New Approach To Calculate The True-coincidence Effect Of HpGe Detector

I.A. Alnour[1,a], H. Wagiran[2], N. Ibrahim[3], S. Hamzah[4], W.B.Siong[5], M. S. Elias[4]

[1]*Department of Physics, Faculty of Pure and Applied Science, International University of Africa, 12223 Khartoum, Sudan*
[2]*Department of Physics, Faculty of Science, Universiti Teknologi Malaysia, 81310 UTM Skudai,Johor, Malaysia*
[3]*Faculty of Defence Science and Technology, National Defence University of Malaysia, Kem Sungai Besi, 57000 Kuala Lumpur, Malaysia.*
[4]*Malaysia Nuclear Agency (MNA), Bangi, 43000 Kajang, Selangor D.E., Malaysia.*
[5]*Chemistry Department, Faculty of Resource Science & Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.*

[a]Corresponding author: aaibrahim3@live.utm.my; ibrahim.elnour@yahoo.com

Abstract. The corrections for true-coincidence effects in HpGe detector are important, especially at low source-to-detector distances. This work established an approach to calculate the true-coincidence effects experimentally for HpGe detectors of type Canberra GC3018 and Ortec GEM25-76-XLB-C, which are in operation at neutron activation analysis lab in Malaysian Nuclear Agency (NM). The correction for true-coincidence effects was performed close to detector at distances 2 and 5 cm using ^{57}Co, ^{60}Co, ^{133}Ba and ^{137}Cs as standard point sources. The correction factors were ranged between 0.93-1.10 at 2 cm and 0.97-1.00 at 5 cm for Canberra HpGe detector; whereas for Ortec HpGe detector ranged between 0.92-1.13 and 0.95-100 at 2 and 5 cm respectively. The change in efficiency calibration curve of the detector at 2 and 5 cm after correction was found to be less than 1%. Moreover, the polynomial parameters functions were simulated through a computer program, MATLAB in order to find an accurate fit to the experimental data points.

INTRODUCTION

This paper presents a simple method to calculate the true-coincidence effects of two HpGe detectors available at Malaysian Nuclear Agency. A true-coincidence effect occurs when multi-gamma radionuclides are utilized by a detector in gamma-ray spectrometry. At the same time, source of error also results within the resolving time of the spectrometer, from the cascade of γ-rays emitted by radionuclides with complicated decay scheme. Correction factors must be calculated from full energy peak. Areas under full energy peak depend on the geometry and reach a high value for close source-to-detector geometries [1-5]. If the efficiency of the detector is determined as a function of energy by means of a set of standard or multi-gamma sources, then true coincidence corrections needs to be applied[1]. No corrections have to be applied if a sample is measured relative to a standard of the same radionuclide. However,

The true coincident effect is independent of the γ-ray activity of the sample measured and is proportional to the detector's efficiency of each γ-ray in coincidence. Corrections for coincident gamma are necessary for close source-detector distance. In this work, correction of true coincident effect was made using the method proposed by Montgomery [2]. The correction factor C_c is the multiplicative factor to convert measured gamma-ray efficiency with summing effects on efficiency. The coincidence summing correction factor can be estimated from the following equation:

Advancing Nuclear Science and Engineering for Sustainable Nuclear Energy Infrastructure
AIP Conf. Proc. 1704, 030005-1–030005-8; doi: 10.1063/1.4940074