

# Atomic and molecular physics

## first written exam

November 13, 2018

1. Write down the radially correlated ground state wavefunction of the helium atom using Slater-determinant formalism.
2. The electron configuration of oxygen atom is  $1s^2 2s^2 2p^4$ . For this configuration, determine all the possible atomic terms and order them by increasing energy.
3. Cobalt atom has the ground state term symbol  $^4F$ .
  - a) Write down the quantum numbers of this term.
  - b) Determine the degeneracy of this term.
  - c) Determine the possible total angular momentum (J) quantum numbers.
  - d) Determine the splitting of this term due to spin-orbit coupling treated as a perturbation (LS-coupling). Use  $H_{SO} = \lambda \mathbf{L} \cdot \mathbf{S}$  interaction with  $\lambda$  as a parameter. Determine the remaining degeneracy of the split states.