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Development of new front end electronics for the SciCRT detector at Sierra Negra, Mexico

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The SciCRT (SciBar Cosmic Ray Telescope) is a new cosmic-ray experiment, an improved solar neutron telescope and muon detector, composed of 14 848 scintillator bars arranged to track and record energy of incident particles. The detector was installed at the top of Sierra Negra volcano in Mexico (4600 m above sea level) and 5/8 of the full SciCRT has been in operation since March 2014. To optimize the detector for operation at the mountain, a new fast readout electronics was developed (described in a separate paper by Y. Sasai et al.) and is planned to be installed soon.

However, current design of front end electronics (inherited from K2K experiment) prevents the completion of the experiment. Existing front end boards (FEB) employ ASIC technology to reduce board size, making construction of new boards expensive. Even operating at 5/8 of the detector's full capacity, there are not enough FEBs to consider a long term observation. Therefore, If we want to complete the installation of the full SciCRT and ensure its function over an extended period of time, front end electronics must be upgraded.

For the development of new FEBs we plan to implement a time over threshold (ToT) processor using a Field programmable gate array. The purpose of this method is to measure deposited energy using simpler electronics than conventional pulse-height processing circuits. Since the relationship between ToT and deposited charge is non-linear, we also need to adapt the basic ToT method to achieve better linearity and resolution. In this paper we will present the details of the proposed system and some tests of ToT method applied to the SciCRT detector.

Collaboration

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