Belfast electrostatic trap and mass spectroscopy with molecular ions

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Linear electrostatic ion traps have been previously exploited in a range of experiments such as lifetime measurements, isotope separation, studies of molecular temperature, and high resolution mass spectrometry. Using the beam-like qualities of the trapped ions, we have used such a device to study the interaction of vibrationally cold simple molecular ions with intense, femtosecond laser beams [1-3]. More recently we have built a new trap which has been optimized for generating parent and fragment molecular ions in-situ and analyzing them with high mass resolution[4].

In the Kilovolt Electrostatic Ion Reflection Analyser (KEIRA), neutral molecular ions are created from a gas jet directed into the laser focus or by desorbing large, non-volatile molecules off the final electrode in the mirror. Molecules are liberated from the surface using a nanosecond pulsed laser via matrix-assisted desorption or acoustic desorption from a thin foil incorporated into the electrode (Figure 1). As the ions are initially produced on the trap axis with essentially zero kinetic energy, they are efficiently trapped and ion bunches are subsequently separated according to their mass.

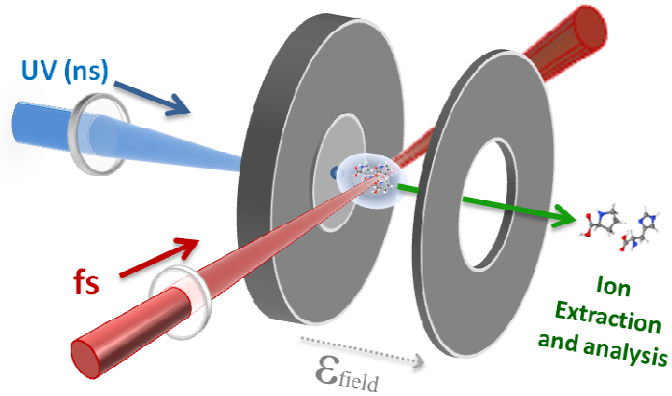

Figure 1. Mirror region of the KEIRA ion trap demonstrating how biomolecules can be volatilized by nanosecond laser induced acoustic desorption, and ionized and fragmented by a femtosecond laser.

Mass spectra are generated from the image charge signals recorded on several pickups rings using a bespoke frequency analysis algorithm CHIMERA [4]. Spectra produced from the interaction of the femtosecond pulses with organic and biological molecules will be presented.

References

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