

1. In the simplest treatment of helium, we used a trial function of the form

$$\phi(1,2) = 1s(1)1s(2) \frac{1}{\sqrt{2}} [\alpha(1)\beta(2) - \beta(1)\alpha(2)]$$

By varying the 1s function in all ways consistent with the form

$$1s(r, \theta, \phi) = [c_0 + c_1 r + c_2 r^2 + c_3 r^3 + \dots] \exp\left[-\frac{Z_{eff} r}{a}\right]$$

We found that the variational integral predicted a ground state energy of -77.9 eV, while the ground state energy is experimentally measured to be -78.99 eV.

- a) Describe why the uncertainty is big for this variational approach. What phenomenon is neglected in this treatment?
 - b) Describe, in as much detail as possible, an approach that can be used to overcome this problem.
2. textbook 8.1, 8.4, 8.6, 8.7, 8.8, 8.14
3. textbook 9.11, 9.12, 9.15