Evaluation of dose rates and DNA damage on microorganisms living in naturally radioactive mineral springs using GATE and Geant4-DNA

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Background: This work focuses on the simulation of the dose rates and the potential DNA damage on diatoms, a species of microalgae, inhabiting naturally radioactive mineral springs in Auvergne, Massif Centrale, France.

Material and Methods: First, using GATE, we modelled the radioactive environment using a source composed of 5 MeV mean energy α-emitters, mainly ^{222}Rn and ^{226}Ra, ^{238}U progenies. Here, the diatom and its nucleus, water spheres of 10 μm and 0.5 μm radius, respectively, are surrounded by a mixture of water and sediments where the α-emitters are uniformly distributed. The dose rates as well as information of the particles entering the nucleus of the diatom (PhaseSpace Actor) were recorded. The Phase Space retrieved was then used in Geant4-DNA as source to simulate DNA damage using the DBCSAN algorithm.

Preliminary results: We show that, for realistic activites observed in mineral springs, ^{226}Ra contributes more than ^{222}Rn to the dose rate received by the diatoms (8 μGy/h and 2 μGy/h, respectively) and we compare these values to the predictions of ERICA tool [1]. For both radionuclides, the DBSCAN algorithm predicts two times more Single (SSB) than Double (DSB) DNA Strand Breaks, while the peculiar morphology of the microorganisms studied does not seem to highly affect both the dose rates and the SSB / DSB values.

[1] J. E. Brown *et al.*, J. Environ. Radioact. 99, (2008), 1371-1383.