Quantum field theory Exercises 2. 2005-10-07

• Exercise 2.1. Mandelstam variables and Dalitz plot

Consider decay of a particle of mass M and four-momentum p into three different particles with masses m_1 , m_2 , m_3 and momenta p_1 , p_2 , p_3 respectively. Introduce the *Mandelstam* variables s, t, u

$$s = (p - p_1)^2$$
,
 $t = (p - p_2)^2$,
 $u = (p - p_3)^2$.

1. Find the relation between these variables, i.e. find the value of

$$s+t+u$$
.

2. Find the kinematically allowed region on the s - t plane. Analyze the case of generic masses, and the cases $m_1 = m_2 = 0$ and $m_1 = m_2 = m_3 = 0$.

The plot of the phase space region allowed by energy-momentum conservation is called *Dalitz plot*.