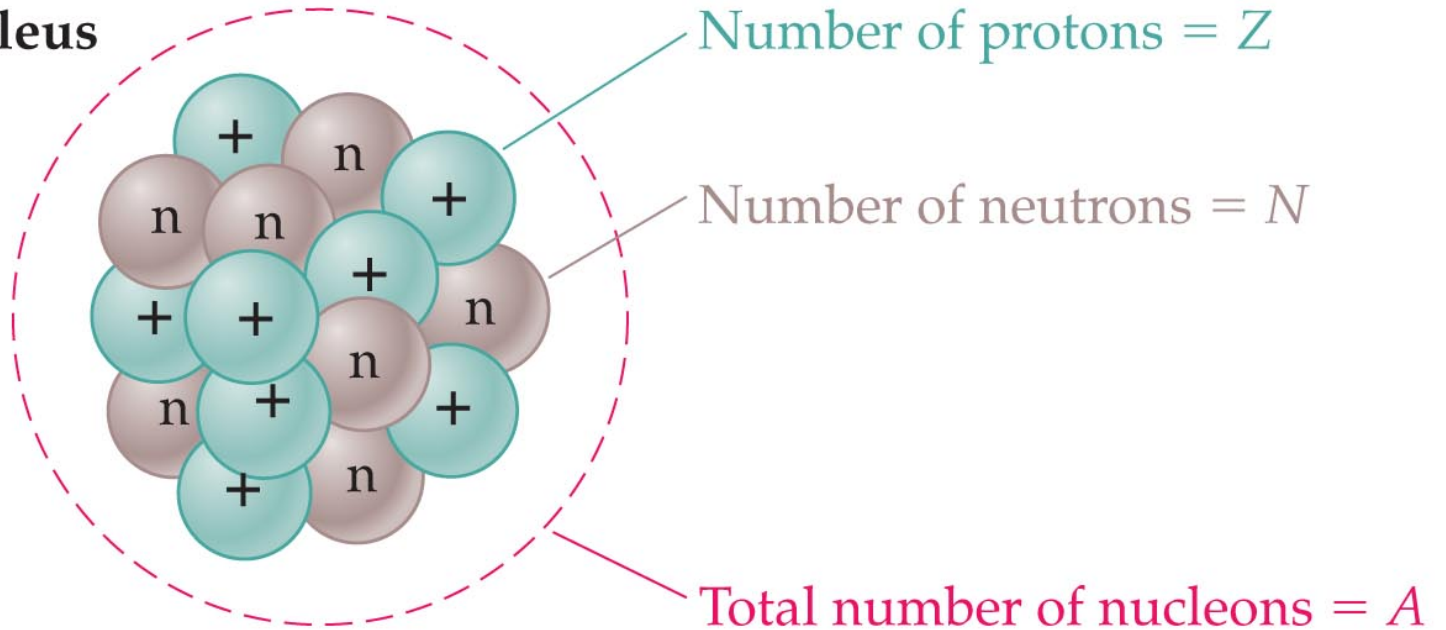


Ch 26 - The Nucleus

Typical nucleus



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Earnest Rutherford established the existence of the nucleus, and discovered a bit about its structure.

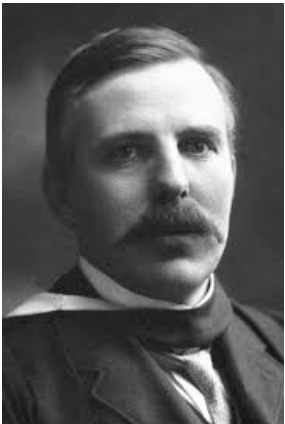
Atomic Number = Number of protons = Z

Nuclear Charge = $Z e$ (e = elementary charge)

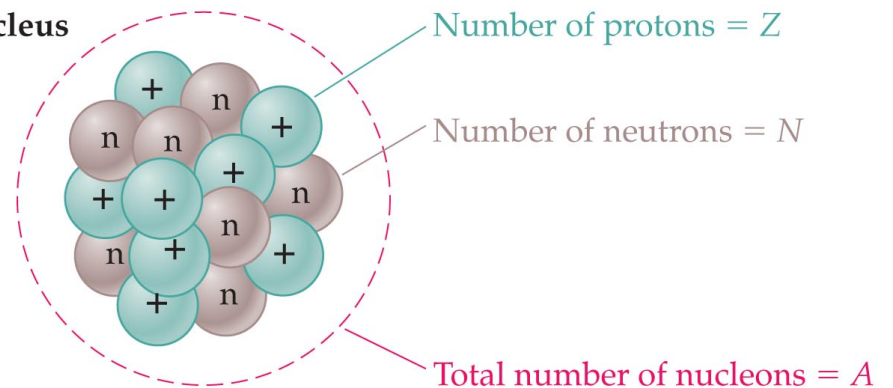
Mass Number = Number of protons + neutrons = A

Nuclear mass approximately = $A u$

u = atomic mass unit



Typical nucleus



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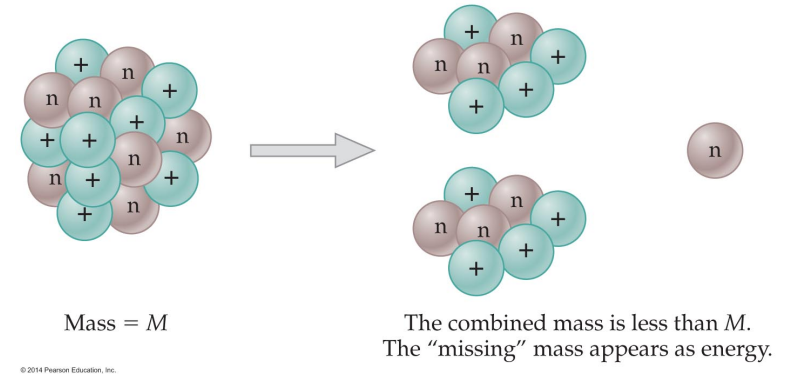
Radioactive Decay:

The nuclei of some isotopes are unstable. They decay by emitting various particles.

An alpha particle is the nucleus of a hydrogen atom.

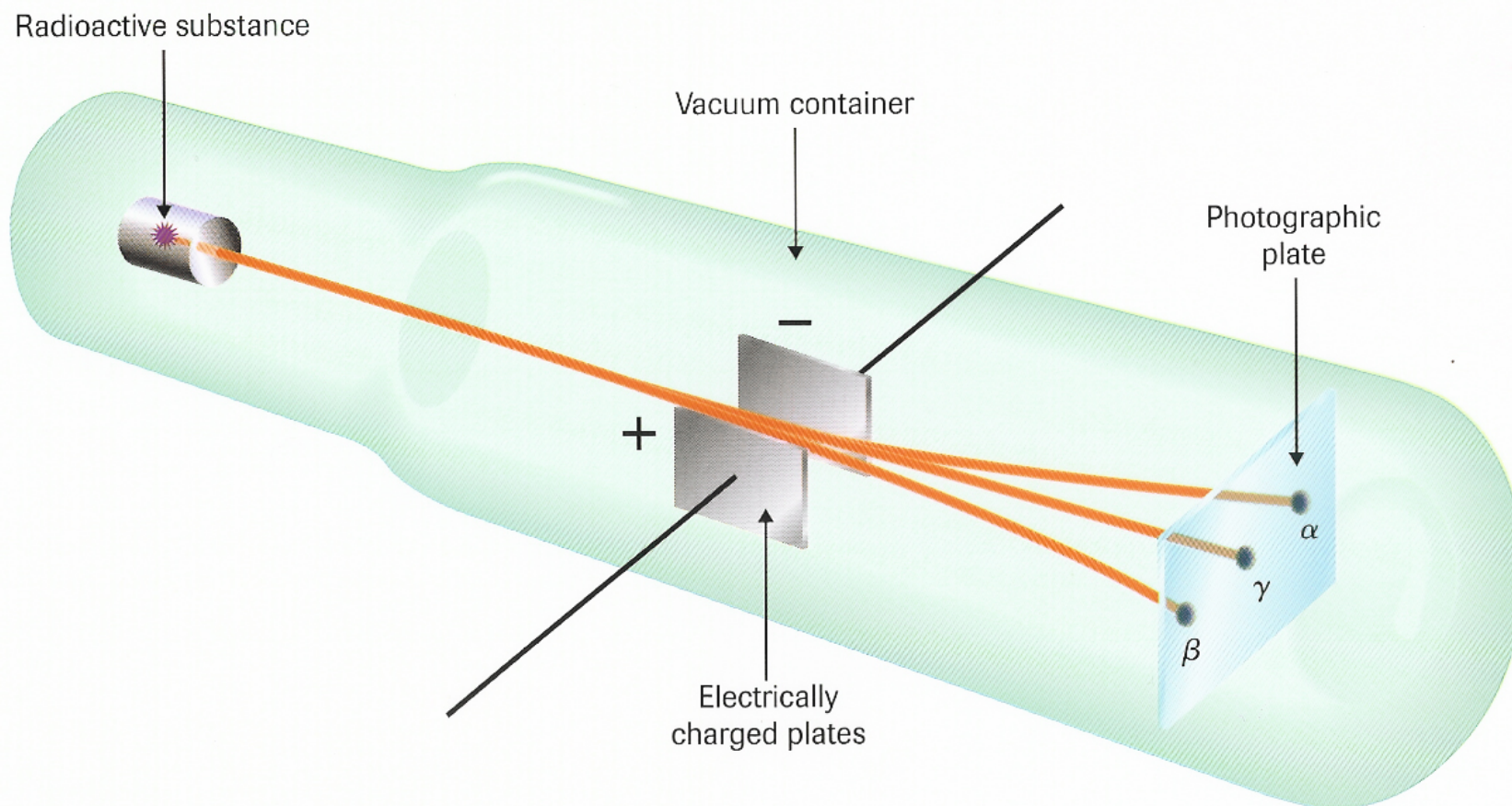
A beta particle is an electron

Gamma rays are high-energy photons.



54 Alpha, Beta, and Gamma Radiation

Use with Chapter 30.



History III

Then we found more stuff!

The list below is in order of increasing mass.

neutrino

electron

muon

pion

kaon

eta

proton

neutron

lambda

sigma

cascade

omega

This is getting to be a mess!

Standard Model:

Matter is divided into Hadrons and Leptons.

Hadrons interact by the strong, electromagnetic, $[\text{L}][\text{SEP}]$ weak, and gravitational forces. They are made up $[\text{L}][\text{SEP}]$ of quarks. Baryons are heavy, mesons are $[\text{L}][\text{SEP}]$ intermediate mass.

Leptons interact by the electromagnetic, weak, $[\text{L}][\text{SEP}]$ and gravitational forces only. Not made up of $[\text{L}][\text{SEP}]$ quarks. Less mass than the Hadrons.

Increasing
Mass

Leptons (truly elementary?)

neutrino

electron

muon

Hadrons -made up of quarks

Mesons

pion

kaon

eta

Baryons

proton

neutron

lambda

sigma

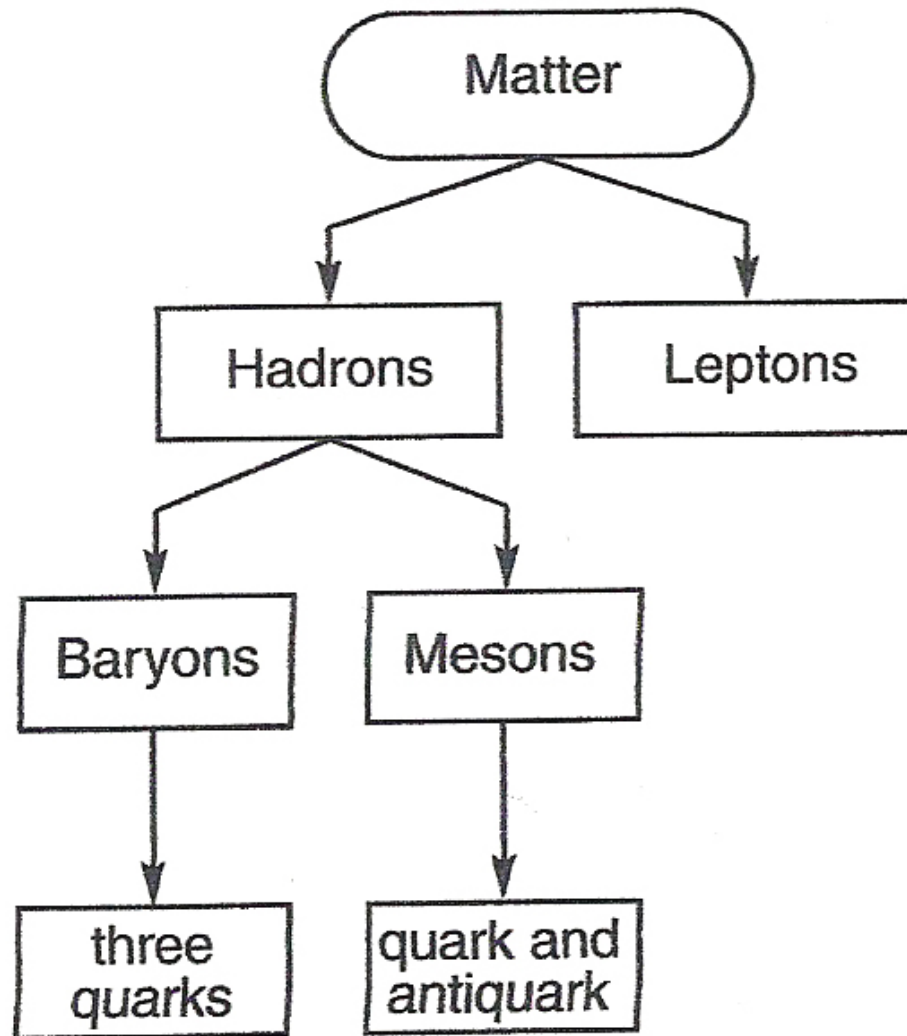
cascade

omega



If you smack an "elementary particle" and it breaks down into other stuff, then it was not an elementary particle.

Classification of Matter



Name	up	charm	top
Symbol	u	c	t
Charge	$+\frac{2}{3}e$	$+\frac{2}{3}e$	$+\frac{2}{3}e$
	down	strange	bottom
	d	s	b
	$-\frac{1}{3}e$	$-\frac{1}{3}e$	$-\frac{1}{3}e$

electron	muon	tau
e	μ	τ
$-1e$	$-1e$	$-1e$
electron neutrino	muon neutrino	tau neutrino
ν_e	ν_μ	ν_τ
0	0	0

Note: For each particle there is a corresponding antiparticle with a charge opposite that of its associated particle.