

Atomic Species

Characterized by the number of neutron N , number of proton Z , and mass number $A = N + Z$

$$(A, Z) = {}^A_ZX = {}^A_ZX_N$$

Nucleon

Defined as bound state of atomic nuclei. The two type are positively charged proton and neutral neutron. Nucleon constitutes three bound fermions called quark: up with charge $(2/3)$ and down with charge $(-1/3)$

$$\text{proton} = uud \quad \text{neutron} = udd$$

Both of the are fermion with mass

$$m_e = 939.56 \text{ MeV}/c^2$$

$$m_p = 938.27 \text{ MeV}/c^2$$

$$m_n - m_e = 1.29 \text{ MeV}/c^2$$

The magnetic moment projected by both are

$$\mu_p = 2.792847386 \mu_N \quad \mu_n = -1.91304275 \mu_N$$

where μ_N denote nuclear magneton

$$\mu_N = \frac{e\hbar}{2m_p} = 3.15245166 \cdot 10^{-14} \text{ MeV/T}$$

Here are the difference in unit used to describe nucleus compared to atom

Properties	Atom	Nucleus
Radius	Angstrom (10^{-10} m)	Femto (10^{-15} m)
Energy	eV	MeV

Radii. In terms of their mass number A , their radius may be approximated as

$$R = r_0 A^{1/3} \quad \text{with} \quad r_0 = 1.2 \text{ fm}$$

This approximation comes from assuming the radius is proportional to the volume which is also assumed to be spherical. Then $\mathcal{V} = 4\pi R^3/3 \approx A$.

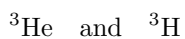
Energy.

Nuclear Relative

Isotop. Same number of charge Z , but different number of neutron N . Isotop has identical chemical properties, since they have the same electron, but different nuclear properties. Example are

$${}^{238}_{92}\text{U} \quad \text{and} \quad {}^{235}_{92}\text{U}$$

Isobar. Same mass A . Frequently have the same nuclear properties due to the same number of nucleon. Example are



Isotone. Same number of neutron N , but different number of proton Z . Example are

