

# *Hyphenated Techniques*

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# INTRODUCTION

- Hyphenated technique is a combination or coupling of two analytical techniques with the help of proper interface.
- The term 'HYPHENATION' was first adapted by Hirschfeld in 1980 to refer combination of separation techniques and one or more spectroscopic detection techniques.

# List of Hyphenated Techniques.

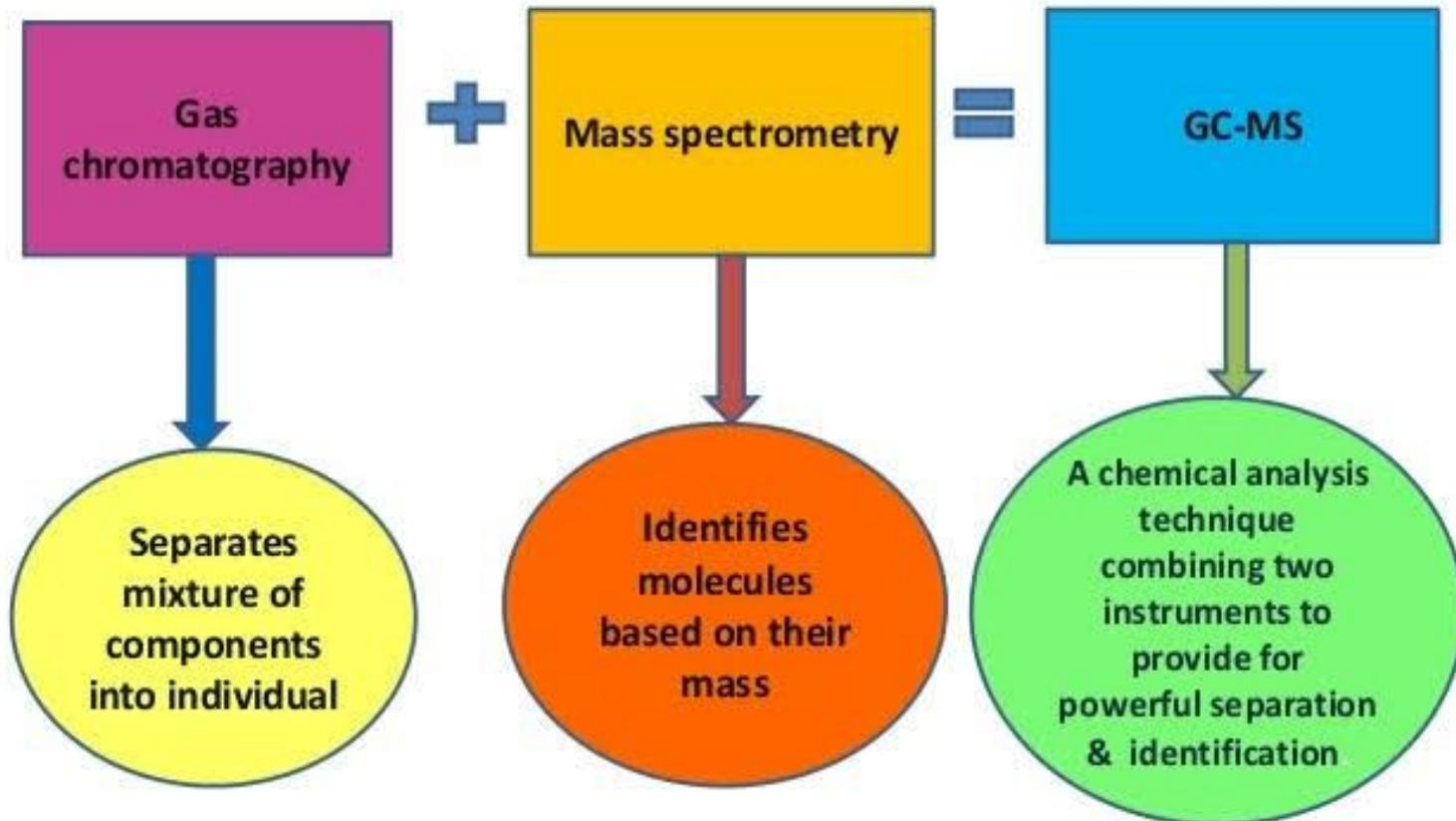
1. GC-MS
2. LC-MS
3. LC-NMR
4. GC-IR

GC-MS

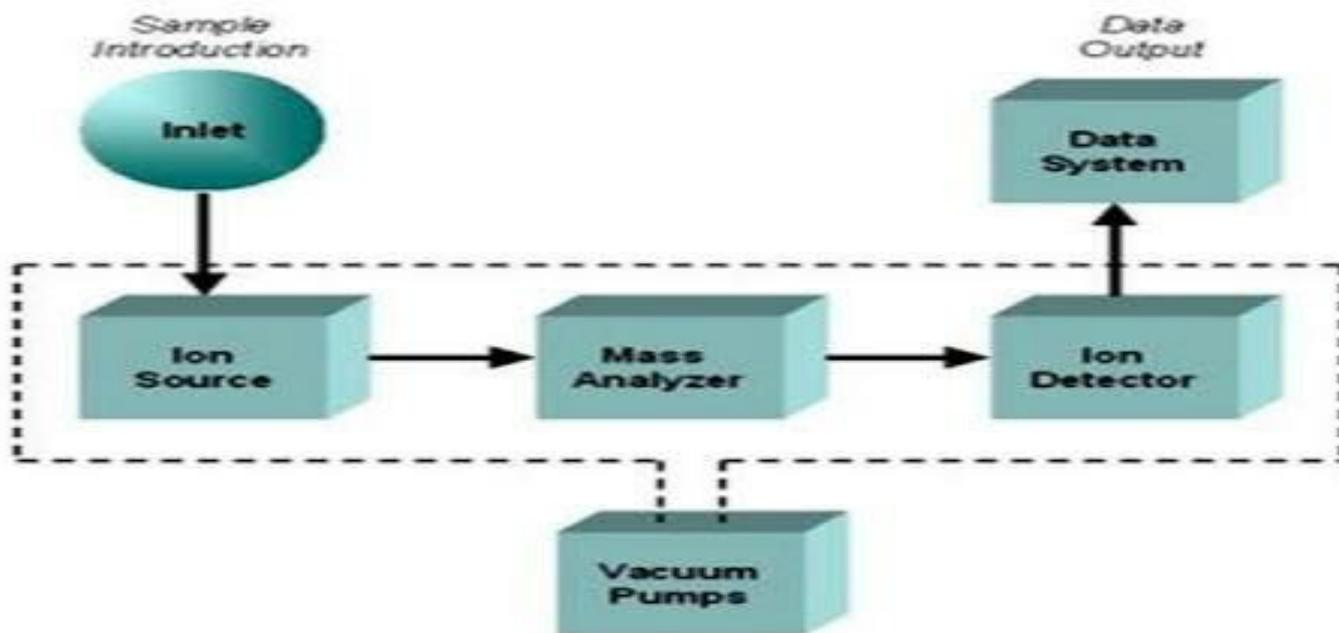


# GC-MS – A BRIEF

- It's a Hyphenated Technique
- Invented By James & Martin in 1952



# Principle of GC-MS



Block diagram of mass spectrometry

## COUPLING OF GC TO MS

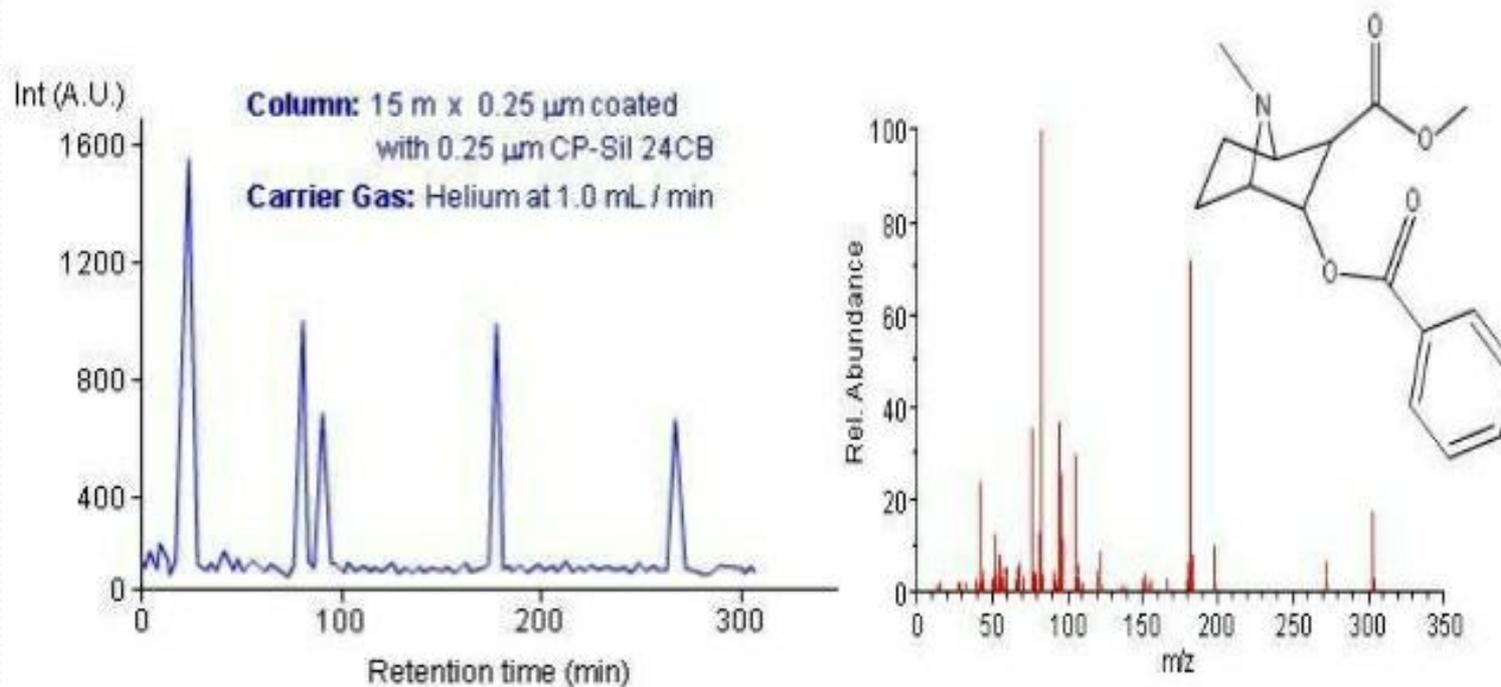


- output of the GC must be reduced to vacuum of  $10^{-5}$  to  $10^{-6}$  atm The interface b/w GC-MS play an important role in the overall efficiency of instrument
- Both system are heated at  $200-300^{\circ}\text{C}$ , both deal with compound in vapor state.
- Only one problem is that the atmospheric pressure

# Pharmaceutical & other applications of GC-MS

## 1. Pharmaceutical applications

GC-MS analysis of urine sample known to contain cocaine.



**GC of cocaine**

**MS spectrum of cocaine**

# What is LC-MS?

## LC-MS:

- is an **analytical chemistry** technique that combines the physical separation capabilities of **liquid chromatography** (or HPLC) with the mass analysis capabilities of **mass spectrometry**.
  - LC-MS is a powerful technique used for many applications which has very high sensitivity and specificity.
  - Its application is oriented towards the specific detection and potential identification of chemicals in the presence of other chemicals (in a complex mixture).
- 
- It is the combination of liquid chromatography and the mass spectrometry.
  - In LC-MS we are removing the detector from the column of LC and fitting the column to interface of MS.
  - In the most of the cases the interface used in LC-MS are ionization source.

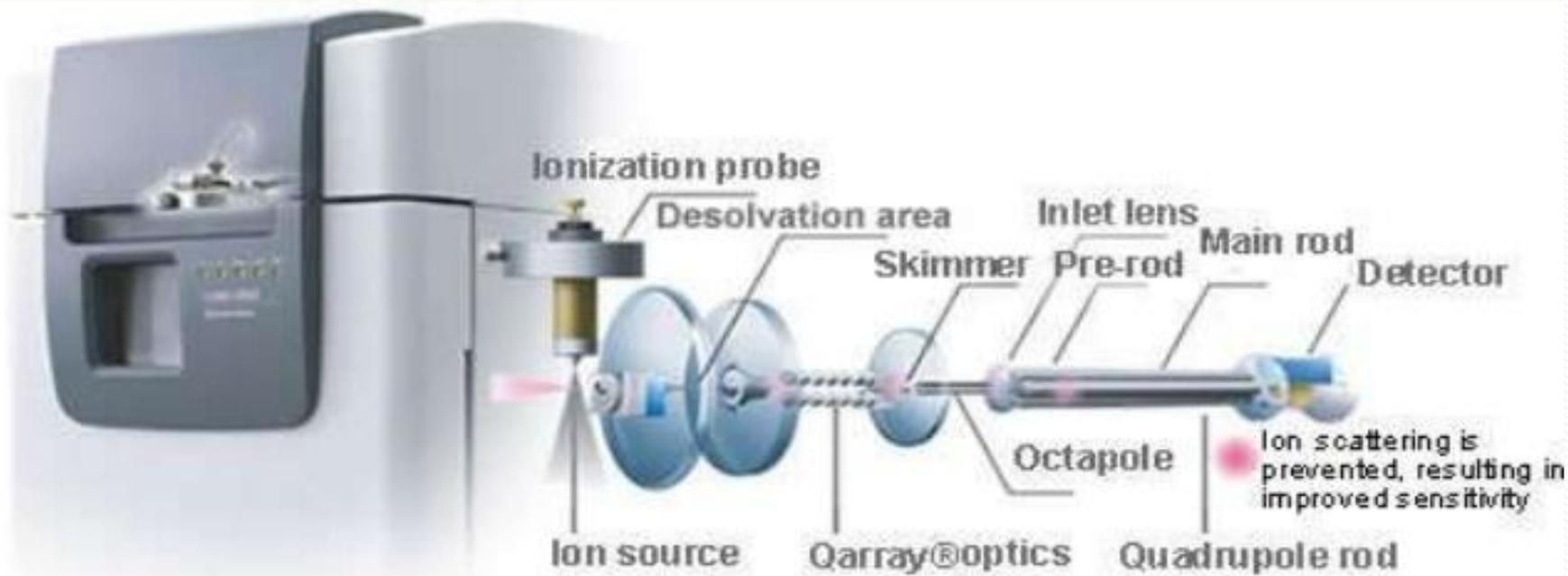


# WHY WE COMBINE THESE TWO?

- Combining the two processes reduces the possibility of error, as it is extremely unlikely that two different molecules will behave in the same way in both a liquid chromatograph and a mass spectrometer.
- Therefore, when an identifying mass spectrum appears at a characteristic retention time in a LC-MS analysis, it typically lends to increased certainty that the analyte of interest is in the sample.



## Modern LCMS (LCMS 2020 SHIMADZU)



### Ultra Fast UFswitching

Rapid polarity switching  
between positive/negative  
ionization modes

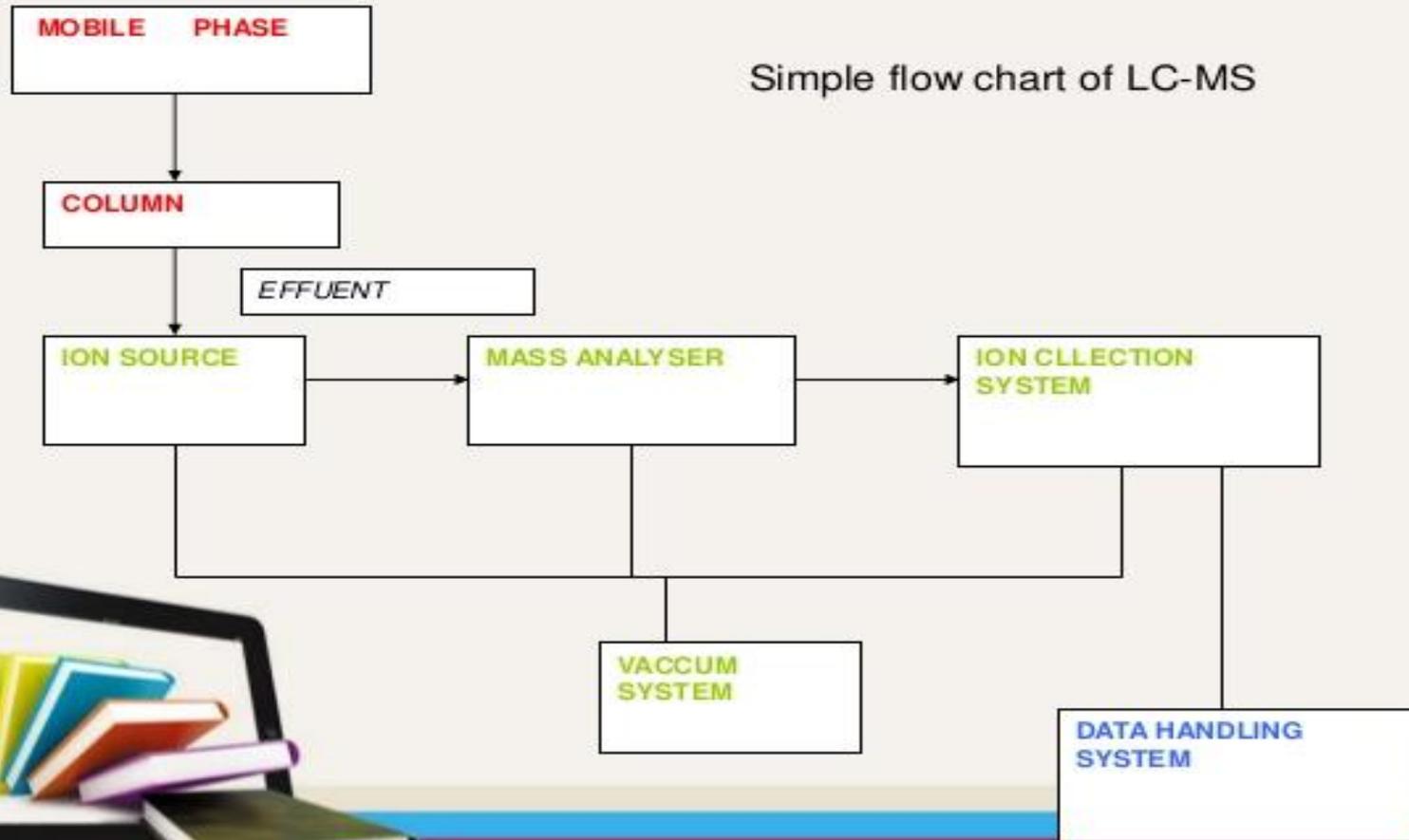
### Ultra Fast UFsensitivity

Superior sensitivity,  
especially for ultra  
high-speed analysis

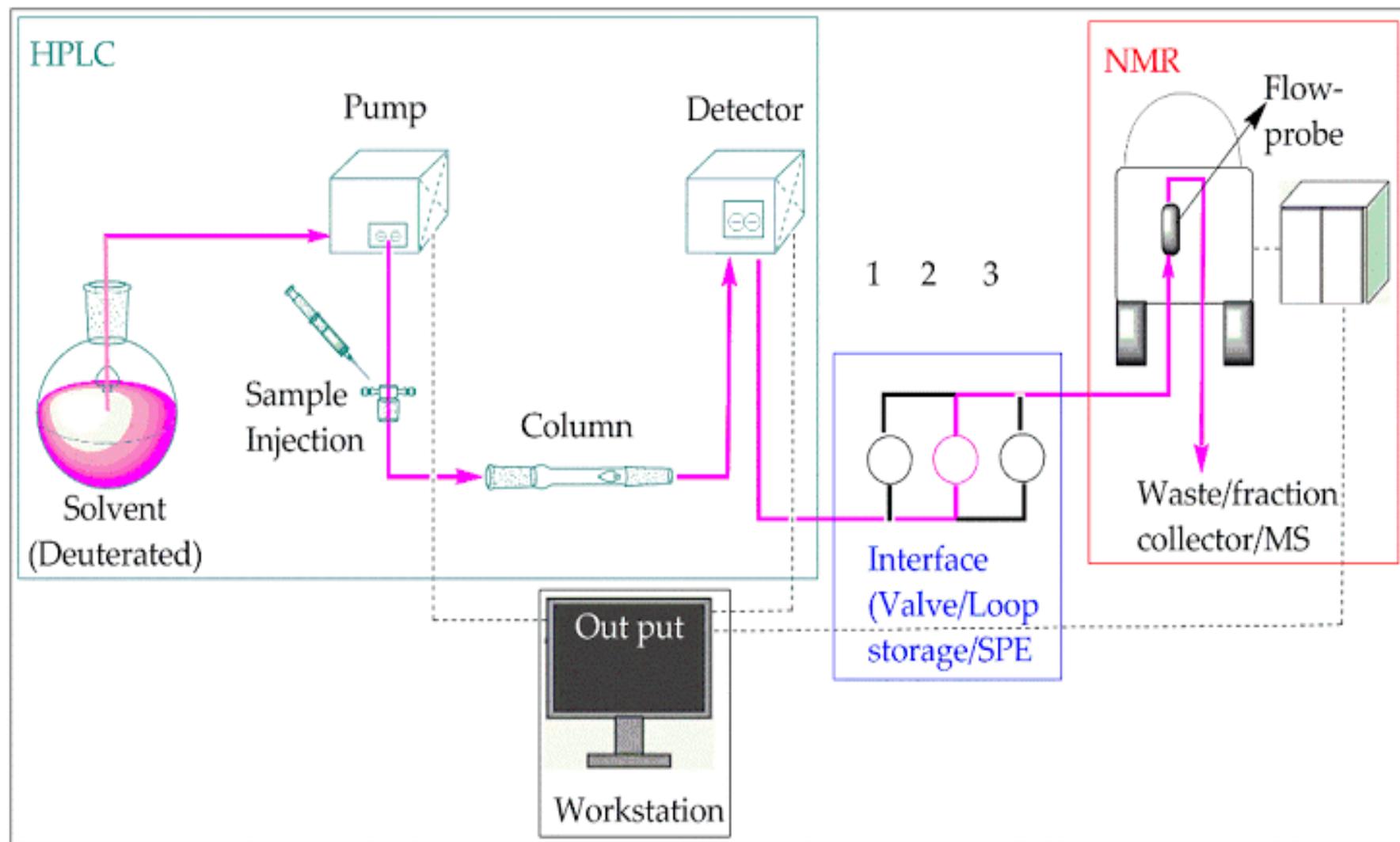
### Ultra Fast UFscanning

High-speed scanning

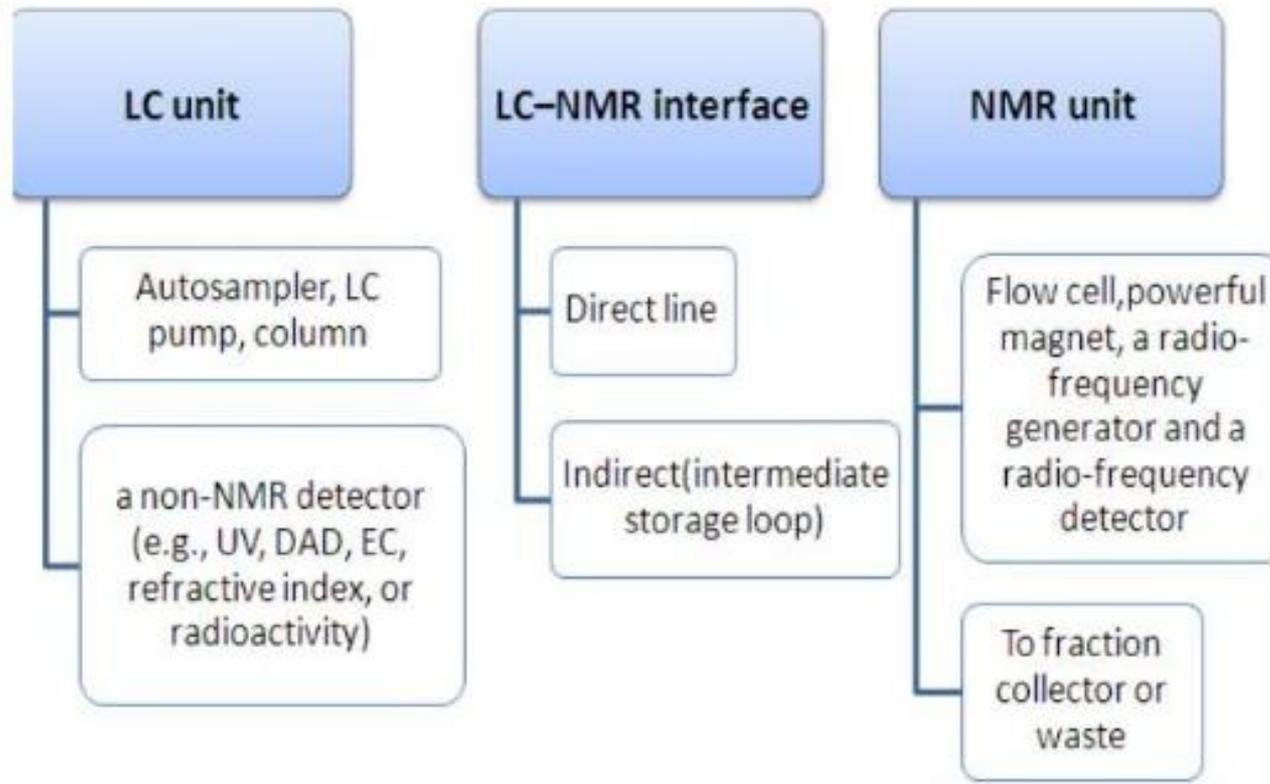
Simple flow chart of LC-MS



# HPLC-NMR



## Instrumentation of LC-NMR



## LC-NMR Interface

- 1) Direct coupling:** It include direct flow of LC effluent in to NMR flow cell and continuous recording of spectra
  - ✓ **post-column splitter**
  - ✓ **valve-switching interface** i.e BNMI (Bruker NMR-Mass Spectrometry Interface)
- 2) Indirect coupling:**
  - ✓ intermediate **storage loop** which transfer outlet of lc to NMR flow cell at specified time interval
  - ✓ **SPE unit**

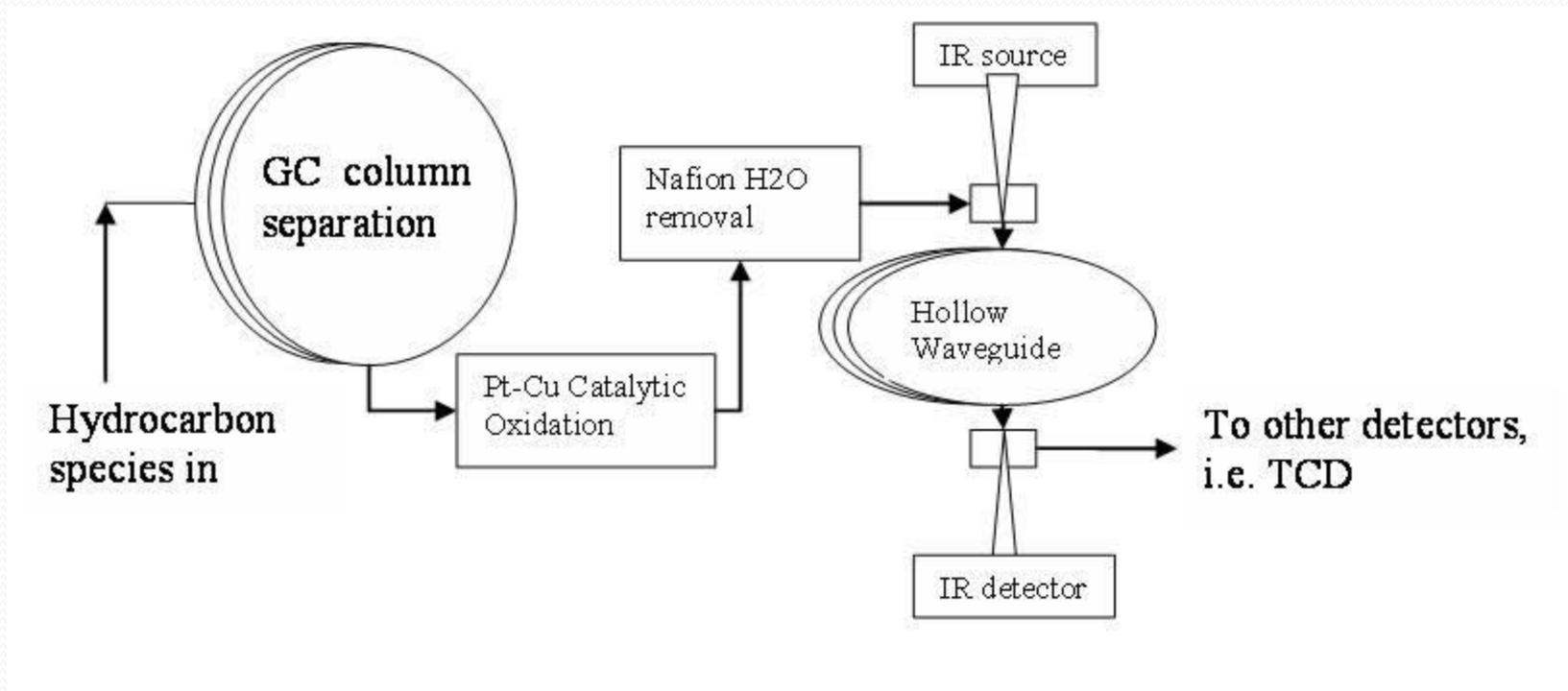


fig: 36 Loop Cassette

# GC-IR ( Gas Chromatography + Infra red spectrometry)

- This technique is very sensitive, very expensive sample recovery is also possible because IR is non-destructive technique.
- In this technique the GC does the separation part where as IR perform the function of identification.
- Effluent from GC is directly forwarded into the heated pipe of IR at atmospheric pressure.

# GC-IR Working



# LC- NMR

- Direct coupling of liquid chromatography to NMR using stop flow method was reported in 1978.
- This method is a powerful tool used in many areas such as a natural products, organic molecules, biomolecules, drug impurities, by - product, reaction mixtures, and drug degradation products.
- Giving structural information no other techniques can.

# Advantages of Hyphenated Techniques

- Fast and accurate analysis.
- Higher degree of automation.
- Higher sample throughput.
- Better reproducibility.
- Reduction of contamination due to its closed system.
- Separation and quantification achieved at same time

# CONCLUSION

- Advances in the hyphenated technique such as LC-MS , GC-MS, LC-NMR, CE-MS and ICP-MS have been made to excellently solve various complex analytical problems in different fields.
- These techniques solve such problems in time efficient manner, higher degree of automation, higher sample throughput better responsibility.

# References

1. <http://www.sciencedirect.com> “hyphenated technique - an overview / science direct topic”.
2. “hyphenated techniques”, by Rastrasant Tukdoji Maharaj Nagpur University. P. G. T. Department of chemistry.
3. “hyphenated technique”, by Dr.Saurabh Bhargava.
4. Kalpesh N. Patel, Jayvadan K. Patel, Pharmaceutical methods, introduction to hyphenated techniques & their applications in 2010.oct-dec; 1(1):2-13.



***Thank U!***

