Name: ____________ PHYS 7501, FS 2021

Homework 4 **Due:** Start of class, October 12th

1. Suppose the 6.917MeV state of ^{16}O is populated by $^{12}C(\alpha,\gamma)$.
   This 2^+ state primarily decays to the 0^+ ground state, but also decays to the 6.049MeV 0^+ first excited state and the 3^- state at 6.129MeV.
   a. Through what decay types El, Ml could these decays occur? List each separately.

   b. For the transition to the ground state, estimate $t_{½}$. Compare to the NNDC.

   c. Calculate the internal conversion coefficient α assuming a K-orbital electron ejection for the transition from the 2^+ state to the ground state.

d. Calculate $t_{½}$ for the transition between the first excited state and the ground state. Compare to the NNDC value. Why is your prediction so far off?

2. Suppose $^{12}C(\alpha,\gamma)$ instead populates the 8.872MeV 2^- excited state, it then decays by an $E1$ transition to the 2^+ excited state at 6.917MeV, which then decays to the 0^+ ground state. What would the angular distribution look like for the 2nd γ-ray when using the 1st γ-ray as the reference axis? Plot it.
   Then plot the case where the 2^- state instead decays via $M2$ to the 2^+ state, followed by a decay to the ground-state.

3. Which nucleus would generally have higher kinetic-energy fission fragments, ^{252}Cf or ^{235}U? What's the ratio of TKE? Keep in mind the shell effects on the fragment mass distributions.

4. Suppose I want to constrain the fission barrier height for a nucleus by measuring the neutron/fission decay branching ratio from a beam-induced reaction. Would I be better served by choosing a higher beam energy or lower beam energy?
(Assume the lowest beam energy is still sufficient to induce fission and populates an excitation energy above the neutron binding energy)