PECULIARITIES OF THE USE OF PHOTOELECTRON MULTIPLIERS (PHEM)

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ABSTRACT. Particular recommendations are given on the use of PHEM in the photon count regime.

The use of photoelectron multipliers (PHEM) in many fields of science and engineering has led to their wide promulgation. In the meanwhile their use in passport regimes is nearly always connected with a number of peculiarities and limitations which are rather wholly described in the handbook (Larionova, 1985).

The investigations of PHEM carried out for the determinations of their characteristics and limiting capacities resulted in using them in the regime of photon count (PHC) or one electron regime. This regime permitted to study radiation sources with energy flux amounting to 10(-17) walt at the PHEM input window.

The use of PHEM in the PHC regime required supplementary investigations on the stability response, spectral sensitivity, multiplication factor, dark current, radiation resistance, temperature stability and on a number of other parameters (Berkovsky et al. 1976, Gulakov et al. 1989, Vetokhin et al. 1979).

In the present work we have made an attempt of giving common recommendations on the use of PHEM with multialkali and oxygen photocathodes.

PHEM power supplies should be of high stability, have the voltage up to 2.5 kilovolts with the possible discrete voltage switching to 10 – 20 volts within all the range of PHEM supply. This is urgent for selecting a working point in the plateau of phem count characteristics.

The voltage divider in supplying the PHEM diode system at the work in the PHC regime should not be uniform to provide the decay of volume changes which are formed in the photocathode and anode area.

Resistances R in the voltage divider are commonly chosen from 100 to 200 kOm and distributed as follows:

photocathode – modulator – 1.5 R, modulator – the first dynode – 0.5 R, up to the last dynode – R, the last dynode – unified bus – 0.1 R.

The case when the work is carried out with the earthed cathode is more efficient since the photocathode proves to be at the same potential as the ambient cooling elements. This brings about the decrease in dark current fluctuations but it is connected with the use of high voltage interstage capacitor for picking up the signal from the PHEM.

The PHEM balloon screening with magnet soft materials permits to remove the Earth's magnetic field influence, whereas the bifiling arrangement of thermoelectrocoolers (THEC) and the wires feeding them saves PHEM from the influence of magnetic and electric fields of THEC.

It is also necessary to supply a safe shielding from the outer exposures to light, radiation fluxes and atmospheric heavy showers, due to high energy particles present in the upper atmospheric layers. These fluxes and showers can give rise to fluorescence of materials being near PHEM.

Main contribution to the PHEM dark current is made by thermoelectron emission of a photocathode and dynodes. One can get rid of greater part of thermoelectron dynode noises by means of the amplifier–discriminator.

One electron pulses from the photocathode of PHEM conditioned by thermoelectron emission principally are not distinct from photoelectron pulses. Therefore, the most efficient procedure of decreasing the dark current is the photocathode thermoemission suppression by means of cooling. According to our data the cooling, for example, of PHEM–83 down to 248 K enables to decrease the dark current by the order of 4 whereas that of PHEM–79 by 30–fold.

It is stated that in the oxygen photocathodes the dark current drops by one order in cooling the photocathode by 14–15 K, whereas it's no use cooling multialkali ones lower than 273 K, it is important to keep temperature on one stable level as precise as 0.5 K. The use of semiconductor thermoelectron coolants permits to attain the task set with the greatest simplicity and economy (Pereversentsev et al. 1989). It tares two–three hours for such systems to start functioning under certain regime. During exploitation there arise unforeseen complications as well, you should know about them beforehand.

So, in particular, it is necessary to get rid of freezing moisture (hoar–frost) sticking to the photocathode in deep cooling.

This phenomenon control is simple enough: dessication of the air in the volume near–by the photocathode with the help of silica gel or this volume hermitization with simultaneous dessication.

One should bear in mind about non–uniform photocathode sensitivity that is of importance during astronomical observations of small angular objects.

The use of fluorine stratum as one of the materials for producing a small panel of the voltage divider provides particularly small current losses but there is some doubt pertaining its luminescence durability.

Taking into account all these measures, nevertheless, a constant control of PHEM condition in sensitivity is needed. For the control it is worth while using light diodes, inexpensive and rather stable in sensitivity, which are fed from current stabilizers.

Taking all these measures against interferences, the following regulations of work with PHEM should be observed.

Before starting the work, wash PHEM and the small panel of the voltage divider by the method of dipping. Let the PHEM stand all day long in full darkness at the voltage by about 100 volts higher than the working one.

It is preferable to switch on PHEM and the system in which it is functioning two–three hours before the outset of the work.

For you own feeling well, it is necessary to provide the safe earthing of the system.

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