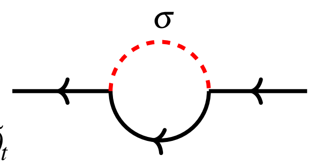
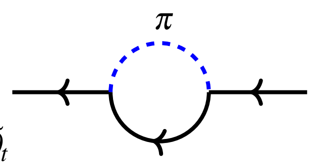
1 Flow equation

$$\partial_t \Gamma_k \sim \partial_t \{\bar{q}(Z_{q,k} i\gamma_\mu q_\mu + m_f)q\}$$

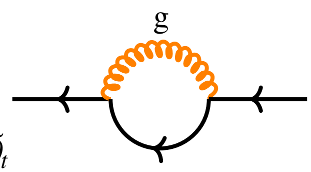
$$= -\tilde{\partial}_t$$



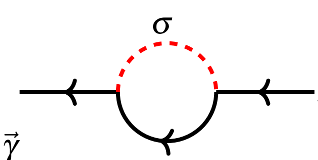
$$-\tilde{\partial}_t$$



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



$$\eta_q^\sigma = -\frac{1}{Z_{q,k}}\frac{1}{p^2}\tilde{\partial}_t\left(\frac{1}{4}tr\left(i\vec{p}\cdot\vec{\gamma}\right.\right.$$



$$\left.\left.\left.\right)\right|_p\right)$$

$$\begin{aligned}
&= -\frac{1}{Z_{q,k}}\frac{1}{p^2}\tilde{\partial}_t \sum\!\!\!\!\!\!\int \left(\frac{1}{Z_{\phi,k}Z_{q,k}}\frac{h_k^2}{4}(\vec{p}\cdot\vec{q}_F)\bar{G}_k^q(q)\bar{G}_k^\sigma(q-p)\right) \\
&= -\frac{1}{Z_{\phi,k}Z_{q,k}^2}\frac{1}{p^2}\frac{h_k^2}{4}\sum\!\!\!\!\!\!\int \Big((\tilde{\partial}_t\vec{q}_F)\cdot\vec{p}\bar{G}_k^q(q)\bar{G}_k^\sigma(q-p) + (\vec{q}_F\cdot\vec{p})\tilde{\partial}_t\bar{G}_k^q(q)\bar{G}_k^\sigma(q-p) \\
&\quad + (\overrightarrow{q-p})_F\cdot\vec{p}\bar{G}_k^q(q-p)\tilde{\partial}_t\bar{G}_k^\sigma(q)\Big)
\end{aligned} \tag{2}$$

$$(\tilde{\partial}_t q_F)\cdot\vec{p} = \vec{q}(\tilde{\partial}_t r_F)\cdot\vec{p} = \vec{q}\cdot\vec{p}\frac{1}{Z_{q,k}}\partial_t(Z_{q,k}r_F) = [(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)\vec{q}\cdot\vec{p} \tag{3}$$

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

$$\tilde{\partial}_t\bar{G}_k^\sigma(q) = -k^2(\bar{G}_k^\sigma(q))^2[(2-\eta_\phi)+\eta_\phi x]\theta(1-x) \tag{5}$$

$$
\begin{aligned}
&T\sum_n\int\frac{d^3q}{(2\pi)^3}(\tilde{\partial}_t\vec{q}_F)\cdot\vec{p}\bar{G}_k^q(q)\bar{G}_k^\sigma(q-p)\\
=&T\sum_n\int\frac{d^3q}{(2\pi)^3}[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)(\vec{q}\cdot\vec{p})\frac{1}{k^4}\tilde{G}_k^q(q)\tilde{G}_k^\sigma(q-p)\\
=&\int\frac{d^3q}{(2\pi)^3}[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)(\vec{q}\cdot\vec{p})\frac{1}{k^3}\frac{T}{k}\sum_n\tilde{G}_k^q(q)\tilde{G}_k^\sigma(q-p)
\end{aligned}
\tag{6}
$$

here we note that

$$
\begin{aligned}
&\frac{T}{k}\sum_n\tilde{G}_k^q(q)\tilde{G}_k^\phi(q-p)\\
&=\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})
\end{aligned}
\tag{7}
$$

then

$$
\begin{aligned}
above=&\int\frac{d^3q}{(2\pi)^3}[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)(qp\cos\theta)\frac{1}{k^3}\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})\\
=&\frac{p}{(2\pi)^2}\int_0^\infty q^2dq\int_{-1}^1 d\cos\theta\frac{1}{k^3}[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)q\cos\theta\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})\\
=&\frac{p}{(2\pi)^2}\int_0^\infty q^3dq\frac{1}{k^3}[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\theta(1-x)\int_{-1}^1 d\cos\theta\cos\theta\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})\\
=&\frac{kp}{2(2\pi)^2}\int_0^1 xdx[(1-\eta_q)x^{-\frac{1}{2}}+\eta_q]\int_{-1}^1 d\cos\theta\cos\theta\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})\\
=&\frac{kp}{2(2\pi)^2}\int_0^1 dx[(1-\eta_q)x^{\frac{1}{2}}+\eta_q x]\int_{-1}^1 d\cos\theta\cos\theta\mathscr{F}1\mathscr{B}1(m_q;m_{\phi,q-p})
\end{aligned}
\tag{8}
$$