

# Detection of neutral metastable fragments from collisions with nucleobases

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**Synopsis** We report on two collision experiments performed on nucleobases, (i) using electron impact on nucleobases in the gas phase, and (ii) using low-energy ion impact of small nucleobase clusters. In both experiments mass-resolved positive ions were detected using time-of-flight mass spectrometers, and neutral metastable fragments were detected, also using a time-of-flight technique.

This paper reports on two collision experiments involving nucleobases. Electron-impact fragmentation of nucleobases is being studied in an experiment at the National University of Ireland, Maynooth. Ion impact studies have been performed at ARIBE at CIMAP in Caen, with support of the ITS LEIF network (RII3-026015) funded by the EU.

In the experiment at Maynooth, a molecular beam of nucleobases is generated by resistively heating a small oven containing the nucleobase of interest. The oven is mounted in an expansion chamber, and the forward section of the beam effusing from a capillary in the oven passes through a skimmer into the collision chamber, where the beam is crossed by a pulsed electron beam.

Fragments produced by electron impact are detected using time-of-flight techniques. Ionised fragments are mass resolved and detected using a reflectron time-of-flight mass spectrometer. Neutral metastable fragments are detected using a metastable detector, consisting of a channeltron with biased meshes in front to prevent the detection of charged particles. The metastable detector is at a distance of 195 mm from the interaction region. Time-of-flight spectra from this detector can be transformed into kinetic energy spectra. These spectra are obtained as a function of electron impact energy, and the location of onsets provides information about the fragmentation processes.

An overview of the experiment and the time-of-flight techniques can be found in [1]. For the experiment in this paper, the pulsed valve in [1] has been replaced by the resistively heated oven.

In preliminary metastable spectra obtained in Maynooth from electron impact on Adenine hemisulphate salt, fragments have been observed in two overlapping time-of-flight ranges 3 - 9  $\mu$ s, due to H\* with kinetic energies of 2.4 - 20 eV, and 9 - 30  $\mu$ s, which could be due to H\* with fragment kinetic energies of 0.2 - 2.4 eV, or C\* with 2.6 - 30 eV, or N\* with 3.0 - 34 eV. Measurements with electron impact on pure Adenine are in progress.

This paper also reports on an experiment performed at ARIBE to look for neutral metastable fragments produced by low energy impact of singly and multiply charged ions on small clusters of Adenine and Thymine. The metastable detector was mounted on the LHI-L3 beamline at ARIBE [2], at a distance of 500 mm from the intersection of the ion beam with the cluster beam. Measurements were done for O<sup>5+</sup> (10 keV/q) on Thymine and for He<sup>+</sup> (10 keV/q) and He<sup>2+</sup> (10 keV/q) on Adenine and Thymine. Fragments have been observed in the time-of-flight ranges 8 - 18  $\mu$ s, possibly due to H\* with kinetic energies of 4 - 20 eV, and 23 - 33  $\mu$ s - possibly due to C\* or N\* with kinetic energies of about 14 - 30 eV.

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## References

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