Энергия упругой волны

$$\xi = a\cos(\omega t - kx + \varphi) \tag{1}$$

$$\Delta V: \quad \frac{\partial \xi}{\partial t} = const; \quad \frac{\partial \xi}{\partial x} = const \tag{2}$$

$$\Delta W_{\text{к}} = \frac{mv^2}{2} = \frac{\rho \Delta V}{2}(\frac{\partial \xi}{\partial t})^2 \tag{3}$$

$$\Delta W_{\text{п}} = \frac{k\Delta l^2}{2} = \{\varepsilon = \frac{\Delta l}{L},\ k = \frac{ES}{L}\} = \frac{ES}{L}\frac{(\varepsilon L)^2}{2} = \frac{ESL}{2}(\frac{\partial \xi}{\partial x})^2 \tag{4}$$

$$\Delta W_{\text{п}} = \frac{E}{2}(\frac{\partial \xi}{\partial x})^2 \Delta V \tag{5}$$

$$\Delta W_{\text{п}} = \frac{\rho v^2}{2}(\frac{\partial \xi}{\partial x})^2 \Delta V \tag{6}$$

$$\Delta W = \Delta W_{\text{к}} + \Delta W_{\text{п}} = \frac{1}{2}\rho[(\frac{\partial \xi}{\partial t})^2 + v^2(\frac{\partial \xi}{\partial x})^2]\Delta V \tag{7}$$

$$w = \frac{\Delta W}{\Delta V} \tag{8}$$

$$w = \frac{1}{2}\rho[(\frac{\partial \xi}{\partial t})^2 + v^2(\frac{\partial \xi}{\partial x})^2] \tag{9}$$

$$\frac{\partial \xi}{\partial t} = ka \sin(\omega t - kx + \varphi) \tag{10}$$

$$\frac{\partial \xi}{\partial x} = -a\omega \sin(\omega t - kx + \varphi) \tag{11}$$

$$w = \rho a^2 \omega^2 \sin^2(\omega t - kx + \varphi) \tag{12}$$

$$< \sin^2 t >= \frac{1}{2} \tag{13}$$

$$< w >= \frac{1}{2}\rho a^2 \omega \tag{14}$$

$$\Phi = \frac{dW}{dt} \tag{15}$$

$$\frac{\Delta \Phi}{\Delta S_\perp} = \frac{\Delta W}{\Delta S_\perp \Delta t} = j \tag{16}$$

$$\Delta W = w \Delta V = w \Delta S_\perp v \Delta t \tag{17}$$

$$j = \frac{\Delta W}{\Delta S_\perp \Delta t} = wv \tag{18}$$

$$\vec{j} = w\vec{v} \tag{19}$$

$$< \vec{j} >=< w > v = \frac{1}{2}\rho a^2 \omega^2 \vec{v} \tag{20}$$

$$\Phi = \int_S \vec{j} d\vec{S} \tag{21}$$

$$< \Phi >= \int_S \vec{j} d\vec{S} \tag{22}$$

$$< \Phi >= \int_S < j > dS_n =< j > S =< j > 4\pi r^2 = 2\pi\rho\omega^2 v a_r^2 r^2 \tag{23}$$

$$Phi = const, \;\; a_r^2 r^2 = const, \;\; a_r \sim \frac{1}{r} \tag{24}$$

$$Phi \neq const, \;\; < j >= j_0 e^{-kx}, \;\; k = 2\gamma \tag{25}$$