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Показатель преломления среды:

$$\bullet n = \sqrt{1 - \frac{f m_e^2}{f_0^2}} = \sqrt{1 - \frac{f m_e^2}{c^2} \lambda^2}$$

Групповая скорость (по формуле Девея):

$$\bullet v_{gr} = \frac{d\omega}{dk} = \frac{c}{n + \omega \frac{dn}{d\omega}} = cn \quad \boxed{K = \frac{n\omega}{c}}$$

$$\begin{aligned} \bullet J(\lambda) &= l \cdot \frac{d^2 K}{d\omega^2} \Delta\omega = l \cdot (v_{gr}^{-2})_{\omega} \cdot \Delta\omega = \\ &= l \cdot \left(\frac{1}{cn} \right)'_{\omega} \cdot \Delta\omega = l \cdot \left(\frac{1}{\frac{n^2 \omega}{kc}} \right)'_{\omega} \Delta\omega = \\ &= \frac{l}{cn \left(\frac{\omega}{c} - \frac{\Delta\omega}{c} \right)} - \frac{l}{cn \left(\frac{\omega}{c} + \frac{\Delta\omega}{c} \right)} = \\ &= \frac{l}{cn(\lambda - \Delta\lambda)} - \frac{l}{cn(\lambda + \Delta\lambda)} = \\ &= \frac{l}{c} \left(\frac{1}{\sqrt{1 - \frac{f m_e^2}{c^2} (\lambda + \Delta\lambda)^2}} - \frac{1}{\sqrt{1 - \frac{f m_e^2}{c^2} (\lambda - \Delta\lambda)^2}} \right) = \\ &= \frac{l}{c} \left(\frac{1}{\sqrt{1 - \frac{f m_e^2}{c^2} \lambda^2 - \frac{f m_e^2}{c^2} \lambda \Delta\lambda}} - \frac{1}{\sqrt{1 - \frac{f m_e^2}{c^2} \lambda^2 + \frac{f m_e^2}{c^2} \lambda \Delta\lambda}} \right) = \frac{l f m_e^2 \lambda \Delta\lambda}{c^3 n^3} \end{aligned}$$

$$\bullet J(\lambda) = \frac{l f m_e^2 \lambda^3}{c^4 n^3 J(0)}, \text{ where } T = 25(0), \text{ m:}$$

$$\boxed{V_{max} = \frac{c^4 n^3 J}{l f m_e^2 \lambda^3}}$$

а) Given $l = 600 \text{ nm}$, $\lambda = 3 \text{ e}$, $T(0) = 3 \text{ eV}$, $f_{\text{inc}} = 30 \text{ MHz}$
mo:

$$n = \sqrt{1 - \frac{9 \cdot 10^{14} \cdot 9}{9 \cdot 10^{16}}} = 0,954$$

$$V_{\text{max}} = \frac{9 \cdot 9 \cdot 16 \cdot 0,87 \cdot 3 \cdot 10^{-6}}{2 \cdot 600 \cdot 10^6 \cdot 10^3 \cdot 9 \cdot 10^{14} \cdot 9 \cdot 3} = 0,72 \cdot 10^6 \frac{\text{eV}}{c}$$

б) Given $l = 1000 \text{ nm}$, $f_0 = 3 \text{ MHz}$, $T(0) = 50 \text{ MeV}$, $f_{\text{inc}} = 26 \text{ MHz}$
mo:

$$n = \sqrt{1 - \frac{2,6^2 \cdot 10^{12}}{9 \cdot 10^{12}}} = 0,5$$

$$V_{\text{max}} = \frac{9 \cdot 9 \cdot 10^{32} \cdot 0,125 \cdot 50 \cdot 10^{-6} \cdot 9 \cdot 5 \cdot 10^{13}}{2 \cdot 10^6 \cdot 6,76 \cdot 10^{12} \cdot 9 \cdot 3 \cdot 10^{24} \cdot 10^6} = 3,7 \cdot 10^3 \frac{\text{eV}}{c}$$

Answer: а) $V_{\text{max}} = 0,72 \cdot 10^6 \frac{\text{eV}}{c}$
б) $V_{\text{max}} = 3,7 \cdot 10^3 \frac{\text{eV}}{c}$