

- Carbon-14 is a β emitter with a half life of 5730 years. What is the daughter nucleus when ^{14}C emits a β -particle and how active is the sample if it contains 1×10^{22} carbon-14 nuclei?
- Radioactive thorium, an alpha emitter, decays in proportion to the amount present. If I have 100mg of ^{234}Th that is reduced to 82.04mg in 1 week, what is the half life of ^{234}Th ? To what nucleus does ^{234}Th decay?
- A bone fragment is found in the desert. If it has a mass of carbon (due to only ^{14}C and ^{12}C) of 200g, how old is it if it has an activity of 15 decays per second? The ratio of ^{14}C to ^{12}C is 1.3×10^{-12} . (As a note, ^{14}C dating has a limited use. It can date objects to times of approximately 60,000 years. To date older objects we use strontium, thorium, or uranium.)
- A theory of nuclear astrophysics proposes that all heavy elements, such as uranium, were created in supernova explosions ending the lives of massive stars. If we assume equal amounts of ^{235}U and ^{238}U were created in a supernova explosion of a star, how long ago did the star(s?) explode that released the elements that formed the earth? The present ratio of $^{235}\text{U} / ^{238}\text{U}$ is 0.00725 and the half lives of ^{235}U and ^{238}U are 0.704×10^9 yrs and 4.47×10^9 yrs respectively.

- What is the nuclear binding energy of $^{238}\text{U}_{92}$? The actual atomic mass of $^{238}\text{U} = 238.0508\text{u}$, the mass of a hydrogen atom is 1.0079u , and the mass of a neutron is 1.0087u .
- ^{238}U decays by α emission.
 - a. What is the decay sequence?
 - b. What is the daughter nucleus?
 - c. What is the energy of the α particle (its mass is 4.0026u)?
 - d. What is the velocity of the α particle?
 - e. Is the α particle relativistic?
- After the nuclear reactor accident in Chernobyl (in 1986), a large amount of the radioactive isotope ^{131}I was emitted, which was deposited on the soil and plants? Thus, the milk of cows that grazed on the contaminated land contained a higher level of ^{131}I , and the milk could therefore be only used for cheese production instead of direct consumption.
 - a. What is the decay constant that characterizes the decay of ^{131}I if it has a half life of 8 days.
 - b. What is the storage time needed to decrease the ^{131}I content of the cheese to 15% of the original level?