2021 - PHY 981 - Homework set 13 (due Apr 18)

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

2. **Read Chapters 34.**

3. **What are the allowed J values for ^{19}O in the $d_{5/2}$ model space? What are the spectroscopic factors from the ^{20}O ground state to each of these states in ^{19}O?**

4. **A ^{21}O(d,p)^{22}O reaction is carried out. What are the possible final states and the spectroscopic factors to each of these in the $0d_{5/2}$ model space? How does the sum over all final states relate to the number of $0d_{5/2}$ neutrons in the ground state of ^{21}O?**

5. **Confirm your results from the last two problems using NuShellX.**

6. **Calculate the spectroscopic factors for the ^{22}Ne ground state going to final states in ^{21}Ne in the sd model space with the USDB Hamiltonian. Compare the results to experiment for states in ^{21}Ne up to 5 MeV in excitation energy.**

7. **In the previous problem, how does the sum over the lowest 10 $5/2^+$ states compare to the average number of $0d_{5/2}$ neutrons calculated to be in the ground state of ^{22}Ne.**

8. **How do the spectroscopic factors for ^{21}O to ^{22}O change if the model space is increased to the full sd shell using the USDB Hamiltonian.**

9. **An experiment is carried out at FRIB to knock out a proton from the $7/2^-$ ground state of ^{55}Co going to 0^+, 2^+, 4^+ and 6^+ states in ^{54}Fe. In the $0f_{7/2}$ model space what are the spectroscopic factors for these. Hint: use the sum rule for adding a proton to the ^{54}Fe states to make ^{55}Co.**

10. **For the previous problem the answer for going to the 6^+ state in ^{54}Fe is $C^2S = (13/4)$. What is the spectroscopic factor C^2S for going from the $7/2^-$**

ground state of ^{55}Co the 6^+ T=1 state of ^{54}Co that is the isobaric analogue of the 6^+ state in ^{54}Fe.

11. **Use the USDB Hamiltonian to calculate the spectroscopic factors for the the second 1^+ state in ^{20}Na to the $1/2^+$ ground state and $5/2^+$ first excited states of ^{19}F. This state is associated with the state observed experimentally at 3.001 MeV in ^{20}Na. Calculate the proton decay width of this state using the experimental value for the proton decay Q value. Compare the obtained width to experiment.**