Understanding and Editing the couplings.f File

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1 Purpose

The purpose of this document is to explain what the couplings.f file is, what is inside of it, what its purpose is does, how to utilize it. This document is meant to serve a supplement the MadGraphUserModel.pdf file which should reside in the same twiki entry.

2 What it is: Essentially the Lagrangian

MadGraph does not have a "one-stop-shop" for altering the Lagrangian in its entire form. What it does have, however, is a method four adding, removing, or altering the different couplings. This is how the user can alter the Lagrangian to work with his model.

3 Constants

This section will cover the constants found in lines 103-114. I will show how it is written in Fortran code and then show it a more familiar form

3.1 W Mass

The mass of the W is written as wm = sqrt(zmass**2/Two+sqrt(zmass**4/Four-Pi/Rt*alpha/gfermi*zmass**2)). At first glance this seems a bit confusing. Written in a more familiar way

$$M_W = \sqrt{\frac{M_Z^2}{2} + \sqrt{\frac{M_Z^4}{4} - \frac{\pi\alpha M_Z^2}{\sqrt{2}G_F}}} \tag{1}$$

3.2 Electric Charge

MadGraph is different in the way they define electric charge. What most literature calls "e" is equivalent to "-e" in MadGraph's definition. The couplings.f file defines electric charge through the fine-structure constant

$$\text{ee2} = \text{alpha} * \text{Fourpi} \rightarrow e^2 = 4\pi\alpha \tag{2}$$

3.3 Weak Boson-Fermion Coupling Constant

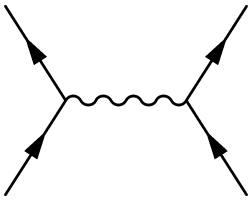
The weak boson-fermion couling constant, g_z, is written as:

$$\text{ez} = \text{ee}/\text{sw} * \text{cw} \rightarrow g_z = \frac{-e}{\sin(\theta_w)\cos(\theta_w)} \tag{3}$$

3.4 Vacuum Expectaion Value

The vacuum expectation value (vev) is used in MadGraph and is defined as

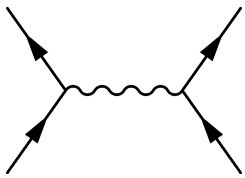
$$\text{v} = \text{Two} * \text{wm} * \text{sw}/\text{ee} \rightarrow v = \frac{2M_W \sin(\theta_w)}{e} = \frac{1}{\sqrt{\sqrt{2}G_F}} \tag{4}$$



4 The Problem

Calculate the total cross section for the process $\mu^-\mu^+ \rightarrow Higgs \rightarrow e^-e^+$. This process is important for considering the feasibility of Higgs production at a muon collider.

μ^+, p_2 $e^-, p_{1'}$



Higgs k

μ^-, p_1 $e^+, p_{2'}$