Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 4 – IPSP

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Exercise Sheet 9 (Summer Term 2013)

Date of Issue to Students: June 11^{st} 2013

Date of Submission: June 18^{th} 2013

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

Exercises:

1. (a) Calculate the next two longest wavelengths in the K series (after the K_α line) of molybdenum. (b) What is the wavelength of the shortest wavelength in this series?
(6 Points)

2. The combination of physical constants $\alpha = e^2k/hc$, where k is the Coulomb constant, is known as the fine-structure constant. It appears in numerous relations in atomic physics. (a) Show that α is dimensionless. (b) Show that in the Bohr model of the hydrogen atom $v_n = c\alpha/n$, where v_n is the speed of the electron in the state of quantum number n.
(6 Points)

3. The *positron* is a particle that has the same mass as the electron and carries a charge equal to +e. Positronium is a bound state of an electron-positron combination. (a) Calculate the energies of the five lowest energy states of positronium using the *reduced mass*. (b) Do transitions between any of the levels found in Part (a) fall in the visible range of wavelengths? If so, which transitions are these? (8 Points)

4. The wavelength of a spectral line of hydrogen is 1093.8 nm. Identify the transition that results in this line.