Exercises Physics VI (Nuclei and Particles)

Summer Semester 2009

Exercise sheet Nr. 11

Work out until 23.07.2008

Exercise 1: Shell model

(Points: 3)

Give spin and parity of the listed nuclei. Calculate the magnetic moment for each of them in units of μ_N using the Landé g-factor. To start, first identify the type of the valence nucleon (if any) and its configuration.

a) Tritium

b) ^{3}He

c) ^{7}Li

d) ^{13}C

e) ^{19}F

f) ^{48}Ca

The Landé g-factor is given by

$$g = \frac{1}{2j(j+1)} \{g_l[j(j+1) + l(l+1) - s(s+1)] + g_s[j(j+1) + s(s+1) - l(l+1)]\}$$

with $g_l = 1$, $g_s = 5.5852$ for protons and $g_l = 0$, $g_s = -3.8256$ for neutrons.

Exercise 2: Moment of inertia of ^{170}Hf

(Points: 2)

From the energy difference ΔE between rotation eigenstates with spins J and $J+2$, calculate the moment of inertia (in $\mathrm{kg\,m^2}$) of ^{170}Hf for $J = 0$ ($\Delta E = 100.0$ keV) and $J = 16$ ($\Delta E = 614.3$ keV). Compare the obtained values to the value for the assumption that ^{170}Hf is a homogeneous sphere (radius parameter $r_0 = 1.3$ fm).

Exercise 3: Radiation (Points: 3)

Inform yourself about the effects of radiation on human beings (for example at `http://www.kernenergie.de/r2/documentpool/de/Gut_zu_wissen/Radioaktivitat_und_Strahlenexposition/ik_radiostrahlwirkung_04_2009.pdf`). Define the units Becquerel, Gray and Sievert. Name natural and civilisation sources of radiation. What are the effects of radiation on health?

Exercise 4: Nuclear power (Points: 2 Bonus)

Discuss advantages and disadvantages of nuclear power. What is your position on nuclear power, do you support it or are you against it? Give reasons for your opinion.