(33.1)

$$B^{\mu\nu}(x) = \frac{B^{\mu\nu}(x)}{2} + \frac{B^{\mu\nu}(x)}{2} - \frac{B^{\nu\mu}(x)}{2} + \frac{B^{\nu\mu}(x)}{2}$$

$$= \frac{\left(B^{\mu\nu}(x) - B^{\nu\mu}(x)\right)}{2} + \frac{\left(B^{\mu\nu}(x) + B^{\nu\mu}(x)\right)}{2}$$

$$= \frac{\left(B^{\mu\nu}(x) - B^{\nu\mu}(x)\right)}{2} + \frac{\left(B^{\mu\nu}(x) + B^{\nu\mu}(x) - \frac{1}{2} g^{\mu\nu} g_{\rho\sigma} B^{\rho\sigma}(x)\right)}{2} + \frac{1}{4} g^{\mu\nu} g_{\rho\sigma} B^{\rho\sigma}(x)$$

$$= \frac{\left(B^{\mu\nu}(x) - B^{\nu\mu}(x)\right)}{2} + \left[\frac{B^{\mu\nu}(x) + B^{\nu\mu}(x)}{2} - \frac{1}{4} g^{\mu\nu} g_{\rho\sigma} B^{\rho\sigma}(x)\right]$$

$$+ \frac{1}{4} g^{\mu\nu} g_{\rho\sigma} B^{\rho\sigma}(x)$$

$$A^{\mu\nu}(x) = \frac{B^{\mu\nu}(x) - B^{\nu\mu}(x)}{2}, \quad S^{\mu\nu}(x) = \frac{B^{\mu\nu}(x)}{2} + \frac{B^{\nu\mu}(x)}{2} - \frac{1}{4} g^{\mu\nu} g_{\rho\sigma} B^{\rho\sigma}(x)$$

$$T(x) = B^{\rho\sigma}(x) g_{\rho\sigma}$$

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(33.2)

$$[N_i, N_j] = [J_i - iK_i, J_j - iK_j] \cdot \frac{1}{4}$$

$$= \frac{1}{4}[J_i, J_j] - \frac{i}{4}[J_i, K_j] - \frac{i}{4}[K_i, J_j] - \frac{1}{4}[K_i, K_j]$$

$$= \frac{i}{4}\epsilon_{ijk} J_k + \frac{1}{4}\epsilon_{ijk} K_k - \frac{1}{4}\epsilon_{jik} K_k + \frac{i}{4}\epsilon_{ijk} J_k$$

$$= \frac{i}{2}\epsilon_{ijk}(J_k - iK_k) = i\epsilon_{ijk} N_k$$

$$[N_i^\dagger, N_j^\dagger] = \frac{1}{4}[J_i + iK_i, J_j + iK_j]$$

$$= \frac{1}{4}[J_i, J_j] + \frac{i}{4}[J_i, K_j] + \frac{i}{4}[K_i, J_j] - \frac{1}{4}[K_i, K_j]$$

$$= \frac{i}{4}\epsilon_{ijk} J_k - \frac{1}{4}\epsilon_{ijk} K_k + \frac{1}{4}\epsilon_{jik} K_k + \frac{i}{4}\epsilon_{ijk} J_k$$

$$= \frac{i}{2}\epsilon_{ijk}(J_k + iK_k) = i\epsilon_{ijk} N_k^\dagger$$

$$[N_i, N_j^\dagger] = \frac{1}{4}[J_i - iK_i, J_j + iK_j]$$

$$= \frac{1}{4}[J_i, J_j] + \frac{i}{4}[J_i, K_j] - \frac{i}{4}[K_i, J_j] + \frac{1}{4}[K_i, K_j]$$

$$= \frac{i\epsilon_{ijk} J_k}{4} - \frac{\epsilon_{ijk} K_k}{4} - \frac{\epsilon_{jik} K_k}{4} - \frac{i\epsilon_{ijk} J_k}{4}$$

$$= 0$$

②