

Calibration of Imaging Plates with radioactive Sources

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Several types of detectors exist in order to diagnose high-energy ions and electrons of pulse plasma: CR-39, radiochromic films (RCF), scintillators and image plates (IP). Although an IPs is passive detectors and cannot be used in high repetition rate experiments, IPs has several advantages over other particle detectors: persistency to electromagnetic pulse, high dynamic range (up to 10^5), high spatial resolution (usually 10 – 50 μm). In addition, IP can be erased with white light, allowing for reuse. In this work, the BAS-MS and BAS-TR image plates were calibrated for electrons and alpha particles using the medical scanner VistaScan Mini from Durr Dental. In addition, the fading measurements and the calibration of signal change from the film depending on the number of scans were performed.

Absolute calibration IP BAS-MS for electrons

Isotope $\text{Sr}^{90}/\text{Y}^{90}$ emits the continuous spectrum with a maximum energy of 2.28 MeV.

$$GL(E) = \alpha \int_0^W \frac{dE_{dep}}{dz}(E, z) e^{-z/L} dz = \alpha dE_{dep}^{eff}$$

where dE_{dep}/dz is amount of energy deposited by the incident and all the secondary particles in the phosphor layer between z and $z+dz$; W is the thickness of the phosphor layer; L is the absorption lengths; A, B, α – coefficients.

Absolute calibration IP BAS-TR for α particles

Isotope Pu^{239} emits α particles with energy of 5.1 MeV.

$$GL(E) = A \int_0^W \frac{dE_{dep}/dz(E, z)}{1 + B \left| \frac{dE_{dep}}{dz} \right|} e^{-z/L} dz$$

