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# NEW EXPERIMENTAL PARAMETERS FOR MONITORING ENERGY SPECTRA OF GAMMA-RAY RADIATIONS IN THE ENVIRONMENT

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## Abstract

Large amount of radioactive sources generate gamma rays of various energies and intensities. Gamma-ray spectroscopy is applied for the quantitative study of the energy spectra of gamma-ray sources. In the present paper, a statistical analysis of the energy spectra of gamma-ray spectroscopy monitored during 4 years at the "Dosimetry and Radioprotection" Laboratory from "Vasile Alecsandri" University of Bacău is provided. Several new mathematical parameters were calculated based upon the experimentally recorded gamma-ray spectra. The coordinates of spectrum mass center (X_CM, Y_CM) in Cartesian axis system Oxy and the area (Area) corresponding to the whole gamma-ray energy spectrum were selected to perform the statistical analysis. The gamma-ray energy spectra were divided into three regions: the first between 1-400 keV; the second between 400-1000 keV and the third beyond 1000 keV. For each of the spectra region there have been calculated the mass center coordinates and the related area: (X1_CM, Y1_CM) and Area 1 corresponding to the first region; (X2_CM, Y2_CM) and Area 2 corresponding to the second region; (X3_CM, Y3_CM) and Area 3 corresponding to the third region. The coordinates of sub-spectrum mass center (Xi_CM, Yi_CM) and area (Area i) for each spectra region described above were also used for statistical analysis. Data were processed by using univariate descriptive statistics and principal components analysis (PCA), as multivariate statistical methods. The analysis of variance ANOVA of the above parameters did not confirm significant statistic differences among mean parameters from one year to another. Pearson correlation coefficients (R) between the proposed parameters revealed a strong inverse association involving Area 1/Area and Area 2/Area (R=-0.981), as well as between Area 1/Area and X_CM (R=-0.868), and between Area 1/Area and Y_CM (R=-0.889), and a strong positive association between Y_CM and Y1_CM (R=1.000), Y_CM and Y2_CM (R=0.969), Y_CM and Y3_CM (R=0.953). Results obtained by PCA applied to correlation matrix of the selected parameter data were able to explain 97.456 % of the total variance (the first three principal components PCs) and establish a certain structure of data. All in all, there have been observed three modifications of time oscillation frequency according to the suggested gamma-ray energy spectra regions. During all recording time, the behavior of the Area 3/Area was distinguished by the others proposed parameter (e.g. Area 1/Area and Area 2/Area). Thus, two of them, Area 1/Area and Area 2/Area have an opposite oscillation while the third: Area 3/Area parameter reveals a slow oscillation. A calibrate model based on this new experimental parameters for monitoring energy spectra of gamma-ray radiations may be useful in environmental risk prediction.

*Key words:* environmental radioactivity, gamma radionuclides, monitoring radiation

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