GAS GAIN AND AGING RATE OF THE GAS DISCHARGE DETECTORS

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The results of the study of gas discharge detectors aging rate dependence from the gas gain have been presented. During the shot time aging tests in laboratory conditions to accumulate the dose equivalent to a few years of work in physical experiment a special accelerated regime have to be applied. This implies irradiation of the detector with high intensity radiation sources or with

a particle accelerator beam that provides 0.5÷5 µA/cm of exposition current. At the same time an applied high voltage to the detector usually provides few times higher gas gain in compare with a normal working point, Ref. [1]. To study the anode swelling mode of aging, which appears at accumulated dose above 1 C/cm, both aging accelerating means were applied, Ref. [2]. Thus the extrapolation reliability of the laboratory test results on the real experiment is a goal of given study. Aging tests of the straw-tubes [2] were performed with a 60%Ar + 30%CO_2 + 10%CF_4 working gas mixture, which components are typical for the modern gas discharge detectors. The degradation study of the straws was carried out using three ^{90}Sr β-sources with a total rate onto one straw of 15 MHz. We chose the working points of the high voltage to achieve gas gains and irradiation currents over a broad range: 2×10^4, 5×10^4, 1×10^5 and 0.38 µA/cm, 0.97 µA/cm, 1.98 µA/cm, respectively. In Fig.1 (left) it is shown the gas gain degradation due to the anode wire swelling with accumulated dose. Fig.1 (right) shows the linear approximation of the aging rate - R (%/C/cm) dependence on the gas gain. As one can see R is stable and in average it is equal to <R>=6.87±0.13. This let us to conclude that accelerated aging results can be extrapolated (gas gain of 5×10^4–1×10^5) to the physical experiment conditions (gas gain of 2×10^4).
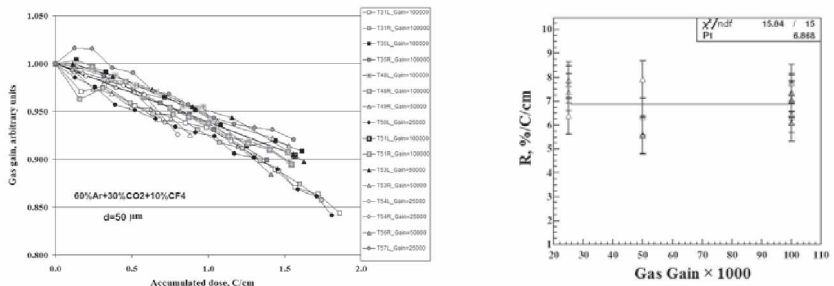

Fig. 1. Gas gain degradation due to the anode wire swelling with accumulated dose (left); swelling aging rate R(%/C/cm) dependence from the gas gain in the straw-tubes (right).

1. T.Ferguson *et al*. // Nucl.Instr. and Methods. A. 2002. 488. V.1-2. P.240.
2. T.Ferguson *et al*. // Nucl.Instr. and Methods. A. 2003. 515. V.1-2. P.266.