Mass Spectrometry with Highly Charged Ions in a Penning trap

$$\nu_c = qB/2\pi M_{total}$$

$$M_{total} = M_{nuc} + N_e m_e + E_{bind}$$

$$(< 0)$$

- *mass measurement in a series of charge states*
- *determination of atomic binding energies (= ionisation potentials)*
- *atomic structure of few-electron systems*

Laser Spectroscopy of Fine-Structure Transitions in Highly Charged Ions

Example: $^{56}_{26}Fe^{13+}$ (Al-like iron)

- $1s^2\,2s^2\,2p^6\,3s^2\,3p_{1/2} - 3p_{3/2}$
- magnetic dipole transition (M1)
- $\lambda = 530$ nm
- transition energies and lifetimes (ms range)
- cooling to quantum mechanical ground state
- temporal drift of fine-structure constant α