Shielding: Effective Nuclear Charge Model

Electron-Electron Repulsion
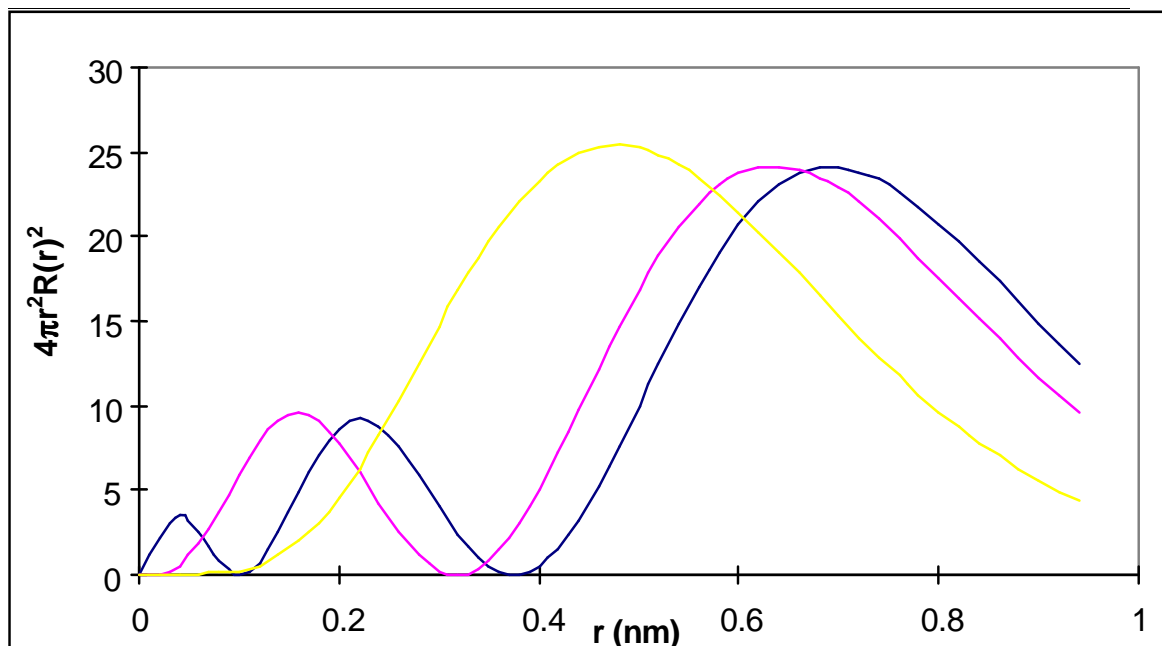
He:

$r_2 \to \infty$	$Z_{eff} \to 1$	$r_2 \to 0$	$Z_{eff} \to 2$
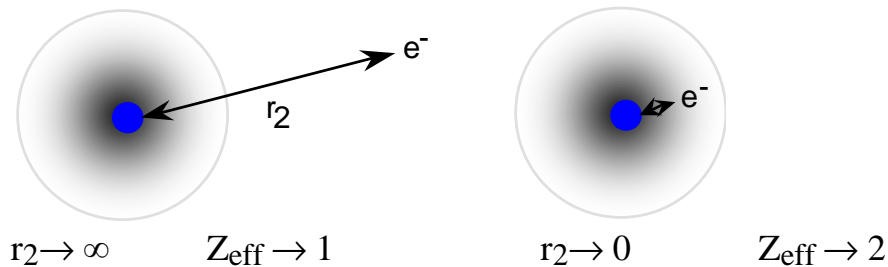
$$\Psi_1(r_1) = N\,e^{-Z_{eff}\,r_1/a_o} \qquad \Psi_2(r_2) = N\,e^{-Z_{eff}\,r_2/a_o}$$

$$E = E_1 + E_2 \qquad\qquad E = -13.6\text{eV}\; Z_{eff}^2 \left(\frac{1}{n_1^2} + \frac{1}{n_2^2} \right)$$

$$E_{exp} = -79\text{ eV} \qquad\qquad Z_{eff} = 1.7$$

$Z_{eff} = Z$ – point charge at the nucleus representing the average electron-electron repulsion

Each successive shell is shielded to a greater extent by previous shells.

Orbitals with low ℓ penetrate more and are then less easily shielded by other electrons.

Electrons in the same subshell don't shield each other well, because they have the same average radius.