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SIMPLE METHOD FOT MEASUREMENTS OF DRIFT VELOCITY AND LIFETIME OF ELECTRONS IN CASEOUS AND LIQUID KRYPTON

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Abstract

New method for measurements of the drift velocity V_d and electron lifetime τ in gaseous and liquid krypton is suggested. The principle of the monitoring system is based on the usage of fast gas-discharge radiating soft X-ray. These X-rays produce photo electrons on the cathode of ionizing chamber. The drift velocity and electron lifetime are obtained from analysis of pulse shape.

1. Introduction

Gaseous and condensed noble gases are extensively used as a working media for ionization detectors of elementary particles, see for example [1–5]. The basic characteristics of these detectors like time, spatial and energy resolution are determined by drift velocity V_d of electrons and its lifetime τ in working media. It is known that even a little amounts of electronegative impurities dramatically affect on the parameters of detecting media [6]. For this reason the development and the implementation of a prompt and accurate method to measure V_d and τ in noble gases and liquids is an important problem.

Below well known methods are listed. Radioactive sources (α, β) and minimum ionization particles can be used for measurements of V_d and τ [7,8]. The weak point of this method is low signal to noise ratio therefore it is often impossible to make on-line measurements with needed accuracy.

A method based on the production of electrons into the ionizing chamber by means of short pulses of X-ray with energy about 30 keV coming to the chamber volume through a thin window was proposed [9]. This method can not be use in large detectors.

In experiments [10,11] short high power pulse of ultraviolet laser radiation was used to extract photo-electrons out of the metal plate of ionizing chamber filled by liquid argon (krypton). The advantages of this method are large signal to noise ratio, possibility to measure V_d and τ with a single laser pulse. High price of UV-laser and the necessity to input the laser light into the cryogenic volume are disadvantages of this method.

The purpose of present work was to develop low price and simple method for the fast measurement of detecting properties of gaseous and condensed noble gases. The method is based on fast pulse gas-discharge operating inside of monitoring device and radiating soft X-ray. Developed monitoring system is used in LKr calorimeter of the «Kedr» detector [1,2,4].

2. Experimental device

Figure 1 shows schematic view of the monitoring device. Two electrodes 3,4 of the ionizing chamber are placed inside of cryostat 1. The gap between electrodes can be varied by moving of electrode 4 along the ceramics roads 5. The discharge unit is installed at the