

goldstone

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

$$\begin{array}{ccc}
 \begin{array}{c} p_1 \quad p_2 \quad p_n \\ \uparrow \quad \uparrow \quad \uparrow \\ \bigcirc \text{---} \bigcirc \text{---} \dots \text{---} \bigcirc \\ \uparrow \quad \uparrow \quad \uparrow \\ q_1 \quad q_2 \quad q_n \end{array} & \equiv & a_{q_1 q_2 \dots q_n}^{p_1 p_2 \dots p_n} \\
 \begin{array}{c} p_1 \quad p_2 \quad p_n \\ \uparrow \quad \uparrow \quad \uparrow \\ \bigcirc \text{---} \bigcirc \text{---} \dots \text{---} \bigcirc \\ \uparrow \quad \uparrow \quad \uparrow \\ q_1 \quad q_2 \quad q_n \end{array} & \equiv & \tilde{a}_{q_1 q_2 \dots q_n}^{p_1 p_2 \dots p_n}
 \end{array} \quad (2)$$

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

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

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

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

$$\frac{1}{4} \bar{g}_{pq}^{rs} a_{rs}^{pq} = \text{diagram} \quad (7)$$

[illegible]

$$\text{Diagram 1} = \text{Diagram 2} + \text{Diagram 3} + \text{Diagram 4} + \text{Diagram 5} + \text{Diagram 6} + \text{Diagram 7} + \text{Diagram 8} + \text{Diagram 9} + \text{Diagram 10} + \text{Diagram 11} \quad (9)$$

[illegible]

$$\begin{array}{c}
1 + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} \\
\hline
\text{[Diagram: a vertex with two incoming lines and two outgoing lines]} + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} = \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]} \\
\hline
1 + \text{[Diagram: a vertex with two incoming lines and two outgoing lines]}
\end{array} \quad (11)$$

$$\begin{array}{c} \text{---} \\ \text{---} \end{array} \left(\begin{array}{ccc} \otimes & + & \\ \uparrow & & \uparrow \\ \downarrow & & \downarrow \end{array} \right) = \exp \left(\begin{array}{cc} \swarrow & \searrow \\ \bullet & \bullet \\ \nwarrow & \nearrow \end{array} \right) = \begin{array}{c} \bullet \quad \bullet \\ \curvearrowright \quad \curvearrowleft \\ \bullet \quad \bullet \\ \text{---} \end{array} \tag{12}$$

$$\begin{array}{c}
 \begin{array}{c} a \quad i \\ \diagdown \quad \diagup \\ \bullet \end{array} \\
 \hline
 \begin{array}{c}
 1 + \begin{array}{c} \bullet \\ \diagdown \quad \diagup \end{array} \\
 \begin{array}{c} \uparrow \\ \bigotimes - \bigcirc \\ \downarrow \end{array} + \begin{array}{c} \uparrow \\ \bigcirc - \text{wavy} - \bigcirc \\ \downarrow \end{array} \\
 1 + \begin{array}{c} \diagdown \quad \diagup \\ \bullet \end{array}
 \end{array}
 \end{array} \quad (14)$$