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Preliminary simulation studies on a cylindrical PEM scanner using GATE

闫强^{1,2}, 高娟^{1,2}, 单保慈¹, 魏龙¹

¹ Key Laboratory of Nuclear Analysis Techniques, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China

² Graduate University of Chinese Academy of Sciences, Beijing 100049, China

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摘要

In this paper, we investigate the performance of a cylindrical positron emission mammography (PEM) by simulation, in order to estimate its feasibility before implementation. A well-developed simulation package, Geant4 Application for Tomographic Emission (GATE), is used to simulate the scanner geometry and physical processes. The simulated PEM scanner is composed of 64 blocks axially arranged in 4 rings with an axial field-of-view (AFOV) of 12.8 cm and 16.6 cm in diameter. For each block, there is a 16×16 array of 2 mm×2 mm×15 mm lutetium yttrium oxyorthosilicate (LYSO) crystals. In the simulated measurements, the spatial resolution is at the center of the FOV of 1.73±0.07 mm (radial) and 1.81±0.08 mm (tangential), but of 4.83±0.09 mm (radial) and 4.37±0.07 mm (tangential) while 5 cm off the center. The central point source sensitivity (ACS) is 4.04% (1.50 Mcps/mCi) at an energy window of 350—650 keV. Moreover, the capillary and cylindrical sources are simulated coupled to breast phantoms for the scatter fraction (SF) and Noise Equivalent Count Rate (NECR) test. For a breast phantom with a 350—650 keV energy window, SF may reach the highest 32.95%, while NECR is degraded down to the lowest 255.71 kcps/mCi. Finally, we model a breast phantom embedded with two spheres of different activities. The reconstructed image gives good results despite a bit of difference in image contrast. Further, the image quality will be improved by scatter and random correction. All these test results indicate the feasibility of this PEM system for breast cancer detection.

关键词

[simulation, GATE, cylindrical PEM, evaluation](#)

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DOI:

通讯作者:

单保慈 shanbc@ihep.ac.cn

作者个人主页:

闫强^{1,2}; 高娟^{1,2}; 单保慈¹; 魏龙¹

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