

Diagrammatic Rep. of Correlation functions

$$G_{12}^{(2)^{-1}} \quad \text{---}$$

$$G_{123}^{(3)} \quad \triangle$$

$$G_{1234}^{(4)} \quad \square$$

① with touching dots meaning $\sum_{\alpha} \int d\vec{r}$

e.g.

$$\begin{array}{c} \bullet^1 \\ | \\ \bullet^{1'} \\ \triangle \\ \bullet^{2'} \quad \bullet^{3'} \end{array} = \sum_{\alpha_1'} \tilde{G}_{1'2'3'}^{(3)} \tilde{G}_{1'1}^{(2)^{-1}} \triangle_{\alpha_1'}$$

② free ends are summed over

$$\begin{array}{c} 2 \\ \bullet \text{---} \bullet^1 \end{array} \quad \sum_{\alpha_1 \alpha_2} G_{12}^{(2)^{-1}} \Delta_{\alpha_1} \Delta_{\alpha_2}$$

$$\Gamma_{12}^{(2)} \psi_1 \psi_2 = \sum_{\xi_1 \xi_2} \int d\vec{r}_1 d\vec{r}_2 \left(-2\chi_{\xi_1 \xi_2} + \text{---} \right) \psi_1 \psi_2$$

$$\Gamma_{123}^{(3)} \psi_1 \psi_2 \psi_3 = - \sum_{\xi_1 \xi_2 \xi_3} \int d\vec{r}_1 d\vec{r}_2 d\vec{r}_3 \text{---} \psi_1 \psi_2 \psi_3$$

$$\Gamma_{1234}^{(4)} \psi_1 \psi_2 \psi_3 \psi_4 = \sum_{\xi_1 \xi_2 \xi_3 \xi_4} \int d\vec{r}_1 d\vec{r}_2 d\vec{r}_3 d\vec{r}_4$$

$$\times \left(\text{---} - 3 \text{---} \right) \psi_1 \psi_2 \psi_3 \psi_4$$

Mean field vertices with replica trick

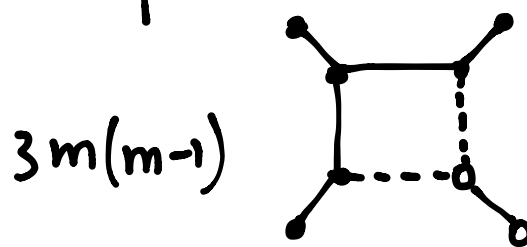
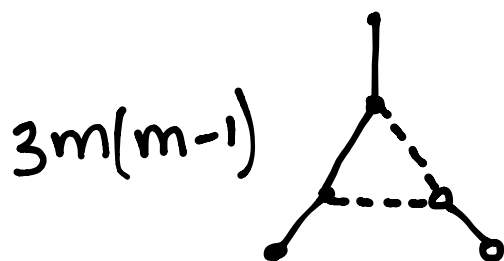
$$\Gamma^{(2)} \quad \text{---} \cdot \text{---} = m \left(-2\chi + \text{---} \cdot \text{---} \right)$$

$$\Gamma^{(3)} \quad \begin{array}{c} \text{---} \\ \diagup \quad \diagdown \\ \cdot \end{array} = m \quad \begin{array}{c} \cdot \\ | \\ \cdot \\ \diagup \quad \diagdown \\ \cdot \quad \cdot \end{array}$$

$$\Gamma^{(4)} \quad \begin{array}{c} \diagup \quad \diagdown \\ \cdot \\ \diagdown \quad \diagup \end{array} = m \left[\begin{array}{c} \cdot \quad \cdot \\ \diagup \quad \diagdown \\ \cdot \quad \cdot \\ \diagdown \quad \diagup \\ \cdot \quad \cdot \end{array} - 3 \begin{array}{c} \cdot \quad \cdot \\ \diagup \quad \diagdown \\ \cdot \quad \cdot \\ \diagdown \quad \diagup \\ \cdot \quad \cdot \end{array} \right]$$

$$+ 3m(m-1) \left\{ \begin{array}{c} \cdot \quad \cdot \\ \diagup \quad \diagdown \\ \cdot \quad \cdot \\ \diagdown \quad \diagup \\ \circ \quad \circ \end{array} - \begin{array}{c} \cdot \quad \cdot \\ \diagup \quad \diagdown \\ \cdot \quad \cdot \\ \diagdown \quad \diagup \\ \circ \quad \circ \end{array} \right\}$$

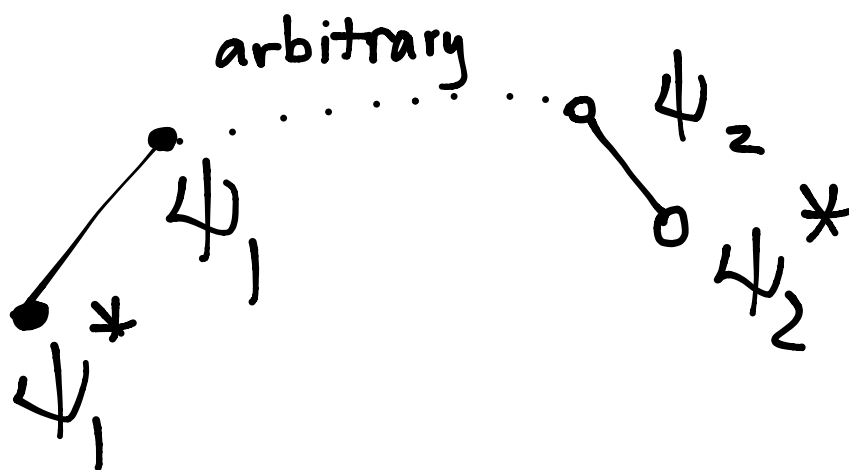
where $\delta(\vec{k})$ contributions to βF are omitted



non-local interaction in $\Gamma^{(4)}$

$$\{ \} = \Gamma_{nl}^{(4)} = \delta(\vec{q}_1 + \vec{q}_2) \delta(\vec{q}_3 + \vec{q}_4) \dots$$

$$\beta F_{nl} = \int d\vec{q}_1 d\vec{q}_2 \Gamma_{nl}^{(4)}(\vec{q}_1, \vec{q}_2) \psi_1^2(\vec{q}_1) \psi_2^2(\vec{q}_2)$$



One-loop Corrections of Correlation

$$\text{---} \text{---} \text{---} = -2\chi + \text{---} + \frac{1}{2} \text{---} - \frac{1}{2} \text{---}$$

$$\begin{array}{c} \vec{k}_1 \quad -\vec{k}_1 \\ \diagup \quad \diagdown \\ \text{---} \\ \diagdown \quad \diagup \\ \vec{k}_2 \quad -\vec{k}_2 \end{array} = \text{---} - \frac{3}{2} \text{---} + \frac{1}{2} \text{---}$$

($\vec{k}_1 \neq -\vec{k}_2$)

$$\begin{array}{c} \vec{k} \quad -\vec{k} \\ \diagup \quad \diagdown \\ \text{---} \\ \diagdown \quad \diagup \\ \vec{k} \quad -\vec{k} \end{array} = \text{---} - 3 \text{---} + 1 \text{---}$$