This is a correction to "SRC single-particle momentum distribution notes."

Terms 2 and 3 were wrong. Corrected derivation below. ($n_\lambda^{m_t}(\vec q) = \hat U \sum_{m_s} a^\dagger_{\vec q m_s m_t} a_{\vec q m_s m_t} \hat U^\dagger$ here)

$$\frac{1}{4} \sum_{m_s m_s' m_s'' m_s''' m_s^{(4)}} \sum_{m_t' m_t'' m_t''' m_t^{(4)}} \langle \vec k\, m_s' m_t' m_s'' m_t'' | \delta \tilde U | \vec k'\, m_s''' m_t''' m_s^{(4)} m_t^{(4)} \rangle \times$$

$$a^\dagger_{\frac{\vec K}{2}+\vec k\, m_s' m_t'}\, a^\dagger_{\frac{\vec K}{2}-\vec k\, m_s'' m_t''}\, a_{\frac{\vec K}{2}-\vec k'\, m_s^{(4)} m_t^{(4)}}\, a_{\frac{\vec K}{2}+\vec k'\, m_s''' m_t'''}\, a^\dagger_{\vec q\, m_s m_t}\, a_{\vec q\, m_s m_t}$$

Contractions w.r.t. $|0\rangle$:

$$a_1^\dagger a_2^\dagger a_4 a_3 a_5^\dagger a_5$$

(anti-symmetrized $\delta \tilde U$ so factor of 2)

$$\rightarrow \quad \delta_{\frac{\vec K}{2}+\vec k', \vec q}\, \delta_{m_s''' m_s}\, \delta_{m_t''' m_t} \qquad (\text{relabel } m_s^{(4)} \equiv m_s'')$$

$$= \frac{1}{2} \sum_{m_s m_s' m_s'' m_s'''} \sum_{m_t' m_t'' m_t'''} \langle \vec k\, m_s' m_t' m_s'' m_t'' | \delta \tilde U | \vec q - \frac{\vec K}{2}\, m_s m_t m_s''' m_t''' \rangle$$

$$a^\dagger_{\frac{\vec K}{2}+\vec k\, m_s' m_t'}\, a^\dagger_{\frac{\vec K}{2}-\vec k\, m_s'' m_t''}\, a_{\vec K-\vec q\, m_s''' m_t'''}\, a_{\vec q\, m_s m_t}$$

Contractions w.r.t. $|\Phi\rangle$

$$a_1^\dagger a_2^\dagger a_6 a_5$$

(antisymmetrized $\rightarrow$ factor of 2)

$$\rightarrow \langle \Phi | \, \delta_{\frac{\vec{K}}{2}+\vec{k},\, \vec{q}} \, \delta_{m_s' m_s} \, \delta_{m_t' m_t} \, \hat{n}_{\vec{q} m_s m_t} \times$$

$$\delta_{\frac{\vec{K}}{2}-\vec{k},\, \vec{K}-\vec{q}} \, \delta_{m_s'', m_s'''} \, \delta_{m_t'', m_t'''} \, \hat{n}_{\vec{K}-\vec{q}\, m_s'' m_t''} \, | \Phi \rangle$$

$$\Rightarrow \vec{K} = 2(\vec{q} - \vec{k}) \Rightarrow \vec{K} - \vec{q} = \vec{q} - 2\vec{k}$$

$$\Rightarrow \sim \langle \Phi | \, \hat{n}_{\vec{q}\, m_s m_t} \, \hat{n}_{\vec{q}-2\vec{k}\, m_s'' m_t''} \, | \Phi \rangle$$

Relabel $m_s'' \equiv m_s'$. Then

$$= \sum_{m_s m_s'} \sum_{m_t'} \sum_{\vec{k}} \langle \vec{k}\, m_s m_t m_s' m_t' | \, \delta U \, | \vec{k}\, m_s m_t m_s' m_t' \rangle \times$$

$$\theta(k_F^{m_t} - q) \, \theta(k_F^{m_t'} - |\vec{q} - 2\vec{k}|)$$

Similarly the third term is

$$\sum_{m_s m_s'} \sum_{m_t'} \sum_{\vec{k}} \langle \vec{k}\, m_s m_t m_s' m_t' | \, \delta U^{\dagger} \, | \vec{k}\, m_s m_t m_s' m_t' \rangle \times$$

$$\theta(k_F^{m_t} - q) \, \theta(k_F^{m_t'} - |\vec{q} - 2\vec{k}|)$$