$\bar{H}\psi - \psi \bar{H} = H_E \psi$

$\boxed{\dot{a}} = \int \cdots e$

$-i\hbar \frac{\partial}{\partial t}(\psi^\dagger \psi) = \{\psi^\dagger H_E + \chi^\dagger \gamma$

$(\because) = \int c_0 + n\, c_1 \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix} + c_2(\;) + c_3(\;)$

$\cancel{\bar{H}\psi = \chi}$

$-i\hbar \frac{\partial \psi}{\partial t} = H\psi + \underline{\cancel{\gamma\psi}\ \chi^\dagger \gamma \chi} \cdots$

$-i\hbar \dot{\psi} = H\psi + (\quad) e^{i\nu t} + e \cdots \quad \dot{a} = \sum_{\mu=0}^{3} c_\mu S_{\mu t}$

$a =$

$\psi = \int \cdots e^{i\nu t} d\nu'$

$i\hbar \frac{\partial \psi}{\partial t} = H\psi - \int \chi^\dagger(x') \chi(x') \{\delta(x, x') - \psi^\dagger(x')$

$\psi_\lambda(x) \int \chi_{(x')}^\dagger \gamma_\mu \psi_\mu^\dagger(x') + \gamma_\mu^\dagger \psi_\mu(x')) \chi(x') d\nu'$

$= \int \chi^\dagger(x') \gamma_\mu \{\delta_{\mu\lambda} \cancel{\psi} \delta(x, x') - \psi_\mu^\dagger(x') \psi_\lambda(x)\} \chi(x') d\nu'$

$- \int \chi^\dagger(x') \gamma_\mu^\dagger \psi_\mu(x') \psi_\lambda(x) \chi(x') d\nu'$

$=$

$i\hbar \frac{\partial \psi_\lambda}{\partial t} = H_{\lambda\mu}\psi_\mu - \int \chi^\dagger(x') \gamma_\mu \chi(x') \{\delta_{\lambda\mu} \delta(x, x') - 2\psi_\mu^\dagger(x') \psi_\lambda(x)\} d\nu'$

$+ 2\int \chi^\dagger(x') \gamma_\mu^\dagger \chi(x') \psi_\mu(x') \psi_\lambda(x)\, d\nu'$

$\psi_\lambda = \int c_\lambda(\nu) e^{-2\pi i \nu t} d\nu.$

$\chi^\dagger(x') \gamma_\mu \chi(x') = A_\mu(x) e^{-2\pi i \nu_0 t}$

$\cancel{i\hbar} + h\nu \int c_\lambda(\nu) e^{-2\pi i \nu t} d\nu = \int H_{\lambda\mu} c_\mu(\nu) e^{-2\pi i \nu t} d\nu \iint c^\dagger(\nu) c_\lambda(\nu) e^{-2\pi i(\nu - \nu')t} d\nu d\nu'$

$- \int \cancel{\chi^\dagger(x') \gamma_\mu \chi(x')} A_\mu(x') e^{-2\pi i \nu_0 t} \{\delta_{\lambda\mu} \delta(x, x') - 2 \cancel{\psi} \}$

$+ \int \cancel{*} A_\mu^\dagger(x') e^{-2\pi i \nu_0 t}\ c_\mu(\nu') c_\lambda(\nu)$

$$i\hbar\frac{\partial\psi}{\partial t} = \cancel{H\psi - 2\int \chi^\dagger(r')\gamma\chi(r')\,d\tau}$$

$$+\ 2\left\{\int \chi^\dagger(r')\gamma\chi(r')\psi^\dagger(r')\,dv + \int \chi^\dagger(r')\gamma^\dagger\chi(r')\psi(r')\,dv\right\}$$

$$\times\ \psi$$

$$\cancel{\psi =}\ \chi^\dagger(r')\gamma_\mu\chi(r') = A_\mu(r)\,e^{-\frac{iE_0 t}{\hbar}}$$

$$\psi_\mu(r) = \sum\int u_\mu^{(\alpha)}(r,\alpha)\,e^{-\frac{iE_\alpha t}{\hbar}}\,d\alpha$$

$$a_\alpha$$

$$\cancel{i\hbar\,u}\int E_\alpha\, u_\mu(r,\alpha)\,d\alpha$$

$$E_0\int a_\alpha u_\mu(r,\alpha)\,e^{-\frac{iE_\alpha t}{\hbar}}d\alpha$$

$$A_\mu(r)\,e^{-\frac{iE_0 t}{\hbar}} = \int\left[A_\lambda(r')\,e^{-\frac{iE_0 t}{\hbar}}\int \tilde{u}_\mu(r',\alpha')\,a^\dagger_{\alpha'}\,e^{+\frac{iE_{\alpha'}t}{\hbar}}\,d\alpha'\right.$$

$$+\int a_\alpha \sum_\lambda C_{\mu\lambda}u_\lambda(r,\alpha)\,e^{-\frac{iE_\alpha t}{\hbar}}d\alpha\ +$$

$$\left. +\ A^\dagger_\lambda(r')\,e^{-\frac{iE_0 t}{\hbar}}\int u_\mu(r')\,a_{\alpha'}\,u_\mu(r',\alpha')\,e^{-\frac{iE_{\alpha'}t}{\hbar}}d\alpha'\right]dv$$

$$\times\int a_{\alpha''}u_\mu(r,\alpha'')\,e^{-\frac{iE_{\alpha''}t}{\hbar}}d\alpha''$$

序

$$A_\mu(r)\,e^{\cancel{iE_0 t}}\ \tilde{u}$$

~~$\cdots$~~

$$i\hbar\frac{\partial\psi}{\partial t} =$$

Preliminary Studies on the Theory of Electrons, Protons and Neutrons.

§1. Introduction

According to the model of atomic nucleus proposed recently by Heisenberg, it can be considered as an assembly of neutrons and protons. The forces ~~as~~ binding them together are caused by the exchange of negative charge between them. Under certain circumstances a neutron can split up into a proton and an electron. ~~As~~ The well known feature of β-disintegration suggests, ~~it may be true that the~~ energy principle ~~does~~ ~~may~~ can may not be applied ~~conserve~~ ~~during~~ to such a splitting process. In other words,

$$\frac{i\hbar}{c}\dot{a}_1 + \frac{W_1}{c}a_1 + \sum_n (b_n V_n^{\dagger 12} + b_n^\dagger V_n^{12}) a_2 = 0.$$

$$\frac{i\hbar}{c}\dot{a}_2 + \frac{W_2}{c}a_2 + \sum_n (b_n V_n^{\dagger 21} + b_n^\dagger V_n^{21}) a_1 = 0.$$

$$\cancel{E_m b_m}$$

$$\frac{i\hbar}{c}\dot{b}_m + \frac{E_m}{c}b_m + (a_1^\dagger a_2 V_m^{12} + a_2^\dagger a_1 V_m^{21}) = 0.$$

$$a_1 = A_1 e^{\frac{i}{\hbar}W_1 t - \Gamma t}$$

$$a_2 = A_2(1 - e^{-\Gamma t}) e^{\frac{iW_2}{\hbar}t}$$

$$-\frac{i\hbar\Gamma}{c}A_1 + \sum_n (b_n V_n^{\dagger 12} + b_n^\dagger V_n^{12}) A_2 (e^{\Gamma t} - 1) e^{\frac{i(W_2 - W_1)}{\hbar}t} = 0.$$

$$+\frac{i\hbar\Gamma}{c} e^{-\Gamma t} e^{\frac{iW_2}{\hbar}t} A_2 + \sum_n (b_n V_n^{\dagger 21} + b_n^\dagger V_n^{21}) A_1 e^{\frac{i}{\hbar}W_1 t - \Gamma t} = 0.$$

$$\cancel{\frac{i\hbar\Gamma}{c}A_1} -$$

$$\cancel{\left(\frac{i\hbar\Gamma}{c}\right)} \cdot \left(\frac{i\hbar\Gamma}{c}\right)^2 A_1 + \sum_n (b_n V_n^{\dagger 12} + b_n^\dagger V_n^{12}) \sum_m (b_m V_m^{\dagger 21} + b_m^\dagger V_m^{21})(e^{\Gamma t} - 1) A_1 = 0.$$

$$\left(\frac{i\hbar\Gamma}{c}\right)^2 A_2 + \sum_n (b_n V_n^{\dagger 21} + b_n^\dagger V_n^{21}) \sum_m (b_m V_m^{\dagger 12} + b_m^\dagger V_m^{12})(e^{\Gamma t} - 1) A_2 = 0.$$

$$b_n b_m (V_n^{\dagger 12} V_m^{\dagger 21} \mp V_m^{\dagger 12} V_n^{\dagger 21}) \qquad b_n^\dagger b_m (V_n^{12} V_m^{\dagger 21} -$$

$$(V_m^{\dagger 12} V_n^{21} \mp \quad \cdot\cdot \quad)$$

$$\cancel{i\hbar\Gamma}$$

$$\Gamma^2 = \left(\frac{c}{\hbar}\right)^2 \sum_n (b_n V_n^{\dagger 12} + b_n^\dagger V_n^{12})$$

$$-i\hbar \dot{n}_i = (b_i c_i - b_i^\dagger c_i^\dagger) e^{-\frac{i E_0}{\hbar}\tau}.$$

$$b = \sum_{\mu=0}^{3} a_\mu s_\mu \qquad \cancel{b^2 = \sum a_\mu^2 + 2a_0(a_1+a_2+a_3) = 0.}$$

$$b^\dagger = \sum_{\mu=0}^{3} \tilde{a}_\mu s_\mu \qquad \cancel{b^{\dagger 2} = \sum \tilde{a}_\mu^2 + 2\tilde{a}_0(\tilde{a}_1+\tilde{a}_2+\tilde{a}_3) = 0.}$$

$$\cancel{b^\dagger b = \sum |a_\mu|^2 + 2\sum(a_0 a_k + a_k a_0)}$$

$b^2=0$:

$$\sum a_\mu^2 = 0$$
$$2a_0 a_1 = 0,$$
$$2a_0 a_2 = 0$$
$$2a_0 a_3 = 0$$

$$\cancel{b b^\dagger = |a}$$

$s_1 s_2$!!!
$i s_3$

$$b^\dagger b + b b^\dagger = \sum_\mu \tilde{a}_\mu a_\mu + i\tilde{a}_1 a_2 s_3 + \dots - i\tilde{a}_2 a_1 s_3 + \dots$$
$$+ \sum_\mu \quad + i a_1 \tilde{a}_2 s_3 + \dots$$
$$+ \quad a_0 \tilde{a}_3 s_3 + \dots$$
$$+ \quad \tilde{a}_0 a_3 s_3 + \dots$$

$$a_0\tilde{a}_3 + \tilde{a}_0 a_3 = 0 \text{ etc}$$

$$\sum_\mu \tilde{a}_\mu a_\mu = 1,$$

$$\sum_\mu a_\mu^2 = 0$$

$$(x_1+iy_1)^2 + (x_2+iy_2)^2 + (\quad) = 0.$$
$$x_1^2 - y_1^2 + x_2^2 - y_2^2 + x_3^2 - y_3^2 = 0,$$
$$x_1 y_1 + x_2 y_2 + x_3 y_3 = 0,$$
$$x_1^2 + x_2^2 + x_3^2 + y_1^2 + y_2^2 + y_3^2 = 1,$$

$$\left.\begin{array}{l} x_1^2 + x_2^2 + x_3^2 = y_1^2 + y_2^2 + y_3^2 = \frac{1}{2}, \\ x_1 y_1 + x_2 y_2 + x_3 y_3 = 0. \end{array}\right\}$$

$$b = (x_1+iy_1)s_1 + (x_2+iy_2)s_2 + (x_3+iy_3)s_3.$$

$$i s_3\{(x_1 - iy_1)(x_2+iy_2) - (x_2 - iy_2)(x_1+iy_1)\}$$

$$b^\dagger b = 1 + (x_1 y_2 - x_2 y_1) s_3 - (x_3 y_1 - x_1 y_3) s_2 - (x_2 y_3 - x_3 y_2) s_1.$$

$$\cancel{-i\hbar} \quad -i\hbar\frac{\partial}{\partial t}(x_2 y_3 - y_2 y_3) = \{(x_1+iy_1)c - (x_1 - iy_1)c^\dagger\} e^{-\frac{iE_0}{\hbar}\tau}$$

$$(\qquad) = \{ \qquad \}$$

$$2\{ \qquad \}$$

$$b = c_0\begin{pmatrix}0&0\\0&1\end{pmatrix} + c_1\begin{pmatrix}1&0\\0&0\end{pmatrix} + c_{01}\begin{pmatrix}0&1\\0&0\end{pmatrix} + c_{10}\begin{pmatrix}0&0\\1&0\end{pmatrix}$$

$$b^\dagger = \tilde{c}_0\begin{pmatrix}0&0\\0&1\end{pmatrix} + \tilde{c}_1\begin{pmatrix}1&0\\0&0\end{pmatrix} + \tilde{c}_{10}\begin{pmatrix}0&1\\0&0\end{pmatrix} + \tilde{c}_{01}\begin{pmatrix}0&0\\1&0\end{pmatrix}$$

$$+ c_{10}c_{01}\begin{pmatrix}0&0\\0&1\end{pmatrix} + c_{01}c_{10}\begin{pmatrix}1&0\\0&0\end{pmatrix}$$

$$b^2 = c_0^2\begin{pmatrix}0&0\\0&1\end{pmatrix} + c_1^2\begin{pmatrix}1&0\\0&0\end{pmatrix} + c_0c_{10}\begin{pmatrix}0&0\\1&0\end{pmatrix} + c_1c_{01}\begin{pmatrix}0&1\\0&0\end{pmatrix}$$

$$c_0^2 + c_{10}c_{01} = 0 \qquad \underline{c_0^2 = c_1^2 = -c_{10}c_{01}} \qquad + c_{10}c_1\begin{pmatrix}0&0\\1&0\end{pmatrix} + c_{01}c_0\begin{pmatrix}0&1\\0&0\end{pmatrix}$$

$$c_1^2 + c_{01}c_{10} = 0, \quad \cancel{c_0^2 = c_1^2 = 0}, \qquad \underline{c_0c_{10} + c_{10}c_1 = 0}, \quad \underline{c_1c_{01} + c_{01}c_0 = 0}.$$

$$b^\dagger b = \tilde{c}_0c_0\begin{pmatrix}0&0\\0&1\end{pmatrix} + \tilde{c}_1c_1\begin{pmatrix}1&0\\0&0\end{pmatrix} + (\tilde{c}_0c_{10} + \tilde{c}_{10}c_1)\begin{pmatrix}0&0\\1&0\end{pmatrix} + (\tilde{c}_1c_{01} + \tilde{c}_{01}c_0)\begin{pmatrix}0&1\\0&0\end{pmatrix}$$

$$b b^\dagger = c_0\tilde{c}_0(\ ) + c_1\tilde{c}_1(\ ) + (c_0\tilde{c}_{10} + c_{10}\tilde{c}_1)\begin{pmatrix}0&0\\1&0\end{pmatrix} + (c_1\tilde{c}_{01} + c_{01}\tilde{c}_0)\begin{pmatrix}0&1\\0&0\end{pmatrix}$$

$$+ \tilde{c}_{10}c_{01}\begin{pmatrix}0&0\\0&1\end{pmatrix} + \tilde{c}_{01}c_{10}\begin{pmatrix}1&0\\0&0\end{pmatrix}$$

$$+ c_{10}\tilde{c}_{01}\begin{pmatrix}0&0\\0&1\end{pmatrix} + c_{01}\tilde{c}_{10}\begin{pmatrix}1&0\\0&0\end{pmatrix}$$

$$\cancel{|c_0|^2 = 1}, \quad c$$

$$\cancel{|c_1|^2 = 1},$$

$$|c_0|^2 = -\tilde{c}_{10}c_{01}$$

$$|c_1|^2 = -\tilde{c}_{01}c_{10}$$

$$\tilde{c}_0c_{10} + c$$

$$c_0\tilde{c}_{10} + c_{10}\tilde{c}_1$$

$$c_{10}(c_0 + c_1) = 0 \qquad c_0 = -c_1 \,!!$$

$$c_{01}(c_0 + c_1) = 0.$$

$$c_0 = x_0 + iy_0$$

$$c_{01} = x_1 + iy_1$$

$$c_{10} = x_2 + iy_2.$$

$$x_0^2 - y_0^2 + 2ix_0y_0 = -(x_1x_2 - y_1y_2) - i(x_1y_2 + x_2y_1)$$

$$x_0^2 + y_0^2 = -(x_1x_2 + y_1y_2) + i(x_1y_2 - x_2y_1)$$

$$= -(x_1x_2 + y_1y_2) - i(x_1y_2 - x_2y_1)$$

$$\underline{x_0^2 + y_0^2 = -(x_1x_2 + y_1y_2)} = \frac{1}{2}$$

$$\underline{\frac{x_1}{x_2} = \frac{y_1}{y_2} = x}$$

$$x_0^2 + y_0^2 = x(x_1^2 + y_1^2)$$

$$c_0 = \sqrt{\tfrac{1}{2}}(x_0 + iy_0) \qquad c_1 = -\sqrt{\tfrac{1}{2}}(x_0 + iy_0)$$

$$c_{01} = x^{-1}\sqrt{\tfrac{1}{2}}(x_1 + iy_1)$$

$$c_{10} = x\sqrt{\tfrac{1}{2}}(x_1 + iy_1)$$

$$b^\dagger b = 1 +$$

$$n_i(t) = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix} + \delta$$

$$= (\tilde{c}_0 c_0 + \tilde{c}_{10} c_{01}) \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix} + (\tilde{c}_1 c_1 + \tilde{c}_{01} c_{10}) \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$$

$$+ (\tilde{c}_0 c_{10} + \tilde{c}_{10} c_1) \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix} + (\tilde{c}_1 c_{01} + \tilde{c}_{01} c_0) \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$$

$$= \frac{1}{2}(x_0^2 + y_0^2 + x_1^2 + y_1^2) \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix} + \frac{1}{2}(x_0^2 + y_0^2 +$$

$$b = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \qquad b^+ b = \begin{pmatrix} |c_{11}|^2 + |c_{21}|^2 & \tilde{c}_{11} c_{12} + \tilde{c}_{21} c_{22} \\ \tilde{c}_{12} c_{11} + \tilde{c}_{22} c_{21} & |c_{22}|^2 + |c_{12}|^2 \end{pmatrix} \qquad b^2 = \begin{pmatrix} c_{11}^2 + c_{12} c_{21} & c_{11} c_{12} + c_{12} c_{22} \\ c_{21} c_{11} + c_{22} c_{21} & c_{22}^2 + c_{21} c_{12} \end{pmatrix}$$

$$b^+ = \begin{pmatrix} \tilde{c}_{11} & \tilde{c}_{21} \\ \tilde{c}_{12} & \tilde{c}_{22} \end{pmatrix} \qquad b b^+ = \begin{pmatrix} |c_{11}|^2 + |c_{12}|^2 & c_{11} \tilde{c}_{21} + c_{12} \tilde{c}_{22} \\ c_{21} \tilde{c}_{11} + c_{22} \tilde{c}_{12} & |c_{22}|^2 + |c_{21}|^2 \end{pmatrix} \qquad b^{+2} =$$

$$2|c_{11}|^2 + |c_{21}|^2 = |c_{12}|^2 + |c_{22}|^2 = 1$$
$$+|c_{12}|^2 \qquad +|c_{11}|^2$$

$$\cancel{c_{11}\tilde{c}_{12} + c_{21}\tilde{c}_{22}} = c_{12}\tilde{c}_{11} + c_{22}\tilde{c}_{21} = 0.$$

$$c_{11}^2 + c_{12} c_{21} = c_{12} c_{21} + c_{22}^2 = 0$$

$$c_{21}(c_{11} + c_{22}) = c_{12}(c_{11} + c_{22}) = 0,$$

$$+ c_{11} = -c_{22} = x_0 + i y_0$$

$$\cancel{b = (\qquad |c_{21}|}$$

$$c_{12} = x_1 + i y_1$$
$$c_{21} = x_2 + i y_2.$$

$$2(x_0^2 + y_0^2) + x_1^2 + y_1^2 + x_2^2 + y_2^2 = 1$$

$$\cancel{2(x_0^2 + y_0^2) +}$$

$$(x_1 - i y_1)(x_0 + i y_0) - (x_0 - i y_0)(x_2 + i y_2)$$
$$+ (x_2 + i y_2)(x_0 - i y_0) - (x_0 + i y_0)(x_1 - i y_1) = 0$$

$$(x_1 + i y_1)(x_2 + i y_2) = -(x_0 + i y_0)^2$$

$\cancel{1 - 2\delta}$

$1 - \delta_0$.

$x_1 + i y_1$: 大

$x_0 + i y_0$; $x_2 + i y_2$: small

$$x_1^2 + y_1^2 = 1 - 2\delta_0^2 - \delta_2^2.$$

$$2(x_0^2 + y_0^2) + x_2^2 + y_2^2 \quad \cancel{2\delta_0} + \delta_2$$
$$\qquad \| \qquad\qquad \|$$
$$\quad \delta_0^2 \qquad\quad \delta_2^2$$

$$\cancel{(1-\delta)e^{i\theta_1}}$$
$$\sqrt{(1 - 2\delta_0^2 - \delta_2^2)}\, e^{i\theta_1} \sqrt{\delta_2}\, e^{i\theta_2} = -\sqrt{\delta_0^2}\, e^{2i\theta_0}$$

$$\sqrt{\delta_2}\, e^{i(\theta_1 + \theta_2)} = \sqrt{\delta_0^2}\, e^{2i\theta_0}$$

$$b = \cancel{(1 - 2\delta_0) e^{i\theta_1} \quad (1 - 2\delta_0) e} \begin{pmatrix} \delta_0 e^{i\theta_0} & (1 - \delta_0) e^{i\theta_1} \\ 0 & -\delta_0 e^{i\theta_0} \end{pmatrix}$$

$$\cancel{b^\dagger} b = \begin{pmatrix} \delta_0 e^{i\theta_0} & (1-\cancel{\delta_1})e^{i\theta_1} \\ 0 & -\delta_0 e^{i\theta_0} \end{pmatrix}$$

$$b^\dagger = \begin{pmatrix} \delta_0 e^{-i\theta_0} & 0 \\ (1-\cancel{\delta_1})e^{-i\theta_1} & -\delta_0 e^{-i\theta_0} \end{pmatrix}$$

$$b^\dagger b = \begin{pmatrix} \cancel{1+}\delta_0^2 & \delta_0 e^{+i\theta_1 - i\theta_0} \\ \delta_0 e^{-i\theta_1+i\theta_0} & 1\cancel{+\delta_0^2} \end{pmatrix}$$

$$b b^\dagger = \begin{pmatrix} \cancel{\delta_0^2} & \\ & \end{pmatrix}$$

$$x_0 + i y_0 = \delta_0 e^{i\theta_0}$$
$$x_1 + i y_1 = (1-\delta_1)e^{i\theta_1}$$
$$x_2 + i y_2 = \delta_2 e^{i\theta_2}.$$

$$2\delta_0^2 + 1 - 2\delta_1 + \delta_1^2 + \delta_2^2 = 1.$$
$$(1-\delta_1)\delta_2 e^{i(\theta_1+\theta_2)} = -\delta_0^2 e^{2i\theta_0}$$
$$(1-\delta_1)\delta_2 = \delta_0^2$$
$$\delta_2 = \delta_0^2. \quad \theta_1 + \theta_2 = \theta_0 + \pi.$$

$$\delta_0^2 - \cancel{2}\delta_1 = 0$$
$$\delta_1 = \cancel{\tfrac{1}{2}}\delta_0^2$$

$$b = \begin{pmatrix} \cancel{(1+\tfrac{2}{3}\delta_0^2)}\,\delta_0 e^{i\theta_0} & (1\mp\tfrac{1}{2}\delta_0^2)e^{i\theta_1} \\ \delta_0^2 e^{i(\theta_0-\theta_1+\pi)} & \cancel{(1+\tfrac{2}{3}\delta_0^2)e^{i\theta_1}} - \delta_0 e^{i\theta_0} \end{pmatrix}$$

$$\cancel{b^\dagger b =}\ b^\dagger = \begin{pmatrix} \delta_0 e^{-i\theta_0} & \delta_0^2 e^{-i(\theta_0-\theta_1+\pi)} \\ (1\mp\tfrac{1}{2}\delta_0^2)e^{-i\theta_1} & -\delta_0 e^{-i\theta_0} \end{pmatrix}$$

$$b^\dagger b = \begin{pmatrix} \delta_0^2 & \delta_0 e^{-i(\theta_0-\theta_1)} \\ \delta_0 e^{i(\theta_0-\theta_1)} & 1 - \tfrac{1}{2}\delta_0^2 + \delta_0^2 \end{pmatrix}$$

$$b b^\dagger = \Big($$

$$-i\hbar\begin{pmatrix} 2\delta_0\dot\delta_0 & \{\dot\delta_0 - i(\dot\theta_0-\dot\theta_1)\delta_0\} e^{-i(\theta_0-\theta_1)} \\ \{\dot\delta_0 + i(\dot\theta_0-\dot\theta_1)\delta_0\} e^{i(\theta_0-\theta_1)} & -2\delta_0\dot\delta_0 \end{pmatrix}$$

$$= \begin{pmatrix} \delta_0(e^{i\theta_0}c - e^{-i\theta_0}c^\dagger) & (1-\delta_0^2)e^{i\theta_1}c - \delta_0^2 e^{-i(\theta_0-\theta_1+\pi)}c^\dagger \\ \delta_0^2 e^{i(\theta_0-\theta_1+\pi)}c - (1-\delta_0^2)e^{-i\theta_1}c^\dagger & -\delta_0(e^{i\theta_0}c - e^{-i\theta_0}c^\dagger) \end{pmatrix} e^{-\frac{iE_0}{\hbar}t}$$

$$-i\hbar\dot\delta_0 = (c\,e^{i\theta_0} - c^\dagger e^{-i\theta_0})\, e^{-\frac{iE_0}{\hbar}t} \quad !!!$$

$$-i\hbar\{\dot\delta_0 - i(\dot\theta_0-\dot\theta_1)\delta_0\} e^{-i(\theta_0-\theta_1)} = \{(1-\delta_0^2)e^{i\theta_1}c - \delta_0^2 e^{-i(\theta_0-\theta_1+\pi)}c^\dagger\}\, e^{-\frac{iE_0}{\hbar}t},$$

$\cancel{\dot\delta_0} =$

$\dot\delta_0 =$

$$b = \begin{pmatrix} \delta_0 e^{i\theta_0} & (1-\delta_0^2)e^{i\theta_1} \\ -\delta_0^2 e^{i(\theta_0-\theta_1)} & -\delta_0 e^{i\theta_0} \end{pmatrix} \quad b^\dagger = \begin{pmatrix} \delta_0 e^{-i\theta_0} & -\delta_0^2 e^{-i(\theta_0-\theta_1)} \\ (1-\delta_0^2)e^{-i\theta_1} & -\delta_0 e^{-i\theta_0} \end{pmatrix}$$

$$n = b^\dagger b = \begin{pmatrix} \delta_0^2 & \delta_0 e^{-i(\theta_0-\theta_1)} \\ \delta_0 e^{i(\theta_0-\theta_1)} & 1-\delta_0^2 \end{pmatrix}$$

$$-i\hbar\dot n = bV \mp b^\dagger V^\dagger$$

$$-i\hbar\begin{pmatrix} 2\delta_0\dot\delta_0 & \{\dot\delta_0 - i(\dot\theta_0-\dot\theta_1)\delta_0\} e^{-i(\theta_0-\theta_1)} \\ \{\dot\delta_0 + i(\dot\theta_0+\dot\theta_1)\delta_0\} e^{i(\theta_0-\theta_1)} & -2\delta_0\dot\delta_0 \end{pmatrix} =$$

$$= \begin{pmatrix} \delta_0(e^{i\theta_0}V - e^{-i\theta_0}V^\dagger) & (1-\delta_0^2)e^{i\theta_1}V + \delta_0^2 e^{-i(\theta_0-\theta_1)}V^\dagger \\ -\delta_0^2 e^{i(\theta_0-\theta_1)}V - (1-\delta_0^2)e^{-i\theta_1}V^\dagger & -\delta_0(e^{i\theta_0}V - e^{-i\theta_0}V^\dagger) \end{pmatrix}$$

$$-i\hbar\dot\delta_0 = \tfrac{1}{2}(e^{i\theta_0}V - e^{-i\theta_0}V^\dagger)$$

$$-i\hbar\{\dot\delta_0 + i(\dot\theta_0-\dot\theta_1)\delta_0\} e^{-i(\theta_0-\theta_1)} = (1-\delta_0^2)e^{i\theta_1}V + \delta_0^2 e^{-i(\theta_0-\theta_1)}\cancel{e}V^\dagger$$

$$\hbar(\dot\theta_0-\dot\theta_1)\cancel{\delta_0}\, e^{-i\theta_0} = (1-\delta_0^2)V + \delta_0^2 e^{-i\theta_0}V^\dagger - V + e^{-2i\theta_0}V^\dagger$$

$$= -\delta_0\{V \cancel{+\delta_0} - (e^{-i\theta_0} + \delta_0^{-2}e^{-2i\theta_0})V^\dagger\}$$

$$-i\hbar\dot{\delta}_0 = e^{i\theta_0} V e^{-i\theta_0} V^\dagger$$

$$\hbar(\dot{\theta}_0 - \dot{\theta}_1) = -\delta_0 \{ e^{i\theta_0} V - (\underbrace{1 - e^{-i\theta_0}}_{+\delta_0^{-2}}) V^\dagger \}.$$

$$\cancel{\dot{\theta}_1 = 0}.$$

$$\cancel{\delta_0(t) = \int} \quad \cancel{\hbar(\theta_0}$$

$$\cancel{\delta_0 =} \quad \cancel{\delta_0 =}$$

$$\gamma^{-1}(\hbar(\dot{\theta}_0 - \cancel{\dot{\theta}_1})) = e^{i\theta_0} V - e^{-i\theta_0} V^\dagger$$

$\frac{d\gamma}{dt}$

$i\hbar$

$$i\hbar^2 \left[\frac{d}{dt} \{ \quad \gamma^{-1} \cdot \dot{\theta}_0 + \{ \quad \gamma^{-1} \cdot \ddot{\theta}_0 \right] = e^{i\theta_0} V - e^{-i\theta_0} V^\dagger.$$

$$\cancel{i\hbar^2} \ddot{\theta}_0 \qquad \theta_0 = k_0 t. \qquad \theta_1 = k_1 t$$

$$\hbar(k_0 - k_1) = -\delta_0 \{ e$$

$$V = \sum_{\mu,\nu} a_\mu^\dagger V_{\mu\nu}^i a_\nu \quad = \quad a_1^\dagger a_2 V_{12}^i$$

$$V^\dagger = \sum_{\mu\nu} a_\mu^\dagger V_{\mu\nu}^{\dagger i} a_\nu \qquad a_1^\dagger a_2 \tilde{V}_{21}^i$$

$$= \sum_{\mu,\nu} a_\mu^\dagger \tilde{V}_{\nu\mu}^i a_\nu$$

$$-i\hbar\dot{\delta}_0 = \cdots V_{12}\, e^{i\theta_0 + i\nu_{12} t}.$$

$$-i\hbar\dot{\delta}_0 = \frac{1}{2}(e^{i\theta_0} V - e^{-i\theta_0} V^\dagger)$$

$$-(1+\delta\, e^{i\theta_0}) V$$
$$-(1-\delta e^{-i\theta_0}) V^\dagger$$
$$= 0.$$

$$-i\hbar\dot{\delta}_0 = \frac{1}{2}\{(1-\delta_0^2) e^{i\theta_0} V + \delta_0^2 V^\dagger - \delta_0^2 V - (1-\delta_0^2) e^{-i\theta_0} V^\dagger \}.$$

$$\hbar(\dot{\theta}_0 - \dot{\theta}_1)\delta_0 = \frac{1}{2}\{(1-\delta_0^2) e^{i\theta_0} V + \delta_0^2 V^\dagger + \delta_0^2 V + (1-\delta_0^2) e^{-i\theta_0} V^\dagger \}$$

$$= \frac{1}{2}\{ e^{i\theta_0} V + e^{-i\theta_0} V^\dagger \}.$$

$$\cancel{-i\hbar}\frac{\partial}{\partial t}(\log\delta_0) = \dot{\theta}_0 - \dot{\theta}_1$$

$$\log\delta_0 = i(\theta_0 - \theta_1) + C$$

$$\delta_0 = C e^{i(\theta_0 - \theta_1)}$$

三月十四日.

$$\overline{H} = \int (\psi^\dagger H_E \psi + \chi^\dagger(\gamma^\dagger\psi + \gamma\psi^\dagger)\chi)\,dv = \overline{H}_1 + \overline{H}_2$$

$$i\hbar\frac{\partial}{\partial t}\{\psi_i^\dagger(x)\psi_k(x')\} = \psi_i^\dagger(x)\psi_k(x')\overline{H} - \overline{H}\,\psi_i^\dagger(x)\psi_k(x')$$

$$= \psi_i^\dagger(x)\{\psi_k(x')\overline{H}_1 - \overline{H}_1\psi_k(x')\}$$

$$+ \{\psi_i^\dagger(x)\overline{H}_1 - \overline{H}_1\psi_i^\dagger(x)\}\psi_k(x')$$

$$+ \psi_i^\dagger(x)\{\psi_k(x')\overline{H}_2 + \overline{H}_2\psi_k(x')\}$$

$$- \{\psi_i^\dagger(x)\overline{H}_2 + \overline{H}_2\psi_i^\dagger(x)\}\psi_k(x')$$

$$= \psi_i^\dagger(x)\,H_{kl}\psi_l(x') + \psi_j^\dagger(x)H_{ji}\psi_k(x')$$

$$+ \psi_i^\dagger(x)\cdot\chi^\dagger\gamma_k^\dagger\chi(x') - \chi^\dagger\gamma_i^\dagger\chi(x)\cdot\psi_k(x')$$

$$\cancel{= \psi_i^\dagger(x)\,H_{kl}}$$

$$\psi_k(x') = \sum_\lambda b_\lambda v_k^\lambda(x') \qquad \sim \tilde{v}_k^\lambda(x) H_{kl} v_l^\nu(x')$$

$$\psi_i^\dagger(x) = \sum_\varkappa b_\varkappa^\dagger \tilde{v}_i^\varkappa(x)$$

$$i\hbar\frac{\partial}{\partial t}(b_\varkappa^\dagger b_\lambda) = b_\varkappa^\dagger b_\nu H_k^{\lambda\nu} + H_i'^{\mu\varkappa} b_\mu^\dagger b_\lambda$$

$$+ b_\varkappa^\dagger V_k^\lambda - b_\lambda V_i'^\varkappa$$

$\varkappa = \lambda,$

$$i\hbar\dot{n}_\varkappa = b_\varkappa^\dagger H_k^{\varkappa\nu} b_\nu + b_\mu^\dagger H_i'^{\mu\varkappa} b_\varkappa + b_\varkappa^\dagger V_k^\varkappa - b_\varkappa V_i'^\varkappa$$

$$= E_\varkappa n_\varkappa +$$

$$\overline{H} = \sum_i n_i E_i + \sum a_\mu^\dagger(b_i V_{\mu\nu}^{\dagger i} + b_i^\dagger V_{\mu\nu}^i)a_\nu$$

$$\underline{i\hbar\dot{n}_i = -\sum_{\mu\nu} a_\mu^\dagger(b_i V_{\mu\nu}^{i\dagger} - b_i^\dagger V_{\mu\nu}^i)a_\nu}$$

$\frac{}{}$/ц

三月十五日

$$V = \sum_{\mu,\nu} a_\mu^+ V_{\mu\nu}^i a_\nu$$

$$V^\dagger = \sum_{\mu,\nu} a_\mu^+ V_{\mu\nu}^{+i} a_\nu$$

$$V_{\mu\nu}^i =$$

$$\overline{H} = \sum_i n_i E_i + \sum_\mu N_\mu W_\mu + \sum_{\mu,\nu}^i a_\mu^+ (b_i^+ V_{\mu\nu}^i + b_i V_{\mu\nu}^{+i}) a_\nu$$

$$V_{\mu\nu}^i = \int \{\tilde{u}_\mu \gamma \tilde{v}_i u_\nu\} dv = \int \tilde{u}_\mu^{(\kappa)} \gamma_j^{\kappa\lambda} \tilde{v}_i^{(j)} u_\nu^{(\lambda)} dv$$

$$V_{\mu\nu}^{+i} = \int \{\tilde{u}_\mu \gamma^\dagger v_i u_\nu\} dv = \int \tilde{u}_\mu^{(\kappa)} \tilde{\gamma}_j^{\kappa\lambda} v_i^{(j)} u_\nu^{(\lambda)} dv$$

$$= \overline{\int \tilde{u}_\nu^{(\lambda)} \tilde{\gamma}_j^{\lambda\kappa} v_i^{(j)} u_\mu^{\kappa} dv}$$

$$= \tilde{V}_{\nu\mu}^i$$

$V_{\mu\nu} = 0$ for ~~μ~~ = neutron, ~~ν~~ ν : proton

$V_{\mu\nu} \neq 0$ for $\{\mu$ = proton, ν = Neutron.

$V_{\mu\nu}^\dagger \neq 0$ for $\{\mu$ = Neutron. ν = Proton.

$$\gamma = \frac{1}{2}(\tau_1 + i\tau_2)\lambda \qquad \gamma^\dagger = \frac{1}{2}(\tau_1 - i\tau_2)\lambda^\dagger$$

$$\tau_1 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \tau_2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

$$\tau_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \quad \frac{1}{2}(\tau_1 + i\tau_2) = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$$

$$\frac{1}{2}(\tau_1 - i\tau_2) = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}$$

$$\underset{\text{Proton}}{(1\ 0)} \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} \underset{\text{Neutron}}{\begin{pmatrix} 0 \\ 1 \end{pmatrix}} = (1\ 0)\begin{pmatrix} 1 \\ 0 \end{pmatrix} = 1.$$

$$\sum_i b_i^\dagger \{ \sum_{\substack{\nu:\text{neutron} \\ \mu:\text{Proton}}} a_\mu^+ a_\nu V_{\mu\nu}^i + \sum_{\substack{\nu:\text{Proton} \\ \mu:\text{Neutron}}} a_\nu^+ a_\mu \tilde{V}_{\mu\nu}^i \}$$

$$a_\mu^\dagger a_\nu = N_\mu(1-N_\nu) \ldots$$

$$a_\nu^\dagger a_\mu = N_\nu(1-N_\mu)$$

$$= \sum_i b_i \sum_{\substack{\nu:\text{neutron} \\ \mu:\text{Proton}}} \{ \cancel{a_\mu^+ a_\nu}$$

$$n_i b_j^\dagger - b_j^\dagger n_i = b_i^\dagger \{b_i b_j^\dagger + b_j^\dagger b_i\} - \{b_i^\dagger b_j^\dagger + b_j^\dagger b_i^\dagger\} b_i = b_i^\dagger \delta_{ij}$$

$$n_i b_j - b_j n_i = -b_i \delta_{ij}$$

$$i\hbar \dot{n}_i = n_i \overline{H} - \overline{H} n_i = \sum_{\mu,\nu} a_\mu^+ (V_{\mu\nu} b_i^\dagger - \tilde{V}_{\nu\mu}^{\dagger i} b_i) a_\nu$$

~~$i\hbar \dot{n}_i =$~~

$$b = \begin{pmatrix} x_0+iy_0 & x_1+iy_1 \\ x_2+iy_2 & x_3+iy_3 \end{pmatrix} \quad \cancel{b^2} \quad \left(\cancel{(x_0+iy_0)^2}+(x_1+iy_1)(x_2+iy_2) \right.$$

$$b^\dagger = \begin{pmatrix} x_0-iy_0 & x_2-iy_2 \\ x_1-iy_1 & x_3-iy_3 \end{pmatrix}$$

$$b^2 = \begin{pmatrix} (x_0+iy_0)^2+(x_1+iy_1)(x_2+iy_2) & (x_0+iy_0)(x_1+iy_1)+(x_1+iy_1)(x_3+iy_3) \\ (x_2+iy_2)(x_0+iy_0)+(x_3+iy_3)(x_2+iy_2) & (x_1+iy_1)(x_2+iy_2)+(x_3+iy_3)^2 \end{pmatrix}$$

$= 0$,

$$(x_2+iy_2)\{(x_0+iy_0)+(x_3+iy_3)\}=0$$

$$(x_1+iy_1)\{\quad '' \quad\}=0$$

$$x_3+iy_3 = -(x_0+iy_0).$$

$$(x_0+iy_0)^2+(x_1+iy_1)(x_2+iy_2)=0.$$

$\cancel{b^\dagger b =}$

$$\frac{x_0+iy_0}{x_1+iy_1} = -\frac{x_2+iy_2}{x_0+iy_0} = \kappa \ \frac{1}{\kappa}$$

$\cancel{x_0+iy_0 \quad x_1+iy_1}$

$\cancel{\kappa(x_0+iy_0)} \quad \kappa$

$$x_0+iy_0 = c_0 e^{i\theta_0}$$

$$x_1+iy_1 = c_1 e^{i\theta_1}$$

$$x_2+iy_2 = c_2 e^{i\theta_2}.$$

$$c_0^2 e^{2i\theta_0} = -c_1 c_2 e^{i(\theta_1+\theta_2)} \qquad c_2 = c_0^2/c_1. \qquad \theta_2 = 2\theta_0-\theta_1+\pi.$$

$$b = \begin{pmatrix} c_0 e^{i\theta_0} & c_1 e^{i\theta_1} \\ c_0^2/c_1\, e^{i(2\theta_0-\theta_1+\pi)} & c_0 e^{i(\theta_0+\pi)} \end{pmatrix}$$

$$b^\dagger = \begin{pmatrix} c_0 e^{-i\theta_0} & c_0^2/c_1\, e^{-i(2\theta_0-\theta_1+\pi)} \\ c_1 e^{-i\theta_1} & c_0 e^{-i(\theta_0+\pi)} \end{pmatrix}$$

$$b^\dagger b = \begin{pmatrix} c_0^2 + c_0^4/c_1^2 & c_0c_1 e^{-i(\theta_0-\theta_1)} + c_0^3/c_1\, e^{-i(\theta_0-\theta_1)} \\ c_0c_1 e^{i(\theta_0-\theta_1)} + c_0^3/c_1\, e^{i(\theta_0-\theta_1)} & c_0^2+c_1^2 \end{pmatrix}$$

$$b b^\dagger = \begin{pmatrix} c_0^2 + c_1^2 & c_0^3/c_1\, e^{-i(\theta_0-\theta_1+\pi)} + c_0c_1 e^{-i(\theta_0-\theta_1+\pi)} \\ c_0^3/c_1\, e^{i(\theta_0-\theta_1+\pi)} + c_0c_1 e^{i(\theta_0-\theta_1+\pi)} & c_0^2+c_0^4/c_1^2 \end{pmatrix}$$

$$2c_0^2 + c_1^2 + c_0^4/c_1^2 = 1$$

$$(c_0^2+c_1^2)^2 = c_1^2 \qquad c_0^2+c_1^2 = c_1 \text{ or } -c_1.$$

$$c_0\left(c_1 e^{i(\theta_0-\theta_1)} + c_0^2/c_1\, e^{i(\theta_0-\theta_1)} - c_0^2/c_1 - c_1\right) = 0.$$

$e^{i(\theta_0-\theta_1)}$ $\quad c_0^2 \leq$

$\cancel{c_0} = 0$

$$c_1^2 - c_1 + c_0^2 = 0 \qquad \frac{c_0^2}{c_1} = 1 - c_1$$

$$c_1 = \frac{1 \pm \sqrt{1-4c_0^2}}{2} \quad !!!$$

$$\boxed{c_0 \le \frac{1}{2}}, \qquad b = \begin{pmatrix} c_0 e^{i\theta_0} & c_1 e^{i\theta_1} \\ (c_1-1) e^{i(2\theta_0-\theta_1)} & -c_0 e^{i\theta_0} \end{pmatrix}$$

$$\frac{c_0^2}{c_1^2}, \ c_1$$

$$b^\dagger b = \left(\cancel{\frac{c_0^2}{c_1}} \right) = (c_0^2+c_1^2) \begin{pmatrix} \frac{c_0^2}{c_1^2} & \frac{c_0}{c_1} e^{-i(\theta_0-\theta_1)} \\ \frac{c_0}{c_1} e^{i(\theta_0-\theta_1)} & 1 \end{pmatrix}$$

$$c_1$$

$$b b^\dagger = (c_0^2+c_1^2) \begin{pmatrix} 1 & -\frac{c_0}{c_1} e^{-i(\theta_0-\theta_1)} \\ -\frac{c_0}{c_1} e^{i(\theta_0-\theta_1)} & \frac{c_0^2}{c_1^2} \end{pmatrix}$$

$$c_0^2 + c_1^2 = c^2 \qquad c^2(1+\delta^2) = 1.$$

$$(1+\delta^2) c_1^2 = \frac{1}{1+\delta^2} \qquad \frac{c_0}{c_1} = \delta.$$

$$c_1 = \frac{1}{1+\delta^2}, \quad c_0 = \frac{\delta}{1+\delta^2}$$

$$n = \frac{1}{1+\delta^2} \begin{pmatrix} \delta^2 & \delta e^{-i(\theta_0-\theta_1)} \\ \delta e^{i(\theta_0-\theta_1)} & 1 \end{pmatrix} \qquad b b^\dagger = \frac{1}{1+\delta^2} \begin{pmatrix} 1 & -\delta e^{-i(\theta_0-\theta_1)} \\ -\delta e^{i(\theta_0-\theta_1)} & \delta^2 \end{pmatrix}$$

$$b = \begin{pmatrix} \frac{\delta}{1+\delta^2} e^{i\theta_0} & \frac{1}{1+\delta^2} e^{i\theta_1} \\ -\frac{\delta^2}{1+\delta^2} e^{i(2\theta_0-\theta_1)} & -\frac{\delta}{1+\delta^2} e^{i\theta_0} \end{pmatrix}$$

$$b^\dagger = \begin{pmatrix} \frac{\delta}{1+\delta^2} e^{-i\theta_0} & -\frac{\delta^2}{1+\delta^2} e^{-i(2\theta_0-\theta_1)} \\ \frac{1}{1+\delta^2} e^{-i\theta_1} & -\frac{\delta}{1+\delta^2} e^{-i\theta_0} \end{pmatrix}$$

$$i\hbar \dot{n} = i\hbar \begin{pmatrix} \frac{2\delta\dot\delta}{1+\delta^2} - \frac{2\delta^3\dot\delta}{(1+\delta^2)^2} & \dot\delta e^{-i(\theta_0-\theta_1)} - i(\dot\theta_0-\dot\theta_1)\delta e^{-i(\theta_0-\theta_1)} \\ \dot\delta e^{i(\theta_0-\theta_1)} + i(\dot\theta_0-\dot\theta_1)\delta e^{i(\theta_0-\theta_1)} & -\frac{2\delta\dot\delta}{(1+\delta^2)^2} \end{pmatrix}$$

$$= \begin{pmatrix} \frac{\delta}{1+\delta^2}\left(V e^{-i\theta_0} - V^\dagger e^{i\theta_0}\right) & \frac{1}{1+\delta^2}\left(-V e^{-i(2\theta_0-\theta_1)} \delta^2 + V^\dagger e^{i\theta_1}\right) \\ \frac{1}{1+\delta^2}\left(V e^{-i\theta_1} + \delta^2 V^\dagger e^{i(2\theta_0-\theta_1)}\right) & \frac{\delta}{1+\delta^2}\left(-V e^{-i\theta_0} + V^\dagger e^{i\theta_0}\right) \end{pmatrix}$$

~~$i\hbar \dot{n} =$~~

$$2\dot{\delta} - \frac{2\delta^2}{1+\delta^2}\delta$$

$$i\hbar \frac{2\dot{\delta}}{1+\delta^2} = Ve^{-i\theta_0} - V^\dagger e^{i\theta_0}$$

$$i\hbar\{\dot{\delta} - i(\dot{\theta}_0 - \dot{\theta}_1)\delta\} = \frac{-1}{1+\delta^2}(Ve^{-i\theta_0} + \delta^2 V^\dagger e^{i\theta_0})$$

$$i\hbar\{\dot{\delta} + i(\dot{\theta}_0 - \dot{\theta}_1)\delta\} = \frac{1}{1+\delta^2}(Ve^{-i\theta_0} + \delta^2 V^\dagger e^{i\theta_0})$$

$$i\hbar \frac{2\dot{\delta}}{1+\delta^2} = Ve^{-i\theta_0} - V^\dagger e^{i\theta_0}$$

$$i\hbar\, 2\dot{\delta} = \frac{1-\delta^2}{1+\delta^2}\{Ve^{-i\theta_0} - \cancel{\tfrac{}{1+\delta^2}} V^\dagger e^{i\theta_0}\}$$

$$-2\hbar(\dot{\theta}_0 - \dot{\theta}_1)\delta = Ve^{-i\theta_0} + V^\dagger e^{i\theta_0}$$

$$\underline{1 = \frac{1-\delta^2}{(1+\delta^2)^2}}$$

~~$(1+\delta^2)^2 = 1-\delta^2$~~

~~$1+\delta^2 = \sqrt{1-\delta^2}$~~

$\delta^2 = -1 + \sqrt{1-\delta^2}$

$$1 + 2\delta^2 + \delta^4 = 1 - \delta^2,$$

$$\delta^4 = -3\delta^2$$

$$\delta = 0, \text{ or } \delta^2 = -3.$$

δ : matrix which does not commute with $V, V^\dagger$.

$\boxed{n : \text{some function}}$

$$H\psi + \chi^\dagger \gamma \chi = 0.$$

$F^\dagger F^\dagger$ "E" $\int \ldots dv$

$$\cancel{\chi^\dagger\gamma\chi}\ A_j = 0.$$

$b_i^\dagger$ $\quad i\hbar \dot{b}_i + H_{ij} b_j + A_i^\dagger = 0.$

b_i $\quad -i\hbar \dot{b}_i^\dagger + b_j^\dagger H_{ji}$

$\psi \quad \psi^\dagger\psi$

$b_i A_j^\dagger + A_i^\dagger b_i$

$$\int \boxed{\psi^\dagger A \psi}\, dv$$

$i\hbar \dot{n}_i =$

mat A	Mat mat	Mat Feld	Strahl.

$H\psi + A_\mu \gamma \psi = 0.$

$H' A_\mu = \psi^\dagger \alpha_\mu \psi.$ Relat. contradict each other.

nichtrel.

$A_\mu = A_\mu^{(0)} + A_\mu^{(1)}$

$H\psi + (A_\mu^{(0)} + \alpha_\mu \int \frac{\psi^\dagger \alpha_\mu \psi}{\ldots})\psi = 0.$

$A_\mu^{(0)}\psi \quad -\psi A_\mu^{(0)} = 0.$

但し　$\psi, \psi^\dagger$ は $\bar{H}$ とは commute 出来ない。

いひかへれば

$$\frac{\partial}{\partial t}\left(\psi_i^\dagger(x)\psi_k(x')\right) \neq \dot{\psi}_i^\dagger(x)\cdot\psi_k(x') + \psi_i^\dagger(x)\,\dot{\psi}_k(x')$$

従って　$\cancel{\psi_i^\dagger(x)\,\psi_k(x') + \psi_k(}$

$$\frac{\partial}{\partial t}\left(\psi_i^\dagger(x)\psi_k(x') + \psi_k(x')\psi_i^\dagger(x)\right)$$

$$= \dot{\psi}_i^\dagger(x)\psi_k(x') + \cdots$$

$$= \{\psi_i^\dagger(x)\psi_k(x') + \psi_k(x')\psi_i^\dagger(x)\}\underset{(\bar{H}_1+\bar{H}_2)}{\bar{H}} - \bar{H}\{\psi_i^\dagger(x)\psi_k(x') + \cdots\}$$

$$= \psi_i^\dagger(x)\{\psi_k(x')\bar{H}_1 - \bar{H}_1\psi_k(x')\} + \{\psi_i^\dagger(x)\bar{H}_1 - \bar{H}_1\psi_i^\dagger(x)\}\psi_k(x')$$

$$+ \psi_i^\dagger(x)\{\psi_k(x')\bar{H}_2 + \bar{H}_2\psi_k(x')\} - \{\psi_i^\dagger(x)\bar{H}_2 + \bar{H}_2\psi_i^\dagger(x)\}\psi_k(x')$$

$$+ \psi_k(x')\{\psi_i^\dagger(x)\bar{H}_1 - \bar{H}_1\psi_i^\dagger(x)\} + \{\psi_k(x')\bar{H}_1 - \bar{H}_1\psi_k(x')\}\psi_i^\dagger(x)$$

$$+ \psi_k(x')\{\psi_i^\dagger(x)\bar{H}_2 + \bar{H}_2\psi_i^\dagger(x)\} - \{\psi_k(x')\bar{H}_2 + \bar{H}_2\psi_k(x')\}\psi_i^\dagger(x)$$

$$\dot{\psi}_i^\dagger = \{\psi_i^\dagger(x)\bar{H}_1 - \bar{H}_1\psi_i^\dagger(x)\} - \{\psi_i^\dagger(x)\bar{H}_2 + \bar{H}_2\psi_i^\dagger(x)\}$$

$$= \{\qquad\qquad\} + \{\qquad\qquad\}$$

1),　$b_\kappa^\dagger$

2),

$$i\hbar \dot{n}_i = \sum_{\mu,\nu} a^\dagger_\mu \left(V_{\mu\nu} b^\dagger_i - \tilde{V}^i_{\mu\nu} b_i\right) a_\nu .$$

$$i\hbar \dot{b}_i = b_i \bar{H} - \bar{H} b_i$$

$$= b_i E_i + \sum_{\mu,\nu}^{j} a^\dagger_\mu \left\{ V^j_{\mu\nu} \left(\delta_{ij} - 2 b^\dagger_j b_j i\right) \mp 2 V^{\dagger j}_{\mu\nu} b_j b_i \right\} a_\nu$$

$$\bar{b}_i = \int C_i(E) e^{-\frac{i}{\hbar}(E_i + E_a)t} dE$$

$$(E_i + E_a) C_i(E) = E_i C_i(E) + \sum_{\mu,\nu}^{j} a^\dagger_\mu V^j_{\mu\nu} a_\nu \cdot \left\{ C_i(E) - 2\int C^\dagger_j(E') C_i(E+E') dE' \right\}$$

$$b^\dagger_j b_i = \int C^\dagger_j(E') e^{\frac{i}{\hbar}(E_j + E'_a)t} dE' \int C_i(E) e^{-\frac{i}{\hbar}(E_i + E_a)t} dE$$

$$\cancel{(E_a - E_a' - E_j)} \quad E'' - E' - E_j = E'''.$$

$$\cancel{= \int C^\dagger_j(E'') e \, dE'' \int C_i(E) e \, dE.}$$

$$b \quad E' = \int C^\dagger_j(E') C_i(E'') e^{-\frac{i}{\hbar}(E'' - E')t} dE' dE''$$

$$E'' - E' = E,$$

$$= \int C^\dagger_j(\cancel{E''-E})(E') \, C_i(E+E') \, dE' dE$$

$$E' + E'' = E$$

$$-2\sum_{\mu\nu}^{j} V^{\dagger j}_{\mu\nu} \cancel{b_j b} \int C^*_j(E') \, C_i(E \mp E') \, dE'$$

$$C_i(E)$$

$$\bar{H} = \sum_i n_i E_i + \sum_\mu N_\mu W_\mu + \sum_{\mu\nu}^{i} a_\mu^\dagger (b_i^\dagger V_{\mu\nu}^i + b_i V_{\mu\nu}^{\dagger i}) a_\nu$$

$$V_{\mu\nu}^{\dagger i} = \tilde{V}_{\nu\mu}^i = \int \tilde{u}_\mu^{(\kappa)} \tilde{\gamma}_j^{\lambda\kappa} v_i^{(j)} u_\nu^{(\lambda)} dv$$

$V_{\mu\nu}^i = 0$ for μ : neutron, ν : proton

$\tau_1 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ $\tau_2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$

$\tau_3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

$V_{\mu\nu}^i \neq 0$ for μ = proton, ν : neutron.

$\frac{1}{2}(\tau_1 + i\tau_2) = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

proton neutron

$(1\,0)\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 0 & 1 \end{pmatrix} = (1\,0)\,(1\,0)$

$= \ldots 1 \ldots + \ldots 0 \ldots$

$V_{\mu\nu}^{\dagger i} \neq 0$ for μ : neutron, ν : proton.

$$i\hbar \dot{n}_i = n_i \bar{H} - \bar{H} n_i = \sum_{\mu,\nu} a_\mu^\dagger (V_{\mu\nu}^i b_i^\dagger - \tilde{V}_{\nu\mu}^i b_i) a_\nu$$

$$n_i b_j^\dagger - b_j^\dagger n_i = b_i^\dagger (b_i b_j^\dagger + b_j^\dagger b_i) - (b_i^\dagger b_j^\dagger + b_j^\dagger b_i^\dagger) b_i$$
$$= b_i^\dagger \delta_{ij}$$

$$n_i b_j - b_j n_i = - b_i \delta_{ij}$$

即ち 或る state にある electron の number の変化は、$b_i^\dagger, b_i$ に比例するが、$b_i^\dagger, b_i$ 自身は

$$i\hbar \dot{b}_i^\dagger = b_i^\dagger \bar{H} - \bar{H} b_i^\dagger = - E_i b_i^\dagger + \sum_{\mu,\nu}^{j} a_\mu^\dagger (2 b_i^\dagger b_j^\dagger V_{\mu\nu}^j + (2 b_i^\dagger b_j - \delta_{ij}) \tilde{V}_{\nu\mu}^j) a_\nu$$

$$b_i^\dagger b_j^\dagger - b_j^\dagger b_i^\dagger = 2 b_i^\dagger b_j^\dagger$$

$$b_i^\dagger b_j - b_j b_i^\dagger = 2 b_i^\dagger b_j - \delta_{ij}$$

$$i\hbar \dot{b}_i = b_i \bar{H} - \bar{H} b_i = E_i b_i + \sum_{\mu,\nu}^{j} a_\mu^\dagger (2 b_i b_j V_{\mu\nu}^j + (2 b_i^\dagger b_j - \delta_{ij}) \tilde{V}_{\nu\mu}^j) \times a_\nu$$

なる式を満足するから $b_i, b_i^\dagger$ の time 変化に対しては 中性子陽子との相互作用を小さいと見ることは出来ない。~~従って solution の形を~~ ~~$b_i, b_j^\dagger$ に関する~~

従って solution の形は

$$b_i = \int c_i(E) e^{-\frac{i}{\hbar}Et} dE$$

$$b_i^\dagger = \int c_i^\dagger(E) e^{\frac{iEt}{\hbar}} dE$$

$b_i = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} \ldots$

$b_i^\dagger = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix} \ldots$

となる。 ~~$c_i(E)$~~, $c_i^\dagger(E)$ 等、~~b_i, b_j~~ time $t = 0$ に於て、

$n_i' = 0$ $i = 1, 2, \ldots$ であったとすれば、 $b_i = \begin{pmatrix} \delta_i(t) & \cdots \\ \cdots & \cdots \end{pmatrix}$

$$\sum_j 2 b_i b_j V_{\mu\nu}^j = \sum_j \delta_i(t) \delta_j(t) V_{\mu\nu}^j$$

$V_{\mu\nu}^{i}$, $V_{\mu\nu}^{+i}$ の大いさが問題となる。

$$\sum_{\mu,\nu} a_\mu^{+} V_{\mu\nu}^{j} a_\nu$$

$\cancel{i\hbar \dot{b}_i^{+} =}$ $\quad \overline{H}' = \overline{H} +$

$$\psi_i^{+}(x)\psi_j(x') \sum_k \int \psi_k^{+}(x'') \underset{H_{kl}}{\psi_l(x'')}\, dv'' = \psi_i^{+}(x) \int \delta_{jk}\,\delta(x'-x'')\, \underset{H_{kl}}{\psi_l(x'')}\, dv''$$

$$- \psi_i^{+}(x) \int \psi_k^{+}(x'') \underset{H_{kl}}{\psi_l(x')}\, dv''\, \psi_j(x')$$

$$= \psi_i^{+}(x)\, \psi_l(x')\, H_{jl} + \int \psi_k^{+}(x'')\, H_{kl}\, \delta_{il}\, \delta(x-x'')\, dv''\, \psi_j(x')$$

$$- \int \psi_k^{+}(x'')\, H_{kk} \cdots$$

$$= \psi_i^{+}(x)\, \psi_l(x')\, H_{jl} + \psi_k^{+}(x)\, H_{ki}\, \psi_j(x')$$

$\cancel{H_{jl}\ H}$

$\overline{H}$,

$$\dot{n}_i = \frac{\partial}{\partial t}(b_i^{+} b_i) = b$$

$$\frac{\partial}{\partial t}(b_i^{+} H_{ij} b_j) = b_i^{+} H_{ij} b_j \left(\sum_i n_i E_i + \sum_\mu N_\mu W_\mu + \sum a_\mu^{i}(b_i^{+} V_{\mu\nu}^{i} + b_i V_{\mu\nu}^{+i})\, a_\nu\right)$$

$$- (\qquad)\, b_i^{+} H_{ij} b_j$$

$\dot{b}_i^{+} H_{ij} b_j$

$$= \sum_{ik} \{ b_i^{+} H_{ikj} E_{kj} b_{kj} +$$

$$\sum b_i^{+} H_{ij} b_j \cdot n_k - n_k \sum b_i^{+} H_{ij} b_j = \sum b_i^{+} \{ H_{ij} b_j - n_k H_{ij} b_j$$

$$- \cdots = \sum b_i^{+} H_{ij} b_j - \sum b_i^{+} H_{ij} b_j - \cdots$$

$$b_i^{+} H_{ij} b_j \cdot b_k^{+} = b_k^{+}(\quad) = b_i^{+} H_{ij} \delta_{jk} - b_i^{+} H_{ij} b_k^{+} b_j - \cdots$$

$$\frac{\partial}{\partial t}(b_i^{+} H_{ij} b_j) = (\quad + \cdots) H_{ij} b_j + b_i^{+} H_{ij} (\quad)$$

$$A_i' H_{ij} b_j + b_i^{+} H_{ij} A_j = c(b_i^{+} H_{ij} b_j\ \overline{A} - \overline{A}(\quad))$$

$$=$$

$$i\hbar \frac{\partial \psi}{\partial t} = H\psi - \chi^\dagger(r)\gamma\chi(r)$$

$$+ 2\left\{\int \chi^\dagger(r')\gamma\chi(r')\psi^\dagger(r') + \int \chi^\dagger(r')\gamma^\dagger\chi(r')\psi(r')\,dv'\right]\psi(r)$$

$$\cancel{i\hbar\frac{\partial\psi}{\partial t}} \quad \psi = \int u(r,E)\, e^{-\frac{i}{\hbar}Et}\, dE.$$

$$\int (H-E)\,u(r,E)\,e^{-\frac{i}{\hbar}Et} - A(r)\,e^{-\frac{i}{\hbar}Wt} + 2\iint A(r')\,u^\dagger(r',E')\,e^{\frac{i}{\hbar}E't}\,dE'\,dv' \cdot \int u(r,E)\,e^{-\frac{i}{\hbar}Et}\,dE$$

$$e^{-\frac{i}{\hbar}Wt}$$

$$+ 2\iint A^\dagger(r')\,e^{-\frac{i}{\hbar}Wt}\,u(r',E')\,e^{-\frac{i}{\hbar}E't}\,dE'\,dv' \cdot \int u(r,E)\,e^{-\frac{i}{\hbar}Et}\,dE$$

$$(H-E)\,u(r,E) - A(r)\,\delta(E,W) + 2\iint A(r')\,u^\dagger(r',\cancel{E+W+E''}\,E')\,u(r,E'')\,dE''\,dv'$$

$$(E-W+E')$$

$$+ 2\iint A^\dagger(r')\,u(r',E')\,u(r,E-W-E')\,dv'\,dE'$$

$$E', E''$$

$$\downarrow$$

$$E', E''$$

$$\int e^{\frac{i}{\hbar}(E'-W-E'')t}\,dE'\,dE''$$

$$\int e^{\frac{i}{\hbar}} \quad E' = E+W+E'' \quad dE$$

$$\frac{\partial E'}{\partial E} = 1 \quad \frac{\partial E'}{\partial E''} = 1$$

$$\frac{\partial E''}{\partial E} = 0 \quad \frac{\partial E'}{\partial E''} = 1$$

$$\frac{i}{\hbar}E'$$

$$e^{-\frac{i}{\hbar}(E''+W-E')t} \quad E''+W-E' = E, \quad E'' = E-W+E'.$$

$$e^{-\frac{i}{\hbar}(W+E'+E'')t} \quad E'' = E-E'-W$$

$(H-E)u$

湯川秀樹
玉城嘉十郎
山下敬治
白銀善作
多田政忠
千田香苗

柳田國男著
桃太郎の誕生

千鳥
鶯
鶯