

## Research on a method for measuring the uniformity of large scale photoelectric converter

Photomultiplier tube(PMT) is a photoelectric element for detecting weak optical signal. Photomultipliers are typically constructed with an evacuated glass housing, containing a photocathode, several dynodes, and an anode. When it working, there is a certain voltage between adjacent electrodes and incident photons strike the photocathode material, the photocathode will release a certain number of photoelectrons which will play on the first multiplier under the acceleration of the electric field and each photoelectron will emit 2.5 secondary electrons from the emitter. These secondary electrons are then accelerated by the electric field on the second multiplier and emit more electrons. Finally, this large number of electrons reaching the anode results in a sharp current pulse.

Currently, the PMT are used in a series of high precision photometry. In industry, we need to test many performance of PMT, such as Photocathode uniformity, Single Photoelectron Spectrum, dark counts and so on. This paper design a test system to test the uniformity of PMT. When the bottom of the photomultiplier tube is illuminated the same intensity and wavelength of light at different pixels, photocathode excitation electrons. These electrons are directed by the focusing electrode toward the electron multiplier, where electrons are multiplied by the process of secondary emission. After measuring the current of PMT photoelectric conversion, we can get the difference of each pixel of PMT. From the bottom of the PMT to the equatorial position, each layer is set to increase the luminous point, there are 80 pixels in all 6 layers which covering the entire PMT. The current can be measured stably when each pixel light 3 seconds and it takes 3 seconds to switch the channel, in general, measure the uniformity of a PMT takes only about 8 minutes. Considering the simplicity and stability of system hardware design, we split system into two parts, with part 1 is control board and part 2 are five signal boards. The signal boards mainly as signal generating section to create the same wavelength light with control board includes power section, mcu, fast ethernet. With external DC power, mcu is responsible for handling the order of ethernet received and then control output of the high precision ADCs on the signal boards to make LD in corresponding channel create voltage precisely. When completely establish the test system, use the reference photomultiplier tube to calibrate the light intensity of each pixel. By lighting 80 channels sequentially, galvanometer collect the PMT current when each channels of LD lights on. After repeated tests, the consistency of the 80 channels of the test system is less than 3% successfully, which includes the consistency of PMT, galvanometer, high voltage, system error and calculation error, among them, the average difference of each channel is 0.8% within one hour and 1.5% within four hours.

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