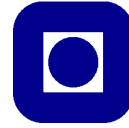


FY3464 Quantum Field Theory

NTNU

Problemset 2

Institutt for fysikk

Problem 1

Let $f(z) = \sqrt{z^2 + 1}$. Use the technique we showed in the lectures to identify the branch-points of this function. Is $z \rightarrow \infty$ a branch point? If so, why?

Problem 2

The correlator $\langle \phi(x)\phi(y) \rangle$ for a scalar field is Lorentz-invariant:

$$\langle \phi(x)\phi(y) \rangle = \int \frac{d^3k}{(2\pi)^3 2\omega(\mathbf{k})} e^{-ik(x-y)}. \quad (1)$$

Consider a timelike separation $(x-y)^2 > 0$, choose a frame $\mathbf{x} = \mathbf{y}$ and assume that $x^0 - y^0 > 0$.

Taking all the above into account, use the Lorentz-invariance to prove that in the limit $m|x-y| \gg 1$ (corresponding to a heavy scalar field):

$$\langle \phi(x)\phi(y) \rangle \simeq \frac{1}{4\pi^2} \left(\frac{m\pi i}{2|x-y|^3} \right)^{1/2} e^{-im|x-y|} \quad (2)$$