

Exercises: Tutorial 12.02.2016 (part 1)

1. Assume electron beam to be prepared in mixed state described by operator

$$\hat{\rho} = \frac{1}{2} |m_s = +1/2\rangle\langle m_s = +1/2| + \frac{1}{2} |m_s = -1/2\rangle\langle m_s = -1/2|$$

Find probability for the electron to be found (detected) in state with “spin up” along some arbitrary direction characterized by angles (θ, ϕ)

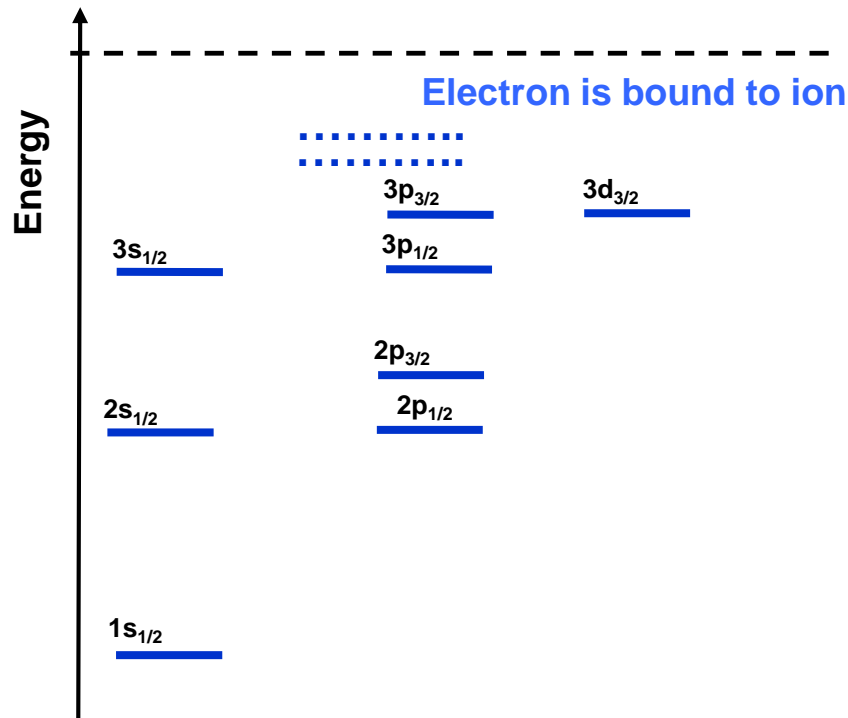
2. Show that any Hermitian 2 x 2 matrix can be represented in terms of the unitary matrix and Pauli matrices:

$$\hat{A} = p_0 \hat{I} + p_1 \hat{\sigma}_x + p_2 \hat{\sigma}_y + p_3 \hat{\sigma}_z$$

where p_i are the real numbers. Find the physical meaning of the p_i coefficients for the parameterization of the density matrix of spin-1/2 particles.

Exercises: Tutorial 12.02.2016 (part 2)

3. Below you can see the energy level scheme of relativistic hydrogen-like ion. Indicate which transitions (which type, electric or magnetic, which multiplicity) are allowed between these levels.



Hint: even in relativistic case the parity of state is defined by an orbital momentum. For example: s-state has parity "+", p-state has parity "-" and so on.