

ARE WE OVER-SHIELDING MAMMOGRAPHIC X-RAY IMAGING INSTALLATIONS?

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Introduction



- ❑ Shielding design of X-ray imaging facilities has been established by international scientific committees;
- ❑ Many countries adopted in their national laws the NCRP Rep. 49, 1976 recommendations on *structural shielding design and evaluation for medical use of X-rays and gamma rays of energies up to 10 MeV*;
- ❑ New reference guidelines on *structural shielding design for medical X-ray imaging facilities* were published on NCRP No. 147, 2004, incorporating new methodologies for calculations of barrier thickness [1] and updated physical data.

Purpose

- Mammographic equipments usually operate at low potentials between 25 and 35 kVp;
- Recent studies have shown that the NCRP recommendations can lead to an over-shielding of mammographic installations [2, 3];
- This can have a significant impact on the cost-benefit analysis of the installation;
- In this work we plan to address the validity of these studies with systematic measurements of shielded and non-shielded kerma values in X-ray laboratories and real mammographic facilities;
- These measurements will be supported by Monte Carlo (MC) simulations.

Methodology

- Measurements of filtered spectra have been performed with a X-ray tube with a SDD at different angles;
- A simple MC simulation of the experimental layout was implemented with the code package PENELOPE [4];
- A complete simulation will be performed in two steps:
 - ▣ Simulation of the primary and scattered radiation by a phantom in a realistic mammographic facility;
 - ▣ The scattered spectra will be used as an input for a second simulation of the attenuation by different shielding thicknesses and materials.

Experimental spectra



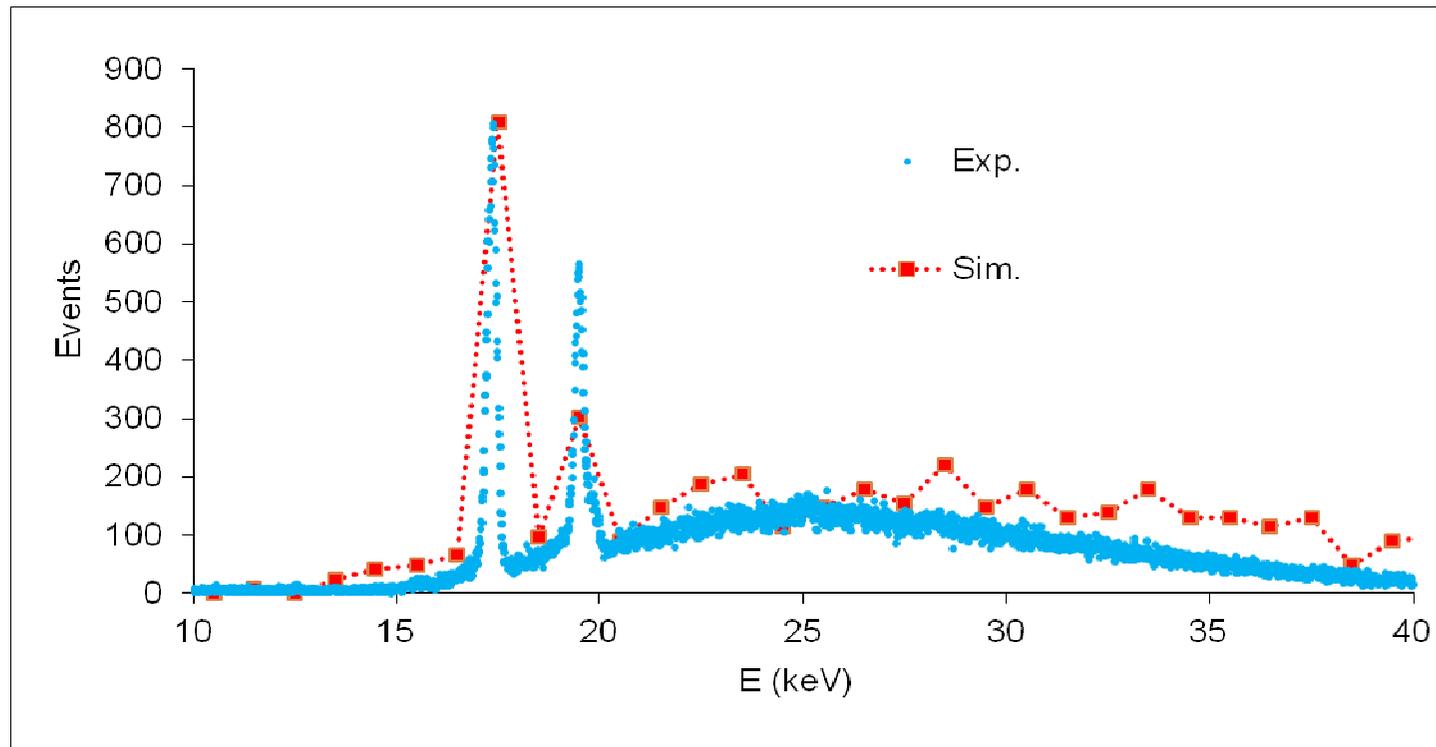
The X-ray tube operated at 50 kVp and 1 mA;

Spectra were acquired for 200s and different angles (0, 45, 90, 135 degrees).

The experimental setup includes:

- ❑ X-ray tube: Oxford instruments Series 5000 Model: XTF5011 with a Be window;
- ❑ Collimator;
- ❑ SDD detector: Vortex with a 25 μm Be window.

Preliminary results



Comparison between measured and simulated transmitted spectra at 0 degrees.

The simulation was done with 3×10^7 primary electrons hitting a Mo anode and including all the main features of the experimental

MC calculations with PENELOPE are in good agreement with the measurements.

Follow up

- MC simulations need to be optimized to get proper statistics. This can be attained by splitting the simulation in one additional step describing the interaction of primary electrons with the anode and X-ray tube;
- The simulation of the transport and attenuation of the scattered radiation is being implemented;
- Measurements of kerma values in realistic mammographic installations are undergoing;
- This will be followed by a simulation of a realistic mammographic installation;
- A fast code package will be developed in the future to help qualified radiation experts in shielding calculations.

References



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