High LET spectral and microdosimetric characterization of secondaries in the treatment of Alzheimer's disease with Neutron Capture Therapy

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Background: Alzheimer Disease (AD) is the most common cause of dementia, with 46.8 million cases worldwide. No cure exists today, treatment addressing the disease being symptomatic treatments. NECTAR[1] is a European project which investigates AD treatment using neutron capture reaction to induce damage in β-amyloid (Aβ) aggregates, whose accumulation in the brain seems to be at the origin of the disease, to induce their depolymerization. Neutron capture on ^{10}B leads to the production of Li and alpha particles (as well as gamma rays) which induce local high energy transfer in the target at the µm and nm scale. Thus, micro- and nanoscale models for describing interactions of these secondaries are necessary to understand the mechanisms leading to the depolymerization of the targeted aggregates.
Material and Methods: A first simulation model representing one nanoparticle containing ^{10}B and specifically developed for the project- was modelled in Geant4 11.0.0. The secondaries spectra were tallied at the external surface of the nanoparticle irradiated by thermal neutrons. Neutron Physic High Precision package was used in the physic list, as well as the Thermal Scattering model which describes elastic collisions for neutron with energies lower than 4 eV. Indeed, this model is necessary as boron capture is maximum for low energy neutron (<1eV).
Preliminary results: Results obtained show alpha, lithium and gamma spectra exiting the nanoparticle. This characterization is used to obtain preliminary microdosimetric results of the Aβ aggregates irradiation.

[1] NEutron Capture-enhanced Treatment of neurotoxic Amyloid aggRegates, European Commission, Horizon 2020.
https://fisica.unipv.it/NECTAR-EU-FETOpen/index.html