Mass Spectrometry in a Storage Ring with Magnetic Fields

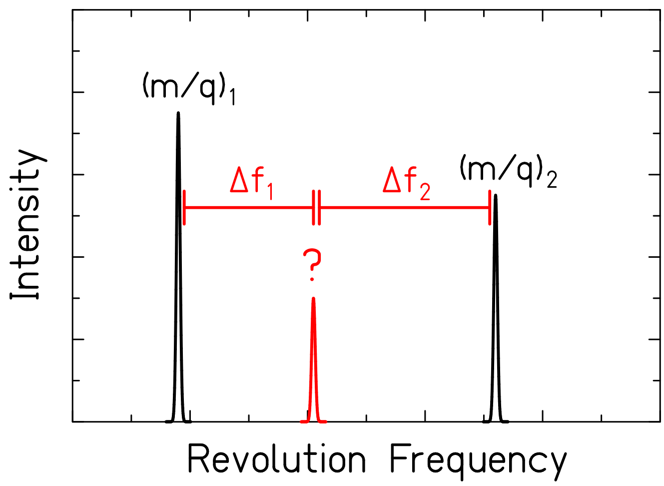
The general relation between the revolution frequencies of different ions and their velocity and mass-to-charge ratio is

$$\frac{\Delta f}{f} = \frac{-1}{\gamma_t^2} \cdot \frac{\Delta(m/q)}{m/q} + \left(1 - \frac{\gamma^2}{\gamma_t^2}\right) \cdot \frac{\Delta v}{v}$$

A unique relation between revolution frequency and mass-to-charge ratio m/q is obtained if the second term is canceled:

- $\gamma = \gamma_t$: Isochronous Mass Spectrometry (IMS):
  - ESR is operated at its transition point
  - beam cooling not necessary
  - frequency measurement with pick-up detector or Schottky spectroscopy
  - accessible halflifes: $T_{1/2} \geq 10\mu$s
- $\Delta v/v = 0$: Schottky Mass Spectrometry (SMS):
  - electron cooling is applied
  - frequency measurement with Schottky spectroscopy
  - accessible halflifes: $T_{1/2} \geq 5$s

Mass determination in both cases:



Charge-state selective β^+ and EC experiments:

Bare Ions: pure β^+ ($\rightarrow$ study of weak β^+ branches, e. g. ^{56}Ni)

H-, He, and Li-like ions: β^+ and EC ($\rightarrow$ Fermi-function, e^-e^--correlation)

Example: ^{190}Au

neutral atom:	$T_{1/2}$= 43m,	EC/β^+= 98/2
He-like ion:	$T_{1/2}$= 70m,	EC/β^+= 60/40
H-like ion:	$T_{1/2}$= 100m,	EC/β^+= 40/60
bare ion:	$T_{1/2}$= 2160m,	EC/β^+= 0/100

Experimental scheme: