$$V \cdot \hat{N}\mathcal{G}(\tau-\tau')\hat{N} \quad V(\tau_1-\tau')V(\tau-\tau_2)\cdot\hat{N}\mathcal{G}(\tau-\tau_1)\hat{N}\mathcal{G}(\tau_1-\tau_2)\hat{N}\mathcal{G}(\tau_2-\tau')\hat{N}$$

$$V_k(\tau) = \sum_k e^{-\omega_k\tau}\frac{\cosh\frac{\omega_k}{2}}{\sinh\frac{\omega_k}{2}}$$

$$\frac{\partial\langle\cos\phi\rangle}{\partial T} \approx \frac{\langle\cos\phi\rangle|_{T_i} - \langle\cos\phi\rangle|_{T_{i+1}}}{\Delta T} \quad , \quad \Delta T = |T_i - T_{i+1}| \tag{1}$$

$$\begin{cases} \frac{\partial\langle\cos\phi\rangle}{\partial T} > 0 & : \quad \text{insulating} \\ \frac{\partial\langle\cos\phi\rangle}{\partial T} < 0 & : \quad \text{superconducting} \\ \frac{\partial\langle\cos\phi\rangle}{\partial T} = 0 & : \quad \text{crossover point} \end{cases} \tag{2}$$

$$\chi_{sp}(\omega=0) \approx \beta\chi_{sp}(\tau=\frac{\beta}{2})$$

$$\frac{\partial\chi_{sp}(\omega=0)}{\partial T} \tag{3}$$

$$\begin{cases} \frac{\partial\chi_{sp}(\omega=0)}{\partial T} > 0 & : \quad \text{insulating} \\ \frac{\partial\chi_{sp}(\omega=0)}{\partial T} < 0 & : \quad \text{superconducting} \\ \frac{\partial\chi_{sp}(\omega=0)}{\partial T} = 0 & : \quad \text{crossover point} \end{cases} \tag{4}$$