Phenomenology course: Problem Sheet 5

1. Show that in the Standard Model the decay width Γ_{WW} of the Higgs boson into two W bosons is

$$\Gamma_{WW} = \frac{\sqrt{2} G_F M_W^2 M_H}{8\pi} \frac{\sqrt{1 - x_W}}{2x_W} (3x_W^2 - 4x_W + 4),$$

where

$$G_F = \sqrt{2} \frac{4\pi\alpha}{8 \sin^2\theta_W M_W^2}$$

and

$$x_W = \frac{4M_W^2}{M_H^2}.$$

Use the expression

$$\Gamma_{WW} = \int d\Omega \frac{|\overline{\mathcal{M}}|^2}{32\pi^2} \frac{|\mathbf{q}_{\text{CM}}|}{M_H^2},$$

where $|\mathbf{q}_{\text{CM}}|$ is the modulus of the three-momentum of either W boson in the Centre-of-Mass (CM) frame (i.e., where the Higgs boson is at rest).