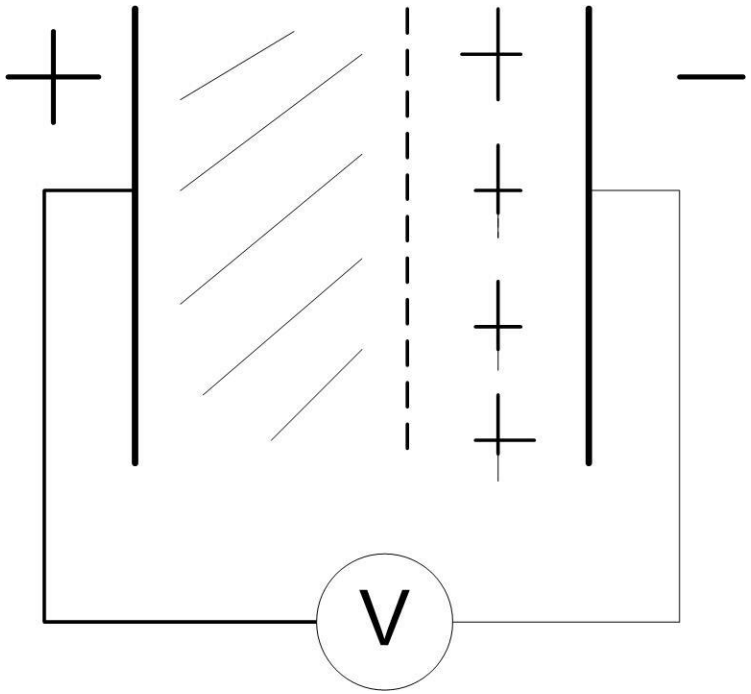
Лекция 1. Ограниченна плазма



$$v = \frac{eE}{m\nu}$$

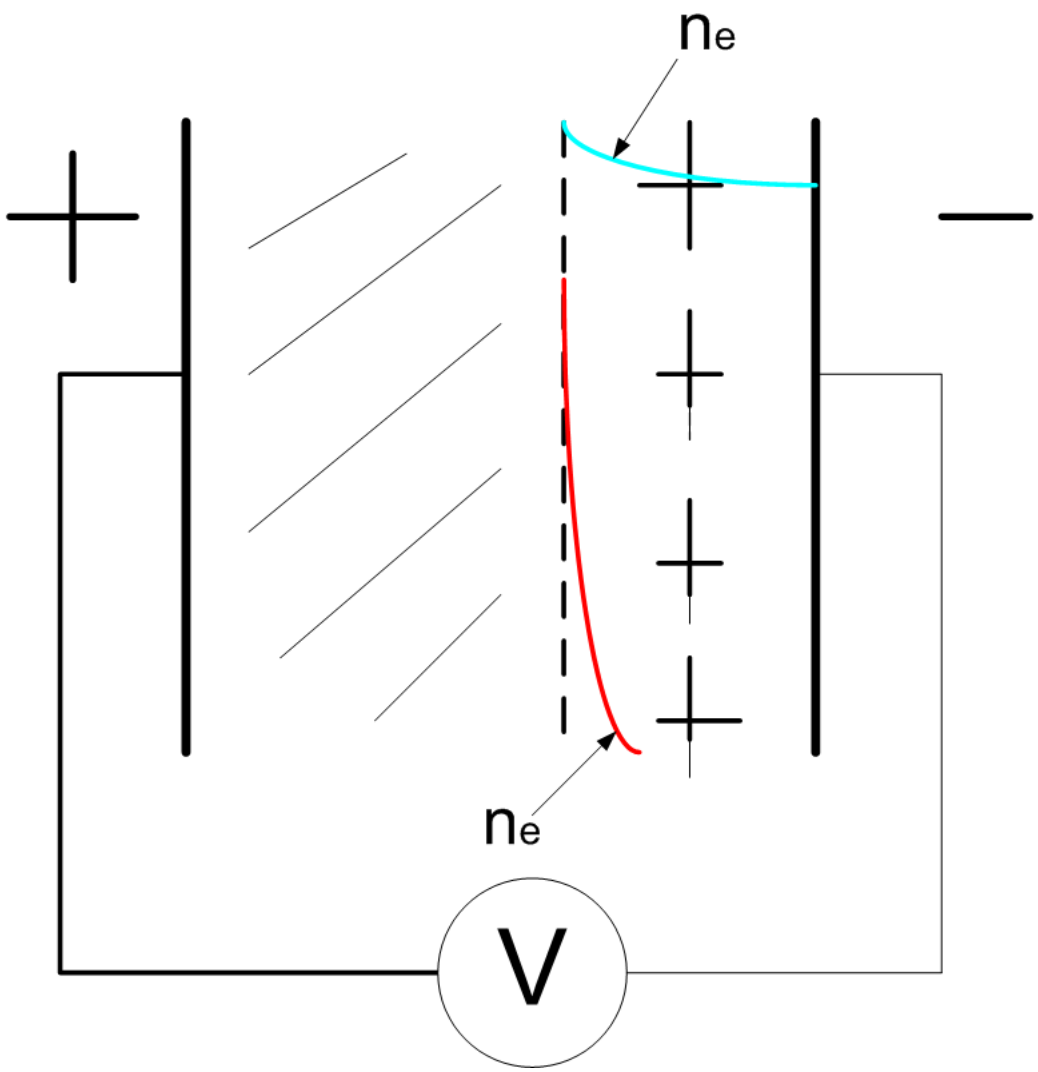
$$\varepsilon_0 \cdot \frac{dE}{dx} = en_i$$

$$E = \frac{en_i}{\varepsilon_0} \cdot x = \frac{-d\Phi}{dx}$$

$$\Phi - \Phi_0 = \frac{-en_i}{\varepsilon_0} \cdot \frac{x^2}{2} = -V$$

$$S = \sqrt{\frac{2\varepsilon_0 V}{en_i}} = \lambda_d \cdot \sqrt{\frac{2eV}{kT_e}}$$

$$\lambda_d = \sqrt{\frac{\varepsilon_0 kT_e}{e^2 n_i}}$$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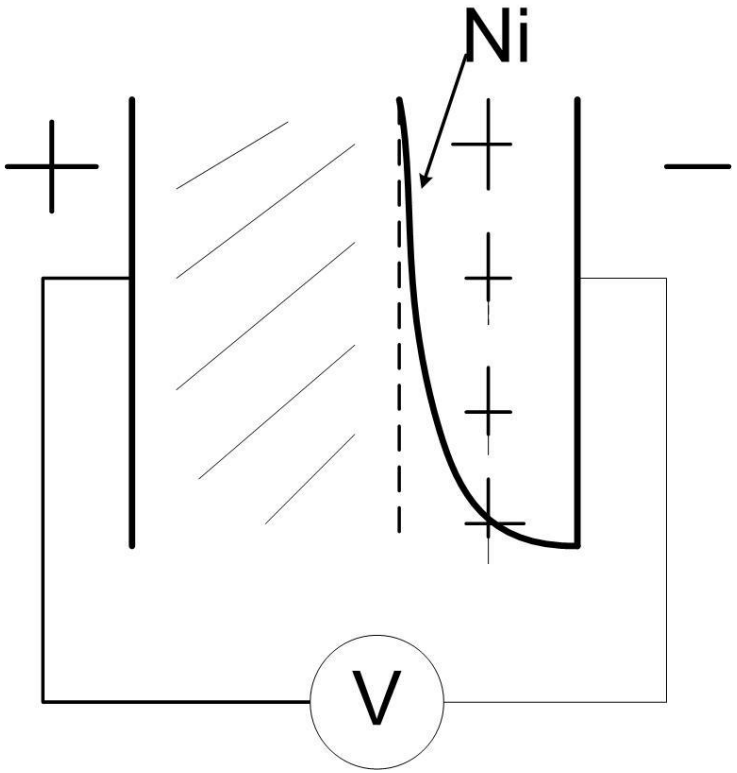
Движение ионов. Бесстолкновительный случай



$$M \cdot U \cdot \frac{dU}{dx} = eE = -e \cdot \frac{d\Phi}{dx}$$

$$M \cdot \frac{U^2}{2} + e\Phi = \text{const}$$

$$U = \sqrt{\frac{-2e\Phi}{M}}$$

$$J_i = e \cdot n_i \cdot U = \text{const}$$

$$n_i = \frac{J_i}{e} \cdot \frac{1}{U}$$

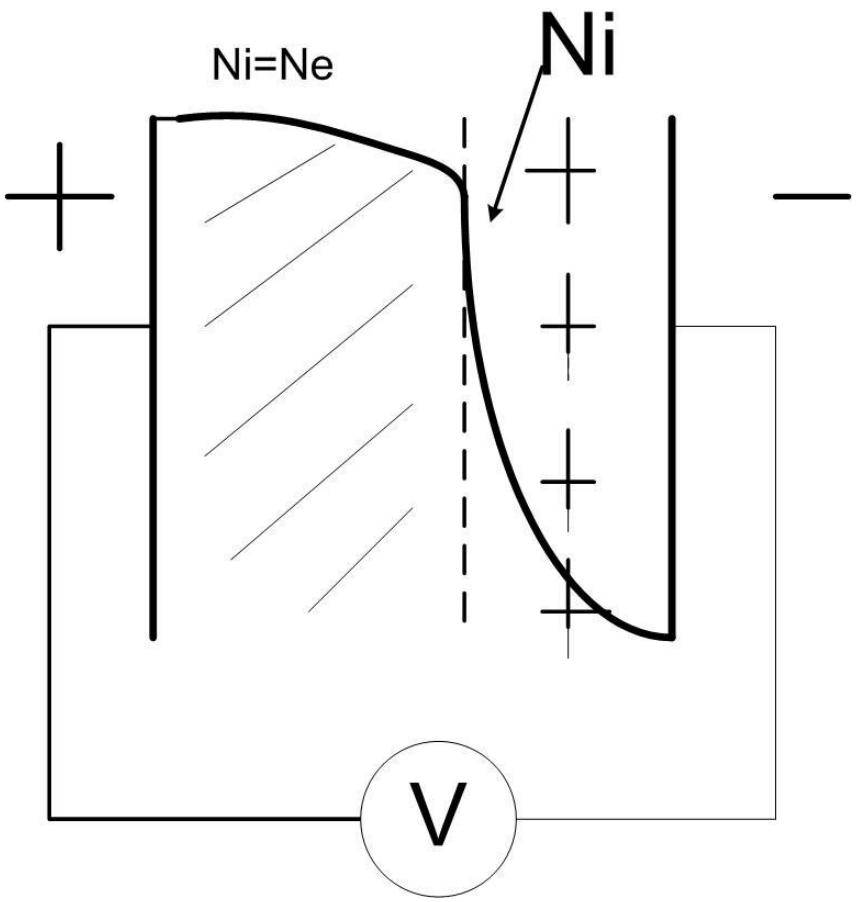
$$\varepsilon_0 \cdot \frac{dE}{dx} = -\varepsilon_0 \cdot \frac{d^2\Phi}{dx^2} = e \cdot \frac{J_i}{e} \cdot \frac{1}{\sqrt{\frac{-2e\Phi}{M}}}$$

$$\sqrt{\frac{-2e\Phi}{M}} \cdot \frac{d^2\Phi}{dx^2} = \frac{-J_i}{\varepsilon_0}$$

$$V^{\frac{3}{2}} = \frac{9}{4} \cdot \frac{J_i}{\varepsilon_0} \cdot \sqrt{\frac{M}{2e}} \cdot S^2$$

Закон Чайлда-Ленгмюра

Формула Бома



$$\nabla\, nU = 0$$

$$MU\,\nabla U = eE - M\nu_i U$$

$$n \cdot \frac{dU}{dx} + U \cdot \frac{dn}{dx} = 0$$

$$MU \cdot \frac{dU}{dx} = eE - M\nu_i U$$

$$E_{amb} = \frac{D_i - D_e}{\mu_i + \mu_e} \cdot \frac{1}{n} \cdot \frac{dn}{dx}$$

Сами

$$E_{amb} = \frac{-kT_e}{e} \cdot \frac{1}{n} \cdot \frac{dn}{dx}$$

$$MU \cdot \frac{dU}{dx} = -kT_e \cdot \frac{1}{n} \cdot \frac{dn}{dx} - M\nu_i U$$

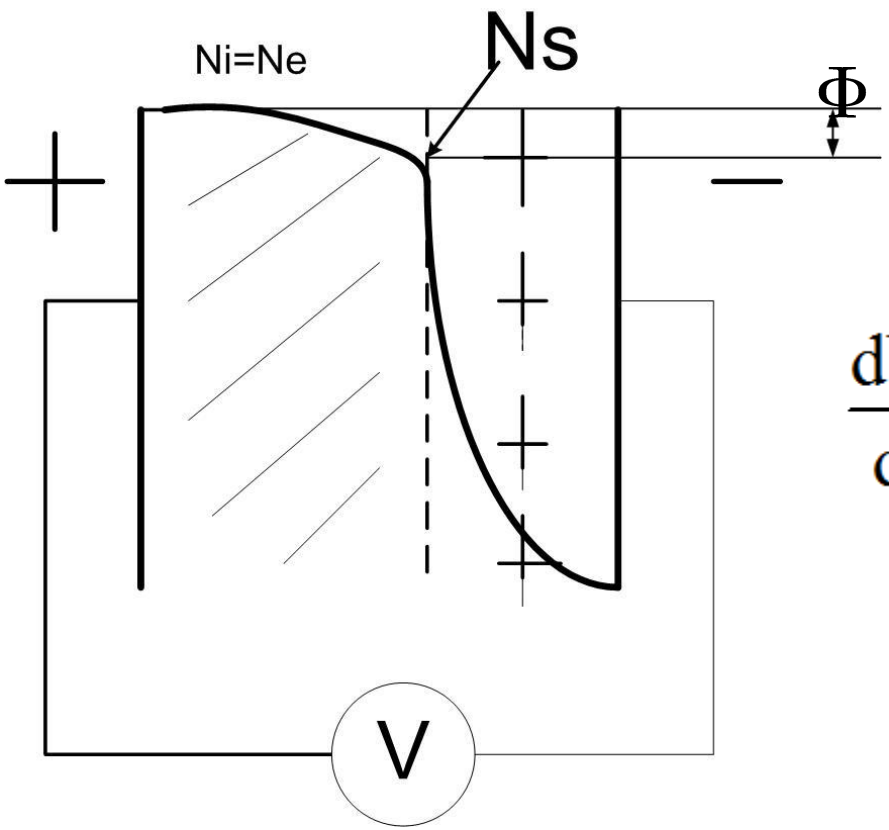
$$MU \cdot \frac{dU}{dx} = kT_e \cdot \frac{1}{U} \cdot \frac{dU}{dx} - M\nu_i U$$

$$\left(U^2 - \frac{kT_e}{M} \right) \cdot \frac{dU}{dx} = -\nu_i U^2$$

$$\frac{dU}{dx} = \frac{\nu_i U^2}{\frac{kT_e}{M} - U^2} = \frac{\nu_i U^2}{(U_b)^2 - U^2}$$

$$Ub = \sqrt{\frac{kTe}{M}}$$

Формула Бома



$$\frac{dU^2}{dx} + 2\nu_i U = 2\frac{eE}{M} = -2\frac{e}{M}\frac{d\Phi}{dx}$$

Бесстолкновительный случай

$$\frac{dU^2}{dx} = -2\frac{e}{M}\frac{d\Phi}{dx}$$

$$U^2 = -2\cdot\frac{e}{M}\Phi = \frac{kT_e}{M}$$

$$\Phi = -\left(\frac{kT_e}{2e}\right)$$

$$e\Phi = -\left(\frac{kT_e}{2}\right)$$

$$n_s = n_0 \exp\left(\frac{e\Phi}{kT_e}\right) = n_0 \exp\left(\frac{-1}{2}\right)$$

$$n_s = 0.61\, n_0$$

Поверхностный потенциал
(отсутствие внешнего поля)

$$G_i = n_s U_b$$

$$G_e = \frac{n_s V_t}{4} \cdot \exp\left(\frac{e\Phi}{kT_e}\right)$$

$$U_b = \frac{1}{4} \cdot \sqrt{\frac{8\,kT_e}{\pi\, m}} \exp\left(\frac{e\Phi}{kT_e}\right) = \sqrt{\frac{kT_e}{M}}$$

$$e\Phi = \frac{-kT_e}{2} \ln\left(\frac{M}{2\pi m}\right)$$

$$\ln\left(\frac{M_{Ar}}{2\pi m}\right) = 9.2$$

$$e\Phi_{Ar} = -4.6 \cdot kT_e$$