Design of readout electronics of scintillators and SiPMs for CEPC ECAL preresearch

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Abstract
This poster shows the research of readout electronics for CEPC-ECAL based on SPIROC2b. There are three main phases in this research, ASIC test, single layer readout system and prototype. This poster is mainly about the result of ASIC test and part of single layer research.

The phase I readout system achieve above goals:
1. 144 channels of Scintillators and SiPMs readout
2. 46fC - 290pC dynamic range @ S/N = 2 with 3% nonlinearity
3. Successful distinct MIPs signal from pedestal with detectors

Requirement
The prototype of ECAL is designed with the following requirements.
1. Granularity: 5mm x 5mm
2. Dynamic Range: 1 - 800MIPs -> 10 p.e. - 8000 p.e. -> 160fC - 100pC
3. Size: 1m x 1m, 30 layers

System overview
FEB is integrated with detectors which consist of scintillants and SiPMs and is surround with steel or tungsten plate which acts as absorber. DIF is connected with FEB outside by connector.

The whole readout system mainly consists of Front-End Board (FEB), Data Interface Board (DIF) and Data Acquisition Board (DAQ). This system is extensible when the amount of channels is increased. The first testboard is only with oneasic on board. This testboard is used for testing the performance of ASIC and the whole system with detectors.

Dynamic Range
Figure above shows the noise of pedestal when input is floated. So the sigma of pedestal is about 3.5 ADC code. Corresponding the result of calibration Figure (b), we can get the conclusion that the rms of pedestal noise is 23fC. If we keep the SNR at 2, the minimum signal we can detect is about 46fC. Figure on the right shows the gain of low gain is about 10.3 ADC code/pC. In the test, we observe that system saturate at 3000 ADC code. So the system is measured and provide 46fC–290pC dynamic range.

Cosmic Ray Test
Using PMT as external trigger, we detect cosmic ray by various scintillators and this simplified system.

According to results of calibration, the MIPs peak mean charge is about 1pC which equivalent to 30 p.e.

Conclusion
We designed the readout electronic system for CEPC ECAL and development two testboard for validating this design. The first testboard with one ASIC chip on performance well and achieve the dynamic range of 46fC - 290pC. In the cosmic ray test, this FEB can distinct MIPs signal from pedestal well. After that, we also develop a testboard called EBU which is as one single layer of the prototype of ECAL. The preliminary test results show that the EBU can work well.