Abstract No: 91 ***Physical Sciences***

ANGULAR CORRELATIONS OF POSITRON EMITTERS BY SETTING UP A COINCIDENCE DETECTION SYSTEM

W.D.S.N. Gunarathna[1], C.S. Sumithrarachchi[2] and M.R. Lamabadusuriya[1*]

[1]Department of Nuclear Science, Faculty of Science, University of Colombo, Colombo, Sri Lanka
[2]Michigan State University, East Lansing, Michigan, USA
[*]manuja.lama@nuclear.cmb.ac.lk

In many nuclear decay processes, two or more simultaneous or successive radioactive emissions occur. The angular correlation of these events carries information that a single detection method cannot acquire. Coincidence methods are employed to detect these events and utilized in applications such as Positron Emission Tomography (PET) to produce functional and static images by acquiring position information. This study is focused on building proper instrumentation to assess a cost-effective method to characterize positron emitters that can be developed as PET-radiotracers in Sri Lanka. As the initial approach, the angular distribution of positron annihilation was obtained using ^{64}Cu. The thermal neutron activation was used to produce ^{64}Cu from a $CuSO_4.5H_2O$ sample. Two NaI (Tl) scintillation detectors have been used to build a delayed coincidence system coupled to scalar counters by applying energy windows using single-channel analyzers. The well-known angular distribution of ^{60}Co with the theoretical angular correlation coefficients has been used to validate experimental results and to optimize input delay time and source-to-detector distance. A standard ^{22}Na source was used to determine the coincidence efficiency of the experimental setup, which was then used to quantify ^{64}Cu in the sample. The experimentally acquired angular distribution correlation function and coefficients for ^{60}Co show an agreement with the theoretical data. The efficiency of the coincidence setup was measured as 0.18% for 511 KeV positron annihilation gamma emission. The activity concentration of neutron-activated ^{64}Cu has been quantified as 136.8 Bq/g. The angular distribution of ^{64}Cu and ^{22}Na was compared with each other. Hence, it can be concluded with this setup; it is possible to evaluate positron emitters produced in Sri Lanka cost-effectively at the production site as the initial approach prior to the direct testing with PET scanners which need higher expenses.

Keywords: Annihilation, Coincidence, ^{64}Cu, PET, Positron