

1120: Are nucleons elementary particles?

(Current common knowledge about atomic nuclei)

Key words: elementary particles; elementary charge; charge of nucleons; up quarks; down quarks; gluons; photons; protons and neutrons are not elementary particles

[What are elementary particles?]

Elementary particles are particles that cannot be divided any further; in other words, particles that have no internal structure.

Protons and neutrons are not elementary particles. Protons are made up of two up quarks and one down quark. On the other hand, neutrons are made up of two down quarks and one up quark. Quarks bond with each other by exchanging elementary particles called gluons. The bond that occurs through gluon exchange is called the "strong force." (According to particle theory, forces (interactions) are thought to arise from the exchange of particles. In the case of universal gravitation, forces arise from the exchange of gravitons, and in the case of electromagnetic force, forces arise from the exchange of photons.)

[Electric charge of a nucleon]

Up quarks have a charge of $+2/3$, measured in units of e ($= 1.6022 \times 10^{-19}$ Coulomb [C] the elementary charge), and down quarks have a charge of $-1/3$. As a result, protons have a charge of $+1$, and neutrons have a charge of 0 .

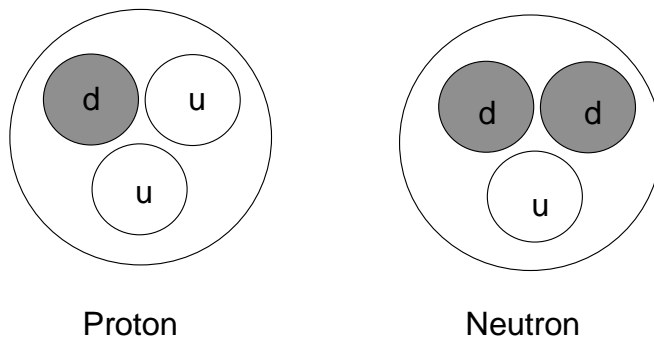


Figure 1. Internal structure of a proton and a neutron