PH-105 Assignment Sheet - 1

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19. One of the atoms in the Hydrogen Atom has a wavelength 4861.320 Å. It was later discovered this line has a faint companion located at 4859.975 Å. The explaination for this line was the presence of a small amount of heavier isotope deuterium in hydrogen. Use this data to compute the deuterium kmass to the proton mass

    Solution :

    We know that wavelength is inversely proportional to reduced mass (mass of electron in Rydberg Formula). Hence

    $$\frac{\lambda_H}{\lambda_D} = \frac{\mu_D}{\mu_H}$$

    $$\frac{\lambda_H - \lambda_D}{\lambda_D} = \frac{\mu_D - \mu_H}{\mu_H}$$

    $$\frac{4861.320 - 4859.975}{4859.975} = \frac{1/M_D - 1/M_H}{1/M_e + 1/M_H}$$

    $$2.7675 * 10^{-4} = \frac{1 - \frac{M_D}{M_H}}{1 + \frac{M_H}{M_e}}$$

    $$2.7675 * 10^{-4} = \frac{1 - \frac{M_D}{M_H}}{1 + 1836.15}$$

    $$1 - 2.7675 * 10^{-4} * 1837.15 = \frac{M_D}{M_H}$$

    $$\frac{M_D}{M_H} = 0.4915$$