Lecture 7. Problems.

1. Obtain the lowest possible J^π values for (i) ^{210}Pb, assuming that two neutrons occupy $g_{9/2}$; (ii) ^{210}Bi, assuming that a proton in $h_{9/2}f_{7/2}$ and a neutron in $g_{9/2}$; (iii) ^{210}Po, assuming that two protons occupy $h_{9/2}$-orbital. Compare with the experimental spectra.

2. Program the matrix elements $\langle j_1 j_2; JT|V|j_3 j_4; JT\rangle$ of the MSDI and print out the resulting matrix elements for p-shell in terms of A_T, B and C coefficients for all possible J and T values (13 two-body matrix elements).

3. Using the empirical single-neutron energies and the USD interaction Wildenthal and Brown (see print-out), calculate the position of 3^+ state in ^{18}O.

4. From the experimental spectrum of ^{90}Zr, find the difference between two-body matrix elements of the type $\langle p_{1/2}g_{9/2}; JT|V|p_{1/2}g_{9/2}; JT\rangle$ for all possible values of J and T of the interaction between two protons in $(p_{1/2}g_{9/2})$ shell model space (with respect to ^{88}Sr-core).

5. Calculate the excitation energy of 0_2^+ state in ^{58}Ni in the $p_{3/2}f_{5/2}$ model space, given the two-body matrix elements (from MSDI with$A_1 = 0.5$ MeV, $B = C = 0$):
   $\langle p_{3/2}p_{3/2}; J=0, T=1|V|p_{3/2}p_{3/2}; J=0, T=1\rangle = -1$ MeV,
   $\langle f_{5/2}f_{5/2}; J=0, T=1|V|f_{5/2}f_{5/2}; J=0, T=1\rangle = -1.5$ MeV,
   $\langle p_{3/2}p_{3/2}; J=0, T=1|V|f_{5/2}f_{5/2}; J=0, T=1\rangle = 1.22$ MeV,
   and experimental single-neutron energies.