2021 - PHY 981 - Homework set 4

1. **We meet Tuesdays and Thursdays 2-3 pm link to zoom**
   Discussion session on Fridays 2-3 link to zoom
   link to lecture notes
   link to nushellx.zip
   link to toi.zip

2. **Read Chapters 11-12.**

3. **Use experimental data to obtain the b and c coefficients of the IMME for the lowest energy 0^+, T=1 states for A=30.**

4. **Use the liquid-drop model to estimate the excitation energy of the lowest 0^+, T=4 state in ^{48}Ti. Compare to experiment.**

5. **The isospin part of two-body Coulomb interaction between nucleons i and j can be written as $(1-\tau_{zi})(1-\tau_{zj})/4$. Rewrite this as a sum of terms proportional to isospin operators tensor operators of rank 0, 1, and 2.**

6. **$X^{(2)} = [\tau_i \otimes \tau_j]^2_0$ is two-body operator whose isospin dependence is given a by rank-2 tensor in isospin space, where $\vec{\tau} = 2\vec{t}$ is the single-particle isospin operator. Show that the matrix element $< T, T_z \mid X^{(2)} \mid T, T_z >$ gives a contribution the a and c terns of the IMME. One could add a term dT_z^3 to Eq. 11.1. Show that the rank-2 tensor operator gives $d = 0$. Hint - you will need Eq. 10.41.**

7. **What is the kinetic energy for the protons in ^{208}Pb in the Fermi gas model? What is the kinetic energy for the neutrons in ^{208}Pb in the Fermi gas model? Estimate the total Coulomb interaction energy for ^{208}Pb. Use these together with the experimental binding energy to get the total strong interaction energy for ^{208}Pb.**