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A readout system for the Ground Tests of the DAMPE BGO Calorimeter

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The DAMPE (DARk Matter Particle Explorer) satellite was successfully launched into a sun-synchronous near-earth orbit, on December 17th, 2015, from the Jiuquan Satellite Launch Center of China. It carries the dream of Chinese scientists searching for dark matter indirectly by observing e^+/e^- and γ energy spectrum in space. As the critical sub-detector of the DAMPE payload, the BGO (Bismuth Germanium Oxide) calorimeter precisely measures the energy of cosmic rays range from 5GeV to 10TeV and provides trigger information for the whole DAMPE payload. It is composed of 308 BGO scintillator strips, 616 PMTs (photomultiplier tubes) with 1848 dynode signal channels, and 16 FEEs (Front End Electronics). From year 2013 to 2015, a qualification model and a flight model for the BGO Calorimeter were successively constructed. For each model, a series of ground-based cosmic ray tests, and qualification/acceptance level environmental tests were carried out, due to the Space Qualification Procedure. Besides long-term ground-based cosmic ray tests, the ground tests before launching includes the Board Level ESS (Environmental Stress Screening) for FEE production, the sub-system level EMC(Electromagnetic Compatibility) test, the vibration test, the thermal cycling test, the thermal-vacuum test, and a 360-hour burn-in test just for the flight model. The complicated procedure for each model took nearly more than half a year, which meant a large amount of time and manpower costs, and proposed a strong demand for a ground support facility with high reliability, high automation, and easy-to-use features. Hence a ground-based readout system was designed, which mainly consists of a DAQ (Data Acquisition) board, a DC-DC power supply module, and a custom software based on LabWindows/CVI. The system was successfully developed and played an important role for the production process and ground tests of both the qualification model and flight model of the BGO calorimeter.

Author: ZHANG, Junbin (University of Science and Technology of China)

Co-authors: FENG, Changqing (University of Science and Technology of China); Prof. AN, Qi (University of Science and Technology of China); Mr WANG, Qi (University of Science and Technology of China); Dr GAO, Shan-shan (University of Science and Technology of China); Prof. LIU, Shubin (University of Science and Technology of China); Mr MA, Siyuan (University of Science and Technology of China)

Presenter: ZHANG, Junbin (University of Science and Technology of China)

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