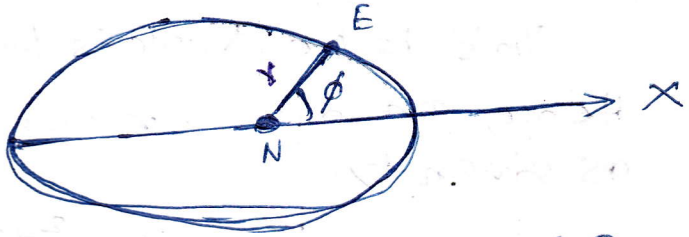
Sommerfeld's Atomic Model :

(i) electrons are revolving around the nucleus in some elliptic paths with different eccentricities



(ii) If the position of a revolving electron around the nucleus at an instant is (r, ϕ), where r = radius vector and ϕ is the angle between the radius vector and a fixed axes. Only certain elliptic orbits are allowed which satisfy the conditions

$$\oint p_\phi \, d\phi = kh \quad \text{and}$$

$$\oint p_r \, dr = n_r h$$

p_ϕ, p_r are the angular and radial momenta

k and n_r are two positive integers called azimuthal and radial quantum numbers.

(iii) $n = n_r + k$, where n is the principal quantum number (Bohr's)

Bohr's th. only one qu. restriction

Sommerfeld's th. two qu. restriction

A. Sommerfeld's first modification (classical mechanical treatment without any relativistic correction)

No force perpendicular to the radius vector is working, so, there is no acceleration (a_ϕ) normal to it.

In polar coordinate,

$\hat{r}$ = unit vector along radial direction

$\hat{\theta}$ = unit vector along transverse direction

$$f_\phi = r\ddot{\phi} + 2\dot{r}\dot{\phi}$$

$$= r\frac{d^2\phi}{dt^2} + 2\frac{dr}{dt}\cdot\frac{d\phi}{dt}$$

$$= \frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\phi}{dt}\right)$$