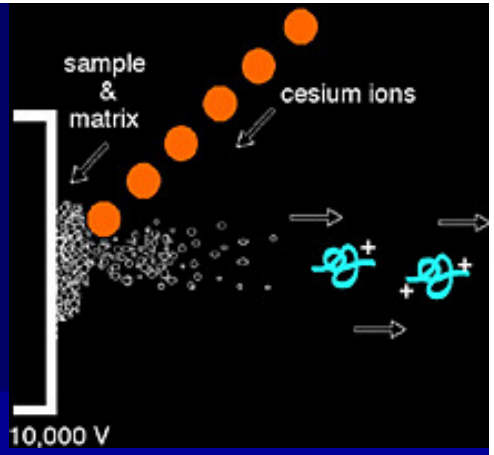
Fast Atom Bombardment (FAB)

FAB



- Also known as liquid secondary ion mass spectrometry (LSIMS)
- An ionization source similar to MALDI in that it uses a matrix and a highly energetic beam of particles to desorb ions from a surface
- Difference between MALDI and FAB

Ionization Source: Laser Atom beam

Matrix: solid crystalline liquid

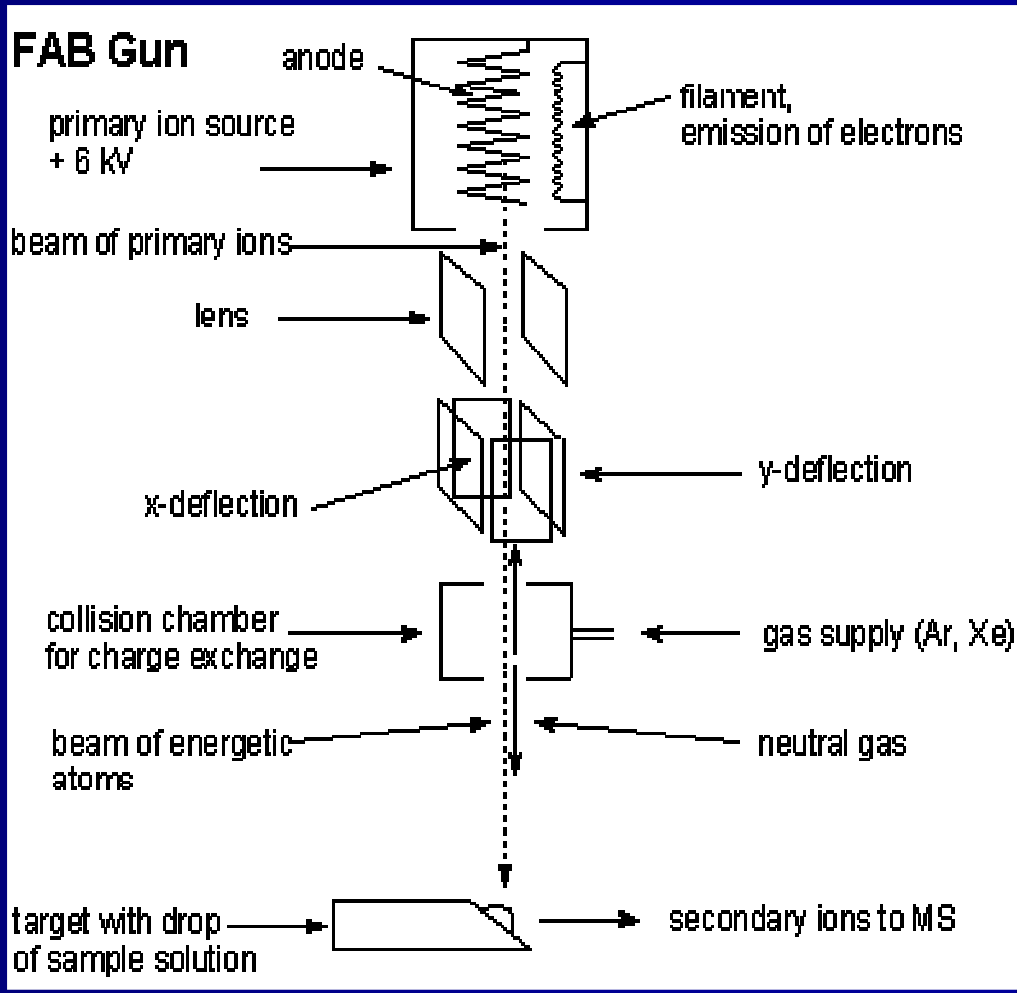
Sensitivity: FAB 1000 times less sensitive

FAB

- Soft Ionization technique
- Used to analyze polar, ionic, thermally and energetically labile and high MW compounds that are not amenable to EI/CI
- MW between 300-6000Da
- Sample is dissolved in a matrix and bombarded with Ar/Xe atoms (8-15keV) or fast ions (Cs^+ up to 35 keV).
- Observed peaks in FAB are those of matrix cluster ions, analyte ions (M^+ and M^-), impurities, and ions of matrix modifiers

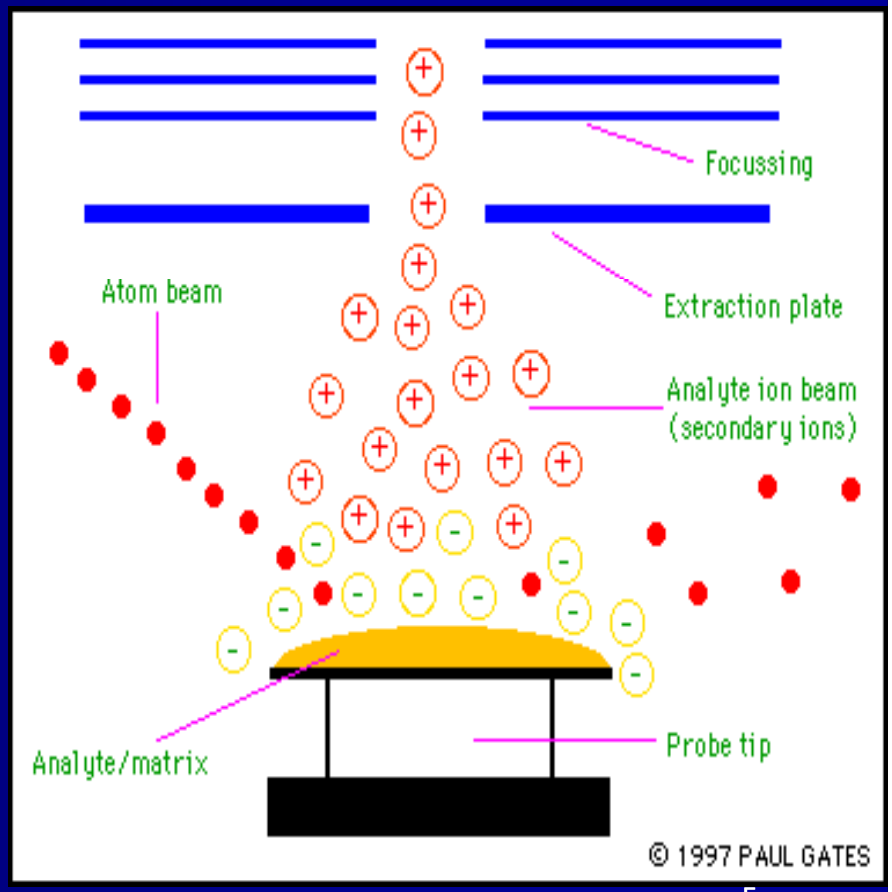
FAB Gun

- Ar/Xe ions are generated by EI
- The ions are accelerated, focussed and neutralized by charge exchange with neutral Ar/Xe in the collision cell.



How Does FAB Work?

- Fast moving beam is directed towards the sample
- Sample is dissolved in a matrix and placed on target
- Beam collides producing +ve and –ve ions from matrix, analyte etc



FAB (contd…)

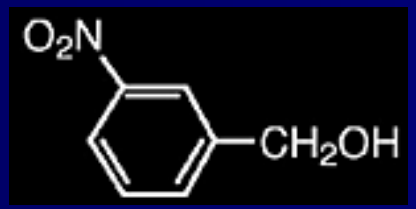
- TFA often added to enhance $[M+H]^+$ formation
- Classes that use FAB are: peptides, proteins, fatty acids, organometallics, surfactants, carbohydrates and antibiotics

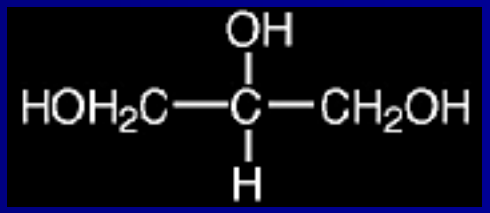
FAB Matrix

1. Facilitating the desorption and ionization process
2. Constantly replenish the surface with new sample as it is bombarded by the incident ion beam
3. By absorbing most of the incident energy, the matrix also minimizes sample degradation from the high-energy particle beam.

- Two of the most common matrices used

  m-nitrobenzyl alcohol (NBA) glycerol





Choice of Matrix in FAB: Often A Trial and Error Process

- Sample MUST be soluble in matrix
- Under vacuum conditions matrix must have low volatility (so that matrix/sample will maintain liquid nature)
- Matrix ions should not interfere with analyte ions
- Matrix should not undergo unexpected chemical reactions with the sample ions.

Examples of Matrices

- Thio Glycerol (for PEG, polypeptides)
- Gycerol
- Magic bullet (3:1 mix of dithiothreitol and dithioerythritol)
- 3-nitro benzyl alcohol
- diethanolamine

Care During FAB

- If there are salts present during FAB, $[M+Na]^+$ and/or $[M+K]^+$ ions will appear (and complicate spectra) which may suppress $[M+H]^+$ formation

- Some samples like strong acids (strong sulphonic acids) will give –ve ion spectra better than +ve ion spectra in FAB (here the pseudo molecular ion is the deprotonated species $[M-H]^-$

Plus and Minus of FAB

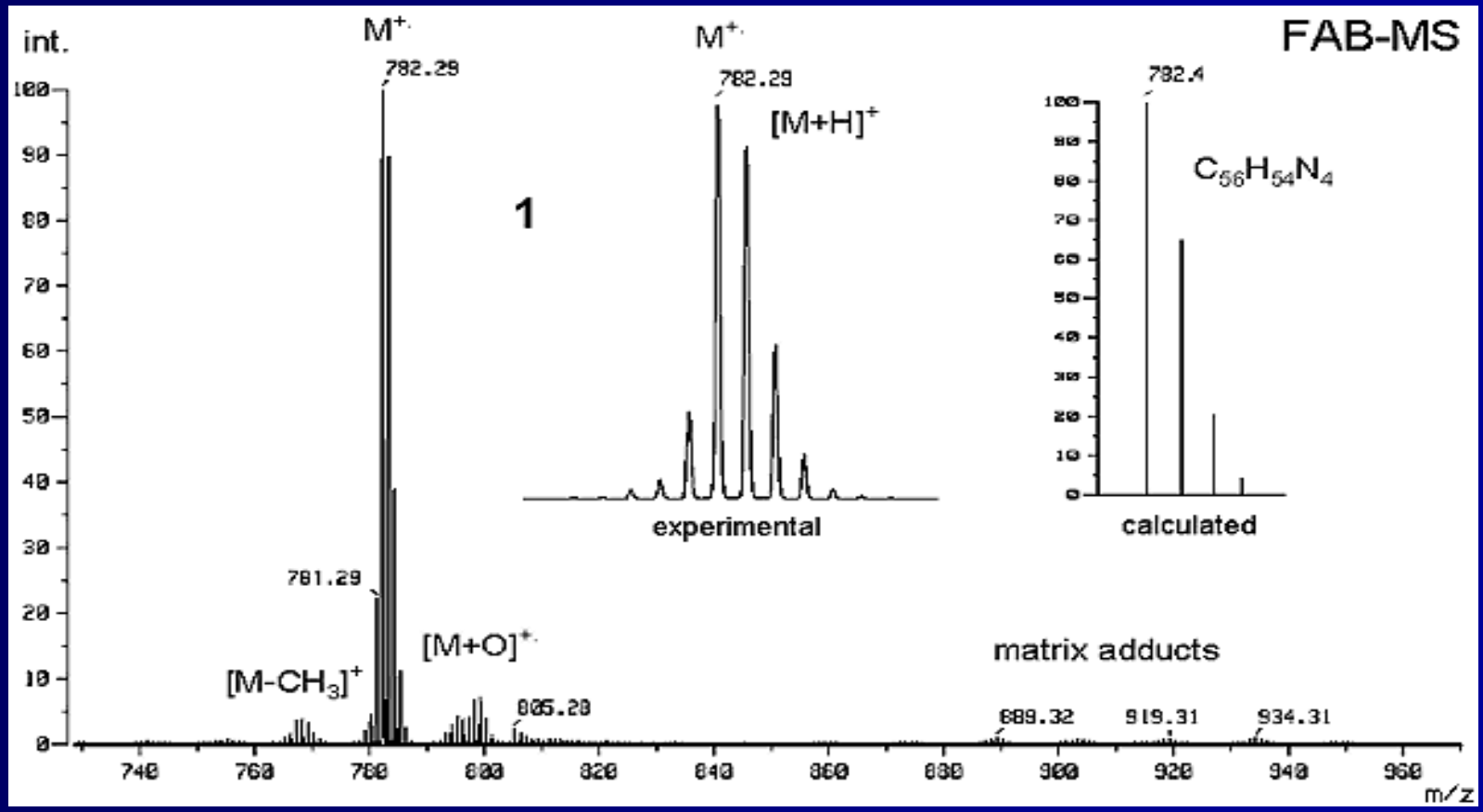
Advantages

- Rapid
- Simple
- High mass compounds
- Thermally labile compounds
- Relatively tolerant of variations in sampling
- Good for a large variety of compounds
- Strong ion current (high res)
- Nanomolar samples

Disadvantages

- High chemical background
- Analyte must be soluble in matrix
- Bad for multiply charged compounds for more than 2 charges
- No fragment library
- Low sensitivity
- Needs skilled operator

FAB Spectra of Trimethylporphyrin



Radical cations and $[M+H]^+$ ions

Interference from Matrix Ions Can Be Serious $[M+H]^+$ =728