility) test, vibration test, thermal cycling test and thermal-vacuum test. The readout electronics system performed well and each electronics channel achieved a dynamic range of 0 to 12.5 pC with a resolution better than 3 fC and nonlinearity less than 1%. Test results showed that it could adapt to the harsh space environments. Later in the fall of 2014, an accelerator beam experiment was successfully carried out at CERN with PS and SPS facilities, which suggested that the design specifications of the BGO calorimeter and its readout electronics were achieved.

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