43

Progress report for the mass Production of Radioisotope by High-Current Proton Cyclotron at KIRAMS

원자력의학원 싸이클로트론 응용연구실

전권수 *, 김재홍, 이동훈, 안광일, 이지섭, 박 현, 안순혁, 양승대, 최창운

Purpose: The interesting radionuclides of positron emitters for PET images and gamma ray emitters for SPECT via various (p,xn) reactions has been produced with several different targets, which have been used for producing specific radionuclides: gas targets employed for C-11, F-18 and I-123 production (Nordion), a liquid target used only for the F-18 production, and solid targets (IBA) prepared for the production of Ga-67 and Tl-201 nuclides. The purpose of this study is to develop cyclotron targets to yield high activities and purities by optimizing proton beam energies, target thickness, and growing time. **Methods:** A Cyclone30 cyclotron (IBA) installed at 2002 and has been operating with four beam lines. The quality and yield of products are evaluated by proton energies, target thickness, bombarding time, and growth time. Radionuclidic impurities are determined by gamma-spectrometer with high purity Germanium (HPGe) detector and the yields are estimated by ion chamber. The theoretical yields based on recommended database are calculated and compared with these yields. **Results:** The production of medical isotopes of five radionuclides (C-11, F-18, I-123, Ga-67, Tl-203) are carried at KIRAMS with enriched target materials. The average yield of F-18, I-123, G-67, and Tl-201 radionuclides are 90mCi/uAh, 10mCi/uAh, 2mCi/uAh, and 1mCi/uAh at EOB, respectively. The radiochemical purity of product have been achieved higher than 99.7% and the production yield closely depends on target thickness, bombarding time, and growing time for the I-123, Tl-201, and Ga-67. **Conclusion:** The result show that KIRAMS established the facility for the mass production of several medical radioisotopes and the product quality is in accordance to Korea Pharmacopoeia. In addition, it is also shown the production yield should be improved while the quality remains acceptable. The future work at KIRAMS is focused on developing high power targets, upgrading cyclotron capability, and expanding beam lines.

44

Design, Simulation, and Reconstruction Strategies for Small Animal PET Scanner with 3-Layer Phoswich Crystals

Dept Nucl Med, Seoul Nat Univ, Korea Detector Lab[1], Dept Nucl Med[2], Korea Univ, Dept Physics, Konkuk Univ[3], Dept Elect Eng, Paichai Univ[4]

JS Lee *, SJ Hong[1], SM Kim, KS Sim[1], B Hong[1], KS Lee[1], DH Moon[1], S Park[1] JG Ghoe[2], JT Rhee[3], SJ Lee[4], DS Lee, J-K Chung, MC Lee

Purpose: Spatial resolution of small ring scanner degrades rapidly in the peripheral region due to the parallax error. Multi-layer phoswich crystal detectors were proposed to avoid this problem by allowing the estimation of the depth of interaction (DOI). In this study, an animal PET scanner with 3 layer-phoswich crystals was designed and simulated, and data storage and reconstruction strategies were investigated. **Methods:** The 3-layer configuration that we propose consists of 7 mm long LuYAP and 7 mm LSO crystals aligned with each other (99 array), and 5 mm LSO crystals (88) with an offset of 1.15 mm. The cross section area of all the crystals is 22 mm^2 and the LuYAP ends are attached to multi-anode PMTs. Four detector ring arrays consist of 24 detector modules around a circle such that the face-to-face diameter of the ring is 16 cm. Every other detector module in a ring is shifted axially for more homogenous axial sampling. In order to estimate the spatial resolution and the sensitivity of the 3-layer configuration, GEANT4 Monte Carlo program was used. LOR data were binned using native acquisition geometry to index a LOR for a pair of detectors. After rebinning the 3D data, transaxial slices were reconstructed using OSEM algorithm with the exact positioning of LOR. System matrix for EM algorithm was calculated using ray tracing method, for which the intersecting length of the LOR with each pixel was estimated. **Results:** The simulation showed that the 3-layer configuration has a potential to improve the spatial resolution by about 20~30% at 40.0 mm from the central axis over the 2-layer configuration without loss of sensitivity. Reconstruction error due to the insufficient spatial sampling was also reduced in comparison with the scanners using 2- or 3-layer configuration without offset of front LSO elements. **Conclusion:** Improvement in spatial resolution without loss of sensitivity was achieved with the system configuration and data analysis strategies that we proposed.