Fundamental forces of nature:

- **Strong nuclear force**
- **Weak nuclear force**
- **Electromagnetic force**
- **Gravitational force**

Nuclear Forces (Ref: Sixth edition Physics by Ginacoli p 840 -841)
We cannot expect a collection of protons and neutron to come together spontaneously since protons are all positively charged and thus exert repulsive electric forces on each other. We may wonder how the nucleus stays together at all, when the positive protons repel each other and the electric forces try to break them apart. Since stable nuclei do stay together, it is clear that there is another force acting, stronger than the electric force (which inturn is much stronger than gravity at the nuclei level). This force is called the **strong nuclear force.** This force is an attractive force that acts between all nucleons (protons and neutrons) alike.

Therefore the **protons** attract each other via the strong nuclear force and at the same time they repel each other via the electric force. The electrically neutral **neutrons** will only attract other neutrons or protons via the strong nuclear force. **Strong nuclear force** is believed to be far more complicated than the **gravitational** or **electromagnetic forces. Strong nuclear force** is a **short range force.** It's very strong between two nucleons, if the nucleons are less than 10^{-15} m apart.(if they are greater than 10^{-15} m apart, then the strong nuclear force will be **zero**). Whereas electric and gravitational forces act over any distance and are called **long range forces**.

The strong nuclear force is strange in that if the nucleide contains too few or too many neutrons compared to the number of protons, the binding of the nucleons is reduced. Nucleides which are too unbalanced in this sense become unstable. no. of neutrons N = (A-Z) A= at. Mass and Z= atomic no.(no. of protons)

Stable nucleide has N=Z, up to around A= 30 or 40. Beyond this, stable nucleide contains more neutrons than protons. As Z increases electrical repulsion between protons increase and a greater number of neutrons (which exert only attractive nuclear force) are required to maintain stability. For every large Z, there is no neutron to overcome the greatly increased electric repulsion. There are no completely stable nucleus above Z=82. Any nucleus which comes apart (unstable) will result in **radioactive decay.**

There is a second type of nuclear force called **weak nuclear force** which is much weaker than the **strong nuclear force.** This is shown only in certain radio active decay. The strong nuclear force, the weak nuclear force, gravitational force and electromagnetic force together are known as the **fundamental forces of nature.**