MICRA : A compact permanent magnet FTICR mass spectrometer

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The range of applications and analitycal power of Fourier Transform Ion Cyclotron Resonance Mass Spectrometry rest on ion trapping and selection capabilities : this allows MS^n type experiments, often avoiding wet chemistry pre-separation steps. Simultaneous detection of a wide mass range is possible with very high resolution and unsurpassed accuracy of mass determination.

MICRA on the way to CLIO facilities

Existing FTICR mass spectrometers are very powerful analytical tools but heavy non transportable machines. Our goal in developing a compact and easy to move and operate FTICR machine is to bring the unique advantages of this technique to on-line or *in-situ* applications and, while maintaining performances and adaptality to various problem, to lower the cost of the spectrometer which constitutes an obstacle to a more frequent use of FTICR.

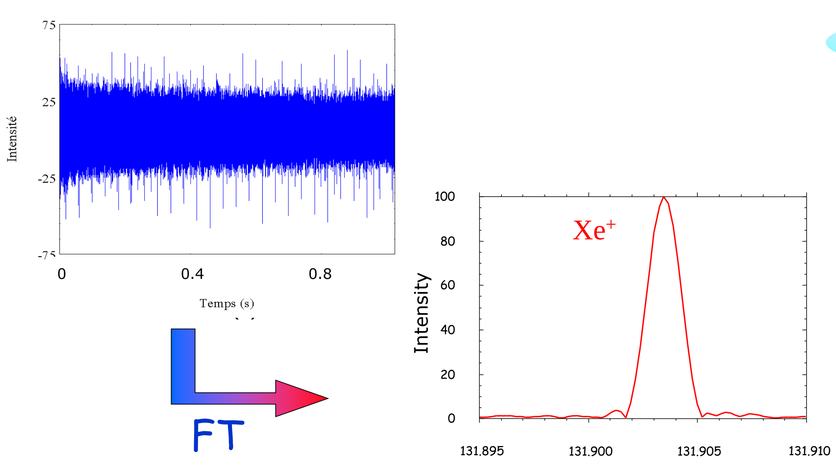
(CNRS patent : FR2835964)

MICRA

MICRA is based on a 1.25 Tesla structured permanent magnet of FeNdB weighing 40kg with a 5 cm internal bore. The ICR cell implemented in MICRA is cubic, with internal dimensions 2x2x2 cm. The structure of the cell is opened to provide wide optical access to the center. The main vacuum chamber is pumped by a 70L/s turbomolecular pump, backed by a three stages diaphragm pump, giving a nominal base pressure better than $3x10^{-9}$ mbar. The mass spectrometer is controlled by a custom detection based on a standard PC computer fitted with commercial PCI cards for excitation/detection of the ions.

Primary ions are generated by :
- -electron impact ionization
- -laser ablation/ionization
- -chemical ionization

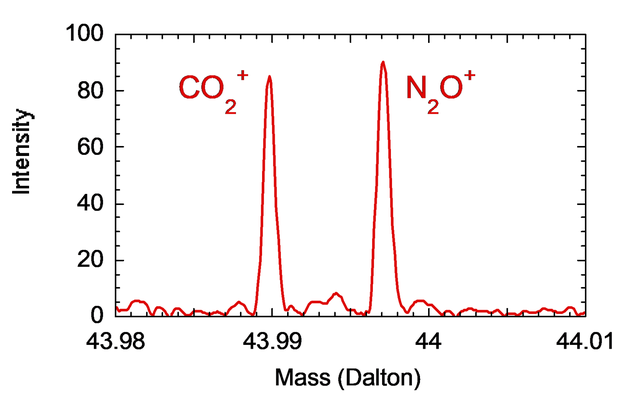
Mass range : 10-1000 Daltons
Weight : ~200 kg
Dimensions : 0.6x1.2x0.8 m
Détection limit : few ppm for VOC's traces
No fluids
Power : 1 kW



Mass resolving power : high resolution

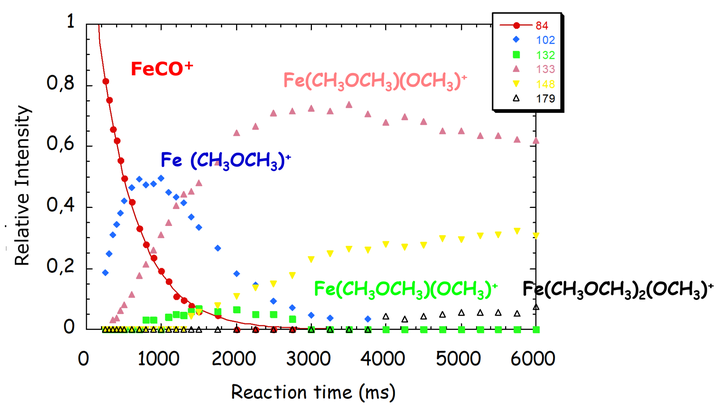
The mass resolving power for $^{132}Xe^+$ is 73000

The ions CO_2^+ and N_2O^+ with the same nominal mass m/z 44 and differing by 0.01 mass unit, are completly separeted.



Applications

Kinetic study

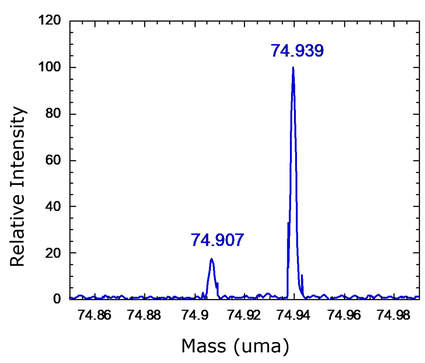


Successive ion-molecule reactions with $FeCO^+$ + Dimethyl ether system

$FeCO^+ + CH_3OCH_3 \rightarrow Fe(CH_3OCH_3)^+ + CO$

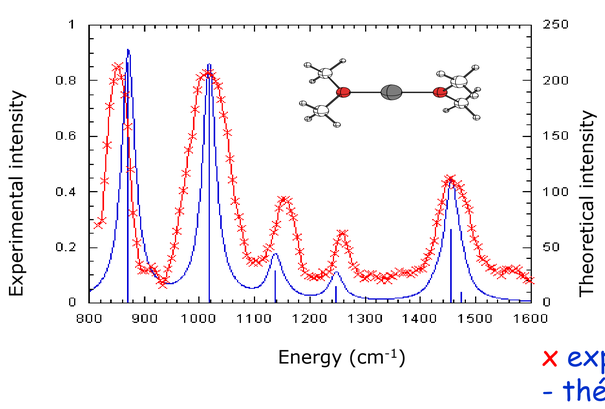
$Fe(CH_3OCH_3)^+ + CH_3OCH_3 \rightarrow \ldots$

High resolution detection of Volatile Organic Compounds traces



Proton transfer mass spectrometry on a mixture of $C_2H_5OC_2H_5$ (Ethoxy ethane) and CH_3COOCH_3 (Acetic acid) at ppm level in water using a membrane introduction system

InfraRed Multiphoton Dissociation (IRMPD) spectroscopy : Ion structure determination



x expériment
- théory

Infrared spctra of $Fe(CH_3OCH_3)_2^+$ ions.
Dissociation efficiency as a function of wavelength

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