Characterization of an extrapolation chamber for low energy X rays: Experimental and Monte Carlo preliminary results

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The extrapolation chamber is a special designed parallel-plate chamber that allows variation in the air cavity mass by means of a controlled change in the electrode separation. This chamber allows to determine directly the air kerma rates, presenting good response, specially for soft radiations as low energy X-rays and beta radiation. In this work, a homemade extrapolation chamber, designed and constructed at the Radiation Metrology Laboratory at IPEN/CNEN, was studied experimentally and using the MCNP-4C code in order to verify its applicability, as a secondary standard, for low energy X-rays. The simulation is important for the determination of the correction factors, the response of this ionization chamber in other X-ray qualities, and its response using electrodes of different materials and sizes. The ionization chamber has a collecting electrode of 30.0mm in diameter, guard rings made of graphite, entrance window of aluminized polyethylene terephthalate (0.84mg/cm^2 thickness), and polyethylene walls. The experiments were performed using a Pantak/Seifert X-ray system (5kV to 160kV), for the RQR3, RQR5 and RQR8 radiation qualities (IEC, 2005). The inter-electrode distance varied from 0.30mm to 1.25mm. The geometry of the extrapolation chamber was established into the MCNP-4C code in accordance with its specifications. The spectrum of the X-ray beams used in the simulation was obtained with a spectrometer, in the same conditions of the experiment, and for all cited radiation qualities. The comparison between the experimental and simulated results are in good agreement for all tested radiation qualities, and the maximum difference obtained was 2.5% for the RQR3 radiation quality, which demonstrates that the ionization chamber and the radiation conditions were simulated adequately. This fact indicates that this technique may be applied to other studies of this ionization chamber, as for instance to obtain the wall attenuation and scatter correction factors.

IEC 2005, *Medical diagnostic X-ray equipment – Radiation conditions for use in the determination of characteristics*, IEC 61267, International Electrotechnical Commission, Genève.

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