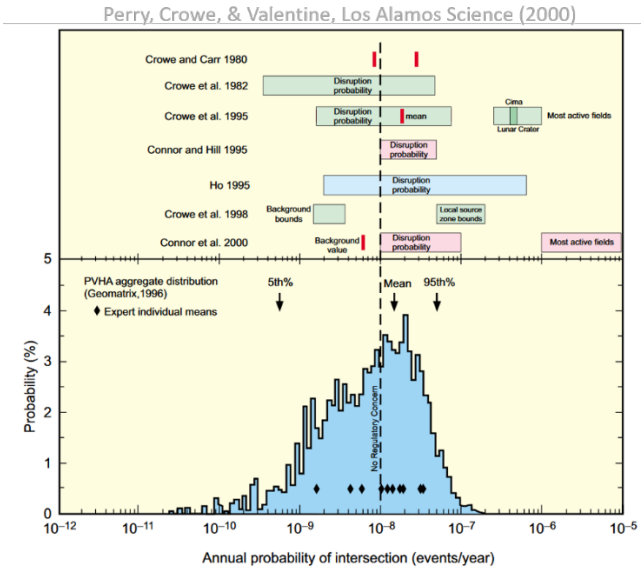
Homework 3 **Due:** Start of class, September 28th

1. It is estimated that Yucca Mountain will have volcanic activity roughly once every 100 Myr. 100 Myr from now, how much of the original ^{238}U will be left? What about ^{235}U? ^{233}U?



2. A household ionization-type smoke detector has ~1μCi of ^{241}Am. What mass of ^{241}Am is this?

3. You want to use ^{131}I for targeted treatment of thyroid cancer, since these tumors are partial to absorbing iodine and the low-energy βs tend to stop in the cancerous tissue. To create it, you created a lot of ^{131}Te in a very short time by irradiating ^{130}Te in a high neutron-flux reactor. How many hours after you have created the ^{131}Te sample will you have the maximum amount of ^{131}I?

4. Calculate the half-lives for α decay from ^{235}U, ^{231}Pa, ^{227}Ac, ^{223}Fr, and ^{219}At, from the ^{235}U decay chain. Rank the half-lives and compare to the experimental ranking.
   Show your calculation for one case, but use a spreadsheet or program for the others.

5. Three nuclei have the state energies and J^π below. If nucleus A were able to α-decay to nucleus B, would you expect this to have a shorter or longer half-life than if nucleus A were instead able to α-decay to nucleus C? Why?

	Energy [keV]		
Nucleus	**0+ g.s.**	**1st 2+**	**1st 4+**
A	0	250	500
B	0	500	1000
C	0	250	830

6. Derive and plot the valley of β stability (Z_{min} vs A) using the semi-empirical mass formula (and your SEMF constants from Homework 1). Attach and code used.

7. Consider ^{64}Cu β-decay. Plot the kinetic energy distribution of the electron using the β^- Q-value and neglecting Coulomb distortion effects. Repeat this using the β^+ Q-value. Determine the new mean kinetic energies for both cases after including (non-relativistic) Coulomb distortion effects. Attach any code used.

8. Estimate log(ft) for electron-capture onto ^{23}Na. Compare to the experimental value of ~3.7.