Particle Physics: Assignment # 3

Due Thursday 26/10/16, 3:00 pm Room A27P

1. For the Yukawa interaction and using its Feynman Rules

$$\mathcal{L}_I = -\lambda_e \phi(x)\bar{\psi}(x)\psi(x) - \lambda_\mu \phi(x)\bar{\chi}(x)\chi(x)$$

write the corresponding Feynman amplitude for

$$e^+(p1, s1)\, e^-(p2, s2) \to \mu^+(q1, r1)\, \mu^-(q2, r2)$$

(you did this already in problem 2 of homework 2 starting from the Wick's theorem).

Using the chiral representation of the 4-spinors given in homework 1, compute the square of the Feynman amplitude derived in each of the 16 possible helicity configurations in the COM (ie for $\vec{p}_1 = -\vec{p}_2$ and $\vec{q}_1 = -\vec{q}_2$). Give the answers as a function of the scattering angles between the incoming electron and the outgoing muon. Reason the answer (think of angular momentum conservation)

2. In the same Yukawa interaction compute the cross section for $e^+e^- \to H$. Show that the cross section explicity displays the condition on the COM energy of this collision required for a H of mass M_H to be produced.