NGD as gas detector and its use in process gas chromatographs

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Apix Analytics

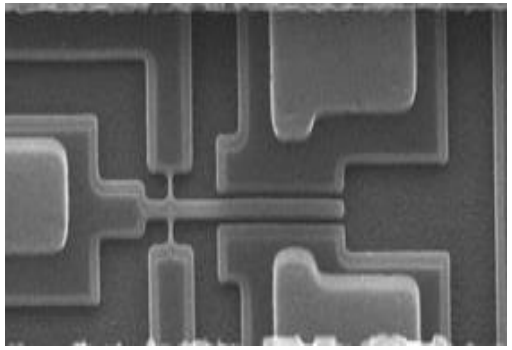
Apix in a few words

Founded in 2014

30 Collaborators :

- R&D center in **Grenoble : 18 persons (5 PhDs, 11 Master degree)**
- Manufacturing in **Pau : 10 persons**
- Commercial office in **Beijing : 2 persons**
- **Subsidiary in Beijing in May 2021**

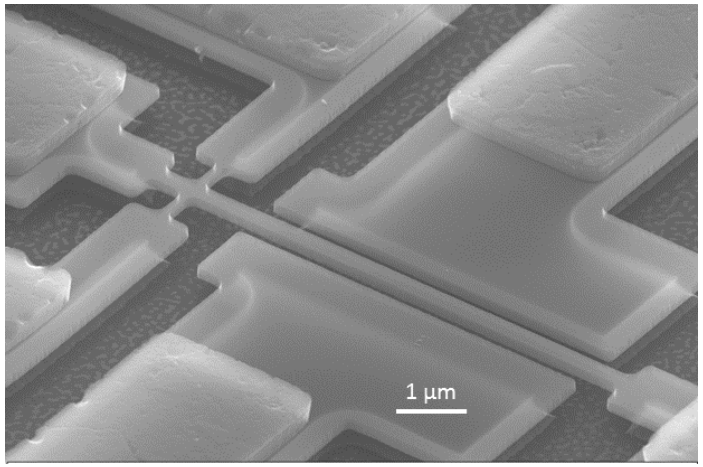
Based on 8 years of Joint R&D
with CEA (France) and CALTECH (USA)
20 patents that protect the technology

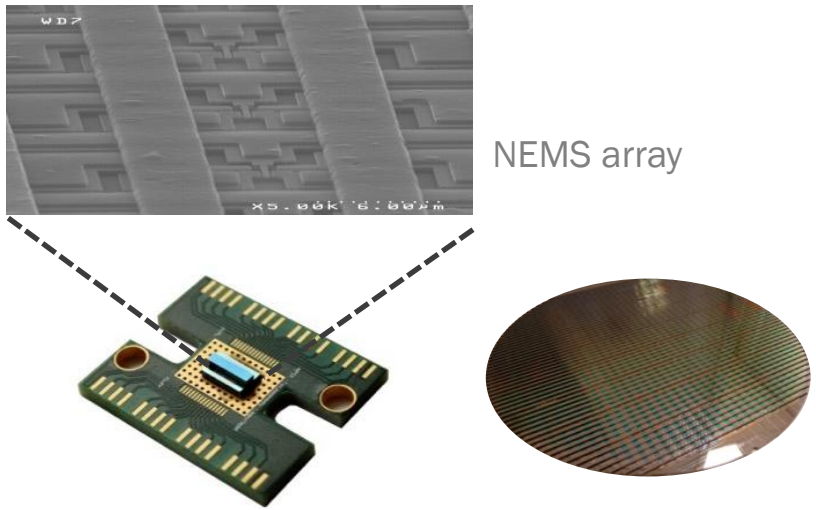


3 round of Investment for a total of 15M€ raised

Industrial Partnerships
with Leading Oil and Gas Players

A unique technology: the NGD (Nano Gravimetric Detector)





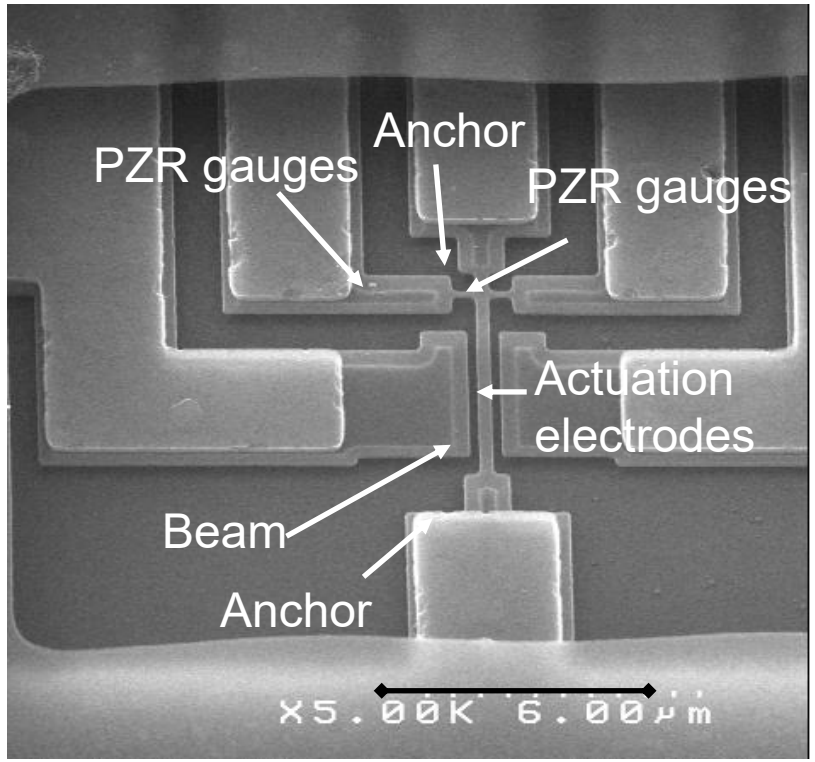
NEMS array

The NanoElectroMechanical System (NEMS) resonator is a

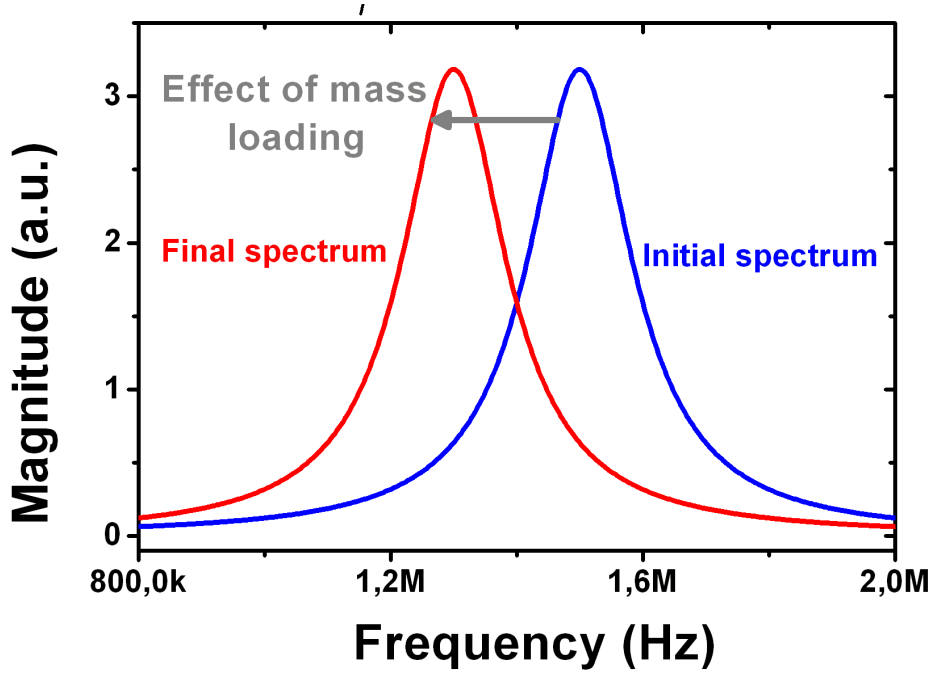
small, sensitive, fast and universal gas sensor

How does it work?

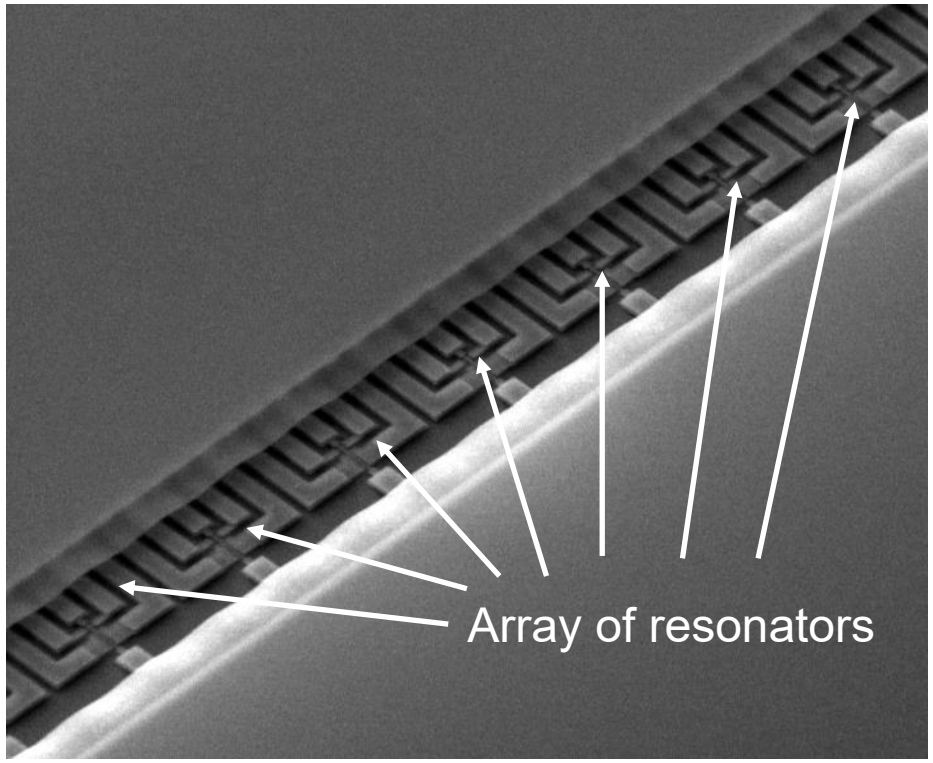
1. Resonating structure covered with a sensitive layer



2. Adsorption of compounds causes resonance frequency shift

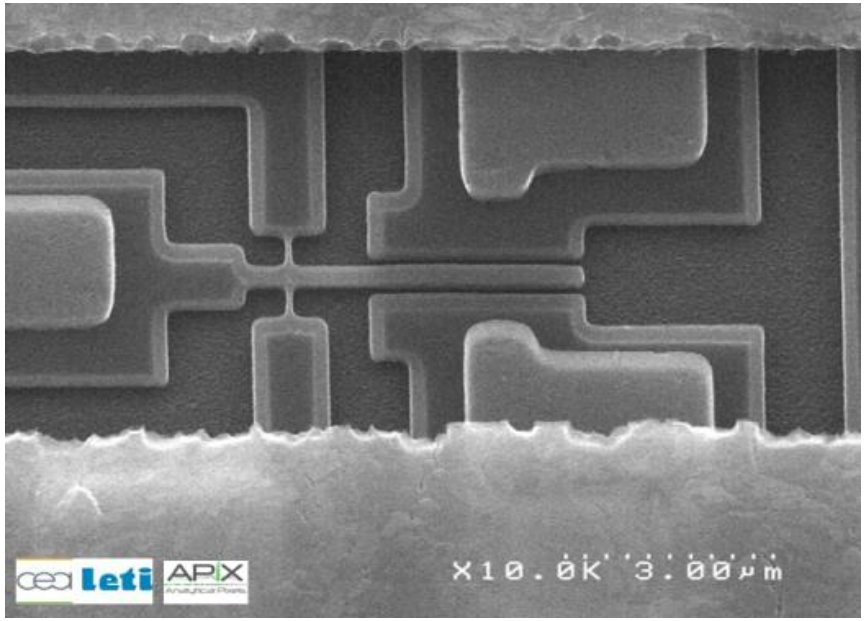


NEMS Array to improve resolution



- Noise between one device to the other is uncorrelated
- LOD is improved by sqrt(25)=5 compared to a single device

- 25 NEMS devices connected in parallel are embedded in an array

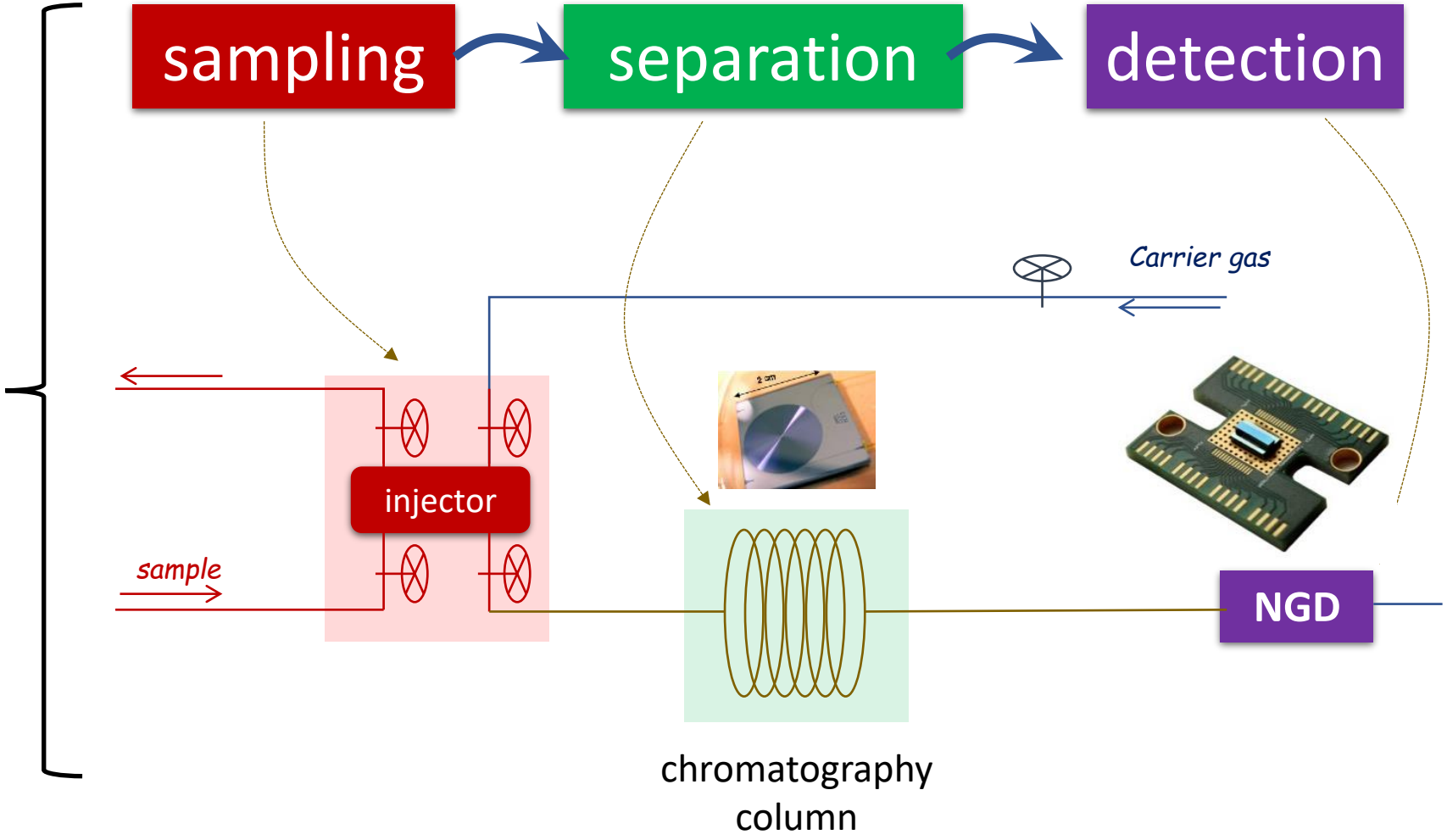


- To reduce exogenous factor such as temperature and pressure fluctuation, a differential measurement is done

NGD versus common detectors

	NGD	TCD	FID
additionnal gas supply	No ☺	No ☺	Yes ☹
make up gas	No ☺	No ☺	Yes ☹
non destructive (combination with other detectors)	Yes ☺	Yes ☺	No ☹
ATEX compatible	Yes ☺	Yes ☺	No ☹
insensitive to carrier gas	Yes ☺	No ☹	Yes ☺
contamination from combustion of silicone compounds	No ☺	No ☺	Yes ☹
sensitivity light compounds	No ☹	Yes ☺	Some ☺
sensitivity heavy compounds	Yes ☺	No ☹	Yes ☺

Our Products: Plug & Play GC Module

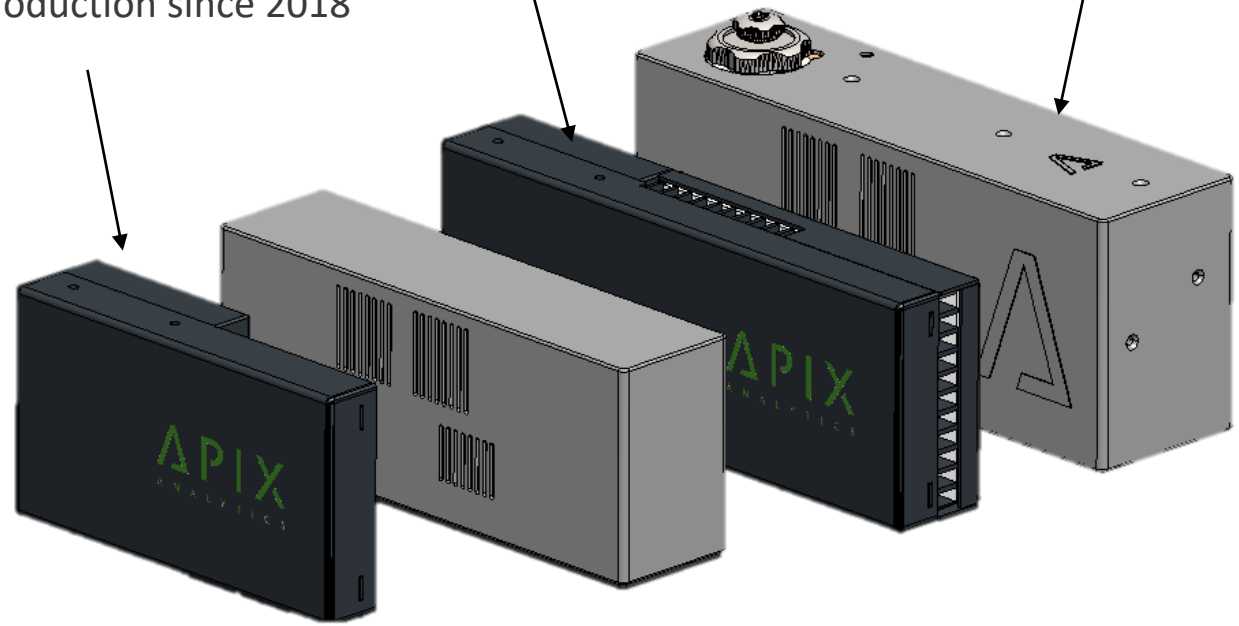


Our Products : plug&play GC modules

NGD module for heavy gases
from C7 to C12
In production since 2020

Module for liquid analysis
from C12 to C40
Commercialization will be
launched 2022

TCD module for light gases
In production since 2018



Chrompix 2

MODULAR MULTI-GAS ANALYZER FOR INDUSTRIAL AND LABORATORY USE. BASED ON APIX ANALYTICS PATENTED MINIATURIZATION TECHNOLOGY, CHROMPIX2 IS THE FIRST TRULY PLUG&PLAY GC. IT NOW FEATURES UNMATCHED FLEXIBILITY WITH UP TO 4 DIFFERENT ANALYTICAL COLUMNS, UP TO 4 DIFFERENT CARRIER GASES AND THE ABILITY TO ANALYSE SIMULTANEOUSLY 4 DIFFERENT SAMPLES.

Features

- 450x460x220mm (19' 4U)
  10 kg
- 100 – 240V AC, 50 – 60 Hz
  150W consumption*
- Carrier gas pressure : 4 bar
  Sample gas pressure : 0,3 bar
- Up to 4 carrier gases (He, H_2, N_2, Ar)
  Up to 4 analytical modules
- Up to 20mL/min/module carrier gas
  Up to 5mL/min/module sample gas
- Operating T°C range : -10 to 40°C
  Noise emission : 45 dB

Chromex 200/400

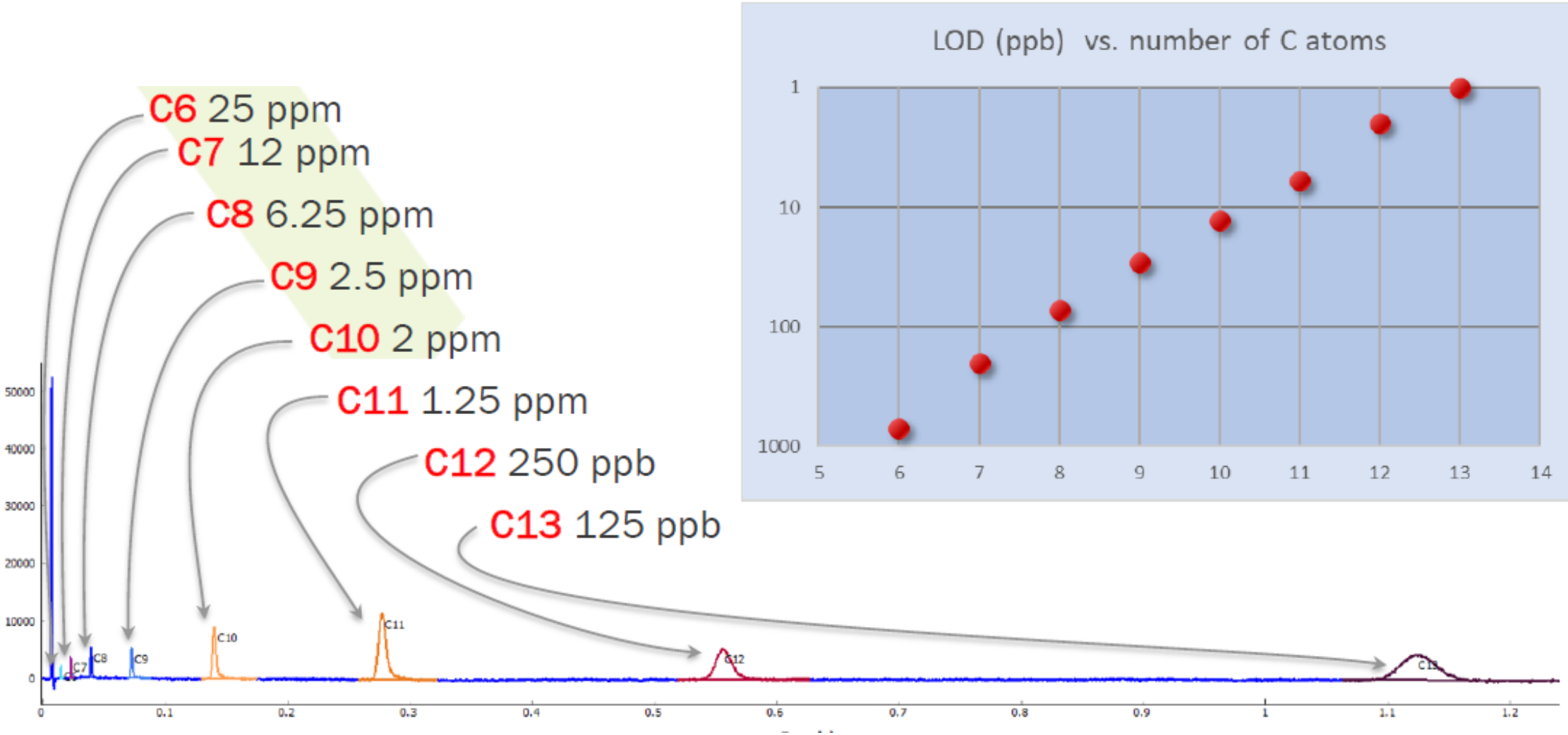
MODULAR MULTI-GAS ANALYZER FOR INDUSTRIAL AND PROCESS USE. BASED ON APIX ANALYTICS PATENTED MINIATURIZATION TECHNOLOGY, CHROMEX IS THE FIRST TRULY PLUG&PLAY GC. IT IS EMBEDDED IN AN ATEX COVER AND IT CAN HANDLE 2 (CHROMEX 200) OR 4 MODULES (CHROMEX 400).

Features

- 485x405x28mm (19' 4U)
  30,4 kg
- 100 – 240V AC, 50 – 60 Hz
  150W consumption*
- Carrier gas pressure : 4 bar
  Sample gas pressure : 0,3 bar
- 1 carrier gases (He, H_2, N_2, Ar)
  Up to 2/4 analytical modules
- Up to 20mL/min/module carrier gas
  Up to 5mL/min/module sample gas
- Operating T°C range : -10 to 40°C
  Noise emission : 45 dB

* Depending on configuration

Analysis of alkanes C6 to C13 with NGD



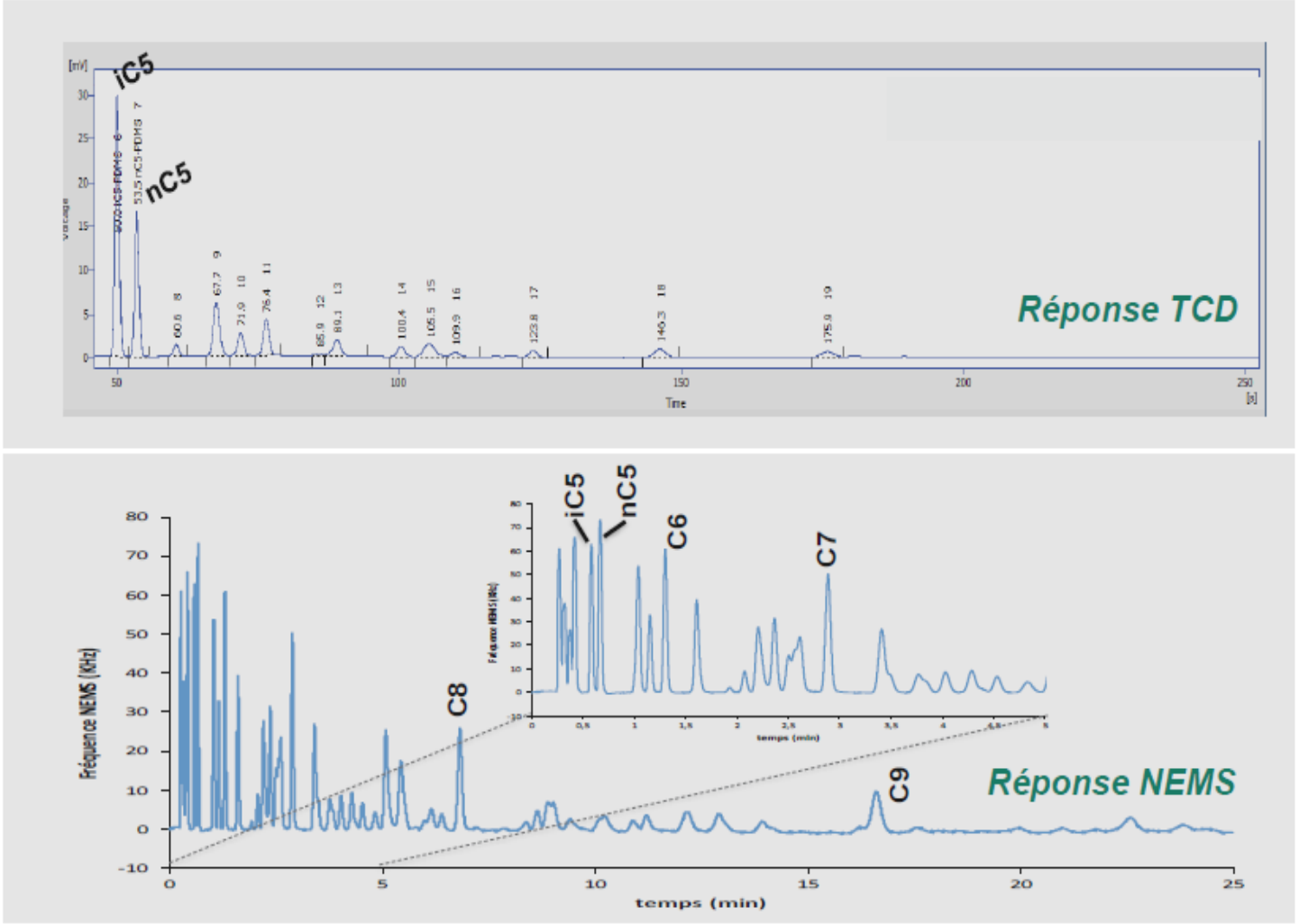
NGD application

- Analysis of hydrocarbons from C6 à C13 (sub-ppm) to evaluate more precisely the calorific value of the gas

- Computation of the hydrocarbons dew point (NF EN ISO 23874)

- Analysis of VOCs et total VOCs and other impurity than may be present in traces for hydrogen quality, biogas/biomethane application

Comparison between TCD and NGD on natural gas

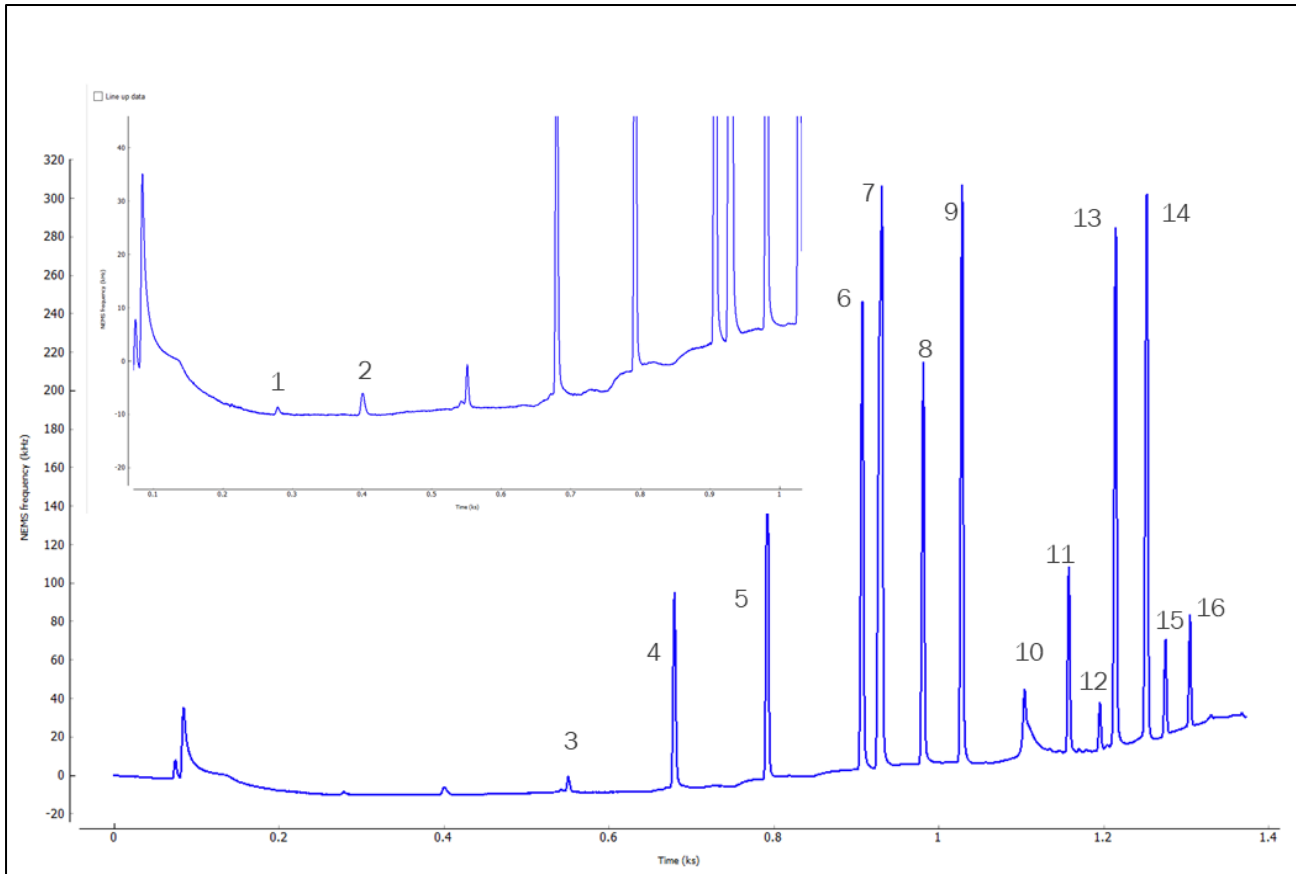


NGD detector for environmental application

Analysis of VOCs at 4ppb in air

AlphaPix

Preconcentration solution included inside to perform on-site analysis



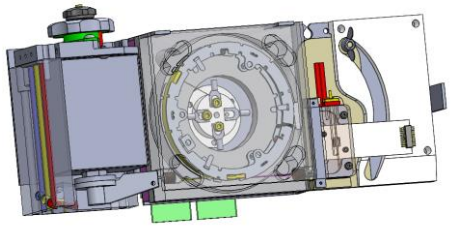
Bouteille à 4ppb

<C5 15composés
n-Pentane
2-Methylpentane
n-Hexane (1)
Isoprene
Benzene (2)
n-Heptane (3)
Toluene (4)
n-Octane (5)
Ethylbenzene (6)
m-Xylene (7)
p-Xylene (7)
o-Xylene (8)
n-Nonane (9) carry over
1,3,5-Trimethylbenzene (11)
A-Pinene (10)
1,2,4-Trimethylbenzene (13)
n-Decane (14) carry over
B-Pinene (12) ?
1,2,3-Trimethylbenzene (15)
Limonene (16)

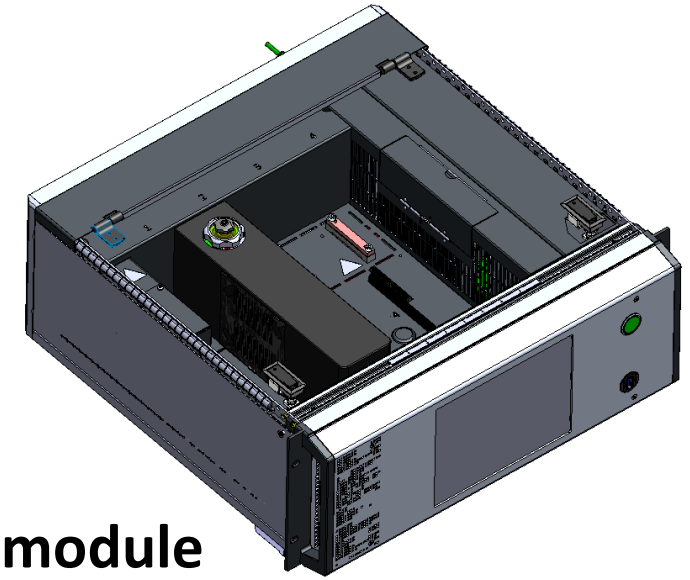
Toward the analysis of sample in the liquid phase

MILAN Module : reduction of the cost and size of traditional lab GC in a Plug & Play module compatible with a Chrompix analyzer.

Traditional lab GC



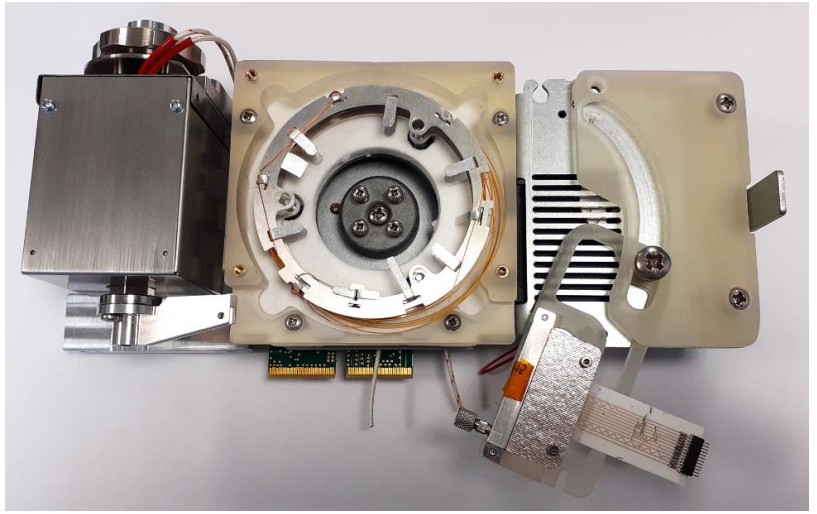
MILAN module



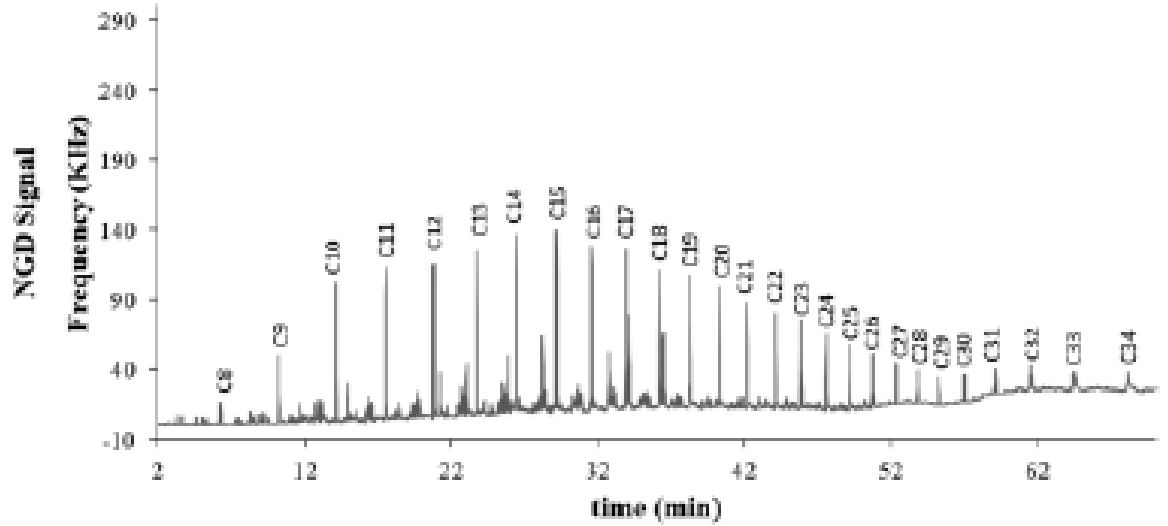
MILAN module in the Chrompix analyzer

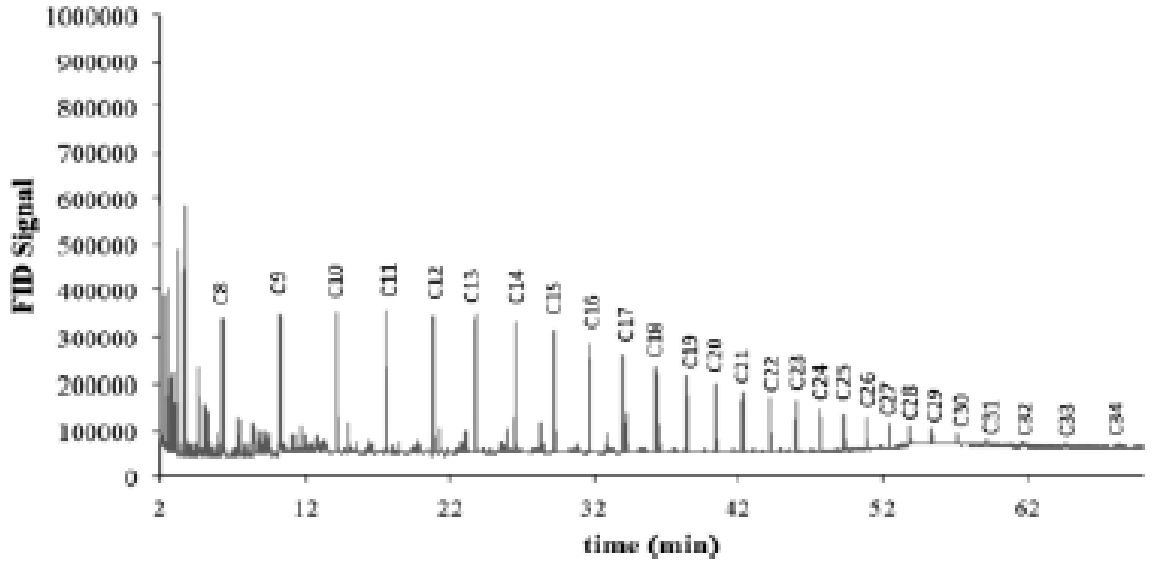
Main specifications of the MILAN module

- A plug&play module specially developed to analyze liquid sample up to C32
- Compatible with a Chrompix analyzer
- It embeds:
  - split/splitless injector that can be heated up to 300°C
  - detector NGD to measure compounds above C6 with limit of detection below the ppm. No hydrogen is required. Can work with any sort of carrier gaz ((Helium, air, etc). Its working temperature is adapted according to the compound eluting from the column. Maximum working temperature 240°C
  - up to a 30m capillary column (characteristic is adapted depending on the application): max temperature 280°C with a maximum heating rate of 100°C/min. Fast cooling rate 100°C/min to minimize analysis cycle time.
  - Integrate GC backflush

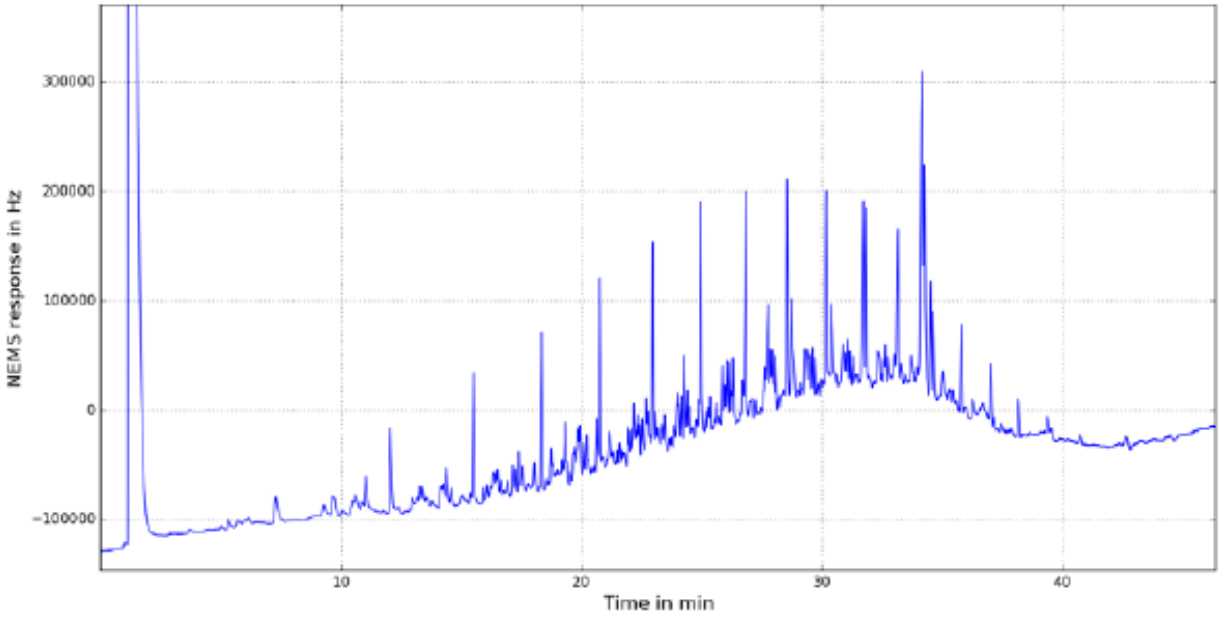


Analysis of a real petroleum fluid : NGD vs. FID

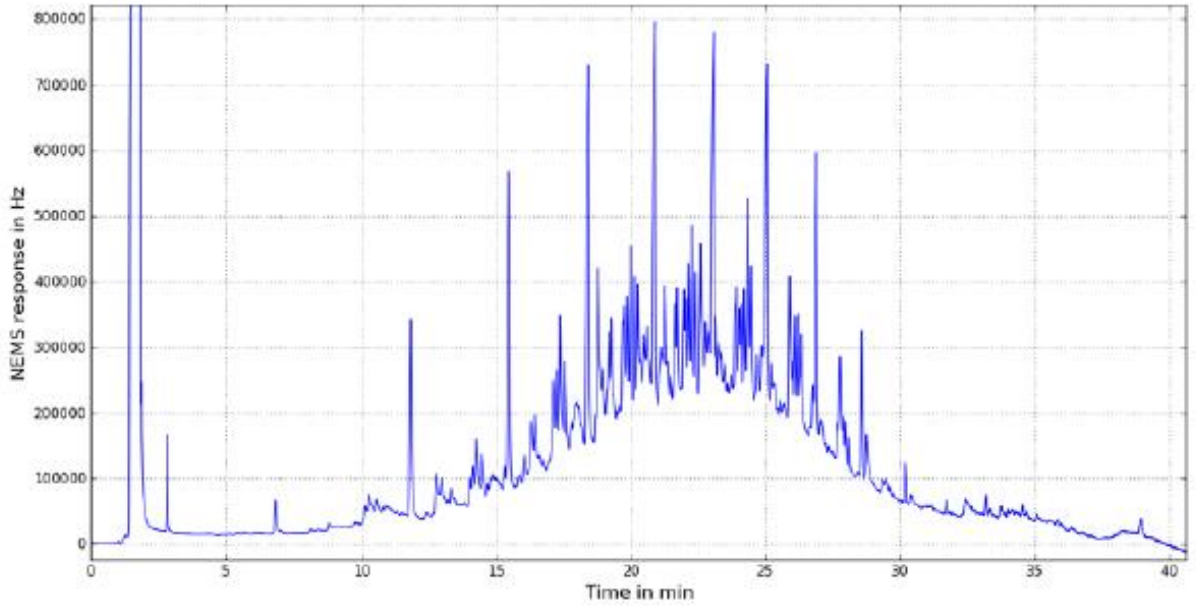




Analysis of a petroleum fluid with MILAN module



Analysis of Diesel



Analysis of Kerozene

Conclusion : our benefits

All-in-One analyzer for process

Capability to analyze all parameters of interest in a single system (4 modules)

>50% CAPEX Reduction

Reduced OPEX

Low carrier gas consumption

Carrier gas can be Air for the NEMS

No need of services from a GC expert

Small footprint

Measurement in situ, right at the sampling point with limited infrastructure and space requirements

Reduced Infrastructure costs

Measurement in situ, right at the sampling point with limited infrastructure and space requirements

Faster Measurements

Shorter measurement cycle times for faster decisions thanks to miniaturization

Cycle time <1 min vs 10+ min

Wide range of detection

Intrinsically safe detector (No flame, no H2)
Wider detection spectrum with the combination of micro TCD and NEMS