

## The new “RPWBA” implemented model for proton ionization and excitation of liquid water above 100 MeV

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**Background:** This work is focused on the extension of proton excitation and ionization of liquid water available in Geant4-DNA above the current upper limit of 100 MeV to cover the entire energy range of interest in proton therapy.

**Material and Methods:** The model reads previously generated data-tables containing total cross sections (CS) and energy differential cross sections (DCS) in projectile energy loss. These datasets were produced with a model based on relativistic plane wave Born approximation (RPWBA) theory [1]. The target response is described by the generalized oscillator strength (GOS). Following [2], the GOS of liquid water is reproduced for the five ionized and the five excited molecular states. The Fermi density effect is also taken into account in the DCS.

**Results:** The results for the stopping power agree within uncertainties with the ICRU90 reference data for the extended energy range (100-300 MeV), as shown in Figure 1. The range relative differences with the ICRU90 data are approximately constant of about 1%.

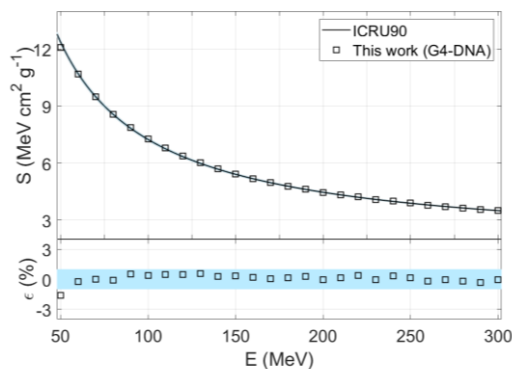


Figure 1: Stopping power of water for protons at 50-300 MeV. Geant4-DNA calculations (squares) and ICRU90 report values (solid line) are shown.

[1] F. Salvat, Nucl. Instrum. Methods Phys. Res. B, 316 (2013) 144-159.

[2] D. Emfietzoglou *et al.*, Radiat. Res., 164 (2005) 202-211.