Klasikoki 2-4 atala (b)

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$$H(q,p) = \frac{1}{2} k q^2 + \frac{1}{2m} p^2$$

$$q = A \cos(\omega t + \phi)$$

$$p = -m\omega A \sin(\omega t + \phi)$$

$(m\dot{q})$

$\omega = \sqrt{\frac{k}{m}}$ ekuazio parametrikoak

$$E = \frac{1}{2} m \omega^2 A^2$$

fase-espazioa

$$\frac{q^2}{(2E/m\omega^2)} + \frac{p^2}{(2mE)} = 1$$

fase-espazioan $+$ desagertzen

$$\left[\frac{x^2}{\left[\left(\frac{2}{m\omega^2}\right)^{1/2} E^{1/2}\right]^2} + \frac{y^2}{\left[(2mE)^{1/2}\right]^2} = 1 \right]$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

ardatzak $(E)^{1/2}$ rekiko proportzionalak

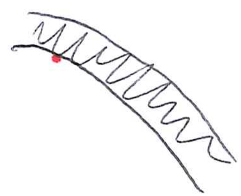
azalera $\frac{2\pi E}{\omega}$

$\pi a b$

$$\pi \left(\frac{2}{m\omega^2}\right)^{1/2} E^{1/2} \cdot (2m)^{1/2} E^{1/2} = \frac{2\pi E}{\omega}$$

geruzak hartuta $\left(E - \frac{1}{2}\Delta, E + \frac{1}{2}\Delta\right)$

$$\frac{2\pi}{\omega}\left(E + \frac{1}{2}\Delta\right) - \frac{2\pi}{\omega}\left(E - \frac{1}{2}\Delta\right) = \frac{2\pi\Delta}{\omega}$$



zenbat mikroegoera dagoen tarteko.

Kuantiko