



# Sub base, Bore Hole and Groundwork analysis using Mass Spectrometry

Aspec. Application Note

# Principles and application:

The Aspec MS system is ideal for the analysis of sub ground environments because of the following reasons:

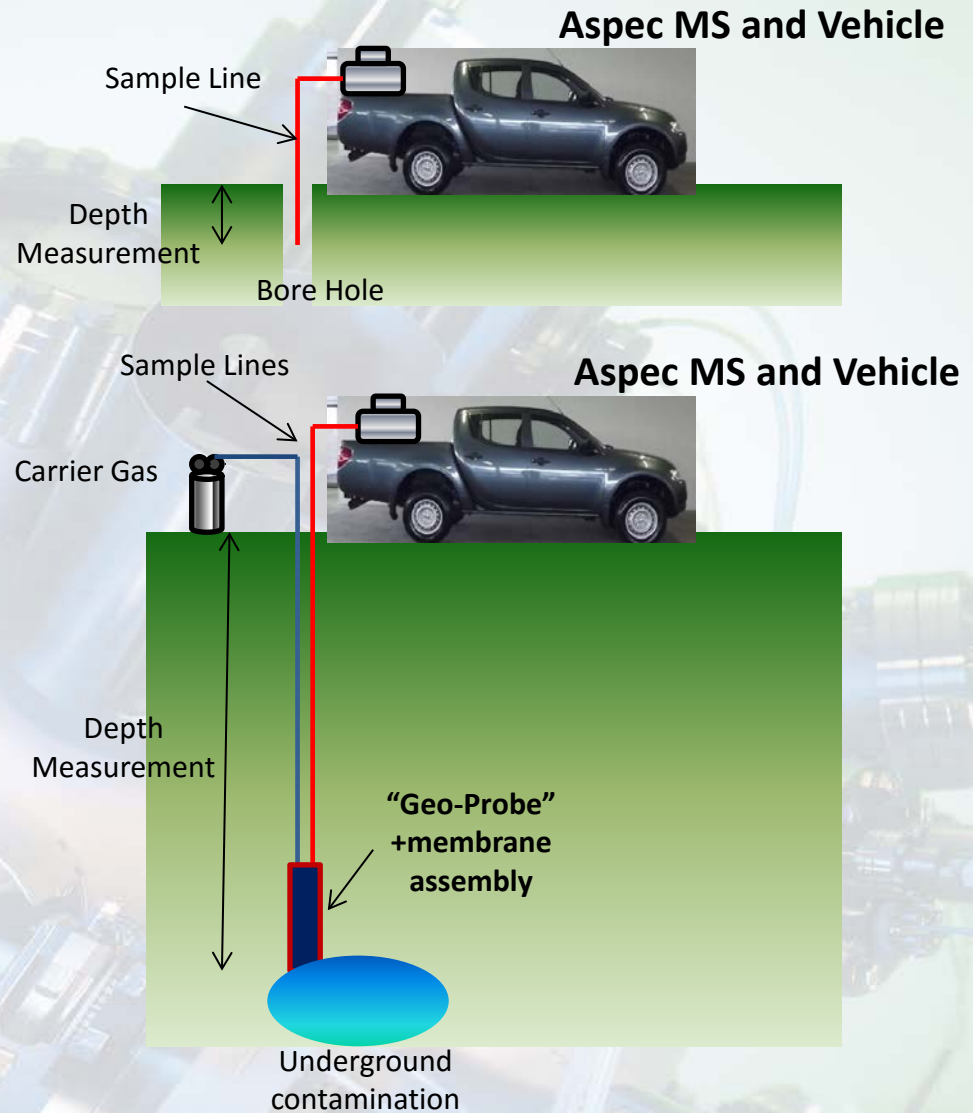
- ✓ Fast deployment of MS instrument
- ✓ Fast detection and analysis of both known and unknown gas species.
- ✓ Large dynamic range of detection.
- ✓ Easy manipulation of data.
- ✓ External interface for connection to other instruments such as GPS and depth profile probes.
- ✓ Several sample inlet types available.

# Shallow hole and deep probe applications:

The Aspec MS system can be used in a number of configurations:

Taken to a location where there is an existing bore hole, mine shaft and a sample line lowered into the cavity whilst continuously taking sample spectra and looking for unknown contamination. The Aspec MS system may also be attached to the outlet of many commercially available underground sampling probes (Geoprobes) that are often driven mechanically into contaminated the ground.

The depth measurement and GPS position may also be correlated with the MS data and an X,Y,Z profile of contaminated land may be created.





# Principles of the Mass Spectrometer

Sample gas is continuously injected into a the vacuum housing held at approximately  $1 \times 10^{-6}$  mbar.

When the sample gas molecule comes in contact with an electron emitted by a hot filament it becomes positively charged and forms an ion or a series of ions (cracking pattern) in predicted ratios.

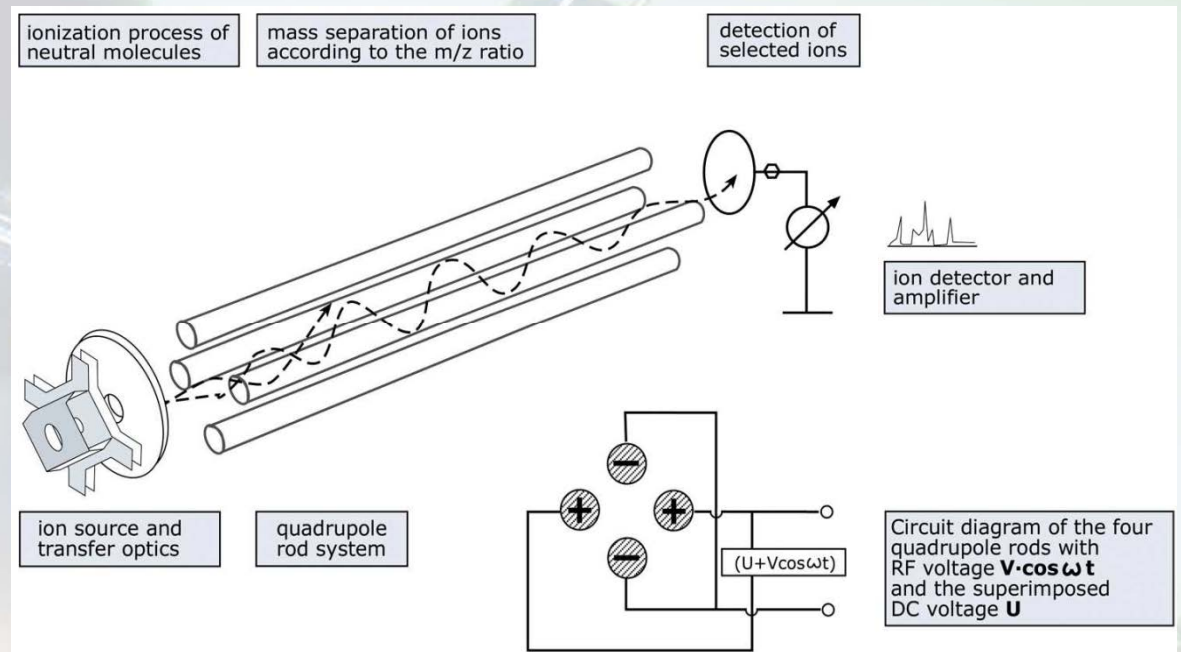
These ions are focused from the Ion Source via transfer optics towards the mass filter (quadrupole rod system). The Rod System consists of 4 accurately ground stainless Steel rods mounted very accurately into a set of ceramic carriers.

Once the ion enters the mass filter they are separated into their individual ion weights by the influence of both RF and DC voltages that are applied to apposing rods to create an electrostatic field.

Ions that leave the Mass Filter Rod Assembly strike a detector and produce an electric current.

**It is an important principle that the Filtered Ion Current produced at the detector is directly proportional to the concentration of each individual gas species.**

**This whole Ionisation of the gas sample, transmission through the mass filter, detection and plotting on a computers Y axis takes far less less than 1ms making a Mass Spectrometer extremely fast.**



# Mass Spectrometer Analysis

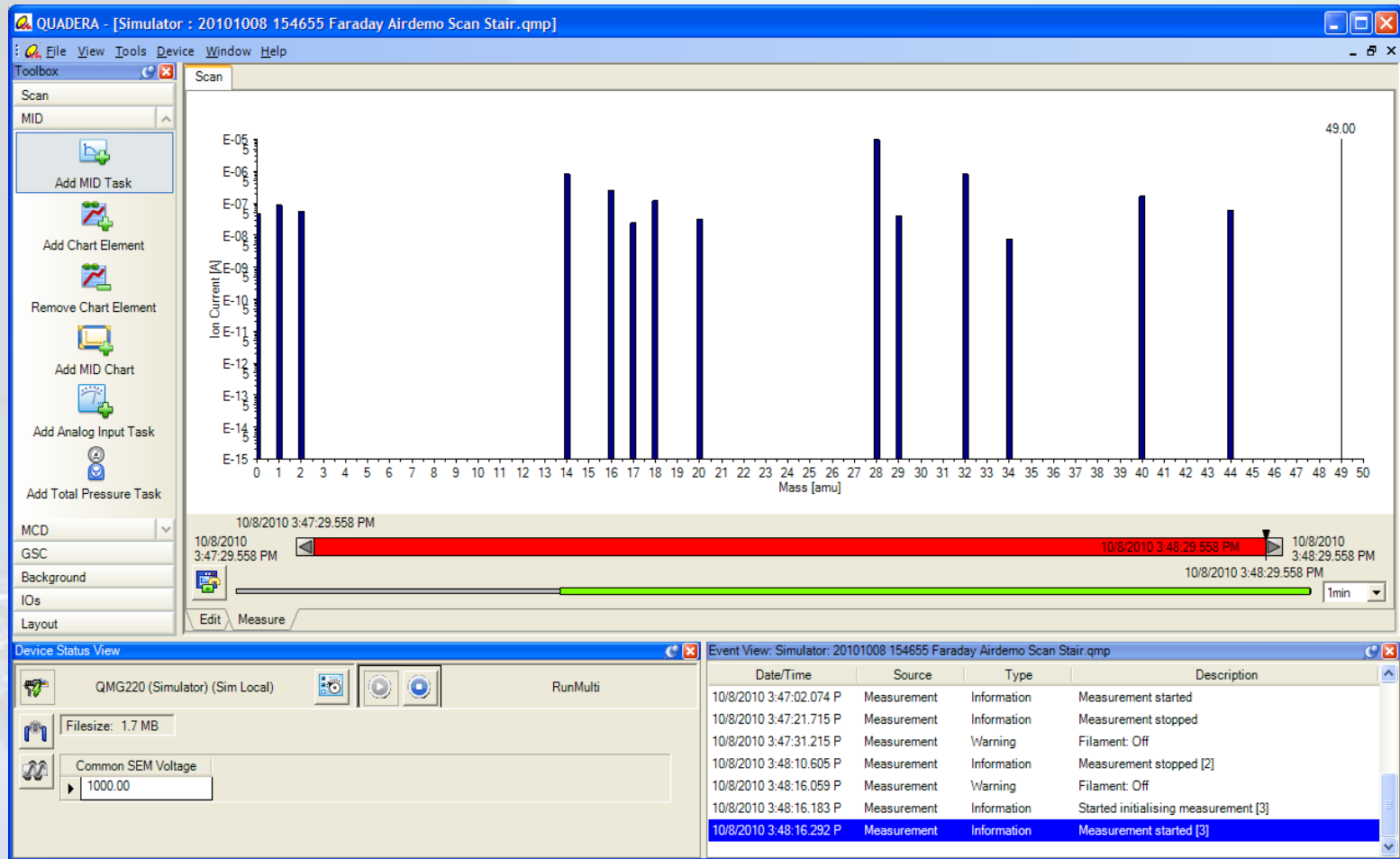
The Mass Spectrometer instrument is an extremely fast and flexible instrument and has the capability to measure up to 64 gas species at any one time.

The choice of gas species may be selected by the operator at any time or a standard matrix of gas species may be stored under a single analysis file and launched when required.

Here are 3 analysis mode examples that demonstrate the capability and power of the Mass Spectrometer instrument

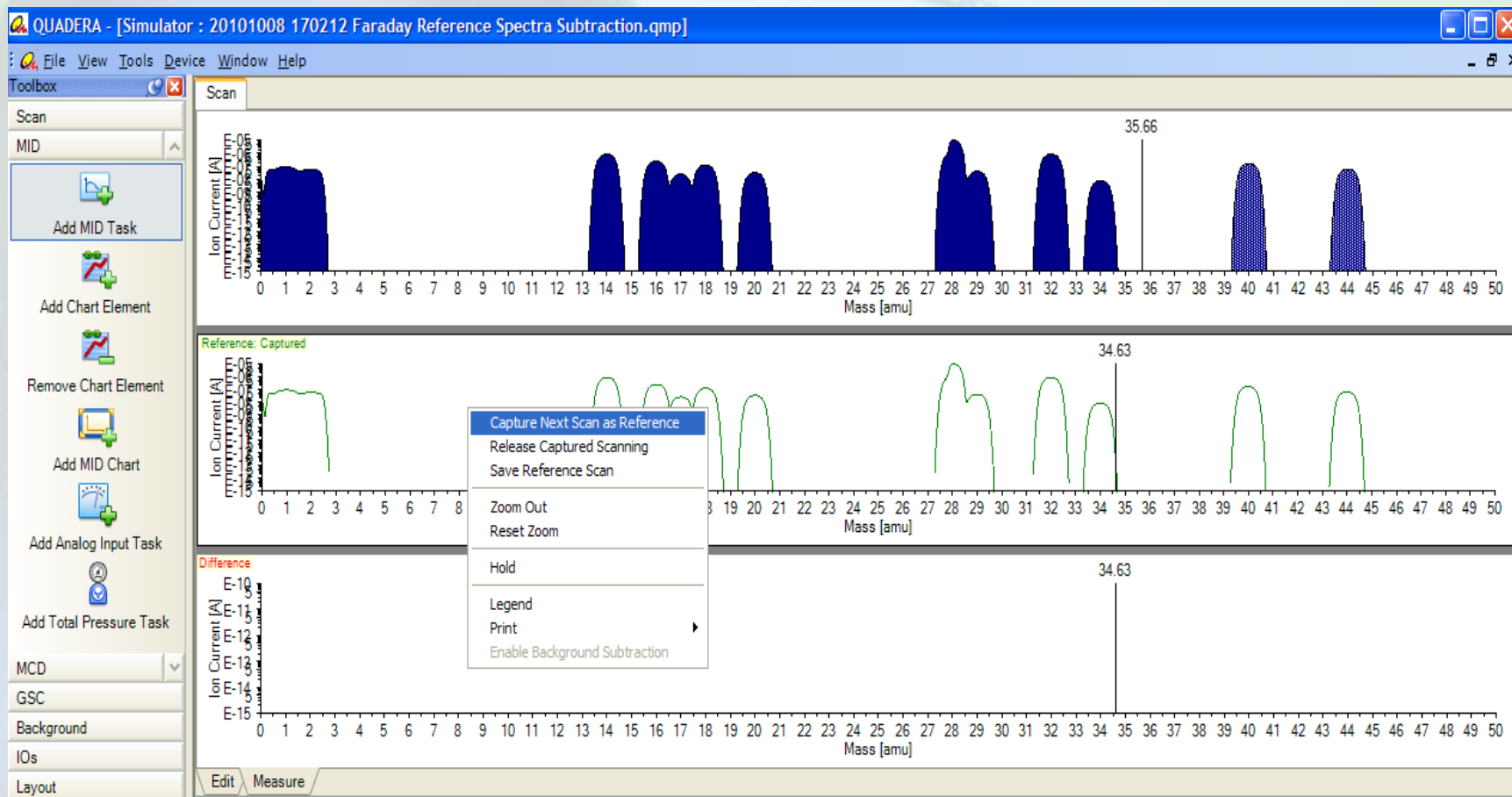
- Raw data **scan** mode.
- Background process subtraction (for looking at unknowns)
- Full Calibration data collection mode and data logging WRT time

# Raw Gas/Mass scan Mode



In this mode, you can “scan” the entire mass range of the instrument in less than 2 seconds and produce a complete spectra of any gas composition. The spectra will automatically show very low as well as very high concentrations all on one single spectra. Each bar of the graph above represents a different gas or isotope of a gas. The higher the signal, the more gas there is. This mode enables the user to quickly see if the gas composition is accurate and correct.

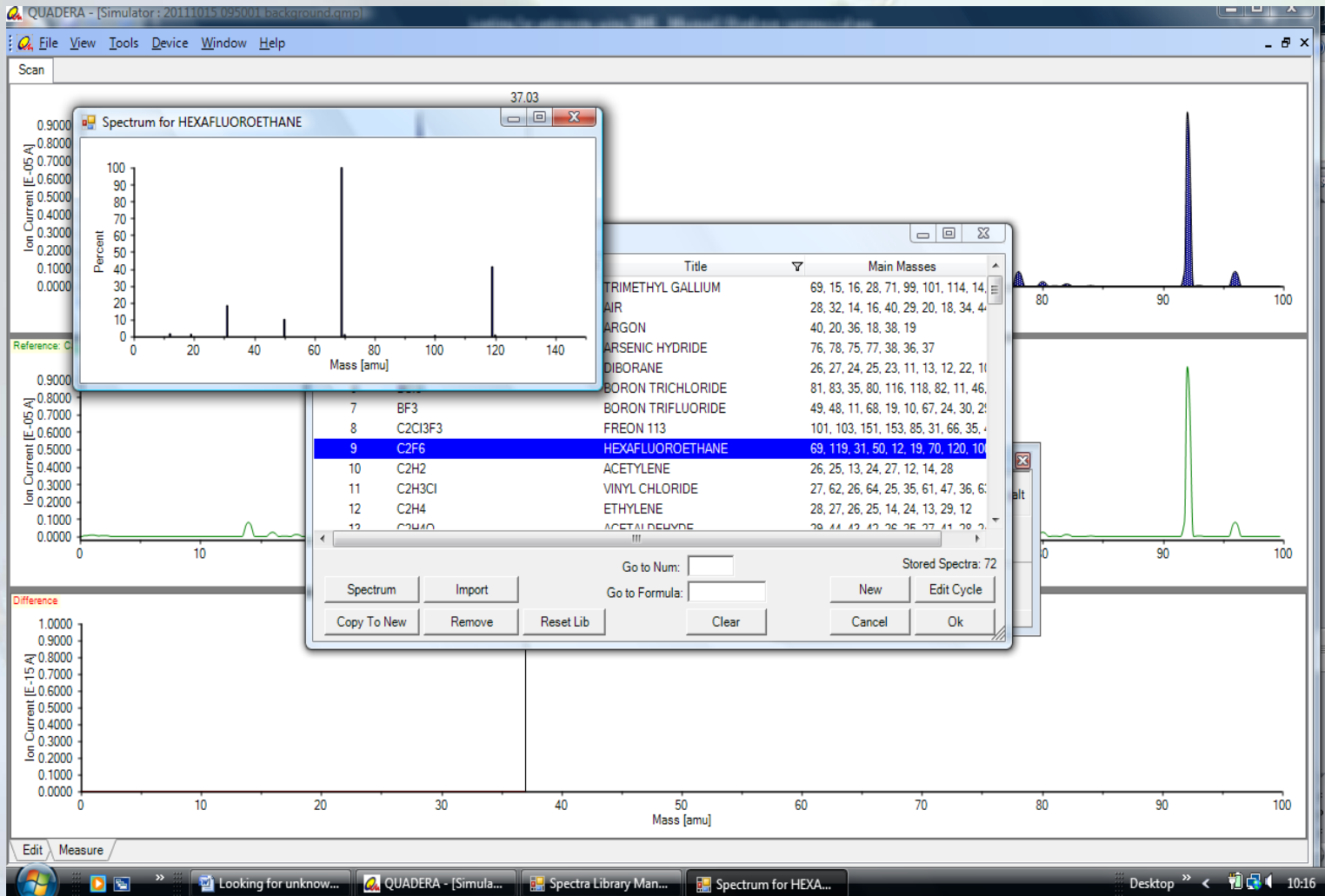
# Background subtraction



This mode enables the operator to monitor a process for any changes that may occur. Any difference in gas composition can easily be logged and displayed on the bottom "Difference" axis. The acquired spectra may be interrogated and compared with a spectra library for identification of new, evolved gas species at any time.



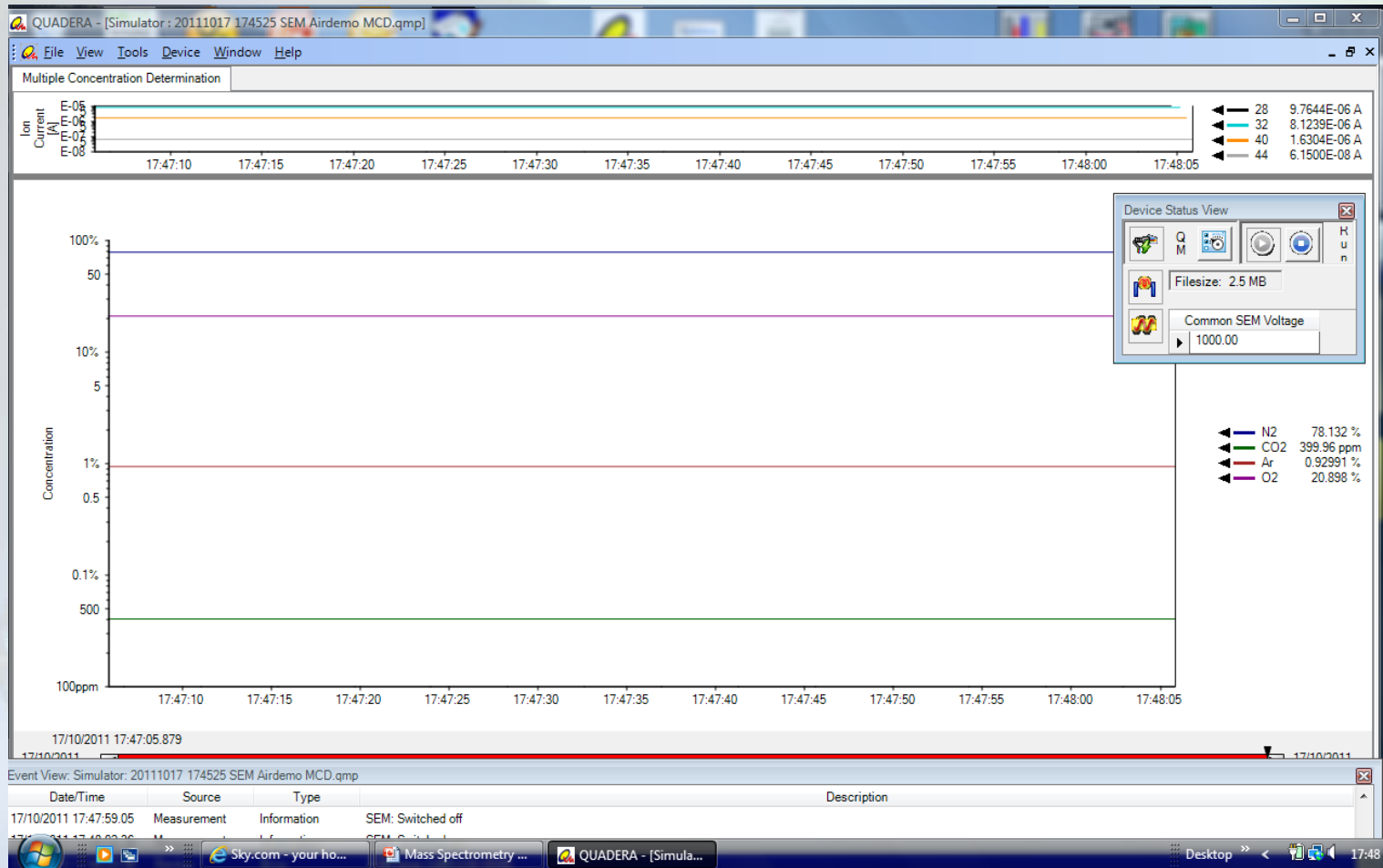
# Gas Identification



Continuously stored data may be interrogated at any time and correlated with known spectra either from the built in spectra library data base or from a remote spectra source such as NIST.



# Full calibration Data Mode



This mode is the most commonly used mode. It enables the user to calibrate and display up to 64 gas species and measure in direct concentration. Each gas component is calibrated by a set up routine and once calibrated the instrument will measure, data log and display the data in real time. The above example shows a simple calibration and data logging of 4 common components that appear in air. All axis can be modified depending on the process and reaction you are wanting to measure.