

goldstone

$$a_p \equiv \begin{array}{c} p \\ \uparrow \\ \bullet \end{array} \quad a_p^\dagger \equiv \begin{array}{c} \bullet \\ \uparrow \\ p \end{array} \quad b_a \equiv \begin{array}{c} a \\ \bullet \\ \uparrow \end{array} \quad b_i \equiv \begin{array}{c} i \\ \bullet \\ \downarrow \end{array} \quad b_a^\dagger \equiv \begin{array}{c} \bullet \\ \downarrow \\ a \end{array} \quad b_i^\dagger \equiv \begin{array}{c} \bullet \\ \downarrow \\ i \end{array} \quad (1)$$

$$\begin{array}{c}
p_1 \quad p_2 \quad p_n \\
\uparrow \quad \uparrow \quad \uparrow \\
\bigcirc \text{---} \bigcirc \text{---} \dots \text{---} \bigcirc \\
\uparrow \quad \uparrow \quad \uparrow \\
q_1 \quad q_2 \quad q_n
\end{array}
\equiv
\begin{array}{c}
p_1 \quad p_2 \quad p_n \\
\uparrow \quad \uparrow \quad \uparrow \\
\bigotimes \text{---} \bigotimes \text{---} \dots \text{---} \bigotimes \\
\uparrow \quad \uparrow \quad \uparrow \\
q_1 \quad q_2 \quad q_n
\end{array}
\quad (2)$$

$$\left(\frac{1}{n!}\right)^2 v_{p_1 p_2 \dots p_n}^{q_1 q_2 \dots q_n} \tilde{a}_{q_1 q_2 \dots q_n}^{p_1 p_2 \dots p_n} \equiv \boxed{v} \text{---} \bigcirc \text{---} \bigcirc \text{---} \dots \text{---} \bigcirc \quad (3)$$

$$h_p^g a_q^p \equiv \text{diagram} \quad (4)$$

$$\begin{array}{c} \boxtimes \\ | \\ \circ \\ | \\ \boxtimes \end{array} = \begin{array}{c} \boxtimes \\ | \\ \bullet \\ | \\ \boxtimes \end{array} + \begin{array}{c} \boxtimes \\ | \\ \bullet \\ | \\ \bullet \\ | \\ \bullet \\ | \\ \boxtimes \end{array} \quad (5)$$

$$\begin{array}{c} \text{---} \square \text{---} \\ \updownarrow \end{array} = \begin{array}{c} \text{---} \square \text{---} \\ \updownarrow \bullet \end{array} + \begin{array}{c} \text{---} \square \text{---} \\ \updownarrow \bullet \end{array} + \begin{array}{c} \text{---} \square \text{---} \\ \updownarrow \bullet \end{array} + \begin{array}{c} \text{---} \square \text{---} \\ \updownarrow \bullet \end{array} \quad (6)$$

$$\frac{1}{4} \bar{g}_{pq}^{rs} a_{rs}^{pq} = \text{diagram of a wavy line with four external legs} \quad (7)$$

$$\text{Diagram 1} = \text{Diagram 2} + \text{Diagram 3} + \text{Diagram 4} + \text{Diagram 5} \quad (8)$$

$$\begin{array}{c} \text{---}\circ\text{---}\circ\text{---} \\ | \quad | \\ \text{---}\circ\text{---}\circ\text{---} \end{array} = \begin{array}{c} \bullet \\ | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \diagdown \quad \diagup \\ | \quad | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \bullet \\ | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \diagdown \quad \diagup \\ | \quad | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \diagdown \quad \diagup \\ | \quad | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \diagdown \quad \diagup \\ | \quad | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \bullet \\ | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \bullet \\ | \\ \text{---}\circ\text{---}\bullet \end{array} + \begin{array}{c} \bullet \\ | \\ \text{---}\circ\text{---}\bullet \end{array} \quad (9)$$

[illegible]

[illegible]

$$\begin{array}{c}
\text{---} \text{---} \text{---} \\
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\text{---} \text{---} \text{---}
\end{array}
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\text{---} \text{---} \text{---}
\end{array}
= \text{---} \text{---} \text{---} \quad (12)$$

$$\begin{aligned}
& \begin{array}{c} a \quad i \quad b \quad j \\ \downarrow \downarrow \downarrow \downarrow \\ \bigotimes \bigcirc \uparrow + \bigcirc \uparrow \text{---} \bigcirc \uparrow \\ \uparrow \quad \uparrow \quad \uparrow \end{array} = \\
& \exp \left(\begin{array}{c} \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \\ \diagup \quad \diagdown \end{array} \right) \\
& \begin{array}{l} + \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad i \quad b \quad j \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ \bigotimes \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} i \quad a \quad j \quad b \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ \bigotimes \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad i \quad b \quad j \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} i \quad a \quad j \quad b \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ \bigcirc \text{---} \bigcirc \end{array} \\
+ \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad b \quad i \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} \\
+ \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} i \quad a \quad j \quad b \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} + \begin{array}{c} a \quad i \quad b \quad j \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ \bigcirc \text{---} \bigcirc \end{array} \end{array} \quad (13)
\end{aligned}$$

