

One loop ϕ self-energy with N_f fermion flavors:

$$\begin{aligned}\Sigma_\phi(\vec{q}, \omega) &= N_f \int \frac{d^2 k}{4\pi^2} \frac{d\Omega}{2\pi} \frac{1}{[-i(\Omega + \omega) + k_x + q_x + (k_y + q_y)^2] [-i\Omega - k_x + k_y^2]} \\ &= \frac{N_f}{4\pi} \frac{|\omega|}{|q_y|}\end{aligned}$$