

The performances of photomultiplier tube of WCDA++ in LHAASO experiment

In order to extend the dynamic range of Water Cherenkov Detector Array (WCDA) in Larger High Altitude Air Shower Observatory (LHAASO), another 1.5-inch photomultiplier tube (PMT) is placed aside the 8-inch PMT in each cell of WCDA. All these 1.5-inch PMTs, total 900, consist of the WCDA++ system. The performances of these 1.5-inch PMTs, with special designed di-output voltage divider, are test by using the PMT test system of Shandong University. Especially, the working voltage and signal width effect on the dynamic range of these PMTs is studied. The results show that: the dynamic range, within 5% charge non-linearity under signal width of 5.5ns, is up to 200 kPEs (PhotoElectrons); the dark noise count rate is less than 200Hz under the 1mV threshold at PMT gain of $2e+05$; the transit time spread (TTS) is less than 4ns. 3 adjacent PMTs' working voltage are difference within 2V , and can share one high voltage power supply. These results confirmed that PMT performance meet the WCDA++ requirements.

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