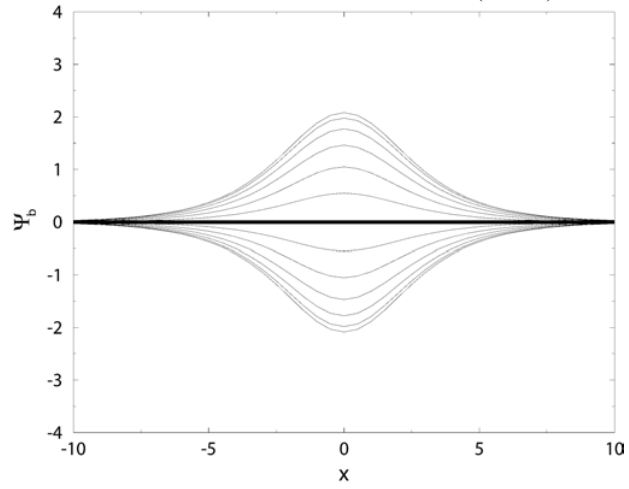


1.

sine- (), φ^4 (. 1).



.1

[1].

d-

l
 X_l P_l
 $t.$ H

$$dX_l / dt = \partial H / \partial P_l \quad dP_l / dt = -\partial H / \partial X_l.$$

$$H = 0 \quad X_l = P_l = 0.$$

$$H = 0,$$

$$(\quad) \quad \Omega_q$$

$$q. \quad \Omega_q$$

$$|\Omega_q| \leq \Omega_{\max}.$$

$$(\quad) \quad \Omega_q$$

$$|\Omega_q| \geq \Omega_{\min}.$$

$$\Omega_q^i$$

$$X_l(t) = X_l(t + T_b) + \lambda m_l, \quad P_l(t) = P_l(t + T_b), \quad (1)$$

$$X_{l \rightarrow \infty} \rightarrow 0, \quad P_{l \rightarrow \infty} \rightarrow 0,$$

$$T_b - \quad , \quad m_l - \quad \lambda \quad (\quad X_l \quad \lambda).$$

$$\lambda = 0. \quad \lambda \neq 0 \quad m_l \neq 0$$

$$[1,2,3].$$

$$X_l(t) = \sum_k A_{kl} e^{ik\omega_b t} + \lambda m_l \frac{t}{T_b} \quad (\omega_b = 2\pi / T_b).$$

$$A_{k,l \rightarrow \infty} \rightarrow 0$$

$$m_{|l|>l_0} = 0.$$

$$A_{kl} (k\omega_b = \Omega_q, k\omega_b \neq \Omega_q) \quad (2)$$

[4].

$$(k = 0)$$

$$\Omega_{q=0} = 0. \quad (2)$$

$$[1,5].$$

[1].

(2),

$$k_1\omega_1 + k_2\omega_2 \neq \Omega_q \quad \omega_1, \omega_2$$

$$(k_1, k_2).$$

[4].

[6] [7].

PtCl [8],
 [9],
 [10],

[11].

2.

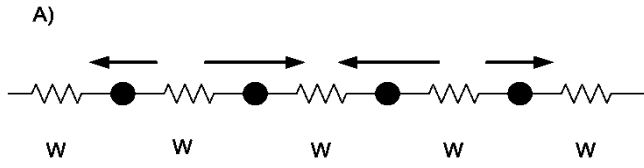
$$H = \frac{1}{2} P_l^2 + V(X_l) + \frac{1}{l} W_{l-l'}(X_l - X_{l'}) \quad (3)$$

$$V(z), W_l(z) \quad V(0) = W_l(0) = 0.$$

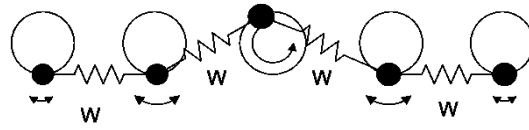
$$\partial^2 V / \partial^2 z \quad z = 0,$$

$\Omega_q,$

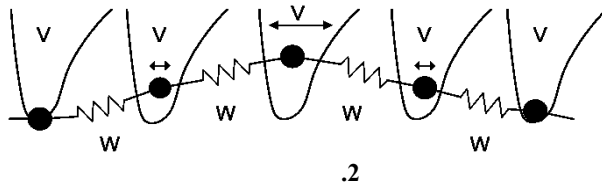
.2



B)



C)



.2

(3) : a) $V(z) \equiv 0$, $W(z) = \frac{1}{2}z^2 + \frac{1}{4}z^4$,
 b) $V(z) \equiv 0$, $W(z) = 1 - \cos(z)$,

c) $V(z) = \frac{1}{2}z^2 + \frac{1}{4}z^4, V(z) = \frac{1}{2}z^2.$

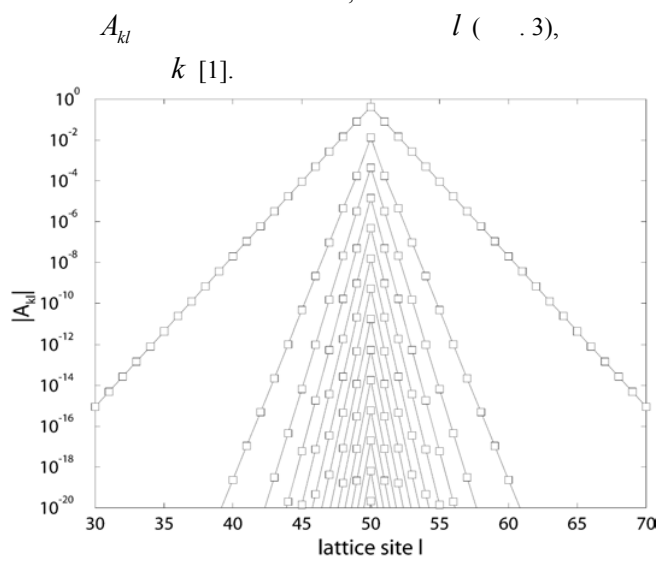
$W_{l>l_c} = 0$

(l, Ω_q^2)

$q.$

$A_{kl}.$

$A_{kl} \propto \int \frac{\cos(ql)}{(k\omega_b)^2 - \Omega_q^2} d^d q,$ (4)



.3

A_{kl}

k

$l.$

$(. [1]).$

$A_{kl} (4)$

$k\omega_b$

$\Omega_q.$

$A_{kl},$

$$k' \neq k$$

[12].

2.1

$$W_l(z) \propto 1/l^s \quad \partial^2 V / \partial^2 z |_{z=0} \neq 0. \quad \Omega_q^2$$

$q,$ (4)

$$A_{kl} \propto 1/l^s.$$

$$s \rightarrow \infty$$

().

$$k\omega_b$$

$$\Omega_q,$$

$$q_c.$$

(4)

$$q_c,$$

$$\Omega_q^2 \quad q_c,$$

$$s > 3$$

$$(q - q_c)^2.$$

$$\Omega_q^2 \quad q$$

$$(q - q_c)$$

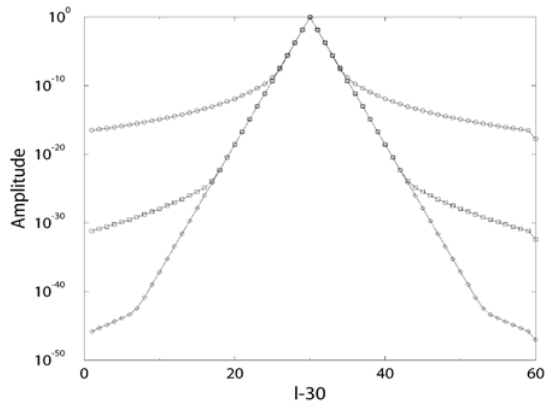
$$A_{kl}$$

$$A_{kl} \quad l-$$

$$\Omega_q,$$

$$l_c,$$

[13].



. 4 $s = 10, 20, 30$. [13].

$$\frac{\ln l_c}{l_c} \approx \frac{\nu}{s}, \quad (5)$$

$\nu -$

$$l_c \rightarrow \infty \quad s \rightarrow \infty,$$

$$\nu \rightarrow 0 \quad (\dots k\omega_b \rightarrow \Omega_{q_c})$$

$$l_c \rightarrow \infty.$$

$$\Omega_q,$$

[13].

2.2

$$\Omega_q$$

$$\Omega_{q=0} = 0,$$

$$H = 0$$

$$k = 0$$

$$(k \neq 0)$$

$$X_l \rightarrow -X_l,$$

$$A_{kl} \equiv 0 \quad k, \quad k=0.$$

$$k=0.$$

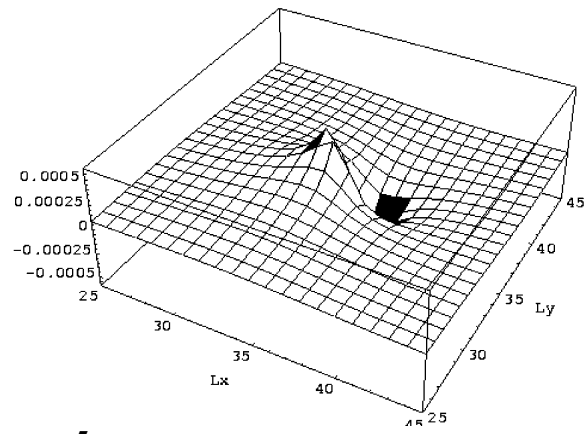
$$\Omega_q^2 \quad q.$$

$$k=0$$

() .

$$A_{0l} \propto 1/|l|^{d-1}$$

$$d=2 \text{ [14] (. 5).}$$



.5

[14].

3.

E_b

ω_b

Ω_q

$$E_b \propto \int_1^\infty r^{d-1} F_d^2(\delta r) dr, \quad (6)$$

$$A_{lr}^2 \propto F_d^2(\delta r).$$

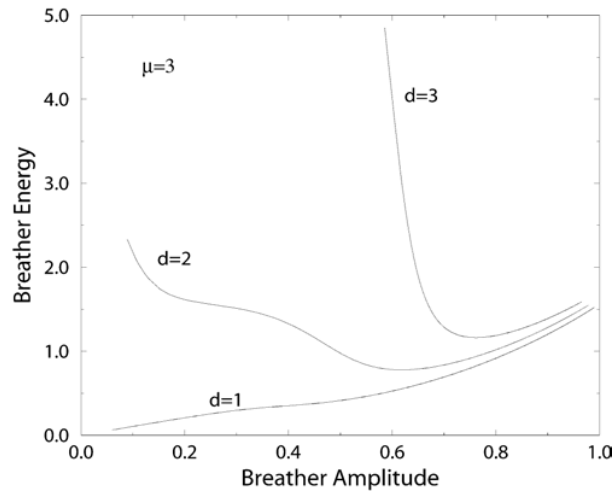
$$\delta \propto |\omega_b - \Omega_{q_c}|, \quad (q - q_c), \quad \Omega_q^2,$$

$$F_d(\delta r) \propto A \omega_b,$$

$$|\omega_b - \Omega_{q_c}| \propto A^2.$$

$$E_b \propto |\omega_b - \Omega_{q_c}|^{1-d/2}. \quad (7)$$

$d \geq 2.$



$d = 1, 2, 3$ [15].

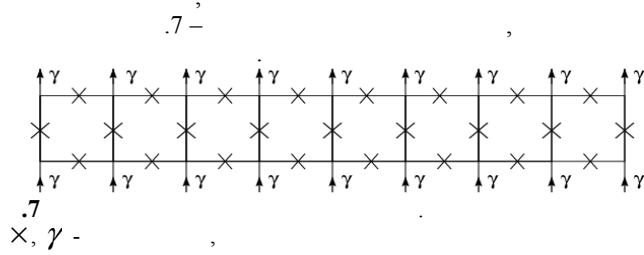
(. 6).

[15].

$$\Omega_q^2$$

() [13].

4.



$$I_l, \quad \varphi_l(t)$$

$$\varphi_l + \alpha \varphi_l + \sin \varphi_l = I_l. \quad (8)$$

$$t_0 = \sqrt{C \Phi_0 / (2\pi l_c)}, \quad \Phi_0 -$$

, C

$I_c -$

$$\alpha = \sqrt{\Phi_0 / (2\pi l_c C R_N^2)} -$$

$$\varphi_l^v, \quad \varphi_l^h, \quad \tilde{\varphi}_l^h$$

l-

[16]

$$\varphi_l^v + \alpha \varphi_l^v + \sin \varphi_l^v = \gamma + (\varphi_l^v - \nabla \tilde{\varphi}_{l-1}^h + \nabla \varphi_{l-1}^h) / \beta_L$$

$$\varphi_l^h + \alpha \varphi_l^h + \sin \varphi_l^h = -(\varphi_l^h - \tilde{\varphi}_l^h + \nabla \varphi_l^v) / (\eta \beta_L), \quad (9)$$

$$\tilde{\varphi}_l + \alpha \tilde{\varphi}_l^h + \sin \tilde{\varphi}_l^h = (\varphi_l^h - \tilde{\varphi}_l^h + \nabla \varphi_l^v) / (\eta \beta_L)$$

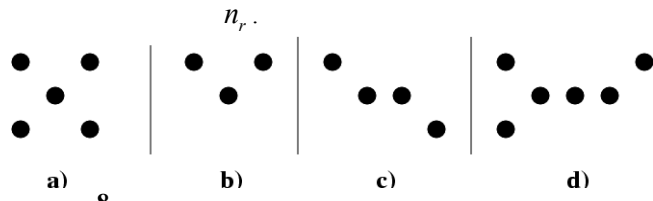
$$\beta_L = \frac{\gamma - I_{cV}}{2\pi L I_{cV} / \Phi_0}, \quad L - \eta = I_{cH} / I_{cV} - \dots$$

$$\nabla \varphi_l = \varphi_{l+1} - \varphi_l, \quad \varphi_l = \varphi_{l+1} - 2\varphi_l + \varphi_{l-1}.$$

$$m_l \neq 0,$$

$$(m_l = 0).$$

[17,18,19].



a) . 8

b)

c)

d)

d)

a)

b)

c)

$$n_r \geq 1.$$

$$V = \frac{1}{T_b} \int_0^{T_b} \varphi_l^y dt.$$

$$a) \quad d) \quad V = 2\omega_b$$

$$b) \quad c) \quad V = \omega_b.$$

[20].

$$\omega_b^a = \frac{n_r \gamma}{2\alpha(n_r + \eta)}, \quad \omega_b^{c,b} = \frac{n_r \gamma}{\alpha(n_r + 2\eta)}, \quad (10)$$

$$\omega_b^d = \frac{n_r \gamma}{\alpha(2n_r + 3\eta)}.$$

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