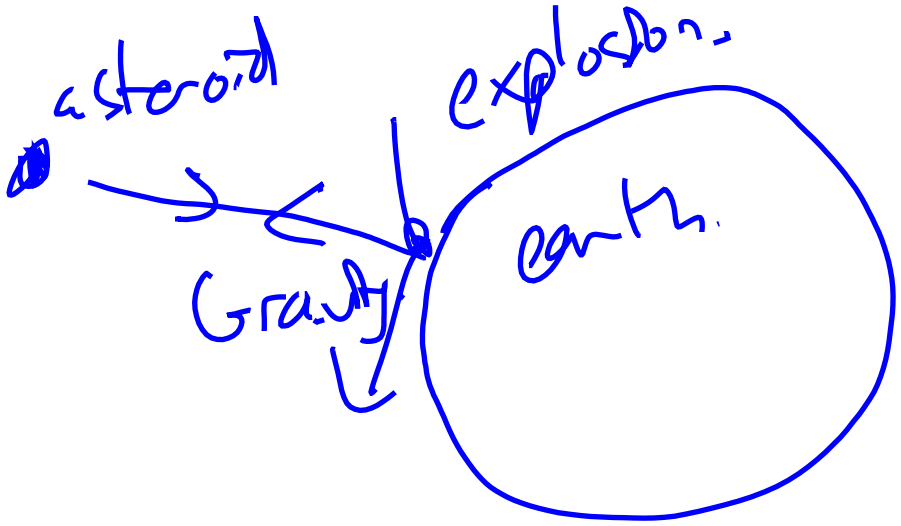
Lecture 10

Binding energy.



Heavy water D_2O

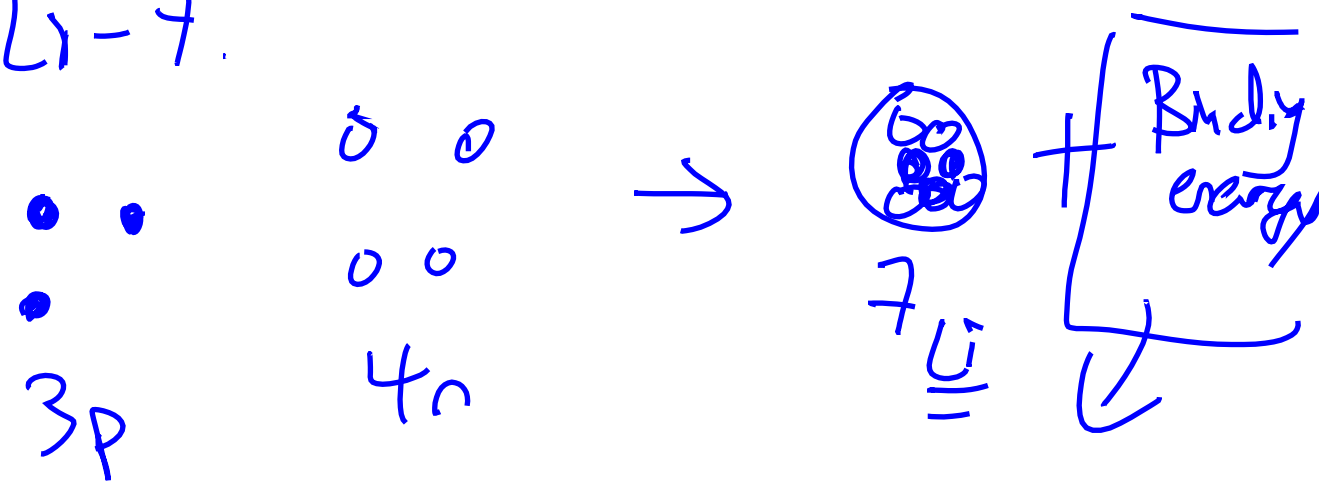
neutron capture.

mass defect ≠ mass excess

but they are both used

to calc binding energy

Li-7.



What is binding energy useful for?

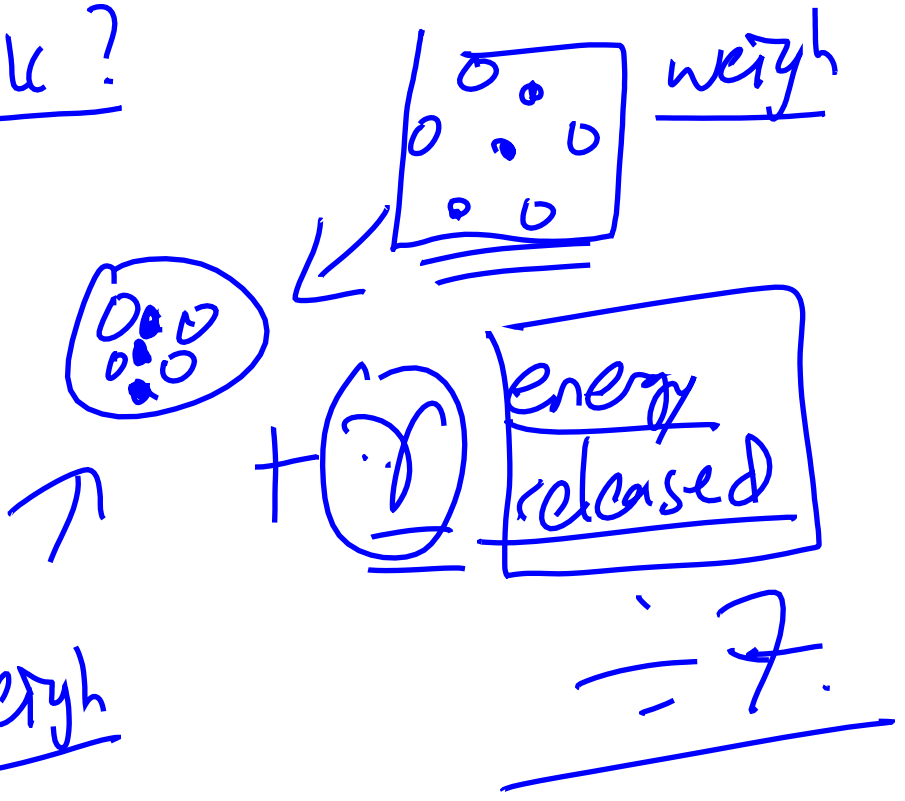
Binding energy / nucleon.

Conceptually speaking BE. is useful to describe how tightly a nucleus is bound.

How to calc?

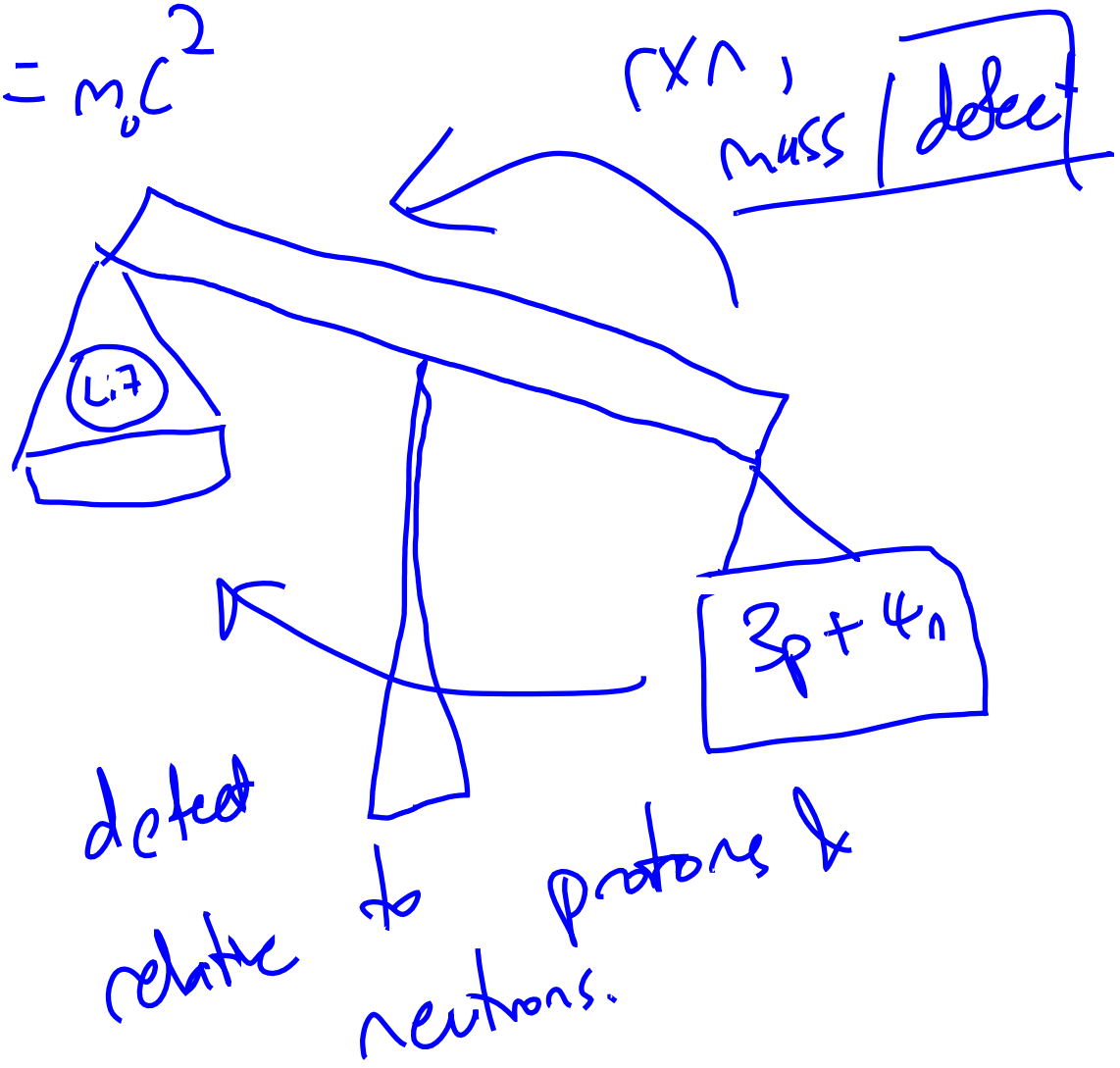
eg.

Li-7



How to measure Binding Energy? (BE)

$E = m_0 c^2$



potential confusion.

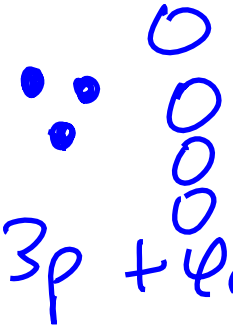
mass defect

vs mass excess.

mass defect.

Li-7

mass compare w/



3p + 4n

mass excess

mass comparison w/

$\frac{1}{12}$ mass of ^{12}C

a.m.u.

X no. of nucleons

practical way to calc mass excess.

for Li-7

mass Li-7 = 7.0

10b Calculating Binding energy practically.

→ wallet cards.

$1 mev = 1.602 \times 10^{-13} J$.

Li-7

Δ (mev)

= 14.907 MeV.

- Calc B.E of Li-7.

energy released when combining individual neutrons & protons into the nucleus.

- mass excess = mass of particle − no. of nucleons. x $\frac{1}{12}$ ^{12}C

Δ (MeV) of ^{7}Li = 14.907 MeV.

BE of ^{7}Li

$$= \text{mass of } Li\cdot 7 - \text{mass of } 3p - \text{mass of } 4n. - \Delta(mc^2)$$

$$= \left(\text{mass of } Li\cdot 7 - 7\times\frac{1}{12}\,^{12}C\right) - 3\left(\text{mass of } p\cdot - \frac{1}{12}\,^{12}C\right)\frac{1\ \text{Dalton}}{1\ \text{amu}} - 4\left(\text{mass of } n - \frac{1}{12}\,^{12}C\right)$$

$$= -7\times\frac{1}{12}\,^{12}C + 3\times\frac{1}{12}\,^{12}C + 4\times\frac{1}{12}\,^{12}C$$

substitute mass excess

$+ BE\ of\ {}^{7}Li$

$= \Delta(MeV)\ {}^{7}Li$

$- 3\,\Delta(m_a)\,p$

$- 4\,\Delta(m_a)\,n$

$= 14.907\ MeV$

$- 3 \times 7.289\ MeV$

$- 4 \times 8.071\ MeV.$

$= -39.244\ MeV.$

note: BE is +ve because

you must supply energy to break apart the nucleus.

^7_3Li: BE = 39.244 MeV

$$BE/nucleon = \frac{39.244}{7} = 5606 \text{ MeV}$$