

goldstone

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

$$\begin{array}{ccc}
\begin{array}{c} p_1 \quad p_2 \quad p_n \\ \uparrow \quad \uparrow \quad \uparrow \\ \circ \text{---} \circ \cdots \circ \\ \uparrow \quad \uparrow \quad \uparrow \\ q_1 \quad q_2 \quad q_n \end{array} & \equiv & \begin{array}{c} p_1 \quad p_2 \quad p_n \\ \uparrow \quad \uparrow \quad \uparrow \\ \odot \text{---} \odot \cdots \odot \\ \uparrow \quad \uparrow \quad \uparrow \\ q_1 \quad q_2 \quad q_n \end{array}
\end{array} \quad (2)$$

$$\left(\frac{1}{n!}\right)^2 v_{p_1 p_2 \dots p_n}^{q_1 q_2 \dots q_n} \tilde{a}_{q_1 q_2 \dots q_n}^{p_1 p_2 \dots p_n} \equiv \boxed{v} \begin{array}{c} \updownarrow \\ \circ \end{array} \begin{array}{c} \updownarrow \\ \circ \end{array} \cdots \begin{array}{c} \updownarrow \\ \circ \end{array} \quad (3)$$

$$h_p^q a_q^p \equiv \begin{array}{c} \uparrow \\ \boxed{\times} - \bigcirc \\ \downarrow \end{array} \quad (4)$$

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

$$\text{Diagram 1} = \text{Diagram 2} + \text{Diagram 3} + \text{Diagram 4} + \text{Diagram 5} \quad (6)$$

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

$$\begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} = \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} + \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} + \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} + \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \begin{array}{c} \uparrow \\ | \\ \circ \\ | \\ \uparrow \end{array} \quad (8)$$

$$\text{Diagram 1} = \text{Diagram 2} + \text{Diagram 3} + \text{Diagram 4} + \text{Diagram 5} + \text{Diagram 6} + \text{Diagram 7} + \text{Diagram 8} + \text{Diagram 9} + \text{Diagram 10} \quad (9)$$

$$\begin{array}{c} \square \\ \downarrow \end{array} \circ + \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} = E_0 + \begin{array}{c} \otimes \\ \downarrow \end{array} \circ + \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array}$$

$$E_0 \equiv \begin{array}{c} \square \\ \downarrow \end{array} \circ \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} + \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array}$$

$$\begin{array}{c} \otimes \\ \downarrow \end{array} \circ \equiv \begin{array}{c} \square \\ \downarrow \end{array} \circ + \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \text{---} \begin{array}{c} \downarrow \\ \circ \end{array} \quad (10)$$

$$\begin{array}{c}
1 + \text{[Diagram: Two horizontal lines with a vertex in the middle, emitting two lines to the right]} \\
\otimes \text{[Diagram: A vertex with a loop, emitting two lines to the left]} + \text{[Diagram: A vertex with a loop, emitting two lines to the right]} \\
1 + \text{[Diagram: Two horizontal lines with a vertex in the middle, emitting two lines to the right]}
\end{array} = \text{[Diagram: A vertex with a loop, emitting two lines to the left]} + \text{[Diagram: A vertex with a loop, emitting two lines to the right]} + \text{[Diagram: A vertex with a loop, emitting two lines to the left]} + \text{[Diagram: A vertex with a loop, emitting two lines to the right]} + \text{[Diagram: A vertex with a loop, emitting two lines to the left]} + \text{[Diagram: A vertex with a loop, emitting two lines to the right]} \quad (11)$$

$$\begin{array}{c} \text{---} \text{---} \text{---} \\ \text{---} \text{---} \text{---} \end{array} \left(\begin{array}{c} \text{---} \uparrow \downarrow \text{---} \otimes \text{---} \uparrow \downarrow \text{---} \\ + \\ \text{---} \uparrow \downarrow \text{---} \text{---} \text{---} \uparrow \downarrow \text{---} \end{array} \right) = \begin{array}{c} \text{---} \text{---} \text{---} \\ \text{---} \text{---} \text{---} \end{array} \left(\begin{array}{c} \text{---} \uparrow \downarrow \text{---} \text{---} \uparrow \downarrow \text{---} \\ \text{---} \uparrow \downarrow \text{---} \text{---} \uparrow \downarrow \text{---} \end{array} \right) \quad (12)$$

(13)

(14)