Single-electron atoms: Bohr model

- postulates (quantisation)
- energy levels: $$\boxed{E_n = -\left(\frac{1}{4\pi\varepsilon_0}\right)^2 \frac{\mu Z^2 e^4}{2\hbar^2 n^2}}$$

Quantum Mechanics + Schrödinger Eq$^{\underline{n}}$

- physical interp. of Schrödinger
- wavefunction (space and spin)
- eigenfunctions / eigenstates, eigenvalues
- angular momentum (quantisation)

Schrödinger Eq$^{\underline{n}}$ for single electron atoms

- solutions involve quantum numbers n, l, m_l

Spin properties and quantum numbers

- s, m_s
- one electron always has $s = 1/2$
- total angular momentum, $\boxed{\underline{J} = \underline{L} + \underline{S}}$
- introduce quantum numbers J and m_J

Addition of angular momenta

- rules for how to obtain quantum numbers of sum of any angular momenta

Spectroscopic notation

- configuration to identify occupied orbitals
- term to identify total L, S, J
- know notation and be able to interpret

Two-electron atoms

- role of electron repulsion
- "independent electron" approximation
- two particle wavefunctions
  - space and spin parts
  - symmetry properties (Pauli principle)
- "exchange force" and Coulomb interaction
- energy level diagram for He

Multi-electron atoms

- central field approximation, Hartree theory
- electron screening and effective nuclear charge
  - dependence on orbital quantum numbers, (n, l)
- Aufbau principle
- residual Coulomb interaction, exchange interaction
- spin-orbit interaction
  - semi-classical derivation, $\boxed{\Delta E = \frac{2K}{\hbar^2} \underline{S} \cdot \underline{L}}$
  - Landé interval rule
- Hund's Rules

Emission and Absorption

- spontaneous emission, stimulated emission, absorption
  - Einstein coefficients
  - selection rules

Zeeman effect

- semi-classical derivation for $\boxed{\underline{\mu}_L = -\frac{e}{2m_e} \underline{L}}$
- interaction with field
- "normal" vs "anomalous"
- splitting of energy levels; polarisation of photons