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The Present and the future of Breast Cancer diagnosis

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The purpose of the presented investigation is to compare the sensitivity, specificity, PPV, and NPV for standard mammography, spectral mammography, ultrasound, and magnetic resource imaging (MRI), which are the commercially available imaging modalities for breast cancer. The aim of our investigation is to design, construct and establish the performance characteristics of the Jagiellonian Positron Emission Mammography (J-PEM), for the detection and diagnosis of cancer. Its construction is based on a novel idea of PET tomography based on plastic scintillators [1,2] and wavelength shifters (WLS) [7,8] and a new concept of positronium imaging [3,4,5]. This study characterizes the performance of a newly developed J-PEM scanner prototype. The prototype system consists of a single module of plastic scintillators, built from two layers of the plastic scintillator (6x24x500 mm) and one layer of the wavelength shifters (3x10x100 mm) [6,7] placed orthogonally between them. Each scintillator bar is attached at both ends to Silicon Photomultipliers for the signal readout. This 3D system is based on the novel idea of applying plastic scintillators to detect annihilation photons and improving spatial resolution by utilization of wavelength shifters (WLS). J-PEM can be an effective system for the detection and diagnosis of breast cancer in its early stage by improving sensitivity and specificity and it can be achieved by the combined use of plastic scintillators, which have superior timing properties, with the WLS. In addition, this device will be developed in view of the classification of malignancy based on the possibility of positronium mean lifetime imaging.

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