2021 - PHY 981 - Homework set 10 (due Mar 28)

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

2. **Read Chapters 22-23.**

3. **Derive Eqs. 22.26 and 22.27.**

4. **Use Eq. 22.31 to obtain an expression for** $< C \mid \hat{F} \mid C >$.

5. **Use the second-quantization method to reduce the following many-particle matrix elements to a sum of single-particle matrix elements for the states** (a, b, c, d)**. (1111) means they are all filled, etc.**
   $< (1100) \mid \hat{F} \mid (1100) >$, $< (1100) \mid \hat{F} \mid (1010) >$, $< (1100) \mid \hat{F} \mid (0101) >$, $< (1100) \mid \hat{F} \mid (0011) >$.

6. **For the last problem replace** $\hat{F}$ **with the number operator of Eq. 22.33.**

7. **Calculate the B(E2) for the** $1/2^+$ **to** $5/2^+$ **transitions in** ^{17}**F and** ^{17}**O assuming these states are represented by** $1s_{1/2}$ **and** $0d_{5/2}$**. single-particle states outside of a** ^{16}**O closed shell. Use hamonic-oscillator radial wavefunctions with** $\hbar\omega =$ **14 MeV. Use can use the** rme **program for the matrix elements. Compare to experiment.**

8. **What are all possible (**ℓ**, S, T) values for each of the following:**
   a) a $J^\pi = 3^-$ **resonance of the two-neutron system.**
   b) a $J^\pi = 2^-$ **resonance of the two-nucleon system with** $\mathbf{T}_z = \mathbf{1}$**.**
   c) a $J^\pi = 2^+$ **resonance of the two-nucleon system with** $\mathbf{T}_z = \mathbf{0}$**.**

9. **For the configuration** $(0f_{7/2})^2$ **for two neutrons what are the allowed** J **values?**

10. **For the configuration** $(0f_{7/2}, 1p_{3/2})$ **for two neutrons what are the allowed** J **values?**

11. **For the configuration** $(0f_{7/2})^2$ **for two nucleons what are the allowed combinations of** (J, T) **values?**