2021 - PHY 981 - Homework set 15 (final exam) (due May 2)

link to lecture notes
link to nushellx.zip
link to toi.zip link to mingw-w64.zip

There are 8 problems.

1. **The 0^+ state at 3.067 MeV in ^{20}Na has a proton decay width of 36 keV. It decays to the $1/2^+$ ground state of ^{19}Ne. Obtain the experimental spectroscopic factor for this decay by using the wspot app to calculate the single-particle proton decay width.**

2. **This 0^+ state in ^{20}Na is calculated to decay the 1^+ state at 0.984 MeV with a B(M1) = 1.85 μ_N^2. If the proton decay and this gamma decay are the only modes of decay, what is the branching ratio for the gamma decay?**

3. **In the $0f_{7/2}$ model space for the calcium isotopes, (a) what is the spectroscopic factor for ^{45}Ca $7/2^-$ to ^{44}Ca 0^+? (b) What is the sum over all states in ^{44}Ca?**

4. **What are the maximum J and T values allowed for ^{46}V in the $(0f1p)$ model space?**

5. **What are the spatial tensor ranks of the following operators (put "none" if it is not a tensor)?**
   a) The creation operator a_k^+ for the proton orbital $\alpha = (n, \ell, j) = (0, 2, 5/2)$.
   b) The destruction operator a_k for proton orbital $\alpha = (n, \ell, j) = (0, 2, 5/2)$.
   c) The two-body isospin operator $\tau_{zi}\tau_{zj}$.
   d) The δ function interaction between two nucleons.
   e) The two-body Coulomb interaction.
   f) The magnetic moment operator.

6. **What are the isospin tensor ranks for the above (put "none" if it is not a tensor)?**

7. **Reduce the following many-body wavefunction matrix elements of a one-body operator to a sum of single-particle terms. (a, b, c, d) represent different occupied m states. (a) $< a, b \mid \hat{F} \mid a, b >$; (b) $< a, b \mid \hat{F} \mid a, c >$; (c) $< a, b \mid \hat{F} \mid c, d >$.**

8. **The magnetic moment of the $9/2^+$ ground state of ^{91}Nb is $+6.521\ \mu_N$ Assuming that this is a $0g_{9/2}$ single-particle state, calculate the magnetic moment of the 8^+ state of ^{92}Mo assuming that it has a $(0g_{9/2})^2$ configuration. Compare to experiment.**