

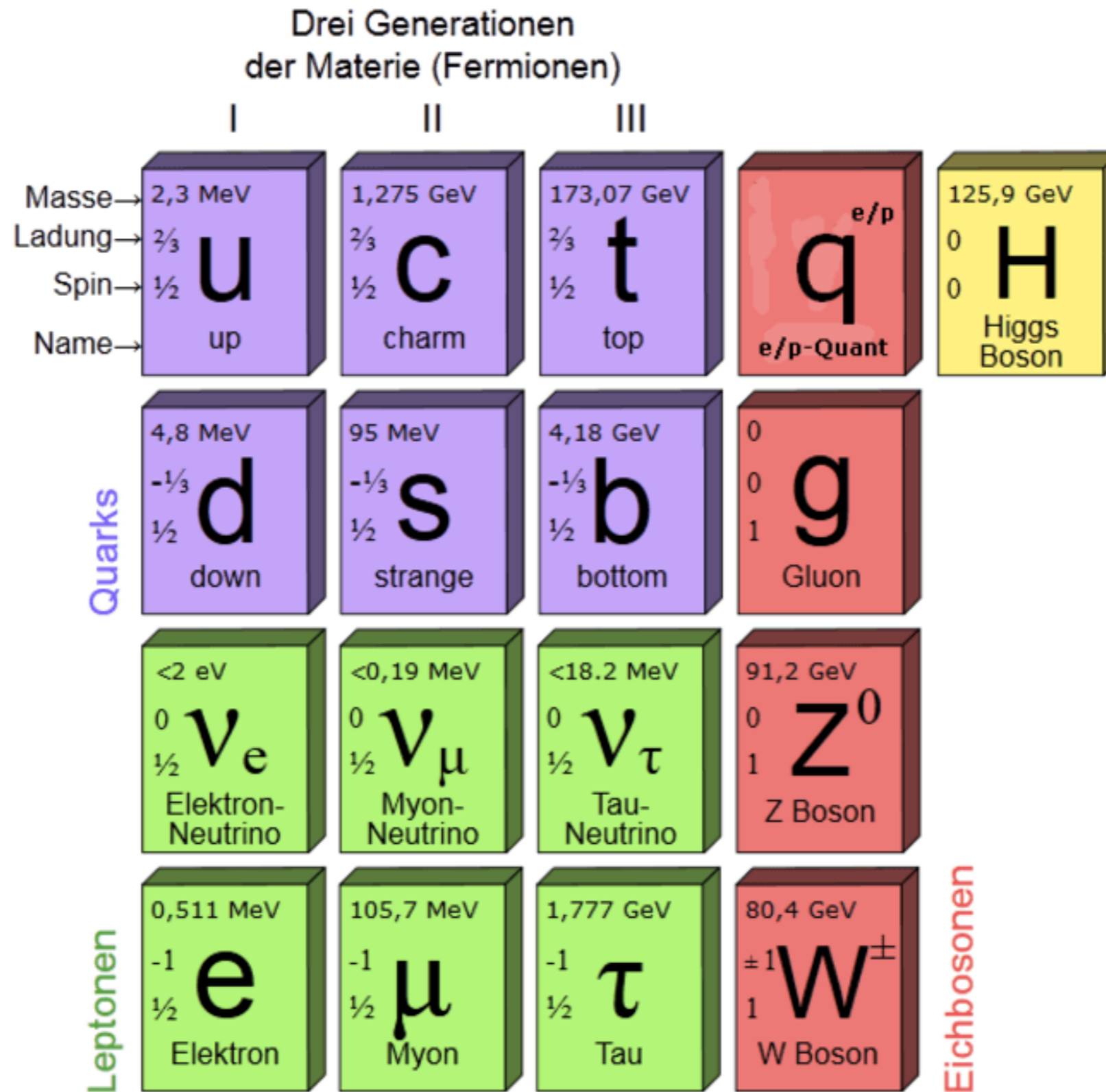
Astroparticle Physics

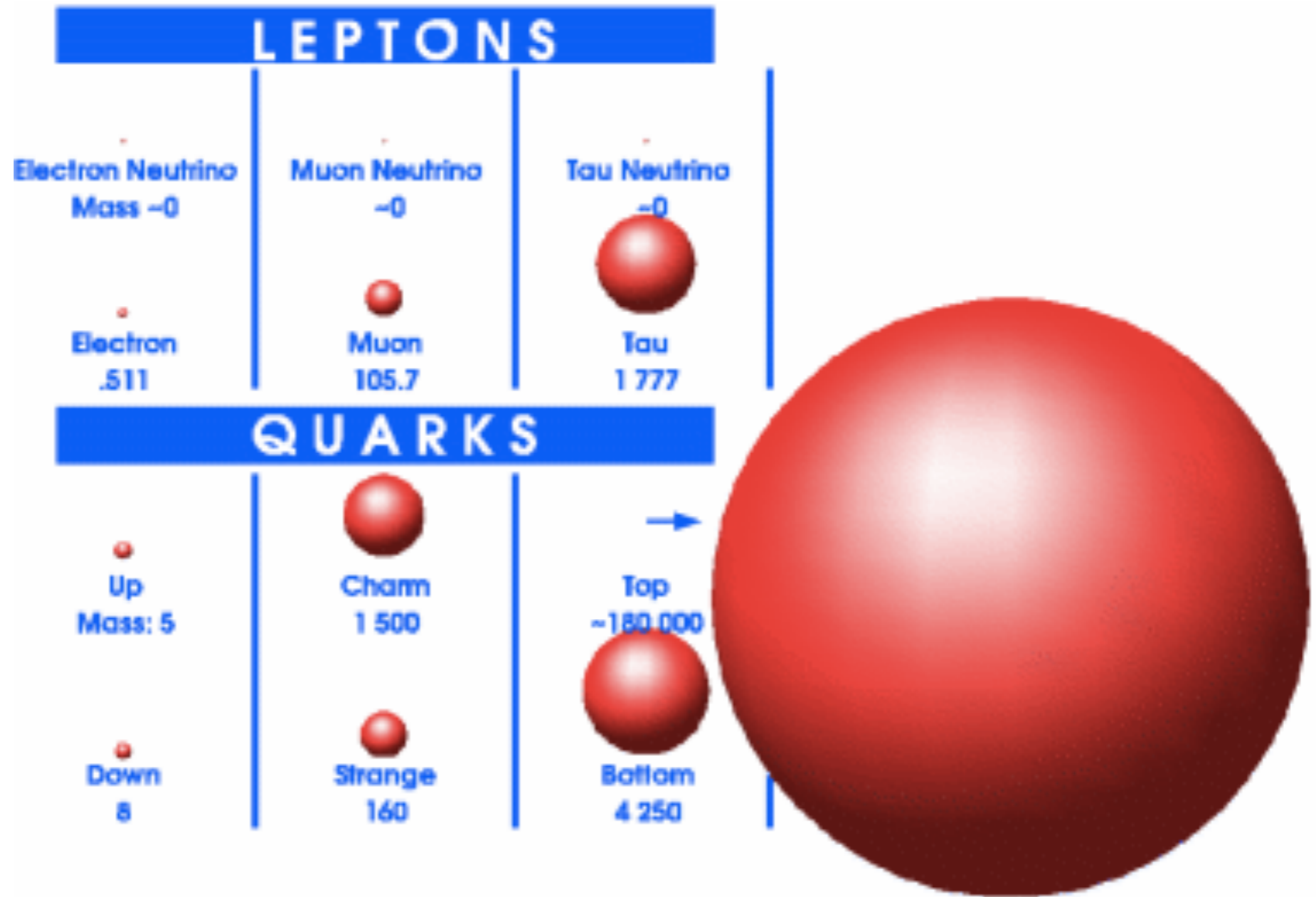
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**Quick Summary: Elementary Particles
and the Standard Model**





Electromagnetic Force

This force is described by a theory called Quantum Electrodynamics (QED), based on the abelian gauge group $U(1)$. The theory describes all the elementary processes among electrically charged particles. The force-carrier boson is the photon.

Strong Force

This force is described by a theory called Quantum Chromodynamics (QCD), based on the non-abelian gauge group $SU(3)$. The theory describes all the elementary processes among coloured particles: quarks and gluons. The gauge-carrier boson is the gluon. Note that also the gluon is colored, while the photon is not charged...

Weak Force

The weak force is based on the non-abelian gauge group $SU(2)$ and has three massive force carriers: the W^+ , W^- , and Z^0 bosons. These bosons have mass, contrary to gluons and photons which are massless. Due to this force, quarks can change their flavour. The weak force is responsible e.g. for the beta decay. Neutrinos interact only through this force.

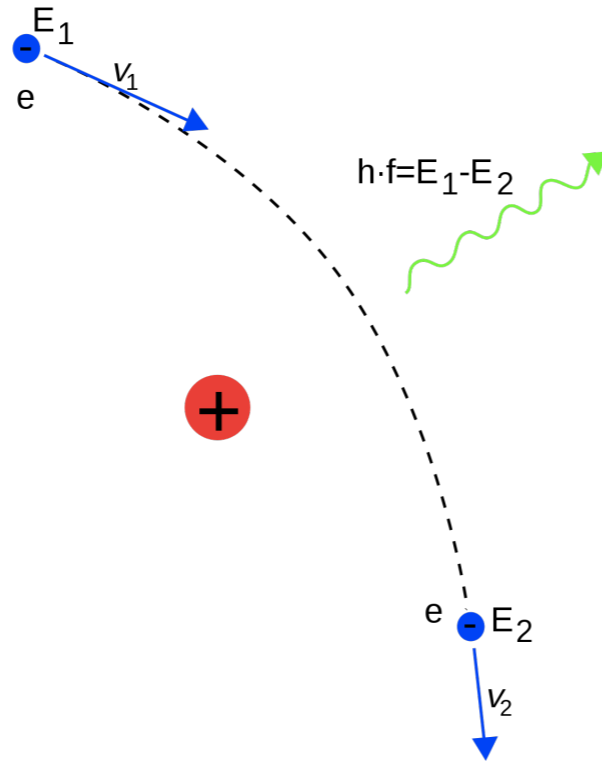
Relevant Processes

We summarize here some elementary processes which will be relevant for particle astrophysics.

Electromagnetic Processes

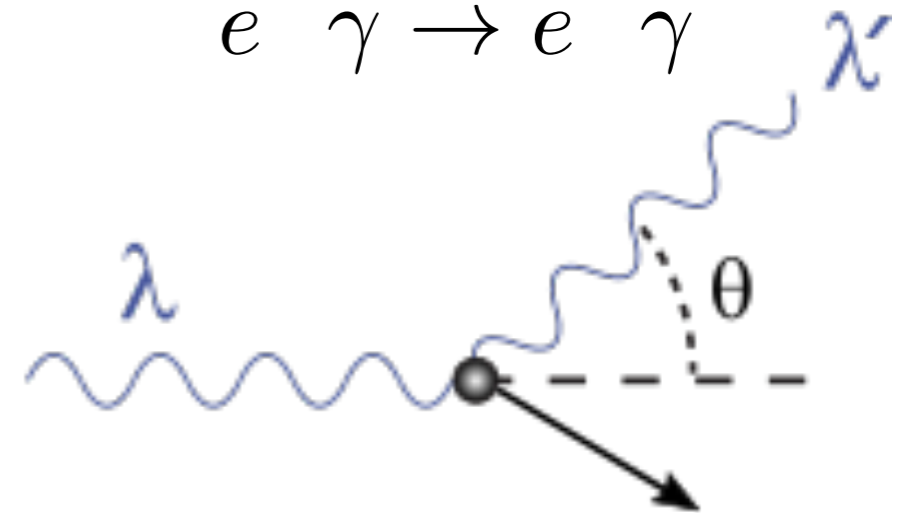
Bremsstrahlung

$$e^- \rightarrow e^- \gamma$$



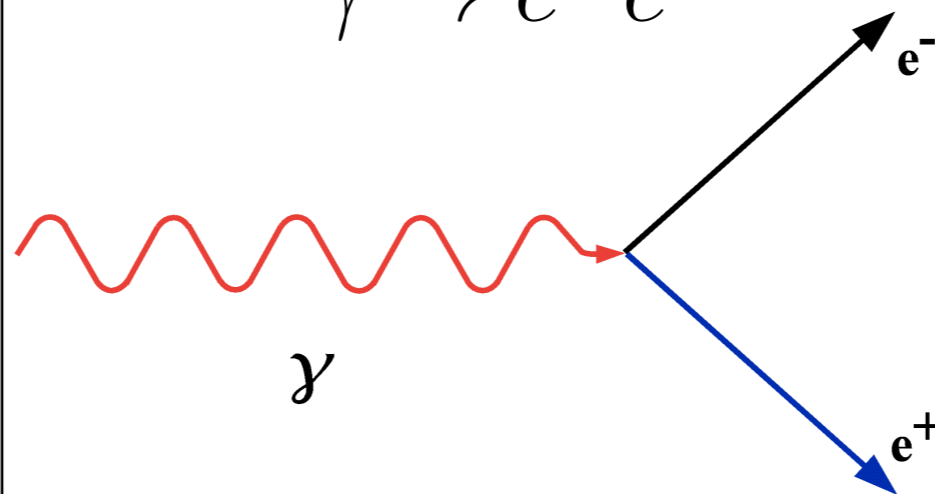
Compton Scattering

$$e^- \gamma \rightarrow e^- \gamma$$

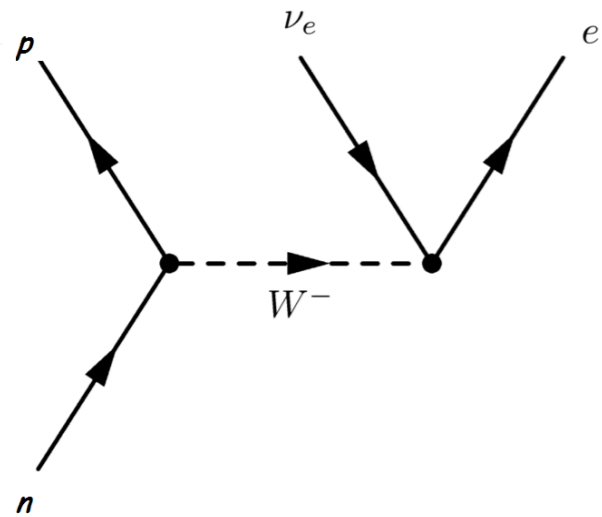


Pair Creation

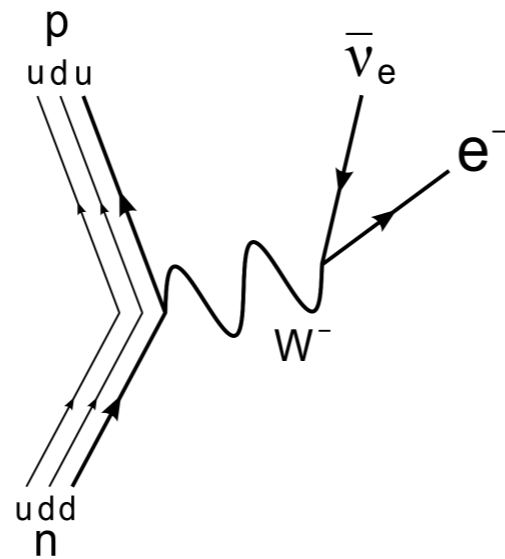
$$\gamma \rightarrow e^+ e^-$$



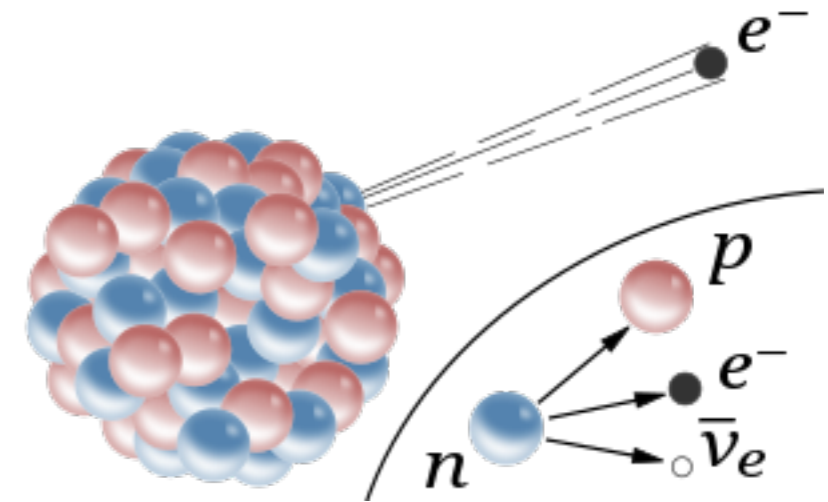
Beta Decay



Nucleon Level

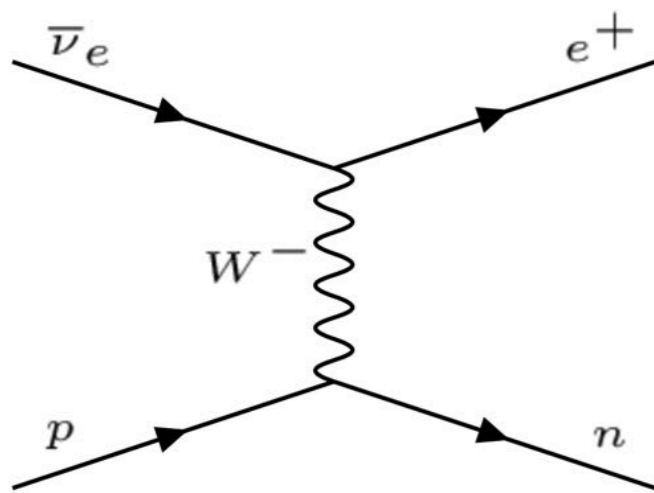


Elementary Level

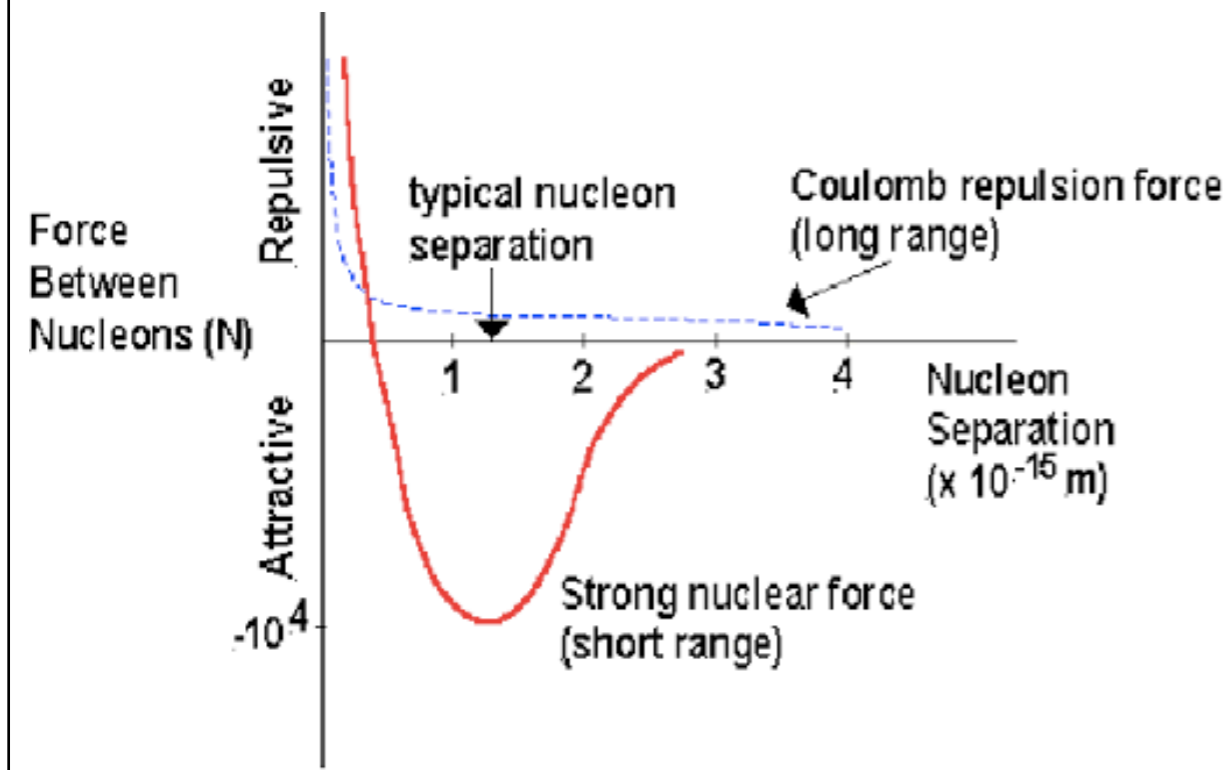


Nuclear Level

Inverse Beta Decay



Nuclear Force



Confinement in the Nucleon

