Exercices and questions for lecture 8

1.- Prove that the Källen function $\lambda(s, m_1^2, m_2^2)$ is actually equal to $(2m_2|\vec{p}_1|)^2$ in the frame where particle 2 is at rest. What is the value in the CM frame? (To simplify calculations you can take $m_1 = m_2$).

2.- Convince yourself that (352) is indeed invariant under boosts in the z direction.

3.- Find the distribution of energies that we shall find when we measure the energy of the state (343).

§ **4.-** Study the kinematics of the process $a \to b + c$. Prove that the matrix element M is a constant. Do the full integral over phase space and give a final result that depends only on the constant $|M|$.

5.- Derive in detail the expression for Mott cross-section describing the scattering of electrons off a central Coulomb potential.

§ **6.-** Bremsstrahlung. Make sure you understand the derivation of formula (6.24) in Peskin and Schroeder's book. This is valid in the soft photon limit (the momentum of the radiated photon is much smaller than the momentum transfer in the process). Perform the sum over polarizations in (6.24) and give an estimate as to how the energy loss due to synchrotron radiation may sacle on the energy of the beam or the mass of the particel. Is the emitted radiation polarized? (Note: Do not attempt to compute the integral over all energies of the emitted photon, it is divergent!)