

2021 - PHY 981 - Homework set 6 (due Feb 28)

1. Discussion session on Fridays 2-3 link to zoom  
link to lecture notes  
link to nushellx.zip  
link to toi.zip
2. Read Chapters 15-17.
3.  $^{132}\text{Sn}$  is a good doubly-magic nucleus. What are the  $(n, \ell, j)$  values associated with the ground state  $J^\pi$  of  $^{131}\text{Sn}$ ,  $^{133}\text{Sn}$ ,  $^{131}\text{In}$  and  $^{133}\text{Sb}$ . Use binding energies to find the single-particle (hole) energies associated with these states. What is the single-particle energy of the proton  $0h_{11/2}$  state?
4. Use the harmonic-oscillator model with  $\hbar\omega=14$  MeV to find the rms proton radius for  $^{20}\text{Ne}$ . What is the total kinetic energy for  $^{20}\text{Ne}$ ?
5. Derive Eq. 16.45.
6. Derive Eq. 16.59.
7. Use the harmonic-oscillator model with  $\hbar\omega=14$  MeV to find the center-of-mass correction to the energy of  $^{20}\text{Ne}$ .
8. Use wspot with the default Bohr-Mottelson set of Woods-Saxon parameters. Assume that  $^{16}\text{O}$  is a doubly closed shell nucleus. What are the single-particle energies for the bound states? How do they compare with experiment? What is the rms charge radius? How does it compare to experiment?