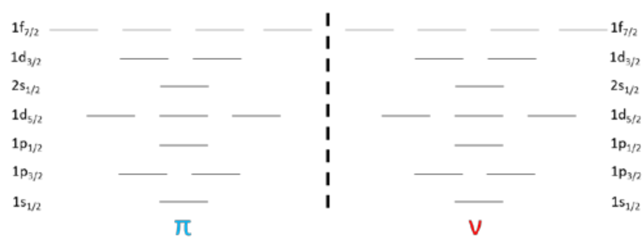
Homework 2 **Due:** Start of class, September 19th

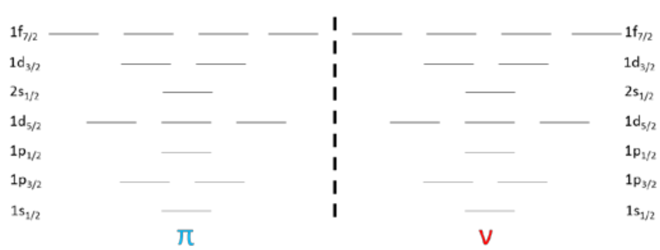
1. What levels lj would result from the n=7 harmonic oscillator state (where the first is n=0)?

2. Other than nuclear masses, nuclear mass differences, radii, electric quadrupole moments, cosmic abundances, and deformation, name at least two other pieces of evidence for magic numbers in nuclei. Provide citation(s) for your answers.

3. Fill-out the single particle levels and, based on this, determine J^{π} for the ground-state and first two excited states of ^{25}Mg. Explain how you came to your conclusions.
Verify your results with the NNDC database.



4. Fill-out the single particle levels and, based on this, determine J^{π} for the ground-state of ^{34}Cl. Explain how you came to your conclusions. Verify your results with the NNDC database.

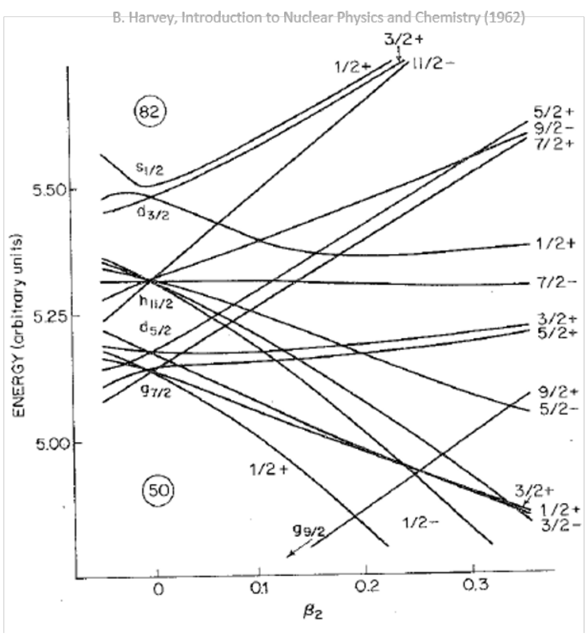


5. Where do we expect the magnetic dipole moment of ^{15}O to be located with respect to the Schmidt lines? Why? Compare your answer to the measured value.

6. $E(2_1^+)$ and $E(4_1^+)$ for ^{226}Ra are 68keV and 211keV, respectively. Show that it is or is not a rigid rotor. Assuming it is, what is the expected value for $E(6_1^+)$? Compare to experiment.

7. ^{122}Te is a spherical nucleus with $E(2_1^+) \approx 564$keV. Predict $E(4_1^+)$ and $E(6_1^+)$ and compare to experiment.

8. Compare the ground-state J^π for ^{173}Lu from the non-deformed and deformed shell-models to the experimental value.



9. Treating the nucleus as a Fermi gas, estimate the time it takes for a typical bound nucleon to cross the nucleus. Now, calculate the time for one revolution of a rigid rotor with $j = 2$, $I = 5000 amu\ fm^2$, and $A = 208$. You may find this helps justify the Nilsson model, where we treat the nucleon as if its orbiting around an essentially stationary rotor.

10. When counting the nuclear levels, we can generally be sure we are starting to miss some from the spectrum when the log of the level count versus energy starts to have negative curvature.
Now that you know that, what is your estimate for the cumulative number of levels for ^{60}Zn at an excitation energy of 10MeV given the experimental data below? Show how you got your answer and compare to the theoretical estimate on BRUSLIB.