Interim Summary

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December 10, 2025

Overview

From *.fr to _UFO

- A generic FeynRules model file contains four parts
  - A list called M$GaugeGroups containing the definitions of all the gauge groups of themodel.
  - A list called M$Parameters containing the definitions of all the parameters of the model.
  - A list called M$ClassesDeclarations containing the definitions of all the fields of themodel.
  - The Lagrangian of the model, written in Mathematica form.

From *.fr to _UFO

- Since we have correct model file, we can get UFO file by the next codes:

Example

```
SetDirectory["/path/to/model/file"];
LoadModel["ComplexScalarDiracMajorana_real.fr"];
WriteUFO[L]
```

An Attempt – YukawaModel

- I have tried to write a model inslude a scalar boson, Dirac fermion and Majorana fermion.

Theorem (Lagrangian)

$$\mathcal{L} = \left(\partial^\mu \phi^\dagger\right) \partial_\mu \phi - m_\phi^2 \phi^\dagger \phi + \bar{\psi} \left(\mathrm{i}\gamma^\mu \partial_\mu - m_\psi\right) \psi + \frac{1}{2} \bar{\chi} \left(\mathrm{i}\gamma^\mu \partial_\mu - m_\chi\right) \chi + \kappa \phi^\dagger \bar{\chi} P_\mathrm{R} \psi + \kappa \phi \bar{\psi} P_\mathrm{L} \chi$$

An Attempt – YukawaModel

- Soon I wrote a model file without GaugeGroups settings
- I also upload it in th path: /lustre/collider/tengpeixu/mg5-learing/majorana/model-file

Part of My File

```
Lpsi = I * psibar.Ga[mu].del[psi, mu] - Mpsi psibar.psi;
Lchi = I/2 * bar[chi].Ga[mu].del[chi, mu] - (Mchi/2) *
bar[chi].chi;
Lint = kappa * (phibar * bar[chi].ProjP.psi + phi *
psibar.ProjM.chi);
Lagrangian = Lphi + Lpsi + Lchi + Lint;
```

Generating Feynman diagrams

- Unfortunately, I tried both Xuliang and my model files, but neither of them succeeded while they can generate UFO successfully.
- Solving this problem would require changing the relevant parameters in *.gen(Or use the latest standard to write the model file), which I think is not worth the effort because we can also do it in MadGraph5.

ERROR

Coupling definition in model file for C[-F(1),F(2),S(1)] is incompatible to generic coupling structure. Coupling is not a vector of length 2.

Basic Operations

- Already known the basic operations in Mg5(MadGraph5). That's includes:
  - check the basic information when import a model.
  - generate and add process in md5
  - draw ftnman diagram

Something About The Parameters

- All parameters is saved in *_card.dat. I already understand includes:
- All the contents of the file para_card.dat.
- Small part of the file run_card.dat:
  - Number of unweighted events requested
  - Collider type and energy
  - Beam polarization from
- Questions still exist in:
  - All in Renormalization and factorization scales. (Unfortunately, my QFT hasn't started restructuring yet; my most optimistic estimate is next month.)
  - Some Detials about cutting conditions.

Some Result I Get

- I uesd the model file given by xuliang in /lustre/collider/zhuxuliang/NNbrem_axion_Snu/NNbrem_axion_Snu.fr
- Generate the UFO file and import it in mg5.

Feynman Diagram

- I tried "generate e- proton > all all" and more "all" in the end. Here is some result.

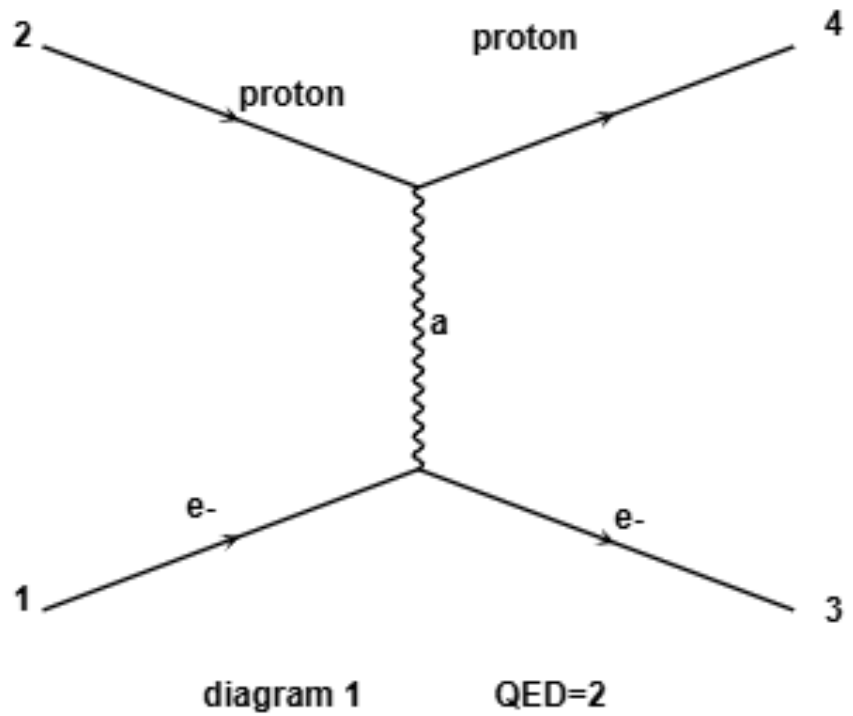

Figure: e- proton > e- proton WEIGHTED=2

Feynman Diagram

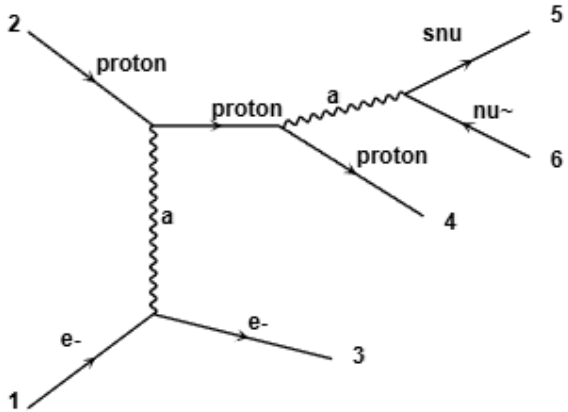

diagram 1 QED=4

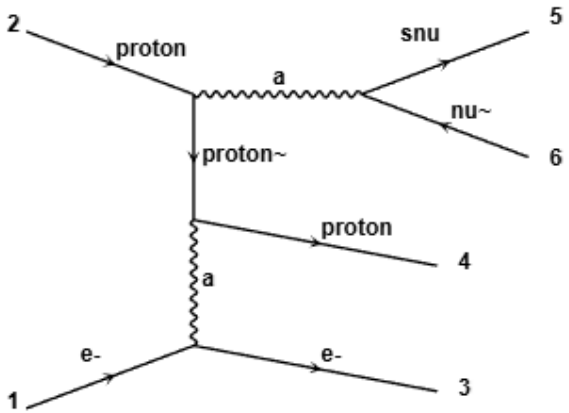

diagram 2 QED=4

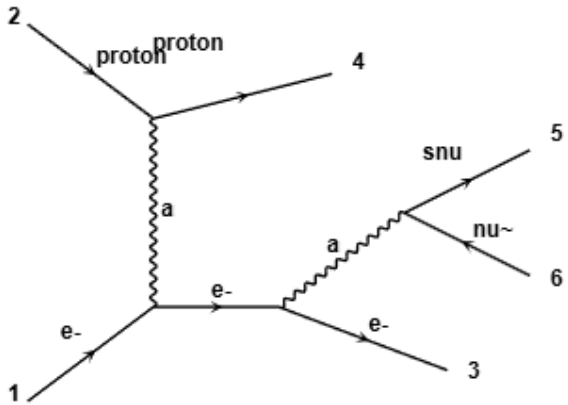

diagram 3 QED=4

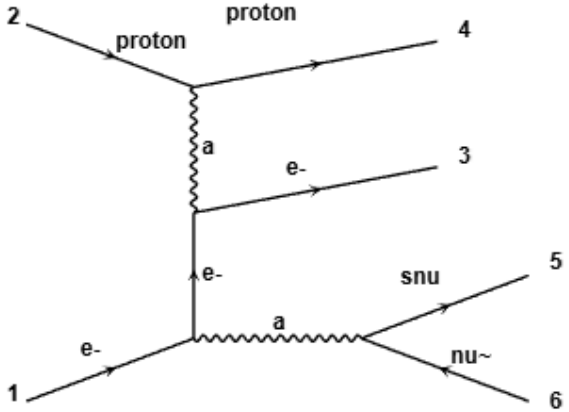

diagram 4 QED=4

Figure: e- proton > e- proton snu nu

Attempt

- It was completed once under Xuliang's guidance.
- But for his model, I'm still trying to adjust the parameters for this part by myself.
- I have generate p p > t t . Though I did not conduct further analysis.