

**Duh?**

Seperate particles weigh more than when joined in a nucleus

●+ protons  
●- neutrons

The illustration shows a man with a thought bubble containing the word "Duh?". To his right is a balance scale where the left pan is higher than the right pan, indicating it is lighter. The left pan contains three particles (two red, one grey), while the right pan contains four particles (two red, two grey). A legend at the bottom right identifies red circles with a plus sign as protons and grey circles with a minus sign as neutrons.

$$E = mc^2?$$

In atomic and nuclear physics, masses are typically given in atomic

mass units (u)  $1 \text{ u} = 1.66054 \times 10^{-27} \text{ kg} = 931.494 \text{ MeV}/c^2$

Proton = 938 MeV  
Neutron = 939.5 MeV

$^2\text{H}$  components

1.007276 amu



1.008665 amu



0.000549 amu



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2.016490 amu

$^2\text{H}$  atom



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2.014102 amu

Mass defect = 0.002388 amu

## Atomic Binding energy

$$B_{\text{atomic}} = M_N c^2 + Z m_e c^2 - M_A c^2$$

$M_N =$  Mass of Nucleus

eV's to keV's

$$A = N + Z$$

A= Atomic Mass Number

N=Neutron Number

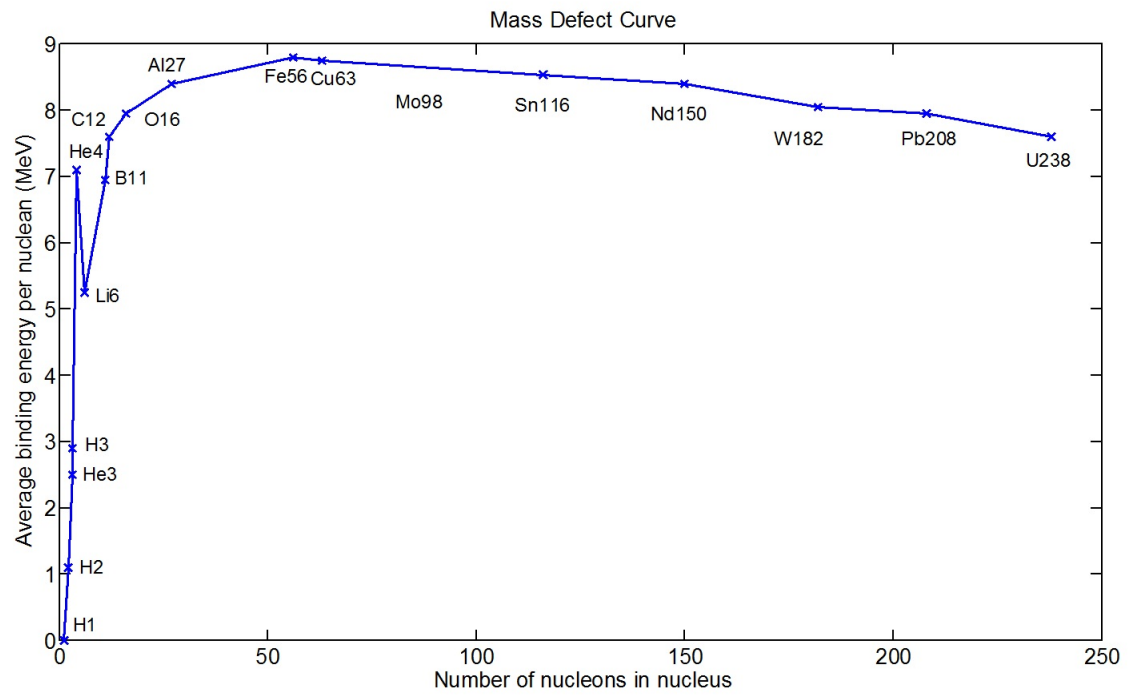
Z=Proton Number

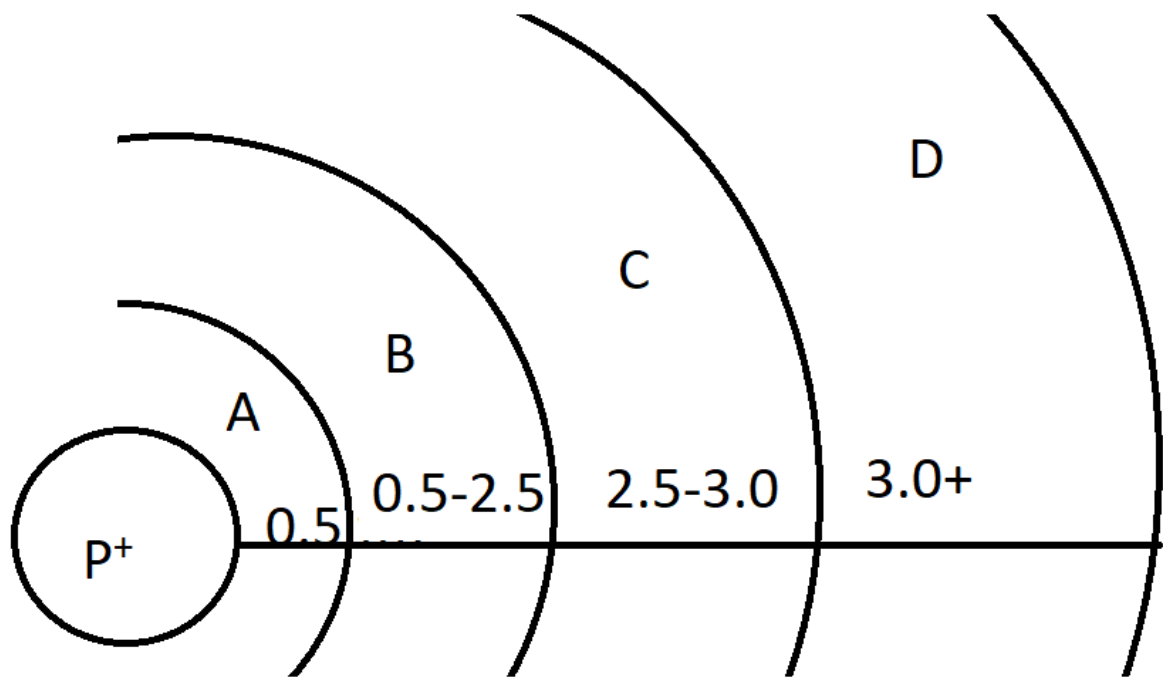
## Nuclear Binding energy

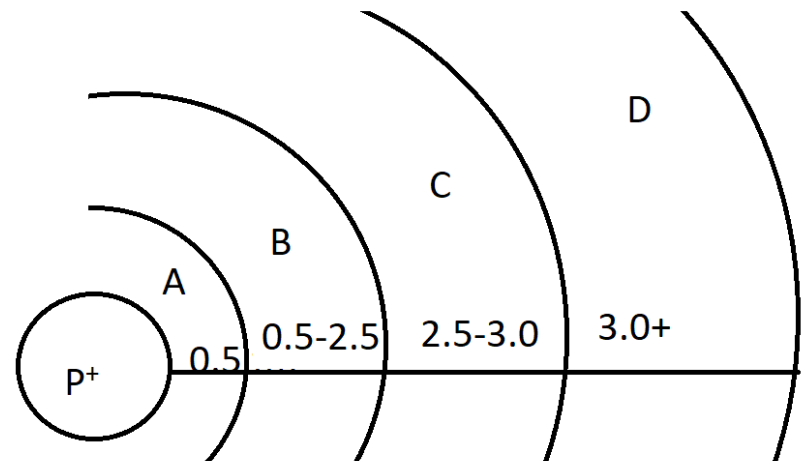
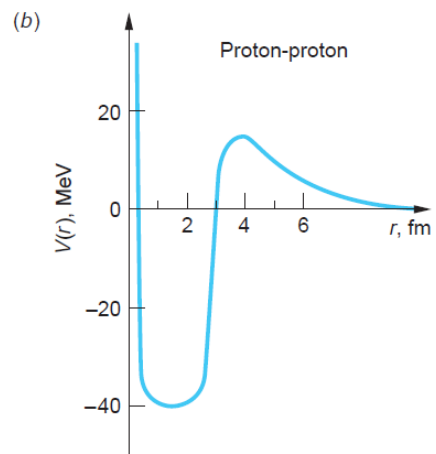
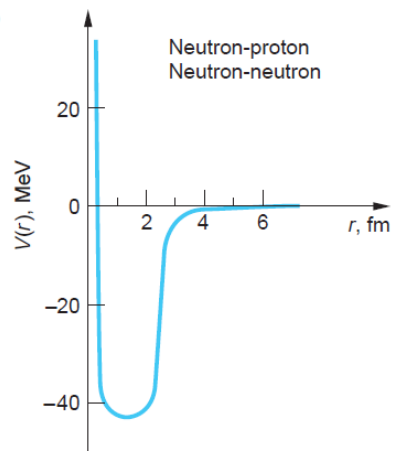
$$B_{\text{nuclear}} = Z m_p c^2 + N m_n c^2 - M_A c^2$$

$M_A =$  Atomic mass

MeV's

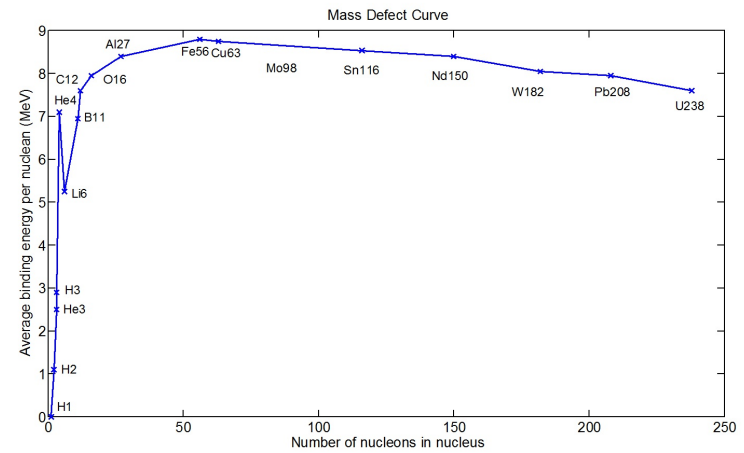
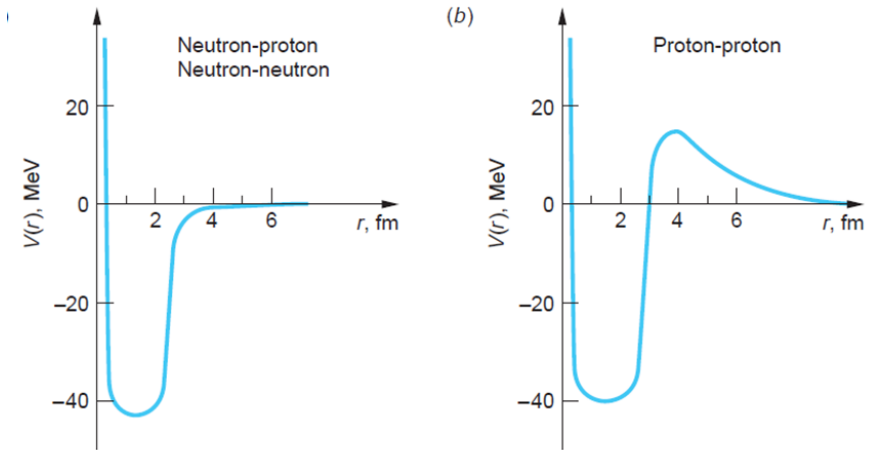






# Nuclear Force

- Charge independent.
- Highly dependent on distance
- Saturated force



# Nuclear Force

- Charge independent.
- Highly dependent on distance
- Saturated force
- Coulomb Repulsion will overcome the Nuclear Force as atoms become larger.

