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Exploring X-Ray Phase-Contrast Imaging using Photon Counting Detectors for Early Breast Cancer Detection[1]

MINI DAS, Department of Physics, University of Houston, Houston, TX — X-ray attenuation-contrast (AC) imaging in the form of digital mammography (DM) is the current gold standard of screening for deep-set cancers like breast cancer. DM creates images based on the attenuation differences between normal and malignant breast tissue, but the extremely low attenuation contrast poses severe challenges for early cancer detection. In order to overcome these limitations posed by AC imaging, there is a growing interest in exploring phase changes in x-rays as they propagate through the tissue. Theoretical estimations show that the x-ray phase difference between normal and malignant breast tissue is three orders of magnitude higher than the corresponding absorption contrast. While x-ray attenuation is determined by the atomic number of the elements forming the tissue, the phase change is determined by the density or refractive index. Due to high energy of x-rays, absolute measurement of phase change is challenging. We will present our efforts to understand x-ray phase contrast in biological tissue using a photon counting detector (TIMEPIX), which is capable of energy and time resolved measurements with very high spatial resolution (about 50 microns). We are exploring novel methods, which will also be clinically feasible to extract phase information using a combination of PCDs and phase retrieval techniques. Phase changes and contrast details of various breast cancer types will also be investigated using the energy resolved measurements obtained using PCDs.

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