

April 22: Radioactivity

Objectives

- Describe the different types of nuclear reactions and identify the properties of nuclei undergoing them.

What's the point?

- What is radioactivity?

Nuclei

Atomic **nuclei** contain positively-charged **protons** and electrically neutral **neutrons** held together by the **strong nuclear force**. Nuclei are specified by the number of protons Z and mass number A , which is equal to the number of protons and neutrons together.

The proton's charge is exactly opposite the electron's charge. The proton's mass is 1836.2 times the electron's mass. The neutron is slightly more massive, at 1838.7 times the electron's mass.

Radioactive decay

Unstable nuclei decay by several mechanisms, producing a new **daughter** element and additional smaller particles. Each type of decay has a characteristic **half-life**, during which half of an initial population of **parent** nuclei decay. In each succeeding half-life, half of the remaining parent nuclei decay.

Alpha decay: A nucleus emits an **alpha particle** (helium nucleus), which contains two protons and two neutrons.

Beta decay: A neutron in the nucleus decomposes into a proton, an electron, and a nearly undetectable electron anti-neutrino. The electron is emitted as the "**beta particle**", the neutrino escapes without notice, and the proton remains in the nucleus.

Gamma emission: An excited nucleus emits a short-wavelength photon, or **gamma ray**.

Fission: A nucleus splits into two **daughter** fragments, also emitting several neutrons.

Fusion: Two nuclei combine into a larger nucleus, sometimes emitting other particles in the process.

