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Broad range detection in a low field FTICR instrument

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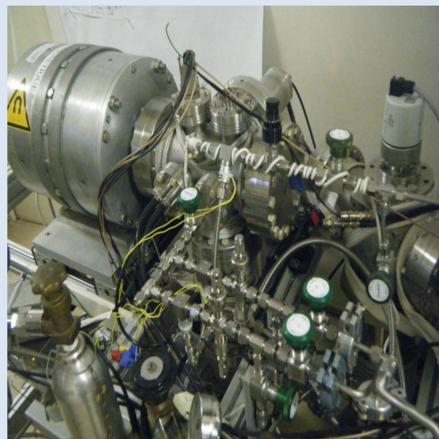
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Introduction.

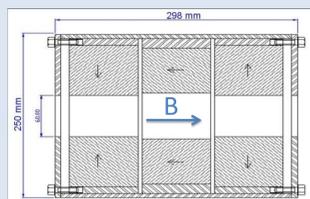
Small permanent magnet FTICR are well suited for real time monitoring of gases at high resolution. Most of the applications of our spectrometers for air monitoring up to now have been realised using chemical ionisation for selective ionisation of volatile organic compounds present in air at trace concentrations with detection in the range $M=10$ to 500. We present here results obtained after extending the detection toward low masses (down to $M=2$)

Mobile Axial Field ICR Analyzer

The results presented are obtained with the MAFIA spectrometer (Mobile Axial Field ICR Analyzer) featuring a permanent magnet producing a magnetic field coaxial with the magnet cylinder main axis. The field is 1 Tesla and the relative homogeneity better than 10^{-3} in the cell volume. The low field is an advantage for low mass detection since even for very low masses the cyclotron frequencies can be detected if the bandwidth of the detection electronics is extended toward high frequencies.

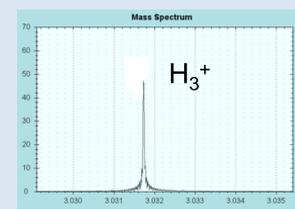
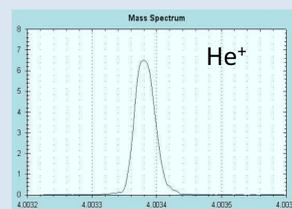


View of the FTICR spectrometer

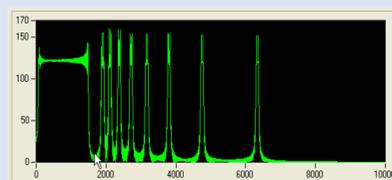


Geometry of the axial field magnet

Detection of small masses



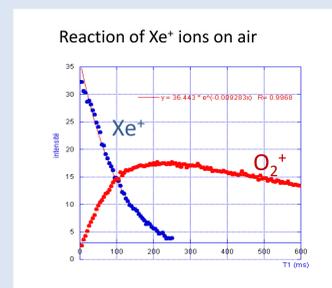
In both cases the resolution $M/\Delta M$ is higher than 100000



Fourier transform of the excitation buffer used for excitation around the nominal mass for $M=3$ to 9 and then continuously between 100Hz and 1.5MHz.

Absolute pressure calibration

For the rate constant measurements in reaction kinetics studies absolute pressure calibration is crucial. This has been done in two ways:
 -By measuring the pressure in the range 10^{-4} to 10^{-3} mbar with both a Bayard Alpert gage and a capacitance gage
 -by measuring the reaction kinetics of a known reaction in the ICR cell and using the literature rate constant value to deduce the absolute pressure in the cell.

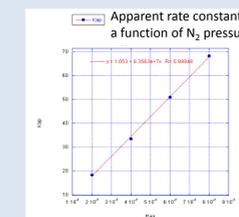
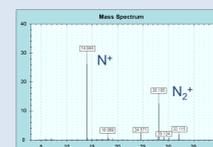
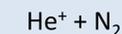


Xe+ + air

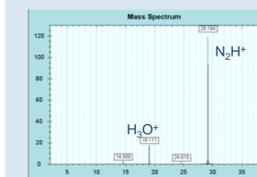
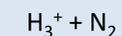
The reaction of Xe^+ with air was used to obtain the absolute pressure calibration. Xe^+ does not react with N_2 and reacts with O_2 with a rate constant of $K=1.1 \cdot 10^{-10}$ molecule. $cm^3 \cdot s^{-1}$

The difference between the results of the two calibration methods was smaller than 10%

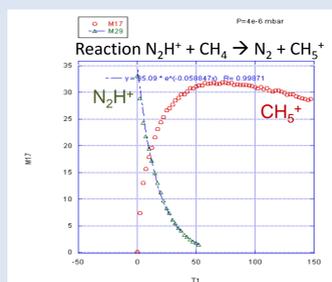
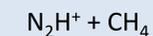
Reaction kinetics



The reaction $He^+ + N_2 \rightarrow He + N^+ \rightarrow He + N_2^+$ is observed with a rate constant $K=1.98 \cdot 10^{-9}$ molecule. $cm^3 \cdot s^{-1}$



H_3^+ react with N_2 and produces N_2H^+ by proton transfer. The small H_3O^+ peak is produced by reaction with the residual background. The observed rate constant is $K=2.7 \cdot 10^{-9}$ molecule. $cm^3 \cdot s^{-1}$



High N_2H^+ ion intensities can be obtained using the $H_3^+ + N_2$ reaction and then used to detect species such as CH_4 by proton transfer. This can be a way to detect by chemical ionization species that are not ionized using proton transfer from H_3O^+

Conclusions

With appropriate excitation buffers we are able to follow masses starting at $M=2$ in our permanent magnet FTICR spectrometers. Proton transfer from H_3^+ on various species has been studied as well as charge transfer from He^+ .

Acknowledgement.

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