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Analysis of complex gamma-ray spectra using particle swarm optimization

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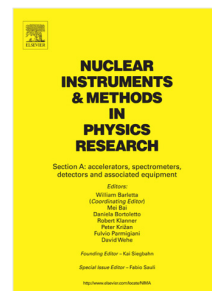
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4                                    **Analysis of complex gamma-ray spectra using particle swarm optimization**

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7                                    **Abstract**

8                                    Analysis of gamma-ray spectra is an important step for identification and quantification of  
9                                    radionuclides in a sample. In this paper a new gamma-ray spectra analysis algorithm based on  
10                                   Particle Swarm Optimization (PSO) is developed to identify different isotopes of a mixed  
11                                   gamma-ray source and determine their fractional abundances. PSO is an iterative algorithm that  
12                                   imitates the social behaviors observed in nature to solve complex optimization problems. The  
13                                   PSO method is used for complex fitting to the response of a 3×3 inch NaI (Tl) scintillation  
14                                   detector and the fitting process is controlled by a test for significance of abundance and  
15                                   computation of Theil coefficient. To test the developed algorithm, a number of experimentally  
16                                   measured gamma-ray spectra related to a mixed gamma-ray source including different  
17                                   combinations of  $^{60}\text{Co}$ ,  $^{57}\text{Co}$ ,  $^{22}\text{Na}$ ,  $^{152}\text{Eu}$  and  $^{241}\text{Am}$  isotopes are analyzed using information of  
18                                   whole spectrum. The performance of the developed PSO algorithm is compared to the multiple  
19                                   linear regression (MLR) method as well. The results of the developed PSO algorithm show a  
20                                   better match with the real fractional abundances than that of MLR method.

21                                   **Keywords: Gamma-ray spectroscopy, Particle swarm optimization, Whole spectrum analysis**

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