場の量子論 p342check11.14

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1 本文

$$
\Delta(x-y) = \int_\Gamma \frac{dk^0}{2\pi} \int \frac{d^3\boldsymbol{k}}{(2\pi)^3} \frac{ie^{-ik\cdot(x-y)}}{k^2-m^2} + \int d^3\boldsymbol{k}\delta(k^2-m^2)f(k)e^{-ik\cdot(x-y)} \tag{1}
$$

$$
\begin{aligned}
(\partial^x_\mu \partial^\mu_x + m^2)\Delta(x-y) &= \int_\Gamma \frac{dk^0}{2\pi} \int \frac{d^3\boldsymbol{k}}{(2\pi)^3} (\partial^x_\mu \partial^\mu_x + m^2) \frac{ie^{-ik\cdot(x-y)}}{k^2-m^2} \\
&\quad + \int d^3\boldsymbol{k}\delta(k^2-m^2)f(k)(\partial^x_\mu \partial^\mu_x + m^2)e^{-ik\cdot(x-y)} && (2) \\
&= \int_\Gamma \frac{dk^0}{2\pi} \int \frac{d^3\boldsymbol{k}}{(2\pi)^3} (-k^2+m^2) \frac{ie^{-ik\cdot(x-y)}}{k^2-m^2} \\
&\quad + \int d^3\boldsymbol{k}\delta(k^2-m^2)f(k)(-k^2+m^2)e^{-ik\cdot(x-y)} && (3) \\
&= -i\int_\Gamma \frac{dk^0}{2\pi} \int \frac{d^3\boldsymbol{k}}{(2\pi)^3} e^{-ik\cdot(x-y)} + 0 && (4) \\
&= -i\delta^4(x-y) && (5)
\end{aligned}
$$

参考文献

[1] 坂本眞人著「場の量子論-不変性と自由場を中心にして」(裳華房,2014,ISBN9784785325114)