

Silicon Photomultiplier selection and signal readout design for the Wide Field of View Cherenkov Telescope Array of LHAASO

The Wide Field of View Cherenkov Telescope Array (WFCTA), a main component of the Large High Altitude Air Shower Observatory (LHAASO), covers more than 2.5 orders of primary cosmic rays in each observation mode, which requires the dynamic range of the photoelectric device from 10 p.e. to 32000 p.e. The silicon photomultiplier (SiPM) is a new kind of photoelectric device developing rapidly in recent years. Compared with the classic photoelectric converter, PMT, the largest advantage of the SiPM for Imaging Air Cherenkov Telescope is that it would not be aged under strong light exposure which means the SiPM-based camera will be able to work during the half-moon night and achieve a longer duty cycle than PMT-based camera. The SiPM is made of multiple avalanche photodiode cells operating in Geiger-mode. The saturation happens when two or more photons hit on the same cell at same time. The fact cause the dynamic range of SiPM is depended on the total number of cells and the uniformity of the distribution of photons hitting on. The design of preamplifier for the WFCTA is introduced in this paper, and the dynamic range of the candidate SiPM for WFCTA is studied. The measured results can be described very well by the function which describes the relationship between the number of fired cells and the total number of cells in the SiPM. The additional non-linearity due to the non-uniform light distribution from the light concentrator and the spherical mirror is also evaluated in this paper, which contribute less than 2% at 32000 p.e. at the condition of the total number of cells in the SiPM is more than 230,000. Furthermore, we compared the performance of the SiPM and PMT under long time duration light pulse from 20 ns up to 3 μ s, since these telescopes will be used as air fluorescence telescopes array at the last observation stage.

Primary author: BI, Baiyang (IHEP, CAS)

Co-authors: Dr ZHANG, Shoushan (Institute of High Energy Physics); Prof. CAO, Zhen (Institute of High Energy Physics); 尹丽巧; 王^①

Presenter: BI, Baiyang (IHEP, CAS)

Track Classification: Astrophysics and space instrumentation