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BENEFITS OF THE MONTE CARLO METHOD IN CHOOSING MATERIALS USED FOR RADIOLOGICAL PROTECTION

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Introduction: The use of computational methods to perform calculations involving stochastic and probabilistic processes are considered increasingly influential, as a tool, to assist new studies. With this, Geant4 (Geometry And Track 4) [1] software is introduced as a new tool that uses the Monte Carlo method. The goal of Geant4 is the visualisation section which has high precision to show the track of particles and interactions in the screen.

Material and method: In the present work, geant4 software is introduced as a new tool, which uses the Monte Carlo method to perform realistic computer simulations. Such simulations are capable of interpreting the interaction of X-ray with different materials.

When using data referring to hospital X-ray sources [2], it was determined that it should be used as input, gamma radiation with energy of 100 keV [2] focusing directly on different materials, in order to study the ability of X-ray penetration in them.

To show the difference between the response of different materials were chosen concrete, polyethylene, water, stainless steel, lead oxide, titanium and iron. In this way it will be possible to highlight the efficiency between these materials.

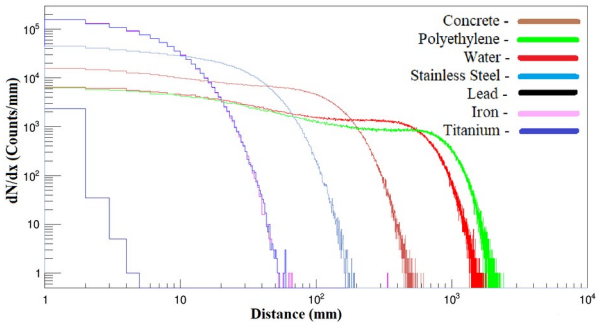

Figure 1: Distance travelled by X-ray before stop or leave material

Results: When focusing the X-ray on each of the materials listed in the material and method session, the distances travelled by the X-ray inside each one were measured and the results are shown in Figure 1.

From this result it is possible to confirm that, among the tested materials, lead remains the most efficient for radiological protection in hospitals, followed by stainless steel and iron which has almost the same behaviour.

By using Geant4, another great information extracted from the Monte Carlo method is the X-ray tracking inside material and the energy loss, explaining all interactions and scattering inside the material, as shown by Figure 2.

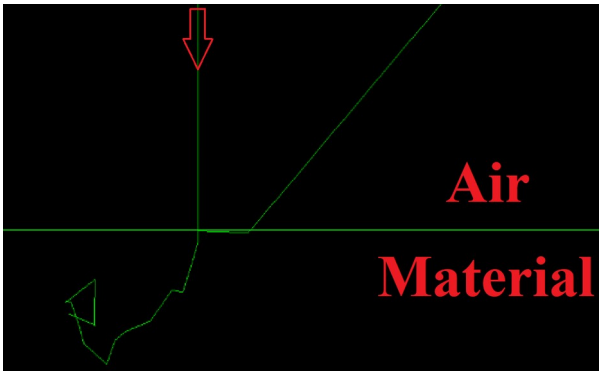

Figure 2: Geant4 simulation. There are two X-rays as input of this simulation with energy of 100 keV. One of those particles stops inside material (below horizontal green line) and the other goes out material after the second interaction.

Conclusions: From the presented data, it is evident that Geant4, through the Monte Carlo method, is an important tool to assist in the interpretation of interactions and analysis of experimentally obtained data.

References:

1. J. S. Agostinelli et al., Nuclear Instruments and Methods **A** 506 (2003) 250-303.
2. https//www.arpansa.gov.au/understanding-radiation/what-is-radiation/ionising-radiation/x-ray