GEANT4 ACTIVITIES IN THE FIELD OF RADIATION THERAPY AT THE UNIVERSITY OF SEVILLE

M.A. Cortés-Giraldo

Dpto. Física Atómica, Molecular y Nuclear, Universidad de Sevilla, 41012 Seville, Spain

* *miancortes@us.es*

We overview the research activities we are carrying out in medical applications, concretely in conventional radiotherapy (with photon beams) and in proton therapy, in which the Geant4 toolkit [1-3] is essential.

As for conventional radiotherapy, we show some technical aspects of an application code developed to reproduce the irradiation of patients with a Siemens Oncor linac, equipped with a 160-MLC multi-leaf collimator, working at 6MV photon mode. Concretely, the geometry model of the 160-MLC, which has complex-shaped leaf ends, was built following a flexible approach without resorting to Computer-Aided Design (CAD) programs [4]. The patient geometries were built from DICOM image files which were processed by means of an in-house developed universal DICOM tool. This application code has been used to re-calculate non-small-cell lung cancer treatments with Geant4, so that we can assess the radiobiological variation due to divergences between dose distributions calculated with Pinnacle^3 treatment planning system (TPS) and with the Geant4 toolkit.

Concerning proton therapy, one research activity aims at calculating an accurate mean ionization potential for water, derived from measurements of depth dose distributions measured with various ion beams (A<16) at GSI (Darmstadt, Germany). Another research line is focused on the radiobiological description of proton beams using macro- and microdosimetry approaches. On the macroscopic description, we have recently came up with a scoring strategy of dose-average LET (LET_d) which was proved to be more reliable as compared with the most popular scoring approach, which actually is subject to bias in low-size (<1 mm) voxels [5]. On the microscopic description, we are currently producing sets of distributions of microdosimetric stochastic quantities (such as lineal energy, or energy imparted per collision) in order to use these data into a TPS under development.

[1] S. Agostinelli *et al.*, *Nucl. Instrum. Meth.* A 506: 250-303 (2003).
[2] J. Allison *et al.*, *IEEE Trans. Nucl. Sci.* 53: 270-278 (2006).
[3] J. Allison *et al.*, *Nucl. Instrum. Meth.* A 835: 186-225 (2016).
[4] A. Perales *et al.*, *Phys. Med.*, in press (2017). [doi:10.1016/j.ejmp.2017.03.026]
[5] M.A. Cortés-Giraldo, A. Carabe, Phys. Med. Biol. 60: 2645-2669 (2015).