



Radiation Damage in Biomolecular Systems COST Action P9



Scientific Report

About the Short Term Scientific Mission
COST-STSM-P9-00200

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Place: Berlin - 14 109 (D)

The aim of the present *short term scientific visit* was to perform experiments studying the fragmentation of water molecules by ion impact, and to discuss and fix the detailed research program of the collaborators for the next one-year period.

During the two-week period of the present STSM, we measured the energy dependence of the fragmentation mechanisms of the water molecule by the impact of He^{2+} ions, in a wide projectile energy range (1-30 keV). This way, we were able to resolve spectral structures belonging to different mechanisms or fragment ion charge states. The experiments were performed at the Electron Cyclotron Resonance (ECR) accelerator facility in Berlin, in a high-vacuum chamber equipped with a water vapour-jet target system and an electrostatic ion-spectrometer. We determined absolute cross sections, by measuring the energy and angular distribution of the charged molecular fragments. We also had a series of discussions about the theoretical interpretation of the data measured earlier and in the present set of experiments.

Our attention was focused to two mechanisms, both leading to the fragmentation of the H_2O molecule. By measuring the yield of the low energy protons originating from the Coulomb-exploding water molecule, we determined the cross section for the double electron capture and the so called transfer-ionization processes. In the latter process, one electron is captured by the projectile 1s shell, and one other electron is removed to the continuum in the collision. We have found that the cross section for the transfer-ionization process is, in a good approximation, independent of the impact ion energy. For slow ion impact, this is a typical signature of dielectronic processes, governed by electron-electron interaction. This has been confirmed by calculations performed in the Landau-Zener model with electron-electron coupling matrix elements.

Some of the above results have already been presented in the talk by Nikolaus Stolterfoht at the Annual COST P9 Meeting, the RADAM Conference in Lyon (June 24-27, 2004). For the future, we discussed the plans of two series of experiments, one in Berlin, and one in Debrecen, where a water target is under development for studying the fragmentation of water molecules by the impact of fast, light ions (in the $Z=1 - 10$ and $E=0.1 - 3$ MeV/u range). We also discussed the wider collaboration between HMI, Berlin, KVI, Groningen, QUB, Belfast and ATOMKI, Debrecen, within the COST P9 framework.

Debrecen, 23-07-2004

Béla Sulik
ATOMKI, Debrecen