Proton Biomolecule Collisions

M.Richard-Viard, A.Le Padellec, J.P.Champeaux
P.Cafarelli and P.Moretto-Capelle

Laboratoire Collisions, Agrégats, Réactivité (UMR 5589, CNRS - Université Paul Sabatier Toulouse 3), IRSAMC, 31062 Toulouse Cedex 9, France

Damages induced by ionizing radiation can directly be linked to alteration of the DNA molecule. In this work, we have investigated interactions of 25 to100 keV energy protons with DNA bases in gas phase, pyrimidines (uracil, cytosine and thymine) and purines (guanine and adenine). The 100 keV collision energy corresponds to the maximum Linear Energy Transfer in biological medium, i.e. the formation of the Bragg peak used in proton-therapy.

In this energy range, single or multiple ionization of the molecule occurs resulting in electronic emission as well as molecular fragmentation. Those two aspects have been investigated by electron spectroscopy and by time of flight multi-correlation technique.

- The electron spectroscopy shows that low energy electrons are emitted preferentially: those electrons can make further damages by a dissociative electron attachment mechanism.

- The dissociation of the molecule produces different fragments which can interact with neighbouring molecules in the biological medium. The branching ratios to the different fragmentation patterns have been measured for singly and doubly charged molecules. An example is given in the following figure for the fragmentation into two charged fragments (plus a neutral) of the Thy^{2+} base.