LET CALCULATIONS FOR LOW ENERGY DIAGNOSTIC X–RAYS

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1 - INTRODUCTION

Radiobiological and microdosimetrics studies have investigated the RBE of low energy X-rays mammography, and related the RBE produced by a reference X-beams of 200 kVp. These studies have shown an expressive disagreement between their RBE values.

The existing studies on mammography have also motivated risk-benefit investigations on diagnostic procedures such as in pediatrics radiology, using low energy X-rays.

This data is presently in need, in order to improve the existing radiation protection recommendations as well as the justifications for the use of diagnostic X rays procedures in pediatrics.

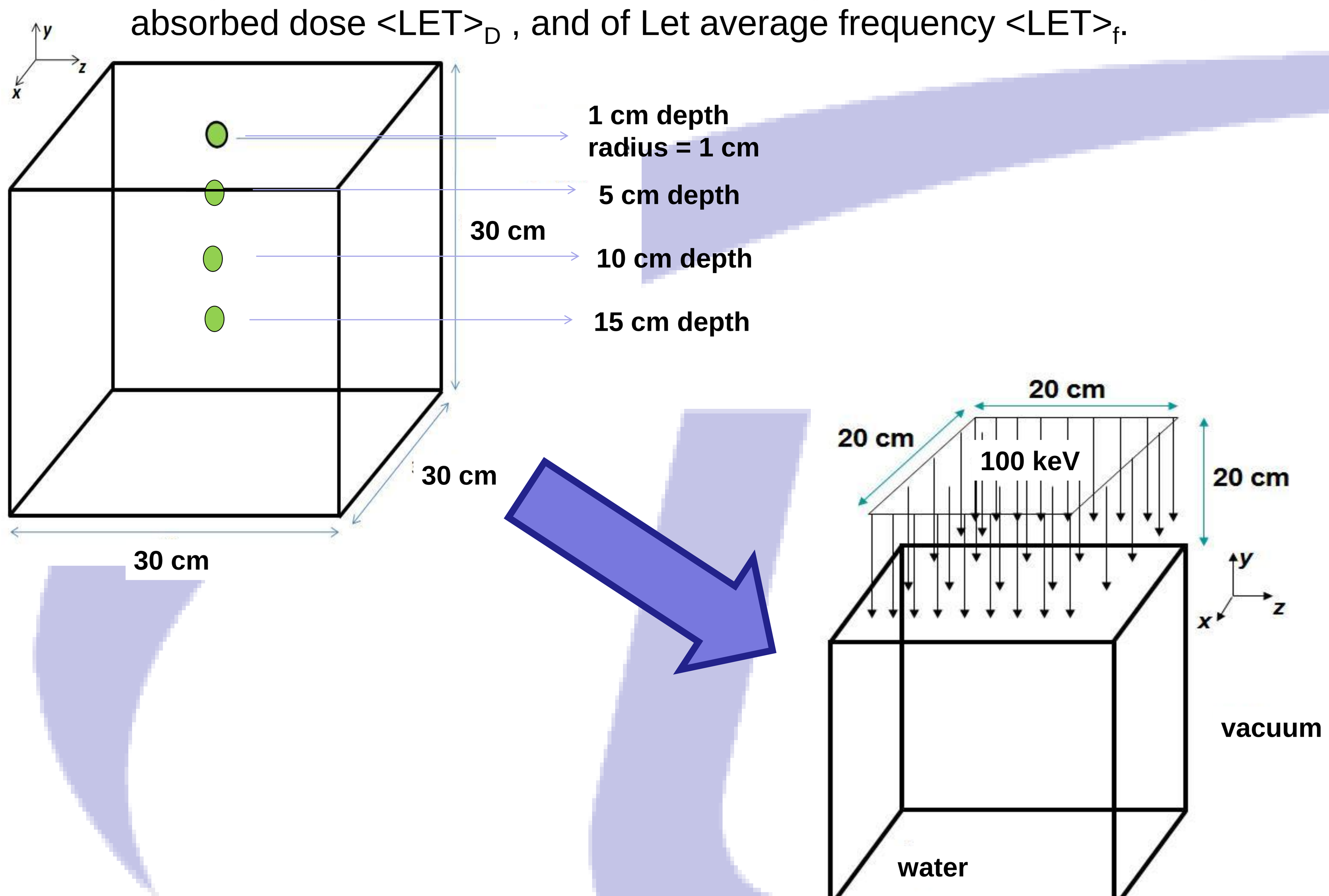
2 - OBJECTIVES

Investigate realistic quality factors for low energy photons and to derive more appropriated values of RBE for the energy range typically used in pediatric radiology.

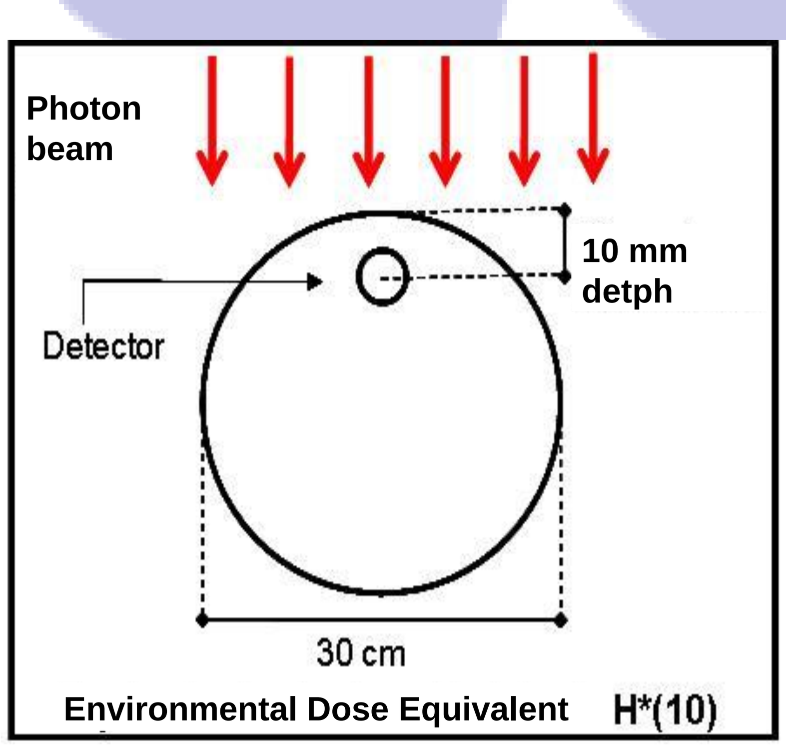
3 - METODOLOGY

The simulations are performed on a computer with an Intel Core 2 Quad 2.4 GHz, 1.98 GB RAM available in the lab, with the operating system LINUX Mandriva distribution and code Geant4 version 9.1.p02. Different geometries have been constructed in accordance with studied.

- Obtaining the spectra of photons and secondary electrons, of Let average absorbed dose $\langle LET\rangle_D$, and of Let average frequency $\langle LET\rangle_f$.



- The ICRU sphere, defined as a reference by the International Commission on Radiation Units and Measurements (ICRU) [3] to obtain the dose distribution for greatness Environmental Dose Equivalent, H * (10).



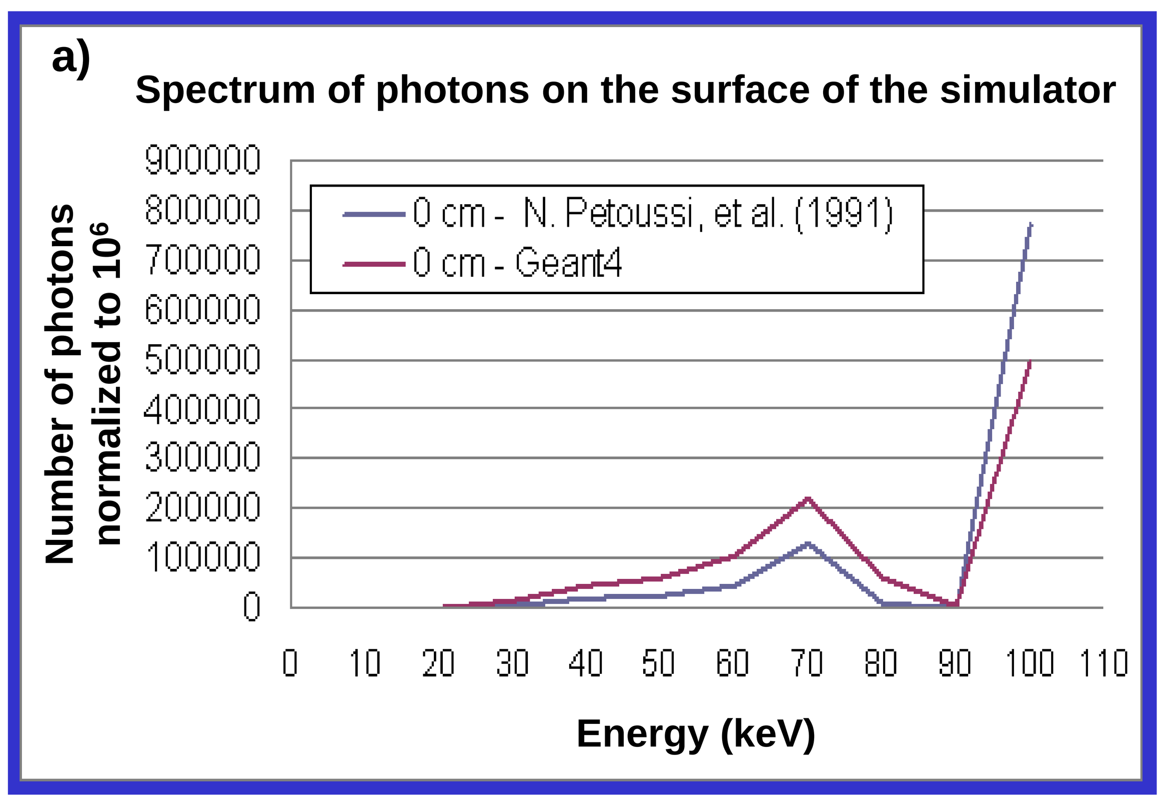
4 - RESULTS

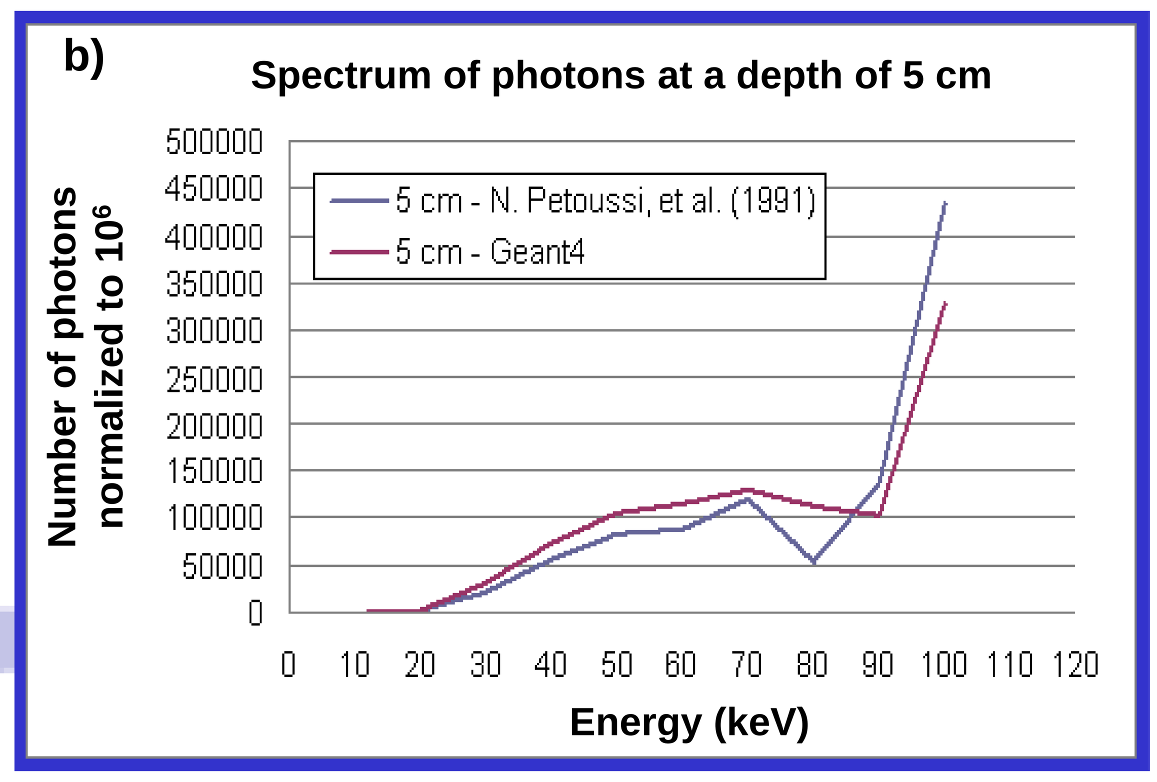
The results were compared with the literature (with a range of 200 kVp) showed good agreement (Table 1). The differences between the values can be assigned to different filtrations considered in the literature adopted.

Table 1: Let average absorbed dose, $\langle LET\rangle_D$, and Let average frequency, $\langle LET\rangle_f$ obtained in the simulation with a monoenergetic beam of 100 keV and those obtained by A. M. Kellerer [1] with a spectrum of 200 kVp.

Beams	$\langle LET\rangle_f$ (keV/µm)	$\langle LET\rangle_D$ (keV/µm)
Monoenergetic of 100 keV (this study)		
1 cm depth in central axis	2,971	3,785
1 cm depth. Shifted -7 cm in Z	2,969	3,797
1 cm depth. Shifted -14 cm in Z	3,020	3,699
5 cm depth in central axis	2,989	3,745
X ray of 200 kVp (obtained by Kellerer)		
Tungsten, 1 mm Cu, 2 mm Al	1,56	3,58
Tungsten, 0,5 mm Cu	1,61	3,74

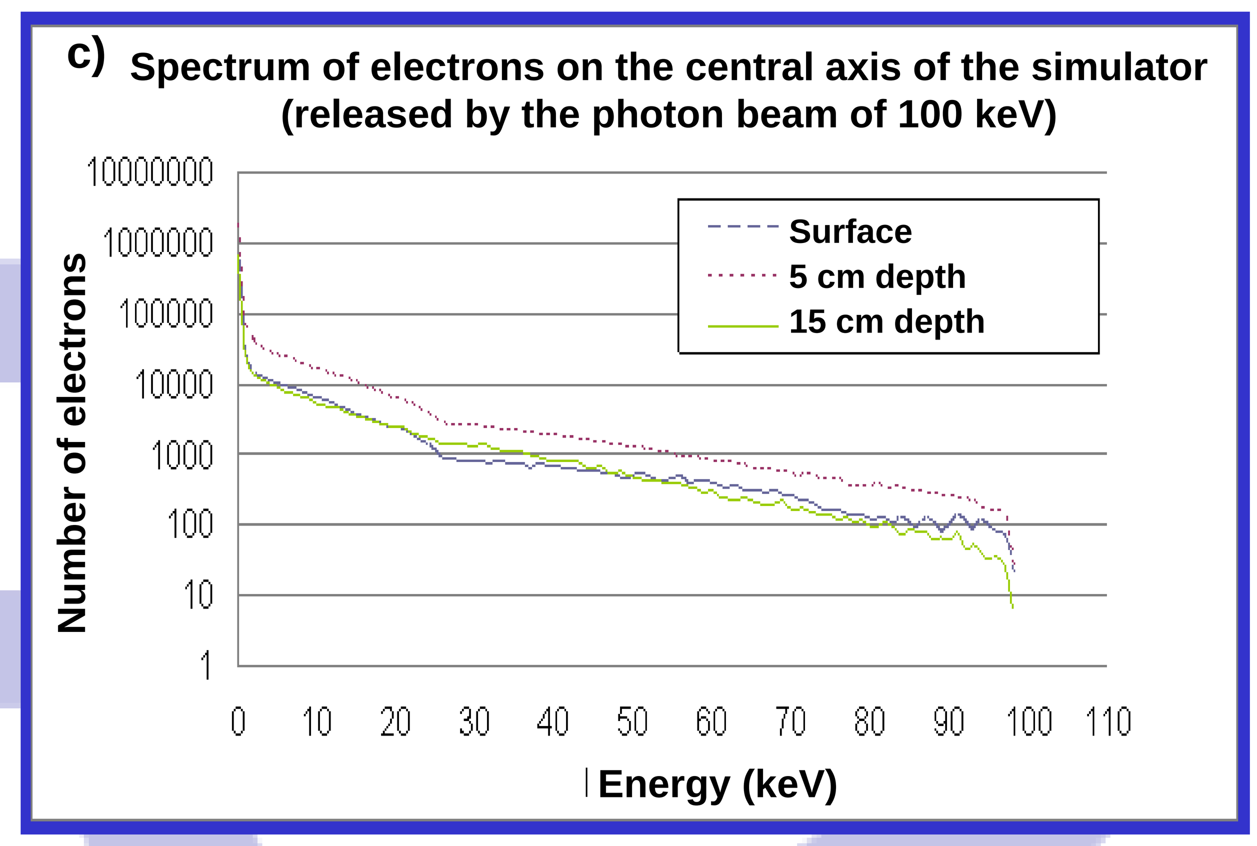
Photon spectrum in depth compared with the reference.

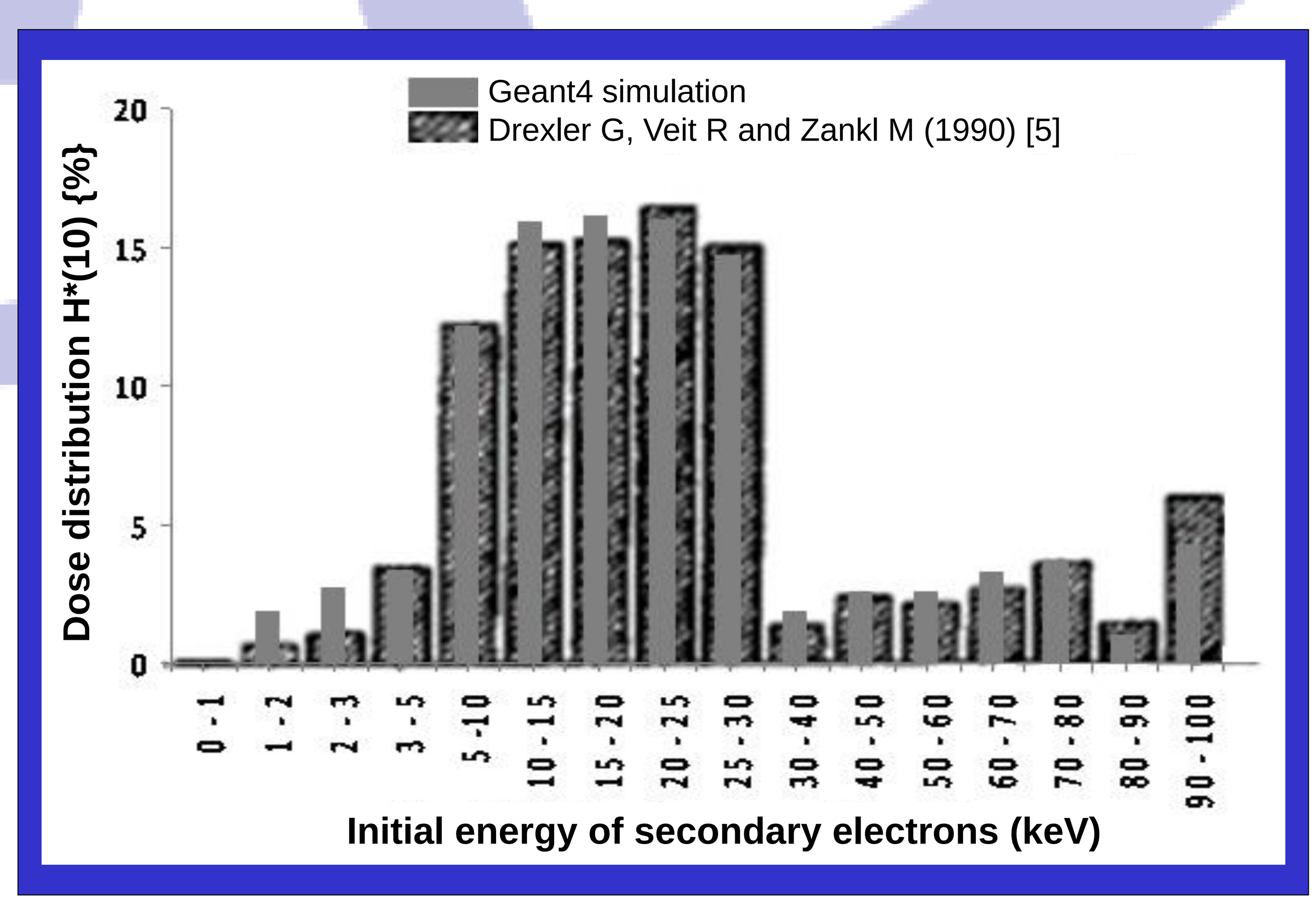




Photon spectrum in depth compared with the reference.

Spectrum of electrons from the photon spectrum.





Distribution of electrons in the ICRU sphere {H * (10)}.

5 - CONCLUSION PARTIAL

The results validate and provide information about the behavior of the photon beam and secondary electrons in homogeneous media in the energy range desired. It follows that the validation code by obtaining the spectrum , of the H * (10), of $\langle LET\rangle_f$, and $\langle LET\rangle_D$, was satisfactory. Values will be investigated for the quality factor of low energy photons and the dependence of RBE values of photons in mammography and pediatric radiology. Thus contributing to the improvement of risk considerations in these procedures.

5 - REFERENCES

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