Mass Number Encyclopedia Article

Mass Number

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Mass Number

The **mass** number of an **atom** is the total number of protons plus neutrons in its **nucleus**.

Different isotopes of the same element have different mass numbers because their nuclei contain different numbers of neutrons. In the written symbol for a particular **isotope**, the mass number is written at the upper left of the symbol for the element, as in $^{238}_{92}U$, where 92 is the **atomic number** of **uranium** (U) and 238 is the mass number of this particular isotope. The symbol is read "uranium-238." The mass number is always a whole number--just a count of the particles. It differs from the exact mass of the atom in atomic mass units (amu) that is often known and expressed to six decimal places. (One amu is exactly one-twelfth of the mass of an atom of carbon-12, ^{12}C, and is equal to approximately 1.66×10^{-24} g.) There are two reasons why the mass number of an atom is different from its exact mass. First, neutrons and protons don't happen to weigh exactly one amu apiece; the **proton** actually weighs 1.0072765 amu and the **neutron** weighs 1.0086650 amu. Second, when neutrons and protons are bound together as an atomic nucleus, the nucleus has less mass than the sum of the masses of the neutrons and protons. The difference in mass, when expressed in **energy** units according to Einstein's formula $E=mc^2$, is called the binding energy of the nucleus.

To understand this strange-sounding situation, we can think of the binding energy as the strength of the "glue" that holds the protons and neutrons together as a nucleus. It is, therefore, the amount of energy that would be required to break the "glue" and pull the nucleus apart into its individual neutrons and protons. But if energy must be added to an object in order to pull it apart, and if energy and mass are equivalent, then we could say that mass had to be added to pull it apart. The separated particles will therefore have more mass than when they were bound together as a nucleus.