

662, Useful Formulas

Dirac fermions

$$\{\gamma^\mu, \gamma^\nu\} = 2\eta^{\mu\nu} \quad (0.1)$$

$$\gamma^0 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \gamma^i = \begin{pmatrix} 0 & \sigma^i \\ -\sigma^i & 0 \end{pmatrix} \quad (0.2)$$

$$\Lambda_{\frac{1}{2}}(\vec{k}) = \begin{pmatrix} e^{\frac{1}{2}\beta\hat{k}\sigma} & 0 \\ 0 & e^{-\frac{1}{2}\beta\hat{k}\sigma} \end{pmatrix}, \quad \cosh \beta = \frac{k_0}{m}, \quad \sinh \beta = -\frac{|\vec{k}|}{m} \quad (0.3)$$

$$u_{\vec{k}}^r = \Lambda_{\frac{1}{2}}(\vec{k})u_0^r, \quad u_0^r = \sqrt{m} \begin{pmatrix} \xi^r \\ \xi^r \end{pmatrix}, \quad (0.4)$$

$$v_{\vec{k}}^r = \Lambda_{\frac{1}{2}}(\vec{k})v_0^r, \quad v_0^r = \sqrt{m} \begin{pmatrix} \xi^r \\ -\xi^r \end{pmatrix}, \quad (0.5)$$

$$\xi^{(1)} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \quad \xi^{(2)} = \begin{pmatrix} 0 \\ 1 \end{pmatrix} \quad (0.6)$$

$$(\not{k} - m)u_{\vec{k}}^r = 0, \quad (\not{k} + m)v_{\vec{k}}^r = 0 \quad (0.7)$$

$$\bar{u}_{\vec{k}}^r u_{\vec{k}}^s = 2m\delta^{rs}, \quad \bar{v}_{\vec{k}}^r v_{\vec{k}}^s = -2m\delta^{rs}, \quad \bar{u}_{\vec{k}}^r v_{\vec{k}}^s = 0 = \bar{v}_{\vec{k}}^r u_{\vec{k}}^s \quad (0.8)$$

$$(u_{\vec{k}}^r)^\dagger u_{\vec{k}}^s = 2\omega_{\vec{k}}\delta^{rs}, \quad (v_{\vec{k}}^r)^\dagger v_{\vec{k}}^s = 2\omega_{\vec{k}}\delta^{rs}, \quad (u_{\vec{k}}^r)^\dagger v_{-\vec{k}}^s = 0 = (v_{\vec{k}}^r)^\dagger u_{-\vec{k}}^s, \quad (0.9)$$

$$\sum_{r=1,2} u_{\vec{k}}^r \bar{u}_{\vec{k}}^r = \not{k} + m, \quad \sum_{r=1,2} v_{\vec{k}}^r \bar{v}_{\vec{k}}^r = \not{k} - m \quad (0.10)$$