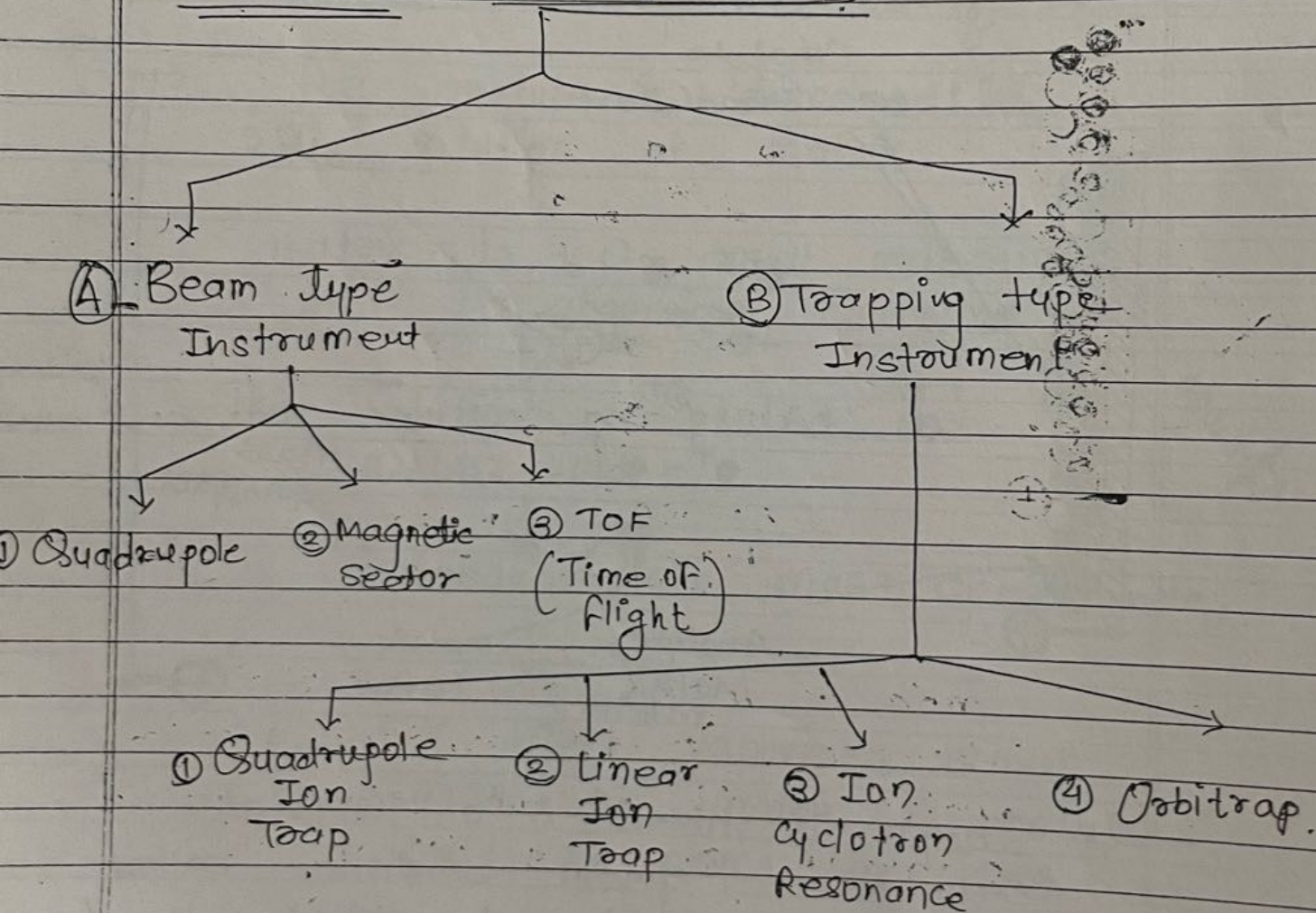


Removal of air from a chamber causes the solvent to evaporate, leaving behind crystalline lattice, called "matrix"



In this matrix, bits of protein have been incorporated.

## \* MASS ANALYZERS :-





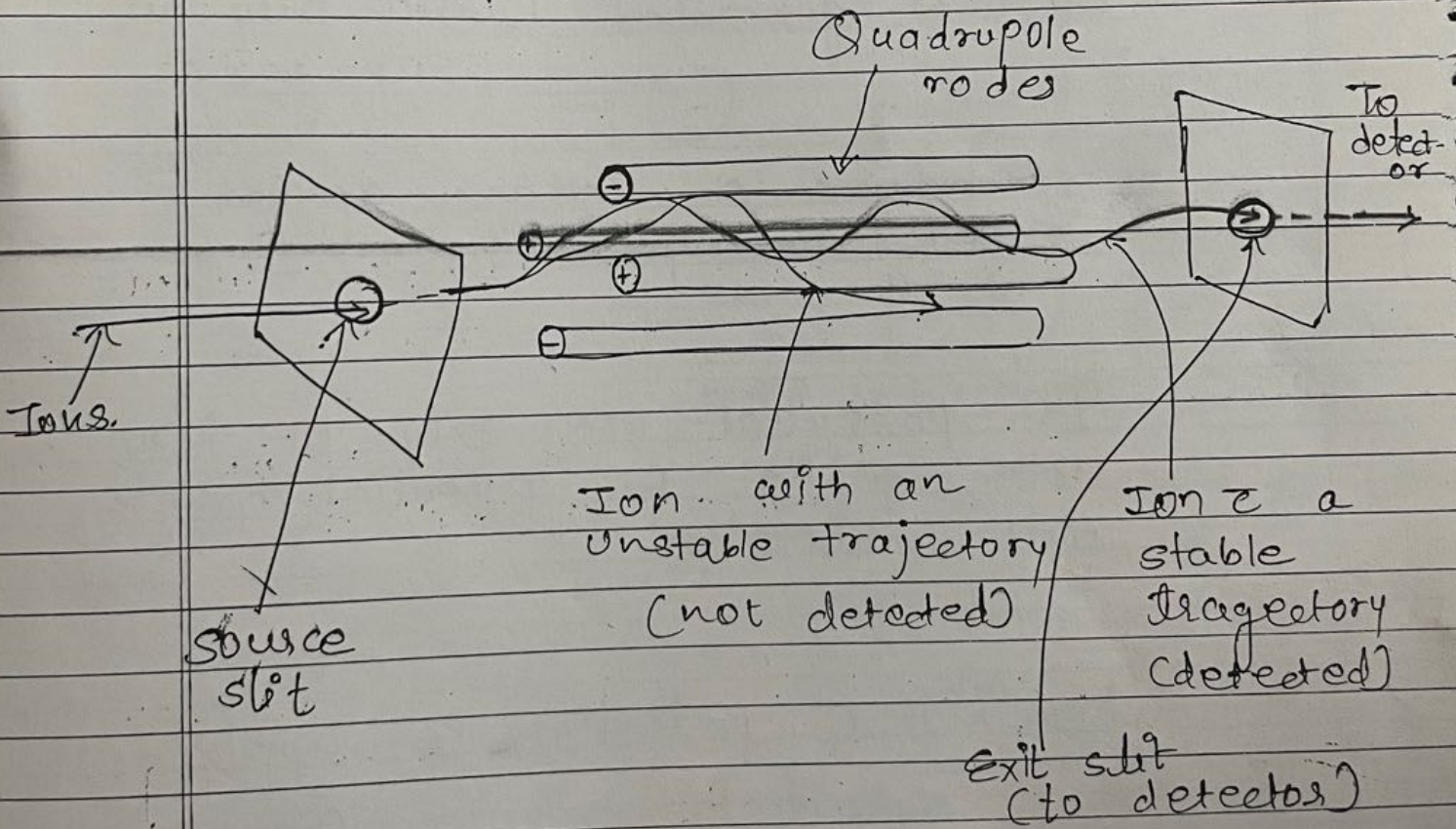
(A) BEAM - TYPE INSTRUMENT :-

↓  
Ions make one pass through the instrument then strike the detector,

↓  
Ions are destructively detected

↓  
Process takes microseconds to milliseconds

(1) Quadrupole :-



→ Ion beam entering the quadrupole array ↓  
may contain mixture of ions of various  $m/z$  values ↓



↓  
Ions of very narrow  $m/z$  range ( $\Delta m/z < 1$ ) are successfully transported through the device to reach the detector at a given voltage (DC/RF)

↓  
Ions outside this narrow range ejected radially

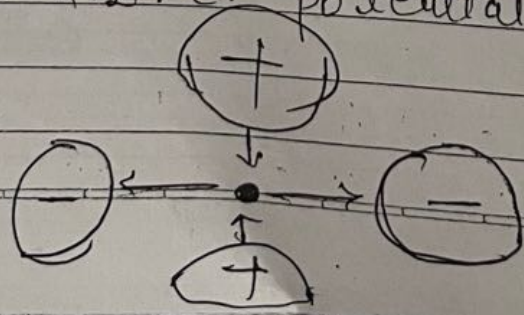
↓  
Quadrupole MS also ~~filter~~<sup>separates</sup> to as "mass filter" because the ions form pass band.

↓  
Potential generated by ① RF only OR ② RF + DC

↓  
Both type of voltage applied in a quadrupole's pattern

↓  
DC potential are only of few volts, while RF potential range upto kilovolts

↓  
When only D.C. potential is applied



if the molecule has the charge

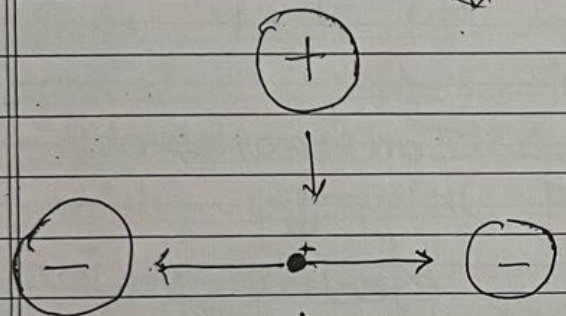


→ it will causes ejection of ions radially  
& no detection occurs

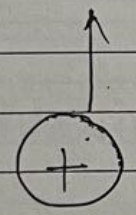


so only D.C. potential is not used

→ Now when <sup>only</sup> R.F. potential is applied



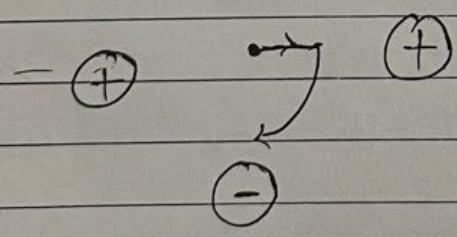
if molecule have  
tively charged,  
it will move  
towards one of the (-ve)  
electrode



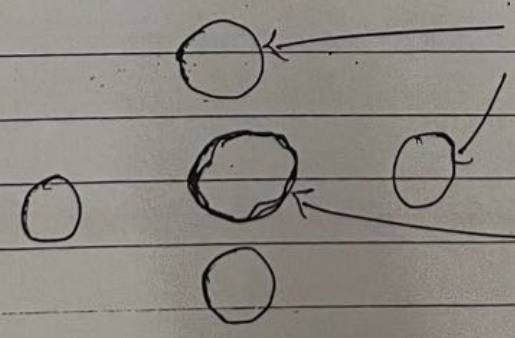
then changing of +/-  
occurs due to RF AC voltage  
before ions has chance to reach  
electrode



→ it will causes oscillation  
of molecule  
& define its trajectory



→ so finally molecule in RF field is



Quadrupole

continued/  
eject  
based on  $m/z$

molecule movement  
in RF only field.

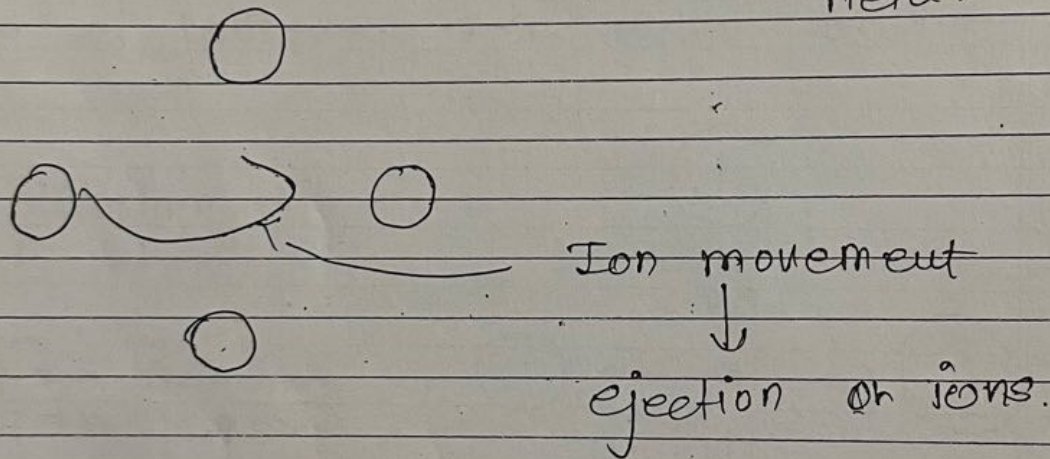


→ This occurs when molecule is within narrow  $m/z$  range.

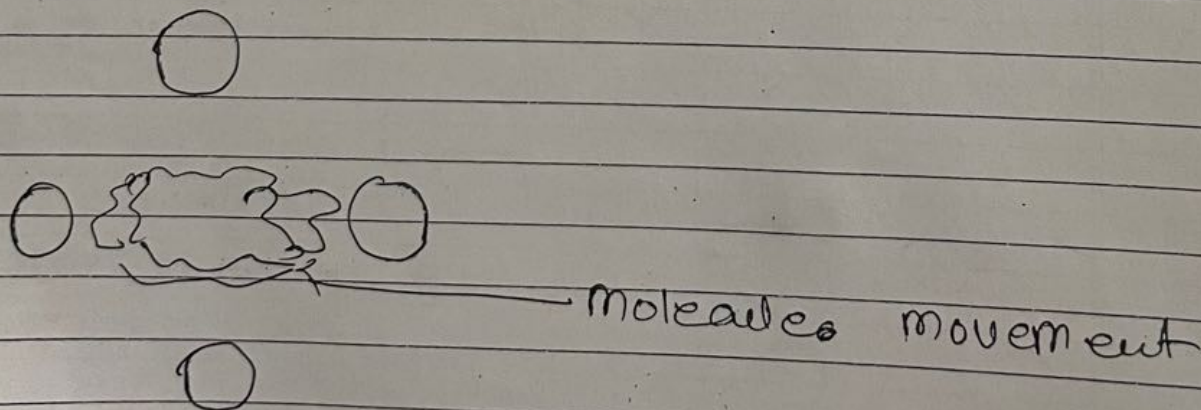
↓  
↳ Causes confinement of ion in RF only field.

→ When  $m/z$  range is ~~at~~ below

→ When ions have  $m/z$  value out of the narrow range, ejected from field.

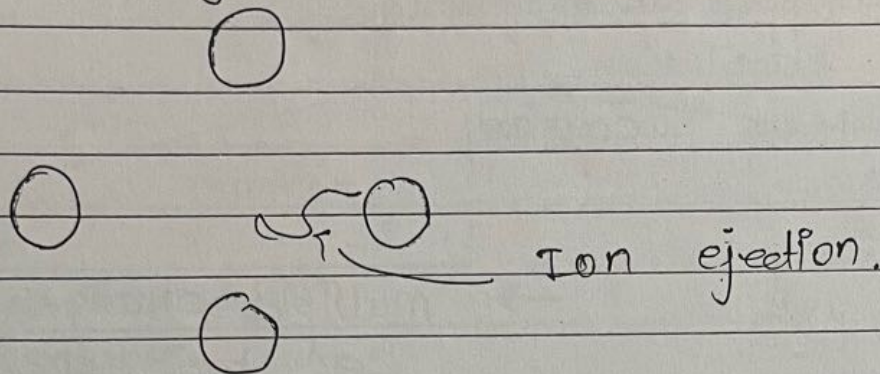


→ Ion confinement is combination of RF & AC.





→ Ion ejection is a combination of RF & DC:-



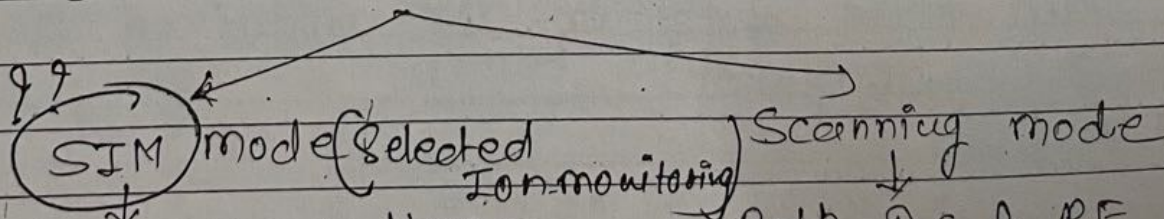
→ When both RF & DC potentials are applied, whether ions are ejected or confined in the field depends on which potential predominates

↓  
ejection will occur, if DC potential predominates RF potential.

→ Quadrupole ms. are limited to a resolution of several thousands

↓  
sufficient to achieve Isotopic resolution for singly charged ions of  $m/z$  as high as several thousands

→ Operational mode of QMS



- Both AC & RF voltage are fixed
- Centre of pass band & width of pass band are fixed.

Both DC & RF are continuously varies.



## ② Magnetic Sector :-

### Limitations :-

- Lack of sensitivity
- " Upper mass range
- " Resolution
- " Mass accuracy

### Advantage :-

- ease of use
  - flexibility
  - Adequate performance
  - Relatively low cost
  - Highly developed software system.
- multiple charges can be separated.

## ② Magnetic Sector :- Triple, classical Traditionally used

- Rarely used now a days.
- Versatile, reliable & highly sensitive.
- Capable of very high  $m/z$  resolution & mass accuracy. But they are expensive, large & heavy.
- Difficult to use.

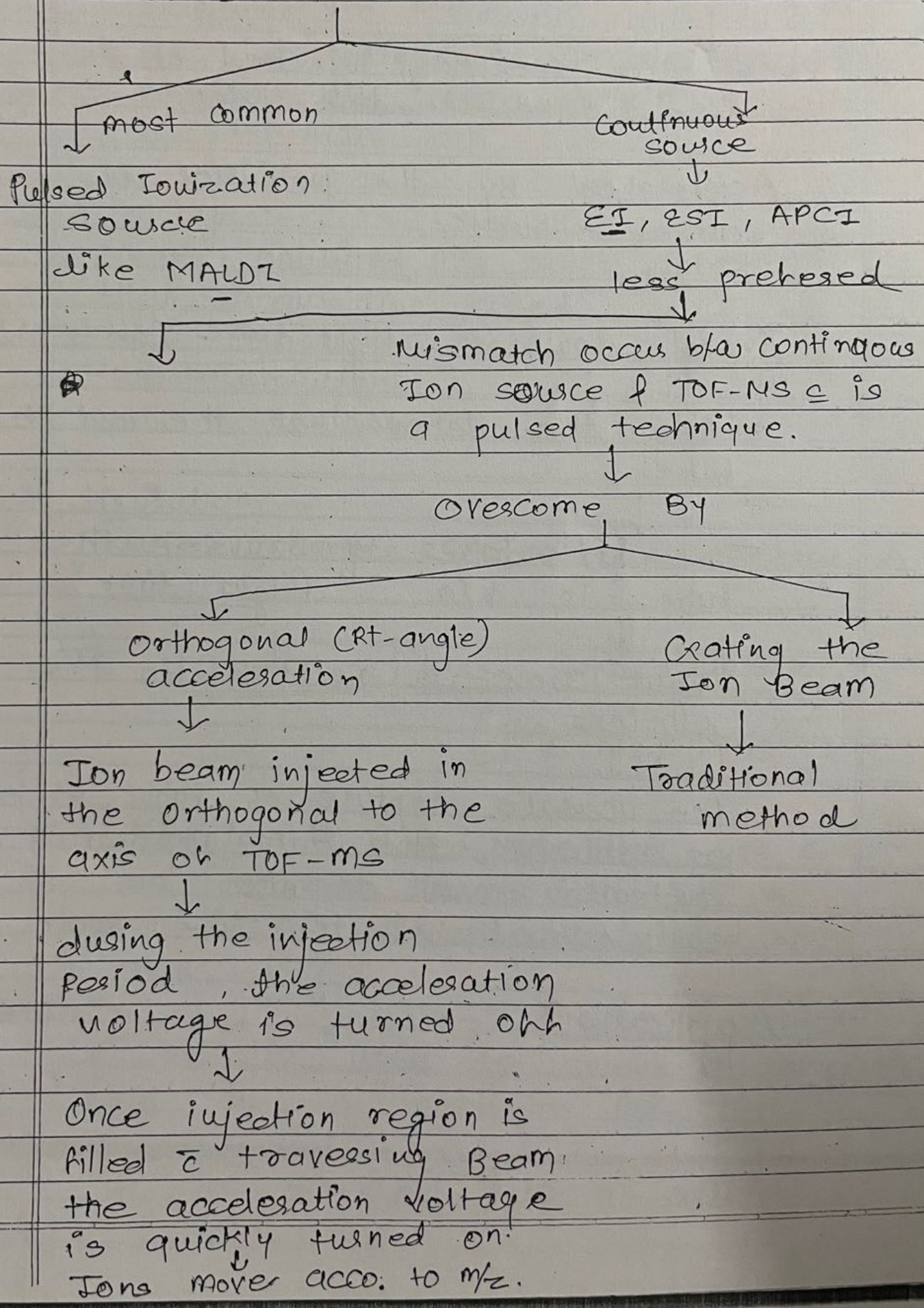
## ③ Time of flight :- Schimetzue

- Non-scanning technique, where by a full mass spectrum is acquired as a snapshot.



→ Pulsed analysis technique.

→ Ionization source used in TOF





### \* TOF Mass analyses :-

↓  
concept is that a lighter ion travels faster than heavier ion, applied to same kinetic energy

↓  
Ions are created / injected at the source & end of the device

↓  
Accelerated by the potential of several kilovolts.

↓  
Travel down a flight tube (analyser)

↓  
strike the detector at the end of tube.

↓  
Time it takes to traverse the tube is  $t$  "flight time"

↓  
Flight time is related to  $m/z$  of ions.

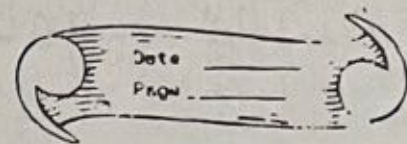
↓  
For accurate capture of flight ion at detector, the data operating system, must operate on  $\approx 1$  ns. or shorter time scale.

### \* Applications :-

SOFT  
TOF

(Poser  
TOF





- ① → Most widely used high speed drug screening in toxicology combined with fast chromatography sample introduction
- ② → Analysis of large protein molecule  
Eg. MALDI TOF

### \* Advantage :-

- Nearly unlimited  $m/z$  range detection
- High acquisition speed
- High Mass accuracy
- Moderate Resolution
- " sensitive

### \* Limitation :-

- Multiple charges can not be separated