QUANTUM FIELD THEORY 1

Problem sheet 4

1. For the electromagnetic field, $A_\mu(x)$, use the commutation relations between the creation and annihilation operators and the sum over the polarisations, λ, of $\varepsilon^\mu(\lambda)\varepsilon^{*\nu}(\lambda)$, in the Feynman gauge to show that the field and the canonical momenta $\pi_\nu(y)$ obey the commutation relations for the space-like components

$$\left[\pi_i(y), A_j(x)\right]_{x_0=y_0} \;=\; -\delta_{ij}\delta^3(\mathbf{x}-\mathbf{y}).$$

2. Calculate the differential cross-section with respect to solid angle Ω, $\frac{d\sigma}{d\Omega}$, in the centre-of-mass frame, for the process

$$\pi^+ + \pi^+ \;\rightarrow\; \pi^+ + \pi^+.$$

   Consider electromagnetic interactions only.