Impact of Compton scattering on the quality of radiographic images acquired with gamma-ray emitters radioisotopes and imaging plates

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The degradation of radiographic images acquired with X-ray-sensitive Imaging Plates, caused by Compton scattering of the incident gamma-rays on the object under inspection has been assessed for various gamma-ray energies, emitted by the reactor-produced radioisotopes ^{164}Dy, ^{198}Au and ^{56}Mn. For this purpose, images of several objects, including a specially tailored test-object, have been analyzed aiming at the evaluation of the related qualitative and quantitative results. A visual inspection of the images of some objects acquired with the three above mentioned radioisotopes, emitting gamma-rays within the range 95-1, 811 keV, has clearly shown the spoiling action of the Compton scattering. This phenomenon renders the exposed object into a volumetric source, casting penumbra on the Imaging Plate, degrading thus the final image. Higher photon energies yielded poorer images due to the higher probability of Compton scattering event. These results have been corroborated through quantitative assessments employing the determined Modulation Transfer Function – MTF [1] for each of the acquired images. As the utilized sources are beta-emitters as well, the response of the Imaging Plate to these particles have been verified by a naked exposure, i.e., with the Imaging Plate outside of its metallic chassis, avoiding thus the shielding due to the 2 mm-thick aluminum sheet. The capability of this sheet to attenuate properly the beta-particles has been verified by using a Geiger-Müller detector [2]. Besides a poorer spatial resolution, radiography employing high energy photons would demand a longer exposure time, as expected from an X-ray designed device. Under these circumstances, beta-particles have been found to rule the exposure process as in the case of ^{56}Mn.

References

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