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Study on the Dynamic Range of SiPMs with Large Pixel Number

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The future Circular Electron-Positron Collider (CEPC) is a large-scale experimental facility, which aims to accurately measure the Higgs boson, electroweak physics and the top quark. For the detector system in CEPC, a highly granular crystal electromagnetic calorimeter is proposed to achieve an EM energy resolution of less than 3%. It is a homogenous structure with long crystal scintillator bar as active material, and SiPM as the preferred photon sensor. There is a high requirement on the dynamic range of SiPM, since more than ten thousand photons can be detected for one channel. However, the response calibration for SiPMs with such a large dynamic range is challenging, mainly because of the limitation of scaler.

We have developed an experiment which used laser and PMT as light source and scaler respectively. In this experiment, we measured the response curves of SiPMs with very large pixel number up to 244k, and small pixel size down to $6\mu\text{m}$. A toy Monte Carlo was also built for comparison, which introduced almost all of the SiPM's characteristics, like PDE, crosstalk, afterpulse and recovery time.

Author: ZHAO, Zhiyu (TDLI/SJTU)

Co-authors: Mr QI, Baohua (IHEP); Prof. LIU, Yong (IHEP)

Presenter: ZHAO, Zhiyu (TDLI/SJTU)

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