

$$\begin{aligned}
& \langle j, (n+1)\varepsilon | j, n\varepsilon \rangle = \tag{6} \\
& \exp\left(-\frac{i}{\hbar}(n+1)\varepsilon E_j'\right) \langle \phi_j'(\square, (n+1)\varepsilon) | \phi_j'(\square, n\varepsilon) \rangle \exp\left(\frac{i}{\hbar}n\varepsilon E_j'\right) \\
& = \langle \phi_j'(\square, n\varepsilon) | \exp\left(\frac{i}{\hbar}\varepsilon H\right) | \phi_j'(\square, n\varepsilon) \rangle \exp\left(-\frac{i}{\hbar}\varepsilon E_j'\right) \\
& \doteq 1 + O(\varepsilon^2) \cdot \dots \cdot (t_2 - t_1) / \varepsilon \text{ 乗しても } \varepsilon \rightarrow 0 \text{ で } \rightarrow 1
\end{aligned}$$

$$\begin{aligned}
\therefore \int D\chi \overline{\text{dar}(f; -3\varepsilon)\Phi_k[\chi]} \cdot \text{dar}(g; 2\varepsilon)\Phi_j[\chi] \\
\doteq \langle k, -3\varepsilon | f \rangle \delta_{j,k} \langle g | j, 2\varepsilon \rangle
\end{aligned}$$

$$\begin{aligned}
& \int D\chi \overline{\text{dar}(f; -3\varepsilon)\Phi[\chi]} \cdot \text{dar}(g; 2\varepsilon)\Phi[\chi] \\
& = \sum_j \sum_k \int D\chi \overline{\text{dar}(f; -3\varepsilon)\Phi_k[\chi]} \cdot \text{dar}(g; 2\varepsilon)\Phi_j[\chi] \\
& \doteq \sum_j \sum_k \langle g | j, 2\varepsilon \rangle \delta_{j,k} \langle k, -3\varepsilon | f \rangle \\
& = \sum_j \langle g | j, 2\varepsilon \rangle \langle j, -3\varepsilon | f \rangle \\
& = \sum_j \exp\left(\frac{i}{\hbar}2\varepsilon E_j'\right) \langle g | \phi_j'(\square, 2\varepsilon) \rangle \langle \phi_j'(\square, -3\varepsilon) | f \rangle \\
& \qquad \qquad \qquad \exp\left(\frac{i}{\hbar}3\varepsilon E_j'\right) \\
& = \sum_j \langle g | \mathbf{U}(2\varepsilon, -3\varepsilon) | \phi_j'(\square, -3\varepsilon) \rangle \langle \phi_j'(\square, -3\varepsilon) | f \rangle \\
& \qquad \qquad \qquad \exp\left(\frac{i}{\hbar}5\varepsilon E_j'\right) \\
& = \langle g | \mathbf{U}(2\varepsilon, -3\varepsilon) | f \rangle \exp\left(\frac{i}{\hbar}5\varepsilon E_j'\right)
\end{aligned}$$