

Fluorescence lifetime measurements in protons tracks in water

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Accelerated proton beams and more generally heavy ion beams are used for the targeted treatment of deep tumors by exploiting their property of energy deposition at the end of the trace, in the Bragg peak, where the density of ionization is upmost. Before their complete stop in the targeted zone, the protons cross the media and their energy distribution widens (longitudinal and angular straggling phenomenon) leading to a Bragg peak spreading over nearly 1 mm (distal zone). At Bragg Peak and in this area, descriptions of chemical effects are poorly known. Recent in line experiments with proton beams from the CAL in Nice have shown that the yields of the chemical system of the Fricke dosimeter collapse at the peak and rise in the distal zone [1].

More recently, this phenomenon has been observed for the hydrated electron and the hydroxyl radical by using organic probes (amplex red, resazurin...) producing the highly fluorescent resorufin molecule. The huge electric fields at high Linear Energy Transfer (LET) is expected to especially quench the fluorescence quantum yield and therefore to affect the fluorescence lifetime. That is the reason why we attempted to analyze the fluorescence lifetime of resorufin by using TCSPC all along the proton track, more precisely at 50 MeV ($\text{LET} = 2.6 \text{ eV/nm}$). A comparison of preliminary fluorescence decays obtained for 3 different fluorescent molecules (Rhodamine B, Rhodamine 6G and Resorufin) under proton irradiation will be presented after describing the multichannel TCSPC method. An example is shown in Figure 1.

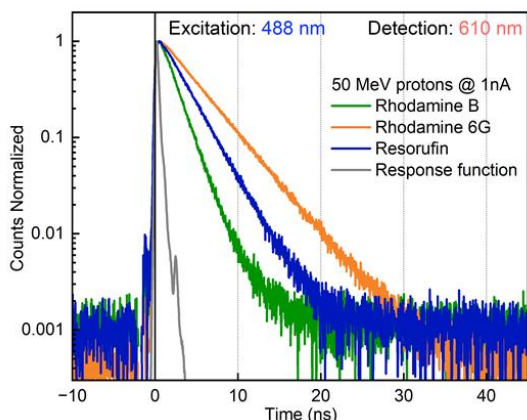


Figure 1: Comparison of fluorescence decays of Rhodamine B, Rhodamine 6G and Resorufin (Concentrations of 10^{-5} M) under 50 MeV protons at 1nA of intensity.

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