【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Engineering)

Title of Project : Study on Multi-photon gamma-ray coincidence tomography

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Research Project Number : 17H06159 Researcher Number : 70216753
Research Area : Nuclear Engineering
Keyword : Radiation Measurement, Nuclear Medicine, Imaging, Coincidence, Gamma ray

【Purpose and Background of the Research】

Conventional gamma-ray diagnostics methods such as PET and SPECT have some fundamental limitations in resolution and sensitivity, respectively. We propose a new concept of time/position correlation type tomography method based on electron-tracking type gamma camera which can identify incident gamma-ray direction. This tomography method utilizes the correlation between multiple photons and provides the radioactivity concentration in the body with high resolution, high sensitivity, and high signal to noise ratio. We will study basic characteristics of this revolutionary gamma-ray imaging approach and try to fabricate a hemisphere scanner and explore the new principle. We plan to demonstrate molecular imaging with the In-111 labelled peptide through the two photon emission nuclide detection scheme for establishing a new gamma-ray diagnostic technique for the multiple gamma photon emitting nuclide such as Sc-44.

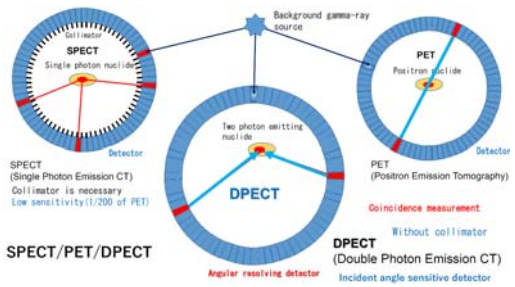

Figure 1 Comparison of SPECT/PET/DPECT

【Research Methods】

Gamma-ray imaging technique based on Time/Space correlation method will be proven and demonstrated. Pursuing its very high spatial resolution, sensitivity, and signal to noise ratio, This method is superior to others because the basic performance. The double photon emission computed tomography(DPECT: see Figure 1) is proposed here. We plan to make a hemisphere scanner which shows an event position without reconstruction methods. This research work is to develop a dedicated detector module, which consists of a semiconductor high resolution electron tracking detector and a high resolution scintillator pixel array. We also plan to fabricate a DPECT scanner using these modules arranged in a hemisphere geometry. Finally we will use an In-111 labelled peptide to show a mouse imaging as a demonstration of DPECT imaging scheme.

【Expected Research Achievements and Scientific Significance】

Establishment of a novel gamma-ray imaging principle and high-resolution molecular imaging beyond PET. PET requires 10^6 line of responses (LORs). Figure 2 shows two Compton camera images. Coincidence image is greatly improved.
Even one event provides one drug position in case if we use electron tracking method. This implies a very high sensitivity of molecular imaging, which can describe molecular interactions or antibody labelled tumor research.

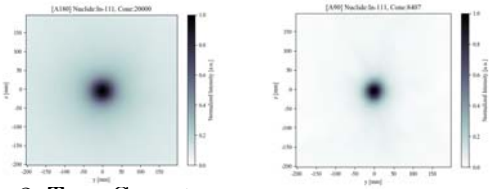

Figure 2 Two Compton camera images without coincidence (left) and with coincidence (right)

【Publications Relevant to the Project】

Y. Yoshihara, et al. Evaluation of double photon coincidence Compton imaging method with GEANT4 simulation, Nucl. Instr. and Meth. A, in press.

【Term of Project】 FY2017-2021

【Budget Allocation】 158,300 Thousand Yen

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