2012 APR 23

Binding Energy

- THE ENERGY REQUIRED TO SEPARATE PARTICLES THAT ARE BOUND.

UNITS FOR MASS:

Kg

AMU (u)

MeV/c^2

$E = mc^2$ REST ENERGY

E

J

eV

MeV = MEGA eV

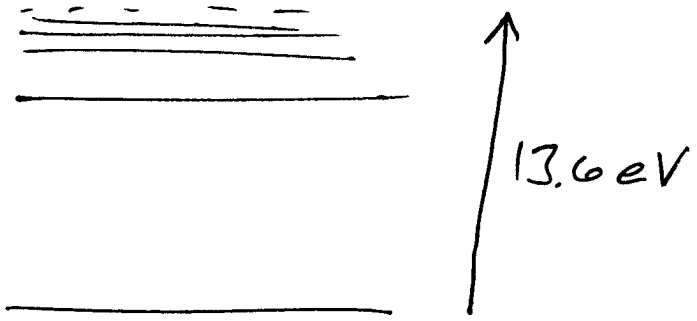
$$m = 2\ MeV/c^2 \times \frac{10^6\ eV}{1\ MeV} \times \frac{1.602\times10^{-19}\ J}{1\ eV}$$

$$= \frac{2(10^6)(1.602\times10^{-19}\ J)}{(3\times10^8\ m/s)^2}$$

$$= \frac{2(10^6)(1.602\times10^{-19})}{(3\times10^8)^2}\ kg$$

PROTON + ELECTRON vs. HYDROGEN ATOM

(1) REST ENERGY OF PROTON + ELECTRON IS 13.6 eV HIGHER THAN THE REST ENERGY OF A HYDROGEN ATOM.



(2) MASS OF PROTON + MASS OF ELECTRON IS $13.6 eV/c^2$ HIGHER THAN THE MASS OF A HYDROGEN ATOM.

n 1.008665 u

H 1.007825 u (INCLUDES THE ELECTRON)

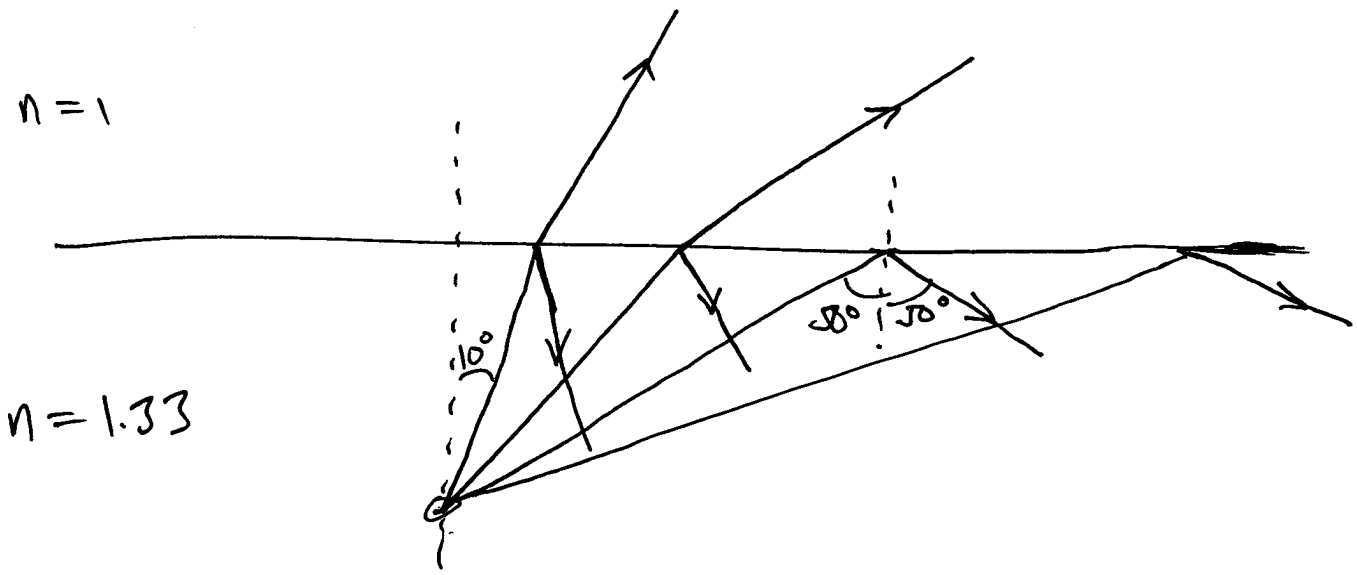
$$1.008665 \times 2 = 2.017330$$
$$1.007825 \times 2 = 2.015650$$
$$4.032980$$
$$-\ 4.002603$$
$$0.030377$$

DIFFERENCE IS 0.030377 u

$$0.030377\,u \times \frac{931.5\ MeV/c^2}{1\,u}$$

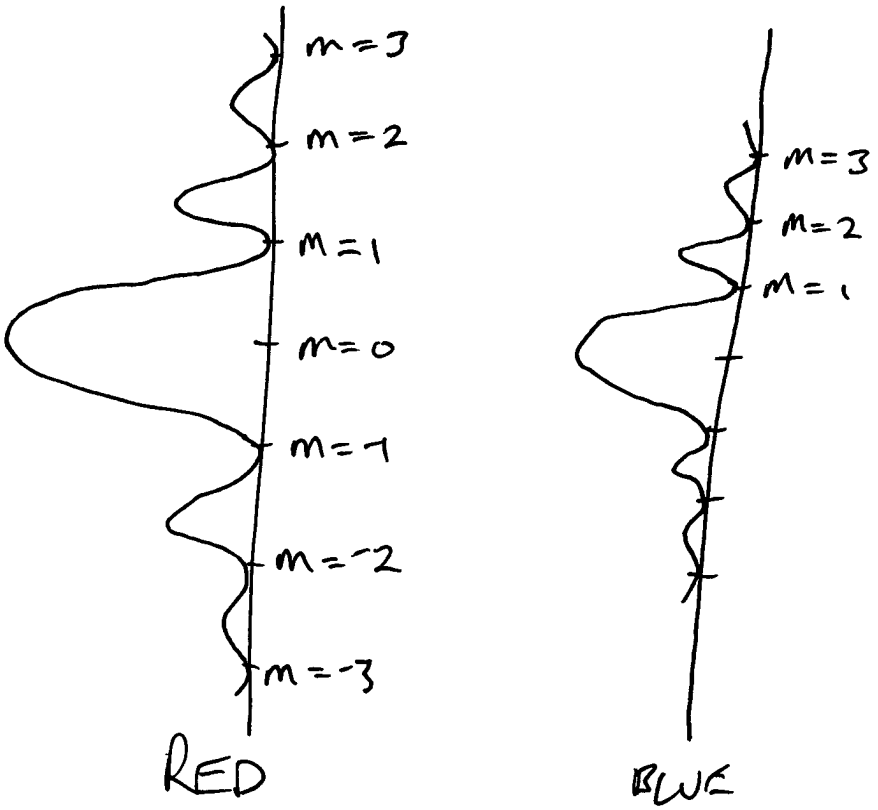
$$= 28.3\ MeV/c^2$$

1.



$$\theta_c = \sin^{-1}\left(\frac{1}{1.33}\right) = 48.75°$$

2.



P2

$$m + \frac{1}{2} = \frac{2t(1.25)}{550\,nm} + \frac{1}{2} + \frac{1}{2}$$

↑ m integer

$$t = \frac{(550\,nm)(m-\frac{1}{2})}{2.5} = (220\,nm)(m-\tfrac{1}{2})$$

110 nm
330 nm

P3

$$\frac{d\sin\theta}{\lambda} = 0, 1, 2, 3, \ldots$$

$$d = \frac{1\,cm}{300}$$

$$\theta = 0, 1.03^\circ, 2.06^\circ, \ldots$$