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Data Acquisition of A totally Active Scintillator Calorimeter of the Muon Ionization Cooling Experiment

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The Electron-Muon Ranger (EMR) is a totally active scintillator detector which will be installed in the muon beam of the Muon Ionization Cooling Experiment (MICE), the main R&D project for a future neutrino factory. It is designed to measure the properties of a low energy beam composed of muons, electrons and pions, and to perform an identification on a particle by particle basis. The EMR is made up of 48 intersecting layers, each of which is made of 59 triangular bars. Wavelength shifting fibers incorporated into the bars trap and transfer light, generated by particles traversing the detector, to PMTs located at the ends of the bars. One side is read out by single-anode PHILIPS XP2972 PMTs and the other by 64-ch. HAMAMATSU R7600 PMTs.

Signals from 48 single-anode PMTs are read out by 8 fast ADCs (CAEN V1731) which store pulse shapes with 2ns time resolution. Each 64-ch. PMT is interfaced to a front-end-board which hosts a MAROC ASIC that amplifies, discriminates, and shapes all input signals. Pulse height information can be extracted at low rate and will be used during calibration and tests with cosmic rays. Fast discriminated signals from the front-end-board are directed to a piggy-back buffer board which stores all the signals created during one duty cycle of the accelerator. Six buffer boards are connected in a chain and read out by a dedicated VME card. Communication between the buffer and VME board is made through TLK chip to allow for fast data transfer. The front-end-boards also have corresponding VME readout boards which at the same time configure the MAROC ASICs. All electronics boards employ FPGA chips which allow for great customization of the detector behavior. The complete read out system of the EMR will be described, including the hardware, firmware, and results of a full system test using cosmic rays.

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