Report of Rotation at Mass General Hospital – Harvard Medical School

Through this report, I intend to summarize and explain what I have learned through my two-month stay in Boston (Massachusetts – United States of America), attending Mass General Hospital and B-lab, which took place from March 1st to April 30th.

The main purpose of this visit was the development of a deeper understanding of the Monte Carlo simulation software developed by this team, Tool for Particle Simulation (TOPAS) and of its chemical and biological extension (TOPAS-nBio), together with the capacity to analyze the results obtained through them using some external programming software (in my case, *Python*).

To start with, I was able to install TOPAS software and do some simple simulations. Given that this montecarlo simulations conform the gold standard for proton dosimetry, they advised ME to start with a PencilBeam of protons, and analyze the absorbed dose in a water phantom, giving special importance to the dose along the propagation axis (therefore, studying its PDD and observing the Bragg Peak at the end of its trajectory) and to the spread of the peak as depth increased, as a consequence of the scattering produced.

After these first simulations and analyses were completed, it was studied how changing other parameters (such as beam energy, homogeneity, density of the materials in the phantom...), so that the parameter system could be better understood.

Following this, and once I was acceptably familiar with TOPAS structure, I included and compiled the TOPAS-nBio extension, which allows to work on a smaller scale (allowing to go down to the nanometric scale) and takes into account the chemical reactions that might take place due to the radicals produced by the incident radiation.

It was advised to try the new scorers and chemistry parameters to see the differences among them and relative to the original TOPAS version, and after that, the most important simulations I was told to do were the ones that allowed me to replicate what had been done in this very same lab to validate the TOPAS-Nbio extension, by analyzing the time evolution of the G-value (number of reactions that take place for every 100 eV of deposited energy), obtaining similar curves to the ones stated by Schumann et al. (2019), therefore stating that I had reached a good understanding point of the subject.

This partnership has received funding from the European Union's "EURATOM" research and innovation program under the 101061037 grant agreement.

Apart from the simulation work, I was also allowed to do some shadowing in different aspects of the radiophysics work at MGH that could be valuable for my learning. As for it, and taking into account that the first objective of TOPAS was to obtain a good proton dosimetric simulation, I was allowed to see several Quality Assurance procedures for proton beam therapy both for patient treatment verifications and for physical dosimetry of the equipment, and also was allowed to see some dosimetric planning of different pathologies, such as breast, CNS or Head and Neck cancers.

Finally, I want to end this report by acknowledging the help and guidance from the members of the B-lab and MGH, towards whom I wish to express my deepest gratitude.

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