Monte Carlo calculations of ionization chambers for the TRS 398 update

Research Project / Research Group Description:
One of the most important issues in modern dosimetry is the determination of absorbed dose in external beam radiotherapy. An update of the current international code of practice for dosimetry based on standards of absorbed dose to water (TRS 398) is currently underway and the Medical Physics Group of the University of Valencia has been invited by the IAEA (International Atomic Energy Agency) to participate in its development. The tasks assigned by the IAEA will be to perform Monte Carlo simulations using several energies, as specified by the beam quality index listed in TRS 398, on PTW ion chambers.

Among those codes available in the literature suited for this task, PENELOPE stands out for its versatility, completeness, and open-source philosophy. PENELOPE has been in continuous development over the last 20 years at the University of Barcelona. It is a general-purpose MC code for the simulation of electrons, positrons, and photons in arbitrary materials and geometries that incorporates a detailed material library including composition data and physical parameters for more than 280 materials.

PENELOPE incorporates physical models for an energy range from 50 eV to 1GeV. Those interaction models are based on the most reliable information currently available, limited only by the required generality of the code. The physical mechanisms incorporated in PENELOPE are: i) scattering of electrons and positrons, ii) impact ionization, iii) Bremsstrahlung emission, iv) positron annihilation, v) photon scattering (polarized and unpolarized), vi) photoelectric absorption, and vii) pair creation. These models combine state-of-the-art results from first-principles calculations, semi-empirical models and evaluated databases.

Therefore, based on all this and following the mandate of the IAEA, Penelope2014 is the tool of choice for this project. It is clear that the results of this ambitious project will significantly contribute to the clinical practice of medical physics.

Job position description:
Specific Aims. This project aims to address the description of the dosimetry of several ionization chambers under different photon beams by using the Penelope2014 Monte Carlo code. A double check using MCNP6 will also be required to benchmark the simulations performed.
Skills required. Knowledge of the MC codes Penelope and MCNP6 is an indispensable requirement for this project.

GROUP LEADER: Javier Vijande Asenjo
javier.vijande@uv.es

"la Caixa" Foundation
IFIC INSTITUT DE FÍSICA CORPUSCULAR
EXCELENCIA SEVERO OCHOA
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 713673.