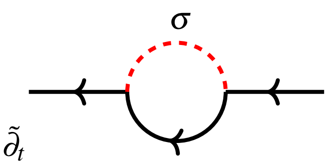
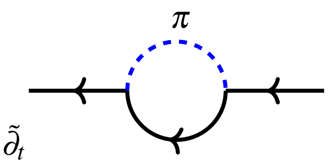
1 Flow equation

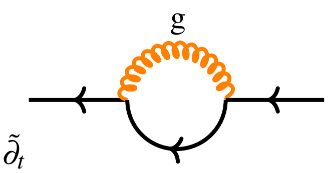
$$\partial_t \Gamma_k \sim \partial_t \{\bar{q} m_f q\}$$



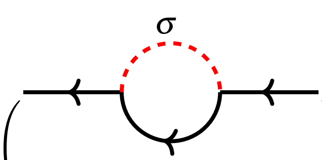
$$= -\tilde{\partial}_t$$



$$-\tilde{\partial}_t$$



$$-\tilde{\partial}_t \tag{1}$$



$$\begin{aligned}
\partial_t (m_f(p))^{\sigma} &= -\tilde{\partial}_t \left(\frac{1}{4} tr \left(\quad \right) \Big|_p \right) \\
&= -\tilde{\partial}_t \sum\!\!\!\!\!\!\int \left(\frac{1}{Z_{\phi,k} Z_{q,k}} \frac{h_k^2}{4} \bar{m}_f \bar{G}_k^q(q) \bar{G}_k^{\sigma}(q-p) \right) \\
&= -\frac{1}{Z_{\phi,k} Z_{q,k}} \frac{h_k^2}{4} \bar{m}_f \sum\!\!\!\!\!\!\int \left(\tilde{\partial}_t \bar{G}_k^q(q) \bar{G}_k^{\sigma}(q-p) + \bar{G}_k^q(q-p) \tilde{\partial}_t \bar{G}_k^{\sigma}(q) \right)
\end{aligned} \tag{2}$$

$$\tilde{\partial}_t \bar{G}_k^q(q) = -2k^2 (\bar{G}_k^q(q))^2 [(1-\eta_q) + \eta_q x^{\frac{1}{2}}] \theta(1-x) \tag{3}$$

$$\tilde{\partial}_t \bar{G}_k^{\sigma}(q) = -k^2 (\bar{G}_k^{\sigma}(q))^2 [(2-\eta_\phi) + \eta_\phi x] \theta(1-x) \tag{4}$$

$$\begin{aligned}
& T \sum_n \int \frac{d^3 q}{(2\pi)^3} (\tilde{\partial}_t \bar{G}_k^q(q)) \bar{G}_k^{\sigma}(q-p) \\
=& T \sum_n \int \frac{d^3 q}{(2\pi)^3} (-2) \frac{1}{k^2} (\tilde{G}_k^q(q))^2 [(1-\eta_q) + \eta_q x^{\frac{1}{2}}] \theta(1-x) \frac{1}{k^2} \tilde{G}_k^{\sigma}(q-p) \\
=& -\frac{2}{k^4} \frac{1}{(2\pi)^3} \int_0^{\infty} q^2 dq \int_{-1}^{1} d\cos\theta (2\pi) [(1-\eta_q) + \eta_q x^{\frac{1}{2}}] \theta(1-x) T \sum_n \tilde{G}_k^q(q))^2 \tilde{G}_k^{\sigma}(q-p) \\
=& -\frac{1}{(2\pi)^2} \int_0^1 x^{\frac{1}{2}} [(1-\eta_q) + \eta_q x^{\frac{1}{2}}] dx \int_{-1}^{1} d\cos\theta \frac{T}{k} \sum_n \tilde{G}_k^q(q))^2 \tilde{G}_k^{\sigma}(q-p)
\end{aligned} \tag{5}$$

here we note that

$$\begin{aligned}\mathscr{F}2\mathscr{B}1p(m_q;m_\phi) &\equiv \frac{T}{k}\sum_n \tilde{G}_k^q(q))^2\tilde{G}_k^\phi(q-p)\\ &= \mathscr{F}2\mathscr{B}1(m_q;m_{\phi,q-p})\end{aligned} \tag{6}$$

Then

$$above = -\frac{1}{(2\pi)^2}\int_0^1 x^{\frac{1}{2}}[(1-\eta_q)+\eta_q x^{\frac{1}{2}}]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}2\mathscr{B}1(m_q;m_{\sigma,q-p}) \tag{7}$$

$$\begin{aligned}&T\sum_n\int\frac{d^3q}{(2\pi)^3}\bar{G}_k^q(q-p)\tilde{\partial}_t\bar{G}_k^\sigma(q)\\ &= -\frac{1}{2(2\pi)^2}\int_0^1 x^{\frac{1}{2}}[(2-\eta_\phi)+\eta_\phi x]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}1\mathscr{B}2(m_{q,q-p};m_\sigma)\end{aligned} \tag{8}$$

Then

$$\begin{aligned}\partial_t(\bar{m}_f(p))^\sigma =&\frac{\bar{h}_k^2\bar{m}_{f,k}}{8(2\pi)^2}\Bigg(2\int_0^1 x^{\frac{1}{2}}[(1-\eta_q)+\eta_q x^{\frac{1}{2}}]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}2\mathscr{B}1(m_q;m_{\sigma,q-p})\\ &+\int_0^1 x^{\frac{1}{2}}[(2-\eta_\phi)+\eta_\phi x]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}1\mathscr{B}2(m_{q,q-p};m_\sigma)\Bigg)\end{aligned} \tag{9}$$

similar

$$\begin{aligned}\partial_t(\bar{m}_f(p))^\pi =&\frac{3\bar{h}_k^2\bar{m}_{f,k}}{8(2\pi)^2}\Bigg(2\int_0^1 x^{\frac{1}{2}}[(1-\eta_q)+\eta_q x^{\frac{1}{2}}]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}2\mathscr{B}1(m_q;m_{\pi,q-p})\\ &+\int_0^1 x^{\frac{1}{2}}[(2-\eta_\phi)+\eta_\phi x]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}1\mathscr{B}2(m_{q,q-p};m_\pi)\Bigg)\end{aligned} \tag{10}$$

$$\begin{aligned}\partial_t(\bar{m}_f(p))^A =&-\frac{3\bar{m}_{f,k}\bar{g}_k^2C_2(N_c)}{2(2\pi)^2}\Bigg(2\int_0^1 x^{\frac{1}{2}}[(1-\eta_q)+\eta_q x^{\frac{1}{2}}]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}2\mathscr{B}1(m_q;m_{A,q-p})\\ &+\int_0^1 x^{\frac{1}{2}}[(2-\eta_A)+\eta_A x]dx\int_{-1}^1 d\cos\theta\,\mathscr{F}1\mathscr{B}2(m_{q,q-p};m_A)\Bigg)\end{aligned} \tag{11}$$

$$\partial_t(\bar{m}_f(p)) = \partial_t(\bar{m}_f(p))^\sigma + \partial_t(\bar{m}_f(p))^\pi + \partial_t(\bar{m}_f(p))^A \tag{12}$$

$$\begin{aligned}\bar{m}_f(p) &= \bar{m}_f(p)\Big|_\Lambda + \int_0^{ln(IR/\Lambda)}(\partial_t(\bar{m}_f(p))dt = 0 + \int_\Lambda^{IR}(\partial_t(\bar{m}_f(p))\frac{dk}{k}\\ &= -\int_{IR}^\Lambda \frac{\partial_t(\bar{m}_f(p)}{k}dk\end{aligned} \tag{13}$$