Alpha Decay

- All nuclei Z>83 unstable to alpha decay
- Emits a helium nucleus with 4-7 MeV
- Alpha is heavy and slow; will not penetrate skin; dangerous in lungs
- Alpha decays have wide range of half-lives; lower energy means longer half-life
- Example of QM barrier penetration

Radon

- Radon is a major public health issue:

  $^{232}Th \rightarrow {}^{224}Ra$ by a series of decays

  $^{224}Ra \rightarrow {}^{220}Rn \rightarrow {}^{216}Po$ by alpha decay

Radon has a half-life of a few days; radon concentration depends on local uranium-thorium concentration, ventilation and barometric pressure changes

Nuclear Scattering

- Nuclear forces are studied by scattering nuclei off other nuclei
- Scattering probability is defined in terms of a cross-sectional area
- 1 barn = 10^{-24} cm^2

$$N = N_0 \rho t \sigma$$

Nuclear Scattering

- Reactions can be exothermic or endothermic
- Endothermic reaction has a threshold energy
- Q value is the energy difference

Neutron Scattering

- Low energy neutrons will be thermalized—that is, energy is of order kT or .025 eV at room temperature
- Thermal neutrons are captured with emission of a photon. Cross-section goes as 1/v with resonances

Nuclear Energy

- Nuclear fission (spontaneous and induced)
- ^{235}U fissions to barium and krypton and 3 neutrons
- ^{238}U captures neutrons and goes to plutonium