Mass Defect

Mass difference between calculated and actual mass of the nucleus. This lost mass is converted to binding energy

Definition of 1 eV

Potential Difference between points A and B is

$V(AB) = W(AB)/Q$

$W(AB) = V(AB) \times Q$

Calculate the Work done on an elementary charge that is moved between two points in an electric field with a potential difference of one volt.

$W(AB) = (1.6 \times 10^{(-19)}) \times (1 \text{ volt})$

$= 1.6 \times 10^{(-19)} \text{ Joule} = 1 \text{ eV}$

Multiples of eV

- 10^6 MeV
- 10^9 GeV

Example

- A charge equal to 2 x 10^7 elementary charges is moved through a potential difference of 3,000 volts. What is the change in potential energy of the charge?
- W = Q x V
- = (2 x 10^7) x (3,000)
- = 6 x 10^10 eV = 60 GeV

26Fe56 Mass Defect

- Compare the mass of 26Fe56 nucleus (mass = 55.9206 amu) with the calculated mass.
- 26 protons: 26 x 1.007276 = 26.1892 amu
- 30 neutrons: 30 x 1.008665 = 30.2600 amu
- Total mass of nucleons 56.4492
- 56.4492 – 55.9206 = 0.5286 amu mass defect
- Mass defect converted to binding energy by E = m c ^2

Convert 1 amu to energy

- 1 eV = 1.60 x 10^(-19) J
- 1 MeV = 10^6 eV
- 1 amu = 1.66 x 10^(-27) kg
- E = m x c^2 where c = 3.0 x 10^8 m/s
- E = (1.66 x 10^(-27))(3 x 10^8)^2 = 1.49 x 10^(-10) J
- = 1.49 x 10^(-10)(1 eV)/(1.6 x 10^(-19)) = 931 x 10^8 eV = 931 MeV

Mass Defect of 26Fe56 in eV

- Mass defect was 0.5286 amu
- Energy = 931 Mev/amu x 0.5286 amu
- = 492 MeV

Energy equivalent

- What is the energy equivalent of a mass of 1 kilogram?
- $E = m \times c^2 = 1 \times (3 \times 10^8)^2 = 9 \times 10^{16}$ J
- $1 \text{ eV} = 1.6 \times 10^{-19}$ J
- $9 \times 10^{16} \text{ J} \times 1 \text{ eV} / 1.6 \times 10^{-19} \text{ J} =$
- 5.625×10^{35} eV