

Scaling equations

$$\begin{aligned}
\Delta\epsilon_d &= \sum_q \left(\frac{|V_q^0|^2}{\omega - \epsilon_q^+ + \epsilon_d} + \frac{|V_q^1|^2}{\omega + \epsilon_q^- - \epsilon_d - U} - \frac{2|V_q^0|^2}{\omega + \epsilon_q^- - \epsilon_d} \right) \\
\Delta U &= \sum_q 2 \left(\frac{|V_q^1|^2}{\omega - \epsilon_q^+ + \epsilon_d + U} - \frac{|V_q^1|^2}{\omega + \epsilon_q^- - \epsilon_d - U} + \frac{|V_q^0|^2}{\omega + \epsilon_q^- - \epsilon_d} - \frac{|V_q^0|^2}{\omega - \epsilon_q^+ + \epsilon_d} \right) \\
\Delta V_k^1 &= \sum_q V_2 V_q^1 \left[\frac{1}{\omega + \epsilon_q^- - \epsilon_k^+} + \frac{1}{\omega - \epsilon_q^+ + \epsilon_d + U} \right] \\
\Delta V_k^{1*} &= \sum_q V_2 V_q^{1*} \left[\frac{1}{\omega + \epsilon_k^- - \epsilon_q^+} + \frac{1}{\omega + \epsilon_q^- - \epsilon_d - U} \right] \\
\Delta V_k^0 &= \sum_q 2V_2 V_q^0 \frac{1}{\omega + \epsilon_q^- - \epsilon_k^+} \\
\Delta V_k^{0*} &= \sum_q 2V_2 V_q^{0*} \frac{1}{\omega + \epsilon_q^- - \epsilon_d}
\end{aligned} \tag{1.47}$$

Scaling equations (New)

$$\begin{aligned}
\mathcal{H} &= \sum_{k\sigma} \epsilon_k \hat{n}_{k\sigma} + \sum_{k\sigma} \left(V_k c_{k\sigma}^\dagger c_{d\sigma} + h.c. \right) + \epsilon_d \sum_{\sigma} \hat{n}_{d\sigma} + U \hat{n}_{d\uparrow} \hat{n}_{d\downarrow} + \sum_{kk'\sigma\sigma'} u_1 c_{d\sigma'}^\dagger c_{k\sigma}^\dagger c_{d\sigma} c_{k'\sigma'} \\
&\quad + \sum_{kk'\sigma\sigma'} u_2 c_{d\sigma}^\dagger c_{k\sigma'}^\dagger c_{d\sigma} c_{k'\sigma'} \\
\Delta\epsilon_d &= \sum_q \left(\frac{|V_q^0|^2}{\omega - \epsilon_q^+ + \epsilon_d} + \frac{|V_q^1|^2}{\omega + \epsilon_q^- - \epsilon_d - U - u_2} - \frac{2|V_q^0|^2}{\omega + \epsilon_q^- - \epsilon_d} \right) \\
\Delta U &= \sum_q 2 \left(\frac{|V_q^1|^2}{\omega - \epsilon_q^+ + \epsilon_d + U - u_2} - \frac{|V_q^1|^2}{\omega + \epsilon_q^- - \epsilon_d - U + u_2} + \frac{|V_q^0|^2}{\omega + \epsilon_q^- - \epsilon_d} - \frac{|V_q^0|^2}{\omega - \epsilon_q^+ + \epsilon_d} \right) \\
\Delta V_k^1 &= \sum_q u_1 V_q^1 \left[\frac{1 - 2u_2/u_1}{\omega + \epsilon_q^- - \epsilon_k^+ + u_2} + \frac{1 + u_2/u_1}{\omega - \epsilon_q^+ + \epsilon_d + U - u_2} \right] \\
\Delta V_k^{1*} &= \sum_q u_1 V_q^{1*} \left[\frac{1 + u_2/u_1}{\omega + \epsilon_k^- - \epsilon_q^+ - u_2} + \frac{1 - 2u_2/u_1}{\omega + \epsilon_q^- - \epsilon_d - U + u_2} \right] \\
\Delta V_k^0 &= \sum_q u_1 V_q^0 \frac{2 - u_2/u_1}{\omega + \epsilon_q^- - \epsilon_k^+} \\
\Delta V_k^{0*} &= \sum_q u_1 V_q^{0*} \frac{2 - u_2/u_1}{\omega + \epsilon_q^- - \epsilon_d}
\end{aligned}$$