

Bilkent University, Department of Physics

PHYS 453: Nuclear & Particle Physics

Third Homework

Due Date: 28 March 2012

1. For an elastic scattering, $a + b \rightarrow a + b$, in the lab frame (b initially at rest), assuming the target is so heavy ($m_b c^2 \gg E_a$) that its recoil is negligible. (Note that in this limit the lab frame and the CM frame are the same.) Show that the differential scattering cross section becomes:

$$\frac{d\sigma}{d\Omega} = \left(\frac{\hbar}{8\pi m_b c} \right)^2 |M|^2.$$

2. For the toy ABC theory considered in class:
 - a) Is $A \rightarrow B + B$ possible?
 - b) Suppose a diagram has n_A external A lines, n_B external B lines, n_C external C lines. Develop a simple criterion for determining whether it is an allowed reaction.
 - c) Assuming A is heavy enough, what are the next most likely decay modes, after $A \rightarrow B + C$. Draw a Feynman diagram for each decay.
 3. For the toy ABC theory considered in class:
 - a) Draw all the lowest-order diagrams for $A + A \rightarrow A + A$ (There are six of them.)
 - b) Find the amplitude for this process, in the lowest order, assuming $m_B = m_C = 0$. Leave your answer in the form of an integral over one remaining four-momentum, q .
-