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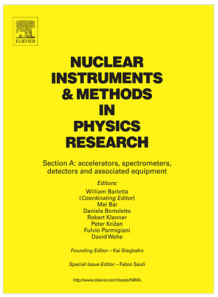

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Design of a Portable Dose Rate Detector Based on a Double Geiger–Mueller Counter

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Abstract

A portable dose rate detector was designed to monitor radioactive pollution and radioactive environments. The portable dose detector can measure background radiation levels (0.1 μSv/h) to nuclear accident radiation levels (>10 Sv/h). Both automatic switch technology of a double Geiger–Mueller counter and time-to-count technology were adopted to broaden the measurement range of the instrument. Global positioning systems and the 3G telecommunication protocol were installed to prevent radiation damage to the human body. In addition, the Monte Carlo N-Particle code was used to design the thin layer of metal for energy compensation, which was used to flatten energy response. The portable dose rate detector has been calibrated by the standard radiation field method, and it can be used alone or in combination with additional radiation detectors.

Keywords:

Portable equipment, dose rate detector, Geiger–Mueller counter, energy compensation

1. Introduction

Nuclear safety has become a growing concern because of the widespread application of nuclear technology in daily life. Nuclear facilities or radioactive nuclides can release penetrating radiation into the surrounding environment; these rays can harm to the human body. However, ionizing radiation cannot be perceived by the physical senses. The use of radiation detectors is one of the most effective ways to protect against exposure to radiation. Gamma radiation is an important part of external exposure because of its strong penetrability [1]. Therefore, accurate measurement of the gamma dose rate is very important.

In recent years, various gamma detectors have been widely used for dose rate measurement, including gas detectors, scintillation and semiconductor detectors [2-4]. Among gas detectors, the Geiger–Mueller (GM) counter is commonly used to monitor the gamma dose rate [5]. The GM counter is one of the oldest existed radiation detector types; this affordable, simple, and flexible detector has numerous advantages [6, 7]. The long “dead time” of the GM counter is its biggest weakness because the measurement range of the dose rate is limited by it [8]. The traditional GM counters (composed of single GM counter) have a narrow range of dose rate responses, and the effective measurement range is approximate three orders of magnitude. Normally, personnel need to carry dose rate detectors close to the target. This methodology is extremely dangerous and inconvenient. Thus, traditional detectors

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