



## A small transportable FTICR for security applications

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# A small transportable FTICR for security applications

*J. Lemaire<sup>1</sup>, C. Le Vot<sup>1</sup>, M. Bouaziz<sup>2</sup>, H. Mestdagh<sup>1</sup>, P. Boisse<sup>2</sup>, G. Mauclaire<sup>2</sup>, M. Heninger<sup>2</sup>*

*1 Laboratoire de Chimie Physique, CNRS UMR 8000, bât 350, Université Paris Sud, 91405 Orsay, France*

*2 AlyXan, bât 207B, Université Paris Sud, 91405 Orsay, France*

## Introduction.

Real time monitoring of gases at high resolution is realized with a small permanent magnet based FTICR mass spectrometer. The mass range of the instrument starts at  $m/z$  4 up to  $m/z$  500 with a resolution higher than 10000 over the whole mass range.

For security applications the resolving power is particularly important since compounds of very different toxicity can be at the same nominal mass.

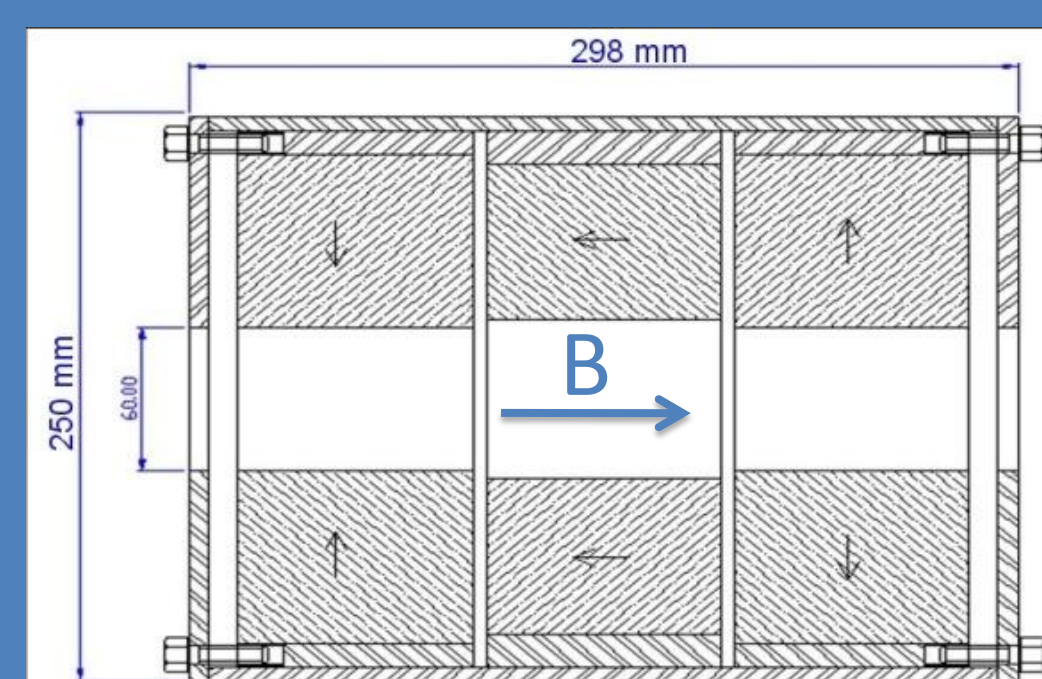
Potential applications are in a wide range of domains : air monitoring in places hosting public, in confined environments ,...

## Magnets

The magnet constructed for this experiment is a structured NdFeB magnet assembled from several magnetized segments. It is composed of three cylinders. The two lateral cylinders are magnetized radially, one in the inward direction and the other in the outward direction. The cylinder placed in the middle is magnetized axially.

The resulting magnetic field in the middle of the magnet is axial, with a strength of 1 Tesla and an homogeneity of  $10^{-3}$ . These two parameters (magnetic field strength and homogeneity ) are key parameters for the good performance of the FTICR instrument.

The internal bore has a 50mm diameter and the magnet weight is 60 kg.



Example of an axial field magnet configuration. With this geometry coupling of the ICR analyzer with an external source is possible.

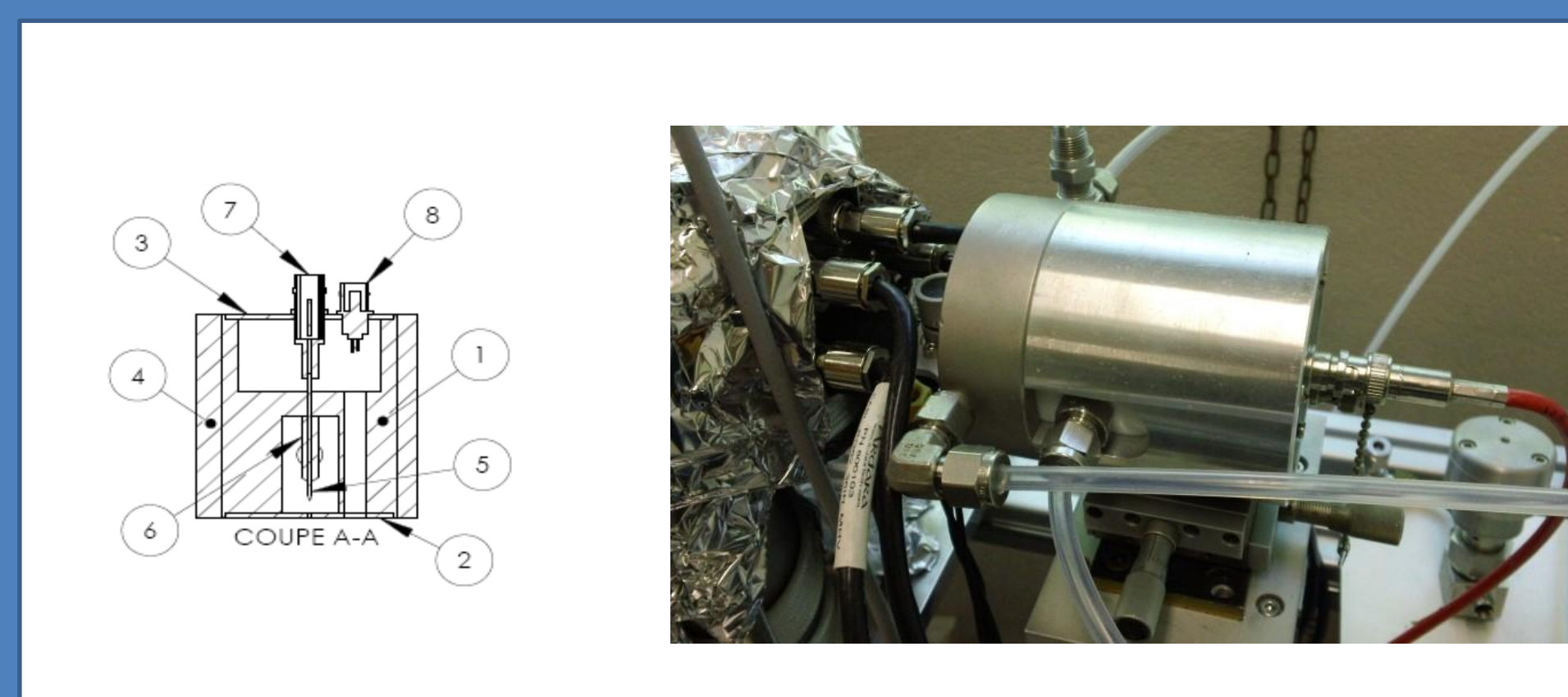
ICR Cell



The ICR cell has a cylindrical configuration and is divided in seven cylinders, each being divided in 4 parts. The central cylinder is for excitation/detection and the others for trapping voltages.

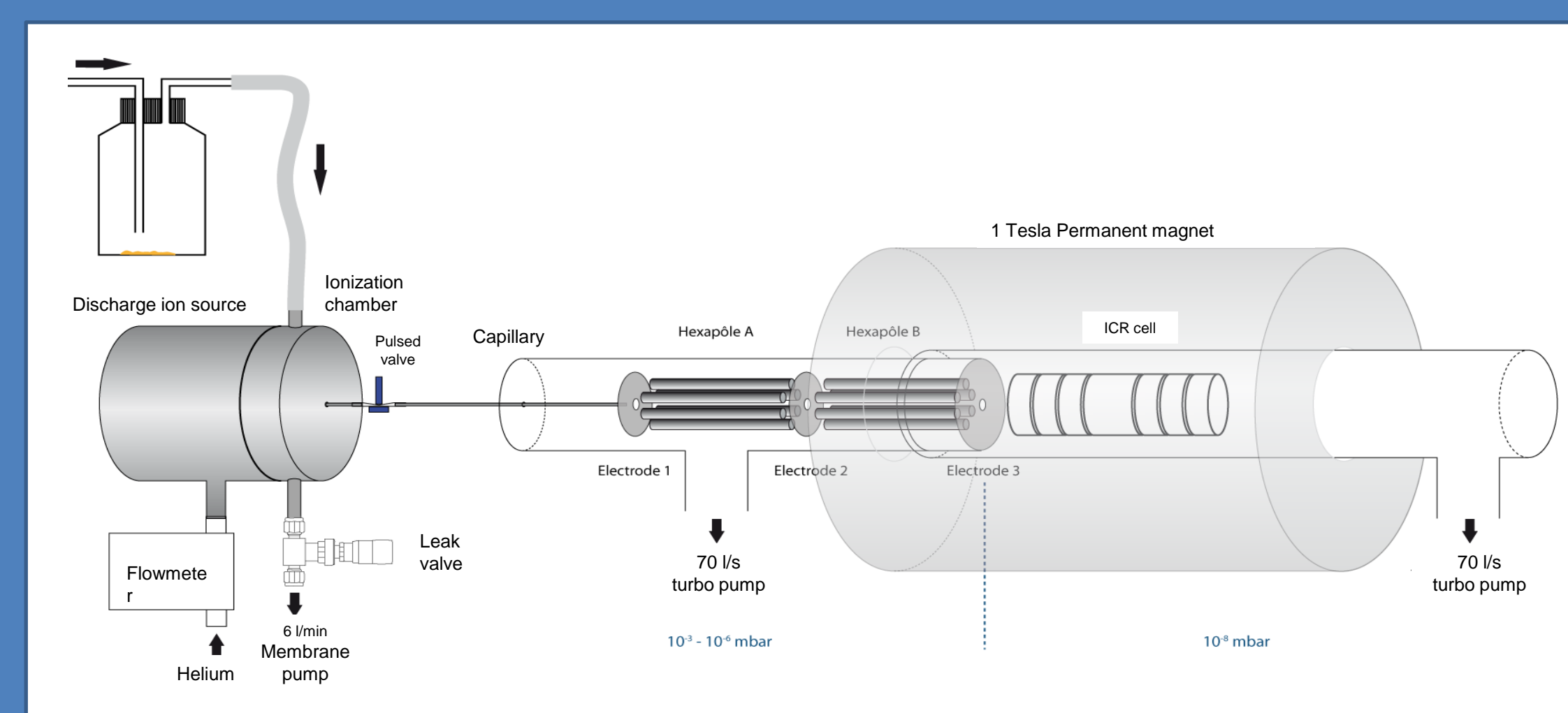
## Atmospheric Ion Source

Ionization of traces present in air is realized using a helium glow discharge ion source. The helium flow is regulated using a flowmeter at a rate between 0.2 and 1l/min. A high voltage is applied to the central tungsten electrodes and once the discharge initiated the voltage applied is close to 1000V with a current of 45mA.



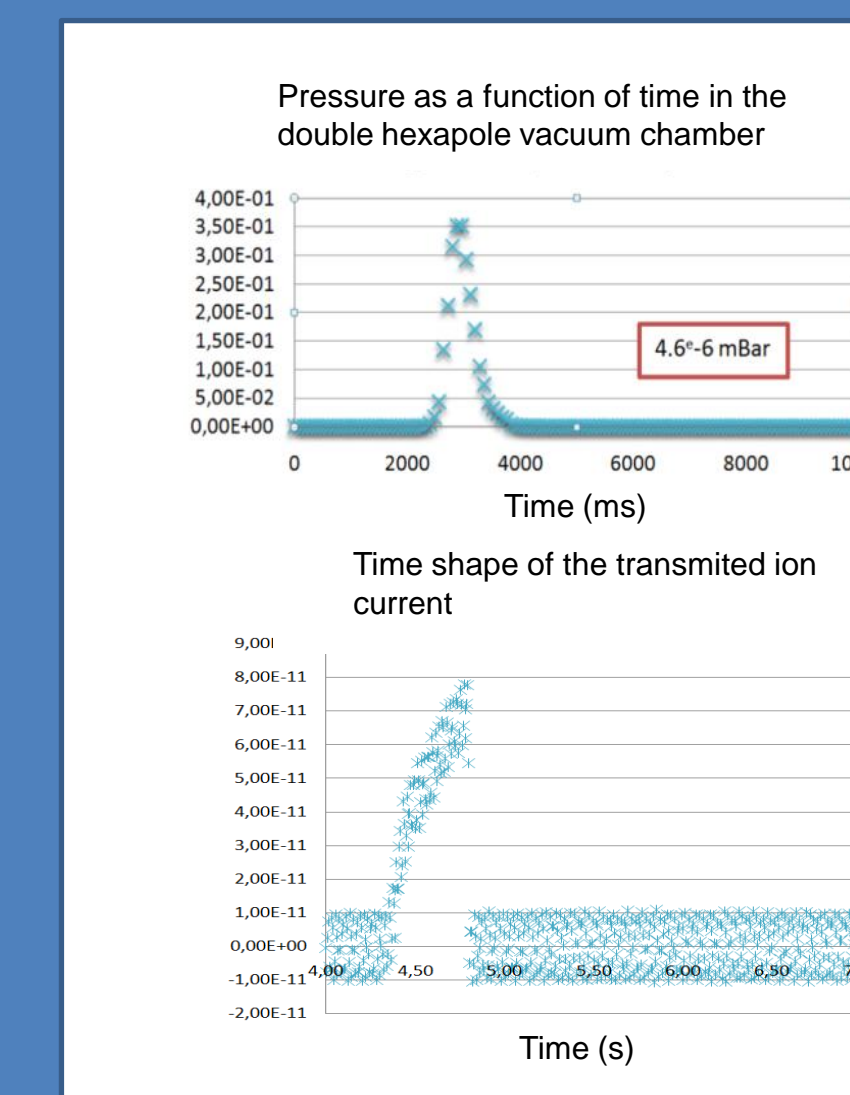
## Chemical Ionization

The excited species formed in the discharge, particularly the helium metastable ionize species present in air and result in the formation of  $N^+$ ,  $N_2^+$ ,... Since water is always present  $H_3O^+$  is formed quite efficiently and will ionize the VOC present in air by proton transfer. A small reaction chamber is placed at the exit of the discharge in which air containing controlled amount of VOC is injected.



## Ion transfer

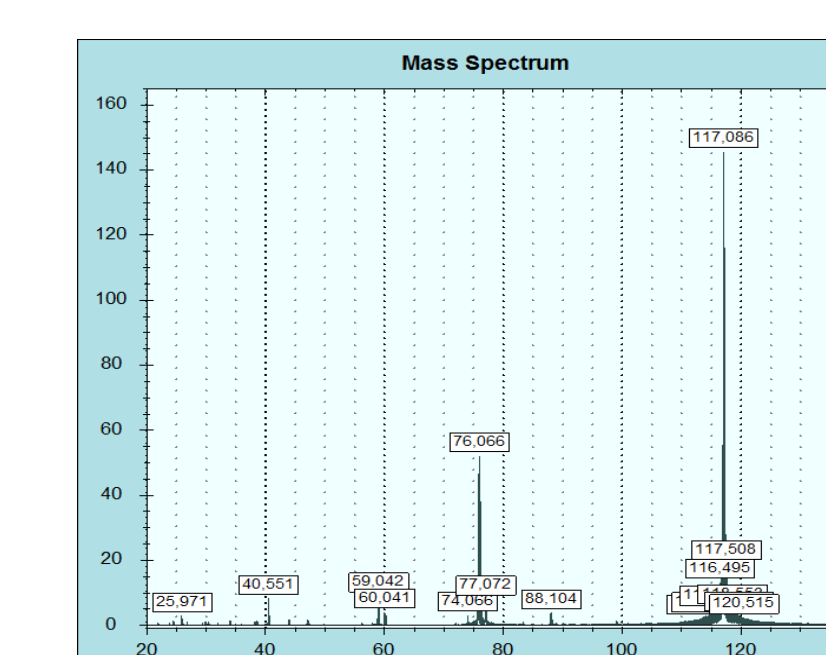
A double hexapole system has been tested in order to realize the transfer of the ions produced at atmospheric pressure to the ICR cell. It is placed in a vacuum chamber separated from the one housing the ICR cell by a 2mm diameter diaphragm and pumped by a 70 l/s turbo pump.



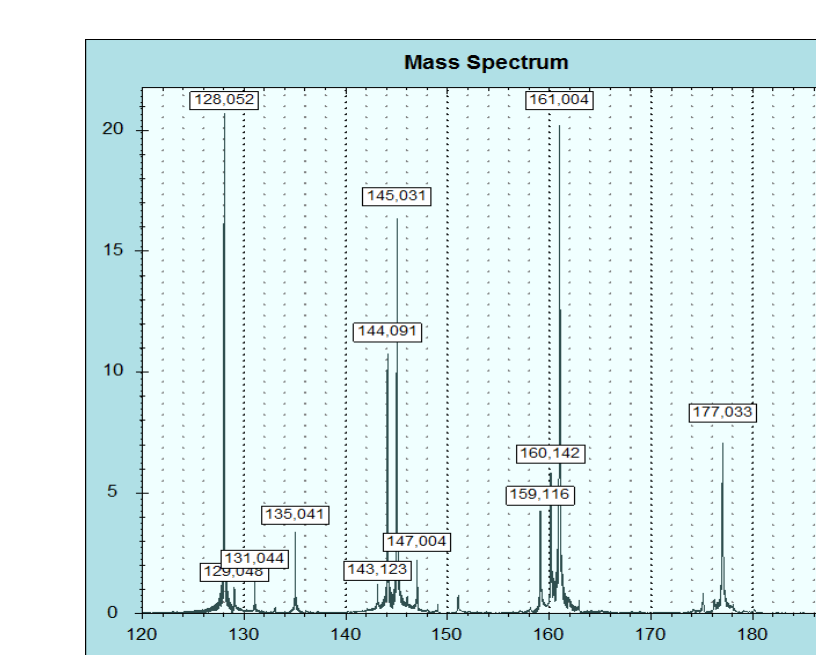
The pressure time evolution in the vacuum chamber housing the hexapoles is here followed with a pirani gage while the transmitted ion current is measured with a Keithley 6485 picoammeter.

During injection a voltage between 20 and 40 Volt is applied to the plate electrodes at both ends of the first hexapole. In this way ions are trapped and can be stored for a few seconds while the pressure gets down to the  $10^{-6}$  mbar range.

Ions are then sent to the ICR cell by applying an axial electric field and the entrance trapping plate of the ICR cell is held down at 0V between 50 and 200  $\mu$ s to let the ions in.

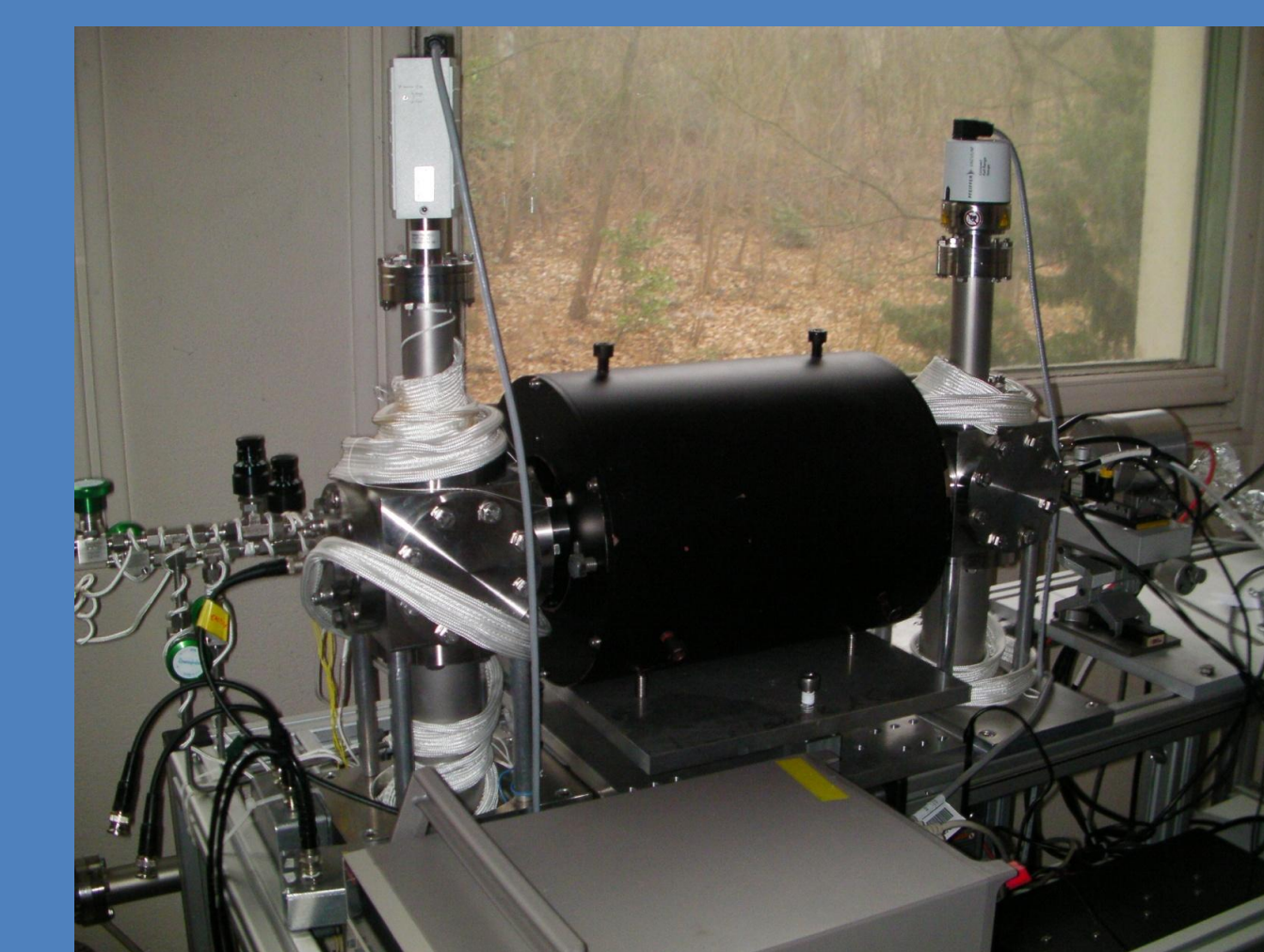


(a)



(b)

First results obtained when flowing air with traces of acetone (a) and naphthalene (b) in the reaction chamber. With the discharge and reaction conditions used here not only the protonated molecule is observed but also the proton bound dimer in the case of acetone and ions resulting from hydroxylation reactions in the case of naphthalene.



## Conclusions.

Permanent magnet FTICR give access to high resolution mass analysis (>10000 over the  $m/z$  4-500 range) and we have shown here that it can be coupled to ambient ionization techniques.

## Acknowledgement.

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