where V_i is the ionization potential of the gas and E is the electric field per cm. The probability that the electron will traverse a distance l without collision is $e^{-l/\lambda}$, where λ is the mean free path of the electron in the gas. Hence number of collisions per cm is $\frac{e^{-l/\lambda}}{\lambda}$ and if it is assumed that each collision results in ionization then the number of ions produced per cm per electron which has been defined as α is given by

$$\alpha = \frac{e^{-l/\lambda}}{\lambda} = \frac{e^{\frac{-V}{E\lambda}}}{\lambda}$$

As $\lambda = \frac{L}{P}$ where L is the mean free path of the electron in the gas at pressure of 1 mm of mercury and P is the pressure.