tail shows lines due to ionized CO^+, and ionized N^+_2 (second negative bands).

The excitation potential of the N^+_2 band has been definitely proved to be 21·10 and that of CO^+ bands (comet tail bands) is *ca* 17 e.volts. It is clear (for further details, reference may be made to the author's forthcoming paper in the *Proc. Nat. Inst. Sci.*) that if we regard that sun radiates like a black body at a temperature of 6000°K, there is not sufficient number of ultraviolet quanta of the proper frequency which can produce the observed ionization of the cometary gases N_2 and CO. In fact, it was shown that most probably the resonance line of He are responsible for the ionization of N_2 to N^+_2 (excited) in the upper atmosphere. The same can be said of the cometary phenomenon. The observed ionization of N_2 to N^+_2 in the comet tail and that of CO to CO^+ may be supposed to be due to the ultraviolet emission lines of He and other elements from the sun.

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60. CAN ELECTRONS ENTER THE NUCLEUS

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A number of experiments have been performed of late to find out whether high energy electrons can be made to enter the nucleus, but with no definite result. The maximum potential so far applied has been 800 K Volts (See *Phys. Rev*, 1935). The failure of these experiments is not difficult to understand, as the de-Broglie wavelength is nearly 100 times larger than the diameter of the nucleus.

But from these experiments, it is not safe to assume that the electron can never enter the nucleus. In fact, the uncertainty principle enables us to find out the energy which the electron must have in order that it may enter the nucleus: if we wish to accommodate a particle in a space of dimension 'l', the uncertainty in its momentum is given by

$$\Delta p \text{ nearly } = \frac{h}{l}.$$

Putting $l = a\,10^{-13}$ cm (dimension of the nucleus) we have Δp

$$\text{nearly } = \frac{h}{a\,10^{-13}}$$

$$\text{nearly } = \frac{6{\cdot}54}{a}\,10^{-14} \text{ gm} \times \text{cm}.$$

Now $\Delta p < < p < < mc$, where m is the relativity-mass of the electron. We have therefore

$$mc > > \frac{6{\cdot}54}{a}\,10^{-14} \text{ gm} \times \text{cm or } \frac{m}{m_0} > > \frac{2{\cdot}4}{a}\,10^3.$$

Taking a nearly $=2{\cdot}4$ (diameter of the N-nucleus), we find that electrons can enter the nucleus if

$$\frac{m}{m_0} \text{ nearly} = 10^4,$$

i.e, the energy is nearly 5×10^9 e volts. Now electrons of such high velocity are found in cosmic rays and it can be easily shown that in course of their passage through the atmosphere a good fraction of them must suffer nuclear collisions. The number of such collisions can be easily calculated. It is given by

$$\pi\; a^2\; (10^{-13})^2 \times 2{\cdot}8 \times 10^9 \times z = 1{\cdot}8 \times 10^{-6} z,$$

where z is the equivalent height of the atmosphere through which the electron has passed. Even at a height of 30 Km, the electron, at vertical coincidence, has passed through 65 meters of air, *i.e.*, suffered $1{\cdot}17 \times 10^{-2}$ nuclear collisions *i.e.*, one electron in a hundred suffers a nuclear collision—on the sea level, the number of nuclear collisions would be about 1·5, *i.e.*, even at a height where the pressure is $\frac{2}{3}$ the atmospheric pressure (5 kms), the primary electron must have passed through the nucleus. This incident cannot be without influence on the general cosmic ray phenomenon.

The effect of the entry on the nucleus would probably be to explode the nucleus, and give rise to secondaries.

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