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# Nuclear Force

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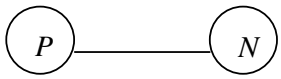
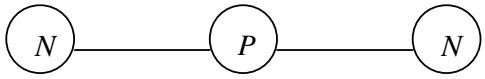
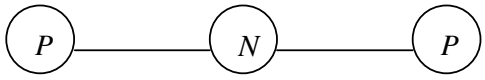
Binding energy of the basic elements:

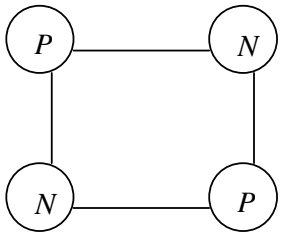
$H^2$ 


$E = 2.2MeV$ ; $\frac{2.2}{2!} = 1.1$

$H^3$ 

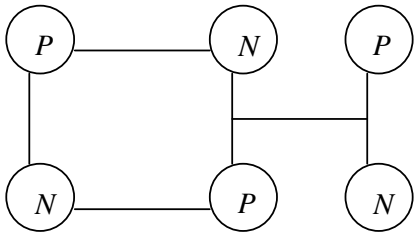

$He^3$ 


$E = 7.8MeV$ ; $\frac{7.8}{3!} = 1.3$

$He^4$ 

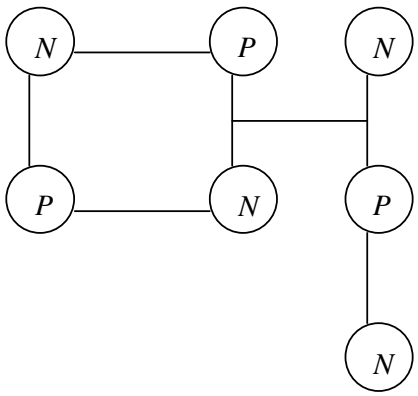

$E = 28.0MeV$ ; $\frac{28}{4!} = 1.2$

All the other nuclei are made of those elements. A stable nucleus with 5 or 8 nucleons doesn't exist.

$Li^6$ 


$E = 28 + 2.2$

$\frac{30.2}{6} = 5.0$ (5.3) -- +0.3

$Li^7$ 


$E = 28 + 7.8$

$\frac{35.8}{7} = 5.1$ (5.6) -- +0.5

$Fe^{56}$ $\quad \frac{14\times 28}{56} = 7$ (8.7) -- +1.7

The $H^3$ is not stable because the repulsion force between neutrons is stronger then the repulsion force between protons.

## Unified force

Two protons: $F_{PP} = m_P g_P = +12.973N$

Two neutrons: $F_{NN} = m_N g_N = +13.041N$

A proton and a neutron: $F_{PN} = m_P g_N = -13.00N$

What about the electric force?

$$13 = \frac{q_e^{\ 2}}{4\pi\varepsilon_0 R^2} \quad \Leftrightarrow \quad R = 4.2\times 10^{-15} m$$

This is precisely the distance between the proton and the neutron in a deuteron. The strong force is equal to the electric force. That means that the strong force doesn't exist.

The neutrons behaves as a negatively charged particles, it is only neutral for macroscopic distances.

$2\pi R = nx_P$ and $x_P = 1.32\times 10^{-15}$ (Compton wavelength of the proton)

$\Leftrightarrow$ n = 20

Acceleration: $g = \frac{v^2}{R} = 7.755\times 10^{27} \quad \Leftrightarrow \quad v = 5.7158\times 10^6$

The binding energy is not kinetic or potential.

## Electric field of the neutron