

QUANTUM FIELD THEORY 1

Problem sheet 2

1. By expanding a complex scalar field in terms of creation and annihilation operators show that

$$\begin{aligned}[\phi(x), \phi(y)] &= 0 \\ [\pi^\dagger(x), \phi(y)] &= 0 \\ [\pi(x), \phi(y)]_{x_0=y_0} &= -i\delta^3(\mathbf{x} - \mathbf{y}).\end{aligned}$$

2. For a complex scalar field, derive expressions for the creation and annihilation operators for the particles and antiparticles in terms of the field, $\phi(x)$ its hermitian conjugate $\phi^\dagger(x)$ and their time derivatives.

Hence write down the LSZ reduction formula for the S -matrix element for a particle with momentum p_1 and an antiparticle of momentum p_2 scattering into a particle of momentum q_1 and an antiparticle of momentum q_2 .