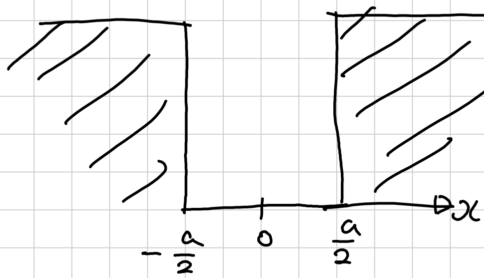
第一問.

$\hbar = \frac{h}{2\pi}$



[1].

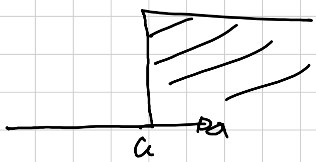
∴ $-\frac{\hbar^2}{2m}\psi''(x) = E\psi(x)$ ∴ $\psi(x) = A\cos(\lambda x) + B\sin(\lambda x)$, $\lambda = \frac{\sqrt{2mE}}{\hbar}$

$x=-a \wedge x=a$ で $\psi=0$ の時

$A\cos(\lambda a) - B\sin(\lambda a)=0 \wedge A\cos(\lambda a)+B\sin(a\lambda)=0$

A or B=0 であり.

※ p43. Potentialの問題」



$x>a$ での Schrödinger eq は.

$-\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} + V\phi_1 = E\phi_1$

∴ $\psi_1 = Ae^{-\lambda(x-a)} + \cancel{Be^{\lambda(x-a)}}$ $\lambda = \sqrt{\frac{2m}{\hbar^2}(E-V)}$

$x\to\infty$ で non zero

$\psi_1 = Ae^{-\lambda(x-a)}$

$\psi = A\cos(\lambda x)$ or $B\sin(\lambda x)$ である

$\lambda a = \frac{\pi}{2}\cdot n_o$ or $\lambda a = \frac{\pi}{2} n_e$

「奇数」 「偶数」

$\phi = A\cos(\frac{\pi n_o}{2a}x)$, $B\sin(\frac{\pi n_e}{2a}x)$

ここで $\int_{-a}^{a}\sin^2(\frac{n_o\pi}{2a}x)dx = a$ ← $\boxed{\text{規格化}}$ $A=B=\sqrt{a}$ である

∴ $\psi = \sqrt{a}\cos(\frac{\pi n_o}{2a}x)$, $\sqrt{a}\sin(\frac{\pi n_e}{2a}x)$

∴ $\lambda = \frac{\pi}{2}\cdot n_o$ ∴ $2mE = \hbar^2\cdot\frac{\pi^2 n^2}{4a^2}$ ∴ $E = \frac{\hbar^2\pi^2 n^2}{8ma^2}$

$\Psi(x_1, x_2) = \frac{1}{2}(\varphi_1(x_1)\varphi_2(x_2) + \varphi_1(x_2)\varphi_2(x_1))$: 対称形

$g(x)$, $e(x)$

[2]

$\longrightarrow (g(x_1)e(x_2) + g(x_2)e(x_1))\frac{1}{2}$

$g(x_1).g(x_2)$, $e(x_1)g(x_2)$

$\longrightarrow \frac{1}{2}(g(x_1)e(x_2) - g(x_2)e(x_1))$ // が成立する

ゆえに $T=0$ における Fermi

粒子のスピン演算子: $\hat{S}_1 = (\hat{S}_{1x}, \hat{S}_{1y}, \hat{S}_{1z})$, $\hat{S}_2 = (\hat{S}_{2x}, \hat{S}_{2y}, \hat{S}_{2z})$

$\hat{S}_{1z}|\psi\rangle = ⓪|\phi\rangle$

V_0

[3]

スピンの復習

$[J_x, J_y] = iJ_z$

$\hat{J}^{(+)}|j,m\rangle = \sqrt{(j-m)(j+m+1)}\,|j,m+1\rangle$
$\hat{J}^{(-)}|j,m\rangle = \sqrt{(j+m)(j-m+1)}\,|j,m-1\rangle$ が成立する

$J^2|j,m\rangle = j(j+1)|j,m\rangle$. $J_z|j,m\rangle = m|j,m\rangle$

$m \geq 0$ の時. $J_z|\phi\rangle = m|\phi\rangle$, $J^2|\phi\rangle = j(j+1)|\phi\rangle$

$m < 0$ の時 $J_z|\phi\rangle = m|\phi\rangle$, $J^2|\phi\rangle = j(j+1)|\phi\rangle$

$s = \frac{1}{2}$ より. $m = (\frac{1}{2}, -\frac{1}{2})$ のみ.

$J_z|\phi\rangle = \frac{1}{2}|\phi\rangle$, $J^2|\phi\rangle = \frac{1}{2}\cdot\frac{3}{2}|\phi\rangle$

$J_z|\phi\rangle =$

- 角運動量の合成

$J = J_1 + J_2$ とすると. J_1, J_2は交換可能であるため

固有ベクトルと固有値はいくつか??

$J^2 = J_1^2 + J_2^2 + 2J_1 \cdot J_2$ であるため

$$J_z |j,m\rangle\rangle = \sum_{m_1=-j_1}^{j_1} \sum_{m_2=-j_2}^{j_2} |m_1,m_2\rangle\langle m_1,m_2|j,m\rangle\rangle$$

$j_1 = 1/2,\ m_1 = 1/2, -1/2;\quad j = 1/2;\ m_2 = \pm 1/2.$

$m_2 \backslash m_1$	$1/2$	$-1/2$	
$1/2$	1	0	$\to m=0$
$-1/2$	0	-1	$\to m \to j=1$

$j=1,\ m=0$ の固有

$|1,0\rangle\rangle$

$j=1,\ m=-1\quad |1,-1\rangle\rangle$

$|1,1\rangle\rangle = |+,+\rangle$

$J_z = m$

4つの状態がある

d : fix　$N \to$ increse (X)

N : fix　d : increse (ok)

$$\frac{xN}{(aN)^2} = \frac{x}{aN}$$

問2数

[1]

$n^+ \cdot (+a) + n^- (-a) = x$　　$W = ($

$$\frac{Nx}{2((aN)^2 - x^2)}$$

$$\frac{\frac{x}{aN}}{2\left(1-\left(\frac{x}{aN}\right)^2\right)}$$

$\downarrow$

0

[158]

$$\frac{\partial F_1}{\partial x} = \frac{\partial F_1}{\partial n} \cdot \frac{\partial n}{\partial x} \quad \left(-\frac{N}{2} \frac{1}{\frac{N-n}{2}} \cdot \left(-\frac{1}{2}\right) + \frac{1}{2}\log\frac{N-n}{2} \right.$$

$$\left. - \frac{N}{2} \cdot \frac{1}{\frac{N+n}{2}} \cdot \frac{1}{2} - \frac{1}{2}\log\frac{N+n}{2} \right)$$

$$= \frac{N}{\cancel{4}\,2} \cdot \frac{\cancel{2}}{N-n} + \frac{1}{2}\log\frac{N-n}{2} - \frac{1}{2}\log\frac{N+n}{2} - \frac{N}{\cancel{4}\,2} \cdot \frac{\cancel{2}}{N+n}$$

$$= \left[\frac{N}{2(N-n)} + \frac{1}{2}\log\frac{N-n}{N+n} - \frac{N}{2(N+n)} \right] \cdot \frac{1}{a}$$

$$\frac{nN}{2(N^2 - n^2)}$$

$\cancel{N^2} + nN - \cancel{N^2} + nN$

$(N-n^+)\ \exp(-\beta K) + n^+ \exp(\beta K)$

$\exp(\beta K) - \exp(-\beta K) = 2\sinh(\beta K)$

$$\boxed{= N \exp(-\beta K) + n^+ (2\sinh(\beta K))}$$

$n^- = N - n^+ \rightarrow a(2n^+ - N) = x$

$n^- (N - n^+) \exp(-) + n^+ \exp(+)$

$2n^+ - N = \frac{x}{a}$

$n^+ = \left(\frac{x}{a} + N\right) \cdot \frac{1}{2}$

$N \exp(-) - \frac{1}{2}\left(\frac{x}{a} + N\right)(\exp(+) - \exp(-))$

$$\langle E \rangle = \frac{\sum E_n \exp(-\beta E_n)}{Z}$$

$-\left(\frac{1}{Z}\right) \cancel{2^N} \cdot N \sinh^{N-1}(\beta K) \cdot \cosh(\beta K) \cdot K$

$\cancel{2^N} \sinh^N(\beta K)$

$$-N \frac{K \cosh(\beta K)}{\sinh(\beta K)} = -\frac{NK}{\tanh(\beta K)}$$

$\beta |K| \ll 1 \qquad \tanh(\beta K) \approx \beta K \qquad \therefore \ -\frac{N}{\beta} = E$

$\langle x \rangle = \sum_n x_n P_n = \exp(-\beta E_n)$

$n_+ \exp(\beta K) - n_- \exp$

$n^- = N - n^+$

$Z(\beta, x)$

$\parallel$

$-\frac{1}{Z} \cdot \left(-\beta N \exp(-\beta K) + \frac{1}{2}\left(\frac{x}{a} + N\right) \cdot 2\cosh(\beta K) \cdot K \right)$

$\langle x \rangle = \sum x_{(n)} P_n = \frac{1}{Z} \cdot \sum_n x_n \exp(-\beta E_n)$

$E = n^+(-k) - n^-(+k) = k(n^+ - n^-) = \quad x$ で表す。

$-Nk \cdot \frac{1}{\cosh^2(\beta k)}$

$E(x)$

$\langle E \rangle = \int E(x) \exp(-\beta E(x))\, dx$??

$\langle an \rangle = a \cdot \langle n \rangle$ $\quad \langle n \rangle = \alpha \sum_n n \cdot \exp(-\beta E(n))$

$Z = \sum_n^N \exp(-\frac{E_n}{k_B T}) = n_+ \exp(-k\beta) + n_- \exp(k\beta)$

$\langle E \rangle = \sum_n E_n \exp(-\frac{E_n}{k_B T})$

$\begin{pmatrix} n_+ \to -k \\ n_- \to k \end{pmatrix} \to \quad -k n(+) \exp(k\beta)$

$+k n(-) \exp(-k\beta) = \langle E \rangle$

(何こ目の分子)

$k(-n^+ \exp(k\beta) + \underset{\overset{\shortparallel}{N-n^+}}{n^-} \exp(-k\beta)) = \langle E \rangle$

$\shortparallel$

$k(N \exp(-k\beta) - n^+ (2\cosh(k\beta))) = \langle E \rangle$

$\frac{x+N}{2} = n^+$

$Z = \exp(\beta k) + \exp(-\beta k)$ 独立

$Z = (\quad)^N$

$\frac{\cancel{2^N} \cdot N \cosh^{N-1}(\beta k) \cdot \sin(\beta k) \cdot k}{2^N \cosh^N(\beta k)}$

$x = na$ $\quad = \frac{\sin(\beta k)}{\cosh(\beta k)} \cdot k$

E と x の対応は:

$= -\boxed{\tanh(\beta k) \cdot k}$

$E = k(2n^+ - N). \quad x = a(2n^+ - N)$

$\langle x \rangle = \frac{k}{a} \langle E \rangle$ //

o 第3問

o. Equation of Motion

$$m\ddot{u} = -e\,\mathbb{E}_{ex} - e\,u\times \mathbb{B}_{ex} - m\nu u$$

$$u = \begin{bmatrix} u_x \\ u_y \\ 0 \end{bmatrix}\cdot(-i\omega)\exp(-i\omega t)$$

$$\therefore \begin{bmatrix} u_x \\ u_y \\ 0 \end{bmatrix}\times\begin{bmatrix} 0 \\ 0 \\ B \end{bmatrix} = \begin{bmatrix} u_y B \\ -u_x B \\ 0 \end{bmatrix}$$

$$\therefore m\begin{bmatrix} u_x \\ u_y \\ 0 \end{bmatrix}(-\omega^2) = e\begin{bmatrix} E_x \\ E_y \\ 0 \end{bmatrix} - e\begin{bmatrix} u_x B \\ -u_y B \\ 0 \end{bmatrix}$$

$$\therefore\ -\omega^2 m u_x = eE_x - eu_x B \quad \therefore \boxed{u_x = \frac{eE_x}{+\omega^2 m - eB}}$$

$$-\omega^2 m u_y = eE_y + eu_y B \quad \therefore \boxed{u_y = \frac{eE_y}{\omega^2 m + eB}}$$

$$\tilde{\varepsilon}\,\mathbb{E}_{ex} = \begin{bmatrix} \varepsilon_{xx} & i\gamma & 0 \\ -i\gamma & \varepsilon_{xx} & 0 \\ 0 & 0 & \varepsilon_{zz} \end{bmatrix}\begin{bmatrix} E_x \\ E_y \\ 0 \end{bmatrix} = \begin{bmatrix} \varepsilon_{xx}E_x + i\gamma E_y \\ -i\gamma E_x + \varepsilon_{xx}E_y \\ 0 \end{bmatrix}$$

$$\mathbb{P} = \varepsilon_0(\tilde{\varepsilon}\,\mathbb{E}_{ex} - \mathbb{E}_{ex}) = -neu \qquad \rightarrow (\exp(-i\omega t)\text{は省略})$$

$$\Downarrow$$

$$\varepsilon_0\begin{bmatrix} (\varepsilon_{xx}-1)E_x + i\gamma E_y \\ -i\gamma E_x + (\varepsilon_{xx}-1)E_y \\ 0 \end{bmatrix} = -ne\begin{bmatrix} u_x \\ u_y \\ 0 \end{bmatrix}$$

$$\therefore\ \varepsilon_0\big((\varepsilon_{xx}-1)E_x + i\gamma E_y\big) = -ne\cdot\frac{eE_x}{\omega^2 m - eB} = AE_x$$

$$\varepsilon_0\big(-i\gamma E_x + (\varepsilon_{xx}-1)E_y\big) = -ne\,\frac{eE_y}{\omega^2 m + eB} = BE_y$$

$$E_x\left(\varepsilon_{xx} - 1 - \frac{A}{\varepsilon_0}\right) = -i\gamma E_y \quad \left[E_y = \frac{i}{\gamma}\cdot\left(\varepsilon_{xx} - 1 - \frac{A}{\varepsilon_0}\right)E_x\right]$$

$$-i\gamma E_x = \left(\frac{B}{\varepsilon_0} - \varepsilon_{xx} + 1\right)E_y$$

$$-\cancel{i}\gamma = \left(\frac{B}{\varepsilon_0} - \varepsilon_{xx} + 1\right)\cdot\cancel{i}\frac{1}{\gamma}\cdot\left(\varepsilon_{xx} - 1 - \frac{A}{\varepsilon_0}\right)$$

$$+\gamma^2 = \left(\varepsilon_{xx} - 1 - \frac{B}{\varepsilon_0}\right)\left(\varepsilon_{xx} - 1 - \frac{A}{\varepsilon_0}\right)$$

③ 取り出せる情報量の上限

$$\left(\gamma(\alpha|0\rangle+\beta|1\rangle) + \delta(\alpha|2\rangle+\beta|3\rangle) \right)|0\rangle$$

1桁目

$$\gamma\alpha|00\rangle + \gamma\beta|10\rangle + \delta\alpha|01\rangle + \delta\beta|11\rangle$$

×2した

1桁目のは 一般的に自明ではない

$|00\rangle\langle 00|$

$+|10\rangle\langle 10|$

$+|20\rangle\langle 01|$ $=U$

$+|30\rangle\langle 11|$

$$U^*U = \big(|00\rangle\langle 00| + |10\rangle\langle 10| + |01\rangle\langle 20| + |11\rangle\langle 30| \big)$$

ユニタリ演算ではない…

(ただ、どのようにして実行するかは非自明)

(メモリがどれくらいあるかを知る必要がある)

他にもいろいろ

(かくれているものがあるかもしれない)

$\big(|00\rangle\langle 00|$ $\to d=4.$

$+|10\rangle\langle 10|$

$+|01\rangle\langle 01|$

$+|11\rangle\langle 11| \big)$

$+\cdots$ 加える要

適当に

$$-eE_x = m u_x(\omega^2 - \omega_0^2) + e u_x B$$

$$u_x = \frac{+eE_x}{-m(\omega^2 - \omega_0^2) \cancel{\mp} + eB}$$

$$u_y = \frac{eE_y}{-m(\omega^2 - \omega_0^2) \pm eB}$$

$$(\varepsilon_{xx} - 1)E_x + i\gamma E_y = -\frac{ne}{\varepsilon_0} A E_x \qquad (\varepsilon_{xx} - 1 + \frac{ne}{\varepsilon_0}\cancel{A}_{a})E_x = \cancel{-}i\gamma E_y$$

$$-i\gamma E_x + (\varepsilon_{xx} - 1)E_y = -\frac{ne}{\varepsilon_0} B E_y$$

$$(\varepsilon_{xx} - 1 + \frac{ne}{\varepsilon_0} B)E_y = i\gamma E_x \quad \therefore E_x = \cancel{-}i \frac{1}{\gamma} \cdot (\varepsilon_{xx} - 1 + \frac{ne}{\varepsilon_0} b) E_y$$

$$(\varepsilon_{xx} - 1 + \frac{ne}{\varepsilon_0} a) \cdot \frac{1}{\gamma} \cdot (\varepsilon_{xx} - 1 + \frac{ne}{\varepsilon_0} b) = \gamma$$

$$(\varepsilon_{xx} - 1)^2 + (\varepsilon_{xx} - 1) \cdot \frac{ne}{\varepsilon_0}(a + b) + \frac{n^2 e^2}{\varepsilon_0^2} ab = \gamma^2$$

$$\dot{u} \times B = -i\omega \cdot \begin{bmatrix} u_y B \\ -u_x B \\ 0 \end{bmatrix}$$

$$\begin{pmatrix} u_x \\ u_y \\ 0 \end{pmatrix} \times \begin{pmatrix} 0 \\ 0 \\ B \end{pmatrix}$$

$u_x \quad 0$

$$-i\omega$$

$$-e\dot{u} \times B$$

$$i\omega e \cdot [u_y B$$

$$m(\omega_0^2 - \omega^2)u_x = -eE_x + i e \omega u_y B$$

$$m(\omega_0^2 - \omega^2)u_y = -eE_y - i e \omega u_x B$$

$$\begin{bmatrix} m(\omega_0^2 - \omega^2) & -ie\omega B \\ ie\omega B & m(\omega_0^2 - \omega^2) \end{bmatrix} \begin{bmatrix} u_x \\ u_y \end{bmatrix} = \begin{bmatrix} eE_x \\ eE_y \end{bmatrix}$$

$$\frac{1}{m^2(\omega_0^2 - \omega^2)^2 - (e\omega B)^2} \cdot \begin{bmatrix} m(\omega_0^2 - \omega^2) & ie\omega B \\ -ie\omega B & m(\omega_0^2 - \omega^2) \end{bmatrix} \begin{bmatrix} eE_x \\ eE_y \end{bmatrix}$$

$$(\varepsilon_{xx}-1)E_x + i\gamma E_y = -\frac{ne}{\varepsilon_0}\cdot\frac{1}{A}\cdot\left[\, m(\omega_0^2-\omega^2)E_x - ie\omega B\cdot E_y \right]$$

$$\underbrace{-i\gamma}\, E_x + \underbrace{(\varepsilon_{xx}-1)}\, E_y = -\frac{ne}{\varepsilon_0}\cdot\frac{1}{A}\left[\, \underbrace{ie\omega B}\, E_x + \underbrace{m(\omega_0^2-\omega^2)}\, E_y \right]$$

$$\therefore\ \cancel{i}\gamma = -\cancel{i}e\omega B\cdot\left(-\frac{ne}{\varepsilon_0}\right)\cdot\frac{1}{A} = \frac{e^2 n\omega B}{A\varepsilon_0}$$

$$\varepsilon_{xx}-1 = -\frac{ne}{\varepsilon_0}\cdot\frac{1}{A}\cdot m(\omega_0^2-\omega^2)$$

$$\varepsilon_{xx} = -\frac{ne}{\varepsilon_0}\cdot\frac{1}{A}\cdot m(\omega_0^2-\omega^2)$$

$\omega_0 \gg \omega > 0.\quad \omega_0 \gg eB/m$

$$\mathbb{K}\times\mathbb{E}_0 = \mu_0\omega$$

$$\mathbb{K}\times(\mathbb{K}\times\mathbb{E}_0) = \mu_0\omega\,(-\tilde{\varepsilon}\,\varepsilon_0\omega)\,\mathbb{E}_0$$

$$= -\underset{\left(\frac{\omega}{c}\right)^2}{\underset{\shortparallel}{\mu_0\varepsilon_0\omega^2}}\ \tilde{\varepsilon}\,\mathbb{E}_0$$

$$\mathbb{K}\times(\mathbb{K}\times\mathbb{E}_0) = \qquad\qquad \mathbb{A}\times(\mathbb{B}\times\mathbb{C}) = (\mathbb{C}\cdot\mathbb{A})\,\mathbb{B} - (\mathbb{B}\cdot\mathbb{A})\cdot\mathbb{C}$$

$$(\mathbb{K}\cdot\mathbb{E}_0)\,\mathbb{K} - |\mathbb{K}|^2\,\mathbb{E}_0$$

$$(E_z)\cdot\begin{bmatrix}0\\0\\k_z\end{bmatrix} - (k_z^2)\cdot\begin{pmatrix}E_x\\E_y\\E_z\end{pmatrix} + \left(\frac{\omega}{c}\right)^2\cdot\begin{bmatrix}\sim\\\frown\\\frown\end{bmatrix} = 0$$

E_x

$$\left(k_z^2 - \left(\frac{\omega}{c}\right)^2 \varepsilon_{xx}\right) E_y = -i\gamma \left(\frac{\omega}{c}\right)^2 E_x$$

$$\begin{bmatrix} k_z^2 - \left(\frac{\omega}{c}\right)^2 \varepsilon_{xx} & i\gamma \left(\frac{\omega}{c}\right)^2 \\ i\gamma \left(\frac{\omega}{c}\right)^2 & k_z^2 - \left(\frac{\omega}{c}\right)^2 \varepsilon_{xx} \end{bmatrix}$$

$$\left(k_z^2 - (\omega/c)^2 \varepsilon_{xx}\right)^2 - \gamma^2 (\omega/c)^4 = 0$$

$$k_z^2 - (\omega/c)\varepsilon_{xx} = \pm \gamma (\omega/c)$$

$$k_z^2 = \left(\frac{\omega}{c}\right)\underset{\vee 0}{(\varepsilon_{xx} \pm \gamma)}$$

$$\left(\cancel{\left(\frac{\omega}{c}\right)^2} (\varepsilon_{xx} \pm \gamma) - \cancel{(\omega/c)^2} \varepsilon_{xx} \right) E_x = i\gamma \cancel{\left(\frac{\omega}{c}\right)^2} E_y$$

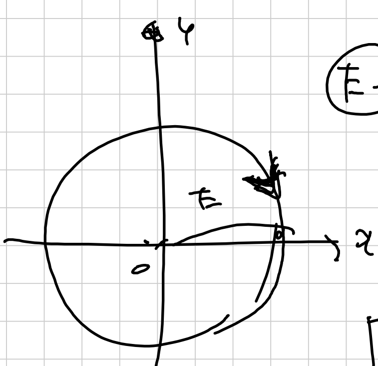
$$(\pm \cancel{\gamma}) E_x = i \cancel{\gamma} E_y$$

$$\pm E_x = i E_y.$$

$$E_x^2 + E_x^2 = E^2 \qquad \therefore E_x = \frac{1}{\sqrt{2}} E$$

$$E_0 = \begin{bmatrix} \frac{1}{\sqrt{2}} E \\ i \frac{1}{\sqrt{2}} E \end{bmatrix} = \frac{1}{\sqrt{2}} E \begin{bmatrix} 1 \\ i \end{bmatrix}$$

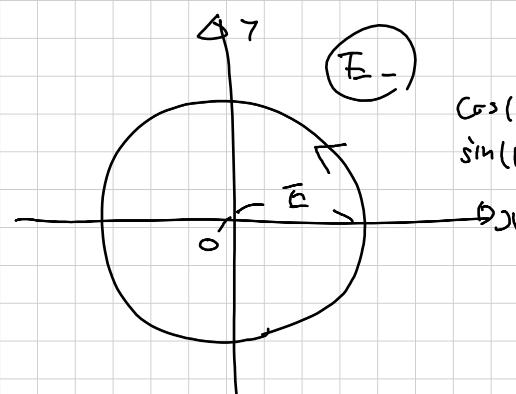
$$\exp(-i\omega t) = \cos(\omega t) + i\sin(\omega t)$$



E_+

$$\begin{bmatrix} \cos(\omega t) \\ -\sin(\omega t) \end{bmatrix}$$

E_x



E_-

$\cos(\omega t)$
$\sin(\omega t)$

$E_+ = \frac{1}{\sqrt{2}} E\begin{bmatrix}1\\i\end{bmatrix}$. $E_- = E\frac{1}{\sqrt{2}}\begin{bmatrix}1\\-i\end{bmatrix} \exp()$

$\exp()$

$$\frac{1}{\sqrt{2}} E \begin{bmatrix} a+b \\ a\hat{i} - b\hat{i} \end{bmatrix}$$

$a=b$

$$\cancel{(E_{0z})k_z} - \cancel{k_z^2 E_{0z}} + \left(\frac{\omega}{c}\right)^2 \cdot E_{0z}\varepsilon_{zz} = 0$$

$$E = E_+ + E_-$$

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[4].

from [2]. $\to$ get

$S \left(\begin{array}{l} g(\alpha_1)g(\alpha_2),\ \frac{1}{\sqrt{2}}(g(\alpha_1)e(\alpha_2) + e(\alpha_1)g(\alpha_2)), \\ e(\alpha_1)e(\alpha_2) \end{array} \right) \to$ Boson

$A \left(\frac{1}{\sqrt{2}}(g(\alpha_1)e(\alpha_2) - e(\alpha_1)g(\alpha_2)) \right)$ Fermion.

$S \left(\begin{array}{l} |\uparrow\rangle|\uparrow\rangle \\ \frac{1}{\sqrt{2}}(|\uparrow\rangle|\downarrow\rangle + |\downarrow\rangle|\uparrow\rangle) \\ |\downarrow\rangle|\downarrow\rangle \end{array} \right)$

$A \left(\frac{1}{\sqrt{2}}(|\uparrow\rangle|\downarrow\rangle - |\downarrow\rangle|\uparrow\rangle) \right) \to$ Fermion - Assymetric

$S \to A \quad 3\times 1$

$A \to 3\ \text{ans.} \quad 3\times 1$

$= 6$

No magnetic field $\to$ Energy should be from

$$g.s: \frac{\hbar^2\pi^2}{ma^2}, \quad \frac{5\hbar^2\pi^2}{2ma^2}, \quad \frac{4\hbar^2\pi^2}{ma^2}$$

$$: \langle (x_1 - x_2)^2 \rangle_{\psi_1} = \frac{1}{\sqrt{2}} \left(\langle \uparrow\downarrow | + \langle \downarrow\uparrow | \right) \left(\int_{R_1} dx_1 \int_{R_2} dx_2 \; g(x_1) g(x_2) g(x_1) g(x_2) \cdot (x_1 - x_2)^2 \right) \frac{1}{\sqrt{2}} \left(|\uparrow\downarrow\rangle + |\downarrow\uparrow\rangle \right)$$

$x_1^2 - 2x_1x_2 + x_2^2$

cancelled

Orbital part.

$$= \underbrace{\int g^2(x_2)\, dx_2}_{1} \int x_1^2 g_1^2(x_1)\, dx_1$$

$$+ \int g^2(x_1) dx_1 \int x_2^2 g_2^2(x_2) dx_2$$

$$- 2 \int dx_1 \underbrace{x_1}_{\text{odd}} \underbrace{g^2(x_1)}_{\text{even}} dx_1 \cdot \int x_2 g^2(x_2) dx_2$$

$0 \cdot B$

$\Rightarrow 2A_H$

$\langle (x_1 - x_2)^2 \rangle_{\psi_3} = 2B_H$

$$\langle (x_1 - x_2)^2 \rangle_{\psi_2} = \frac{1}{2} \int (\underbrace{x_1^2}_{\text{even}} - \underbrace{2x_1x_2}_{\text{odd}} + \underbrace{x_2^2}_{\text{odd}})_{\text{even}} \left(g^2(x_1) e^2(x_2) + g(x_1) g(x_2) e(x_1) e(x_2) + g^2(x_2) e^2(x_1) \right)$$

even, even, odd

$\downarrow$

$$= \frac{1}{2}(A+B) + 2(B+A) - c^2 = A + B - 2c^2$$

$$\langle (x_1 - x_2)^2 \rangle_{\psi_4} = A + B + 2c^2$$

ψ_6

$\rightarrow$ Consider the parity.

[6]

$$H = H_0 + \lambda H_1$$

$$|\psi\rangle = |\psi_n^{(0)}\rangle + \lambda |\psi_n^{(1)}\rangle + \cdots$$

$$E_n = E_n^{(0)} + \lambda E_n^{(1)} + \lambda E_n^{(2)}$$

$$\left(H|\psi_n\rangle = E_n|\psi_n\rangle \right)$$

$\lambda = 0$

$$H_0|\psi_n^{(0)}\rangle = E_n^{(0)}|\psi_n^{(0)}\rangle$$

$\lambda = 1.$

$$\sum_{n \neq m} \frac{|\langle \psi_m^{(0)}|V|\psi_n^{(0)}\rangle|^2}{E_n^{(0)} - E_m^{(0)}}$$

$$E_1^{(1)} = \langle \underbrace{\psi_n^{(0)}}_{gg} | \underbrace{V}_{V_0 x_1 x_2} | \underbrace{\psi_n^{(0)}}_{gg} \rangle$$

$$E_{\psi_1} = E_{\psi_1}^{(0)} + \langle gg| V x_1 x_2 |gg\rangle = \frac{\pi^2\hbar^2}{ma^2} + V\int x_1 g^2(x_1)dx_1 \int x_2 g^2(x_2)$$

$$= \frac{\pi^2\hbar^2}{ma^2}$$

$$E_{\psi_2} = E_{\psi_2}^{(0)} + \frac{1}{2}(\langle ge| + \langle eg|)(V x_1 x_2)(|ge\rangle + |eg\rangle)$$

$$= \frac{5\pi^2\hbar^2}{2ma^2} + V_0 \int x_1 g(x_1) e(x_1) dx_1 \int x_2 g(x_2) e(x_2) dx_2$$

$$= \frac{5\pi^2\hbar^2}{2ma^2} + V_0 c^2$$

$$E_{\psi_3} = \frac{\hbar^2\pi^2}{ma^2}$$

$$E_{\psi_4} = E_{\psi_5} = E_{\psi_6} = E_{\psi_4}^{(0)} - V_0 c^2 = \frac{5\hbar^2\pi^2}{2ma^2} - V_0 c^2$$

$$\left(-m^2 \left(\left(\frac{\omega_0}{\omega}\right)^2 - 1 \right)^2 + (e\beta)^2 \right) \omega^2$$

$$\frac{1}{\sqrt{2}}\left(E_+ + E_-\right)$$

$$E_+ \rightarrow \begin{pmatrix}1\\ i\\ 0\end{pmatrix} \exp\Big(i\frac{\omega}{c}\underbrace{\sqrt{\varepsilon_{xx}+i\varepsilon_{xy}}}_{k_+} - i\omega t\Big)$$

$$E_- \rightarrow \begin{pmatrix}1\\ -i\\ 0\end{pmatrix} \exp\Big(i\frac{\omega}{c}\underbrace{\sqrt{\varepsilon_{xx}-i\varepsilon_{xy}}}_{k_-} - i\omega t\Big)$$

$$\downarrow$$

$$E_{out} = \frac{1}{2}E\exp(i\,l k_+ - i\omega t) + \frac{E}{2}\exp(i\,l k_- - i\omega t)$$

$$\frac{E}{2}\exp(-i\omega t)\Big(\exp(i\,l k_+) + \exp(i\,l k_-)\Big)$$

$$\hookrightarrow \Big(\exp$$

$$E_T = E\begin{pmatrix}\cos\left(\frac{k_+ - k_-}{2}l\right)\\ -\sin\left(\frac{k_+ - k_-}{2}l\right)\\ 0\end{pmatrix}$$

難しい：「DMRGの開発」

(H E)で Haldane ってのこいては というように ← Haldane (モデル)

MIPS ← 物性

→ 物理

というmath.

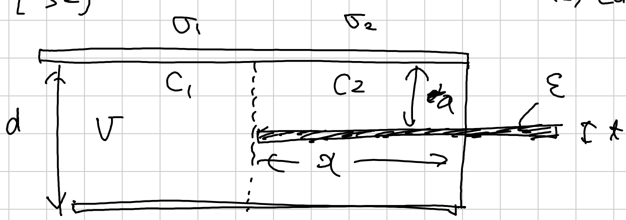
, KPZ eq → (界面成長)

(T.I. 誘電体 → というくて 対称性?) → ε, と行列の(固有値)⇒

→ εの場合は電場の移動あり

[32]

→ 「Laplace eqの解」



C_2の時 $D = \varepsilon_0 E_1 = \varepsilon E_2 = \varepsilon_0 E_3 = \sigma_2$ であり.

$$V = \sigma(E_1 + t E_2 + (d - a - t) E_3 = \sigma\left(\frac{d-t}{\varepsilon_0} + \frac{t}{\varepsilon}\right)$$

$$\therefore C = \frac{Q}{V} = \left(\frac{S}{\frac{d-t}{\varepsilon_0} + \frac{t}{\varepsilon}}\right)$$

$$\therefore C_1 = \frac{\varepsilon_0 S\left(\frac{a-a}{a}\right)}{d}, \quad C_2 = \frac{S(a/a)}{(d-t)/\varepsilon_0 + t/\varepsilon}$$

$$C = C_1 + C_2 = \frac{\varepsilon_0 S}{a}\Big\{\frac{a}{d} +$$

$$U = \frac{CV^2}{2}$$

$\therefore$ a方向の力は $F_x = \frac{\partial U}{\partial a} = \frac{\partial}{\partial a}\left(\frac{CV^2}{2}\right) = \frac{\varepsilon_0 S' t'}{a(d-t)} \frac{V^2}{2}$

[A]

「高真空」

油拡散pump > 油回転 pamp.

油の蒸気で気体を圧縮する　⊕ ターボ

ガイスラー管「放電」

[B]

$$C = \frac{Q_{12}}{P_1 - P_2}$$

$$1.0 \times 10^{-4} m^3/s = \frac{Q_{12}}{P_1 - P_2} = C$$

「$P_2 = \frac{Q_{12}}{S}$」

$$\frac{P_2}{P_1 - P_2} S = C$$

$$\simeq \boxed{\frac{P_2}{P_1} S = C}$$

$\boxed{Q = Q_{12}}$

$\therefore \frac{Q}{C} = P_1 - P_2. \quad P_2 = \frac{Q}{S}$

$$\therefore P_2 = \frac{2.0 \times 10^{-8} Pa\, m^3/s}{2.0 \times 10^{-1} m^3/s} = \underline{1.0 \times 10^{-7} Pa}$$

$$P_1 = \frac{Q}{C} = \frac{2.0 \times 10^{-8} Pa}{1.0 \times 10^{-4}} = \underline{2.0 \times 10^{-4} Pa}$$

$\boxed{P_a \gg P_2}$

Ok.

$0 = Q - Q_{12} + q$

$$C = \frac{Q + q}{P_1 + P - P_2} \qquad \frac{Q+q}{C} \simeq P_1 + P$$

$\therefore C(P_1) = Q + q$

Q??

たぶん??

$$P = \frac{Q+q}{C} - P_1$$

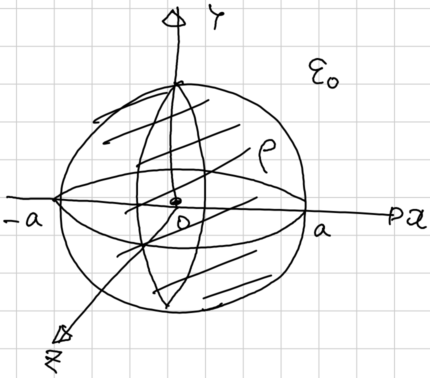
[3]

(c) ガイスラー管は ⓑ　　「電離 = ⓓ

(d)

2020 大修

[2]



(1) ガウスの法則より.

$$4\pi r^2 \mathbb{E} = \begin{cases} \frac{\rho}{\varepsilon_0} \cdot \frac{4}{3}\pi a^3 \mathbb{e}_r & (r \geq a) \\ \frac{\rho}{\varepsilon_0} \cdot \frac{4}{3}\pi \left(\frac{r}{a}\right)^3 \mathbb{e}_r & (r < a) \end{cases}$$

$$\therefore \mathbb{E} = \begin{cases} \frac{\rho a^3}{3\varepsilon_0 r^2} \mathbb{e}_r & (r \geq a) \\ \frac{\rho r}{3\varepsilon_0 a^3} \mathbb{e}_r & (r < a) \end{cases}$$

(2) $U = \frac{1}{2}\varepsilon_0 E r^2$ //

[3]

・Lでへいは 対称である時のみ 成立する

・重ね合わせの原理から いけば良い.

$\mathbb{e}_r = \sin\varphi \sin\theta \, \mathbb{e}_x +$